# SAP WORKSHEET #1 – TITLE AND APPROVAL PAGE

**Final**
**Addendum 02 to the**
**Final Sampling and Analysis Plan**
**(Field Sampling Plan/Quality Assurance Project Plan)**

**PRELIMINARY ASSESSMENT/SITE INSPECTION**
**INSTALLATION RESTORATION PROGRAM SITE 75**
**AGRICULTURAL WELL KAYO-SB**
**NAVAL WEAPONS STATION SEAL BEACH**
**SEAL BEACH, CALIFORNIA**

**October 2016**

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**Prepared under:**
**Contract No.** N62473-13-D-4801
**Delivery Order No.** 0015
**AMJV-2613-0018-0006.A2/F**

Reviewed by: _____ Date: 10/05/16
Jesse MacNeill, Brady QA Manager

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Approved by: _____ Date: _____
Joe Arlauskas, NAVFAC SW QA Officer

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## Executive Summary

This addendum 02 to the *Final Sampling and Analysis Plan (Field Sampling Plan/Quality Assurance Project Plan) for the Preliminary Assessment (PA) and Site Inspection (SI) at Installation Restoration Program Site 75 (Site 75), Naval Weapons Station (NAVWPNSTA) Seal Beach, California, 6/30/11* (AMJV and Brady, 2011a) was prepared to present planned activities for additional sampling of site monitoring wells. This document was prepared by Richard Brady & Associates (BRADY) for the Department of the Navy (DoN), Naval Facility Engineering Command Southwest (NAVFAC SW) under Contract Number N62473-13-D-4801, Delivery Order No. 0015. The DoN is the lead agency on this project, with regulatory oversight by the California Environmental Protection Agency Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) - Santa Ana Region.

This addendum will be used in conjunction with the original SAP indicated above, and SAP addendum 01 (AMJV and Brady, 2011b). All policies and procedures set forth in the original SAP, and the modifications in addendum 01, will remain in effect where applicable.

The original SAP addressed the installation and sampling of up to nine groundwater monitoring wells. During the implementation of the original SAP, two distinct contaminated water-bearing units were discovered at boring SB75MW01. SAP addendum 01 added a tenth monitoring well to the investigation, and the groundwater monitoring program was changed from well pairs at two groundwater monitoring well locations and individual wells at seven locations, to well pairs at five groundwater monitoring well locations (See Figure 5 in the Final SAP and Figure 1A in the SAP Addendum). The paired wells at five locations allowed both water-bearing units to be investigated in accordance with the project data quality objectives in the original SAP.

This addendum includes only those SAP worksheets that have been updated for the next two groundwater monitoring events. Included are the applicable administrative worksheets (Worksheets #3, 4, 5, & 6), the project screening criteria and laboratory limits (Worksheet #15), the sample IDs to be used for each sampling event (Worksheet #18), and the field quality control samples to be collected during each sampling event (Worksheet #20). Per the request by the RWQCB, 1,4-Dioxane (USEPA Method 8270C-SIM) was added to the analytical suite. Laboratory information for that analyte was provided in Worksheets 15, 19, 23, 24, 25, & 28. Figure 1 has been included to show the well locations.

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## FIGURE

Figure 1 Site Map

## ATTACHMENTS

Attachment 1 Analytical Laboratory Information

- Analytical Lab DoD Accreditation & State of California Certification
- Analytical Standard Operating Procedure for EPA Method 8260B
- Analytical Standard Operating Procedure for EPA Method 8270C-SIM

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# ACRONYMS / ABBREVIATIONS

| | |
|---|---|
| AR | Administrative Record |
| bgs | below ground surface |
| BRADY | Richard Brady & Associates |
| CAS | Chemical Abstracts Service |
| CSM | conceptual site model |
| DCN | document control number |
| DoN | Department of the Navy |
| DQO | Data Quality Objective |
| DSITMS | direct sampling ion trap mass spectrometry |
| DTSC | Department of Toxic Substance Control |
| EDR | Environmental Data Resources |
| EPA | Environmental Protection Agency |
| FCN | Field Change Notice |
| ft | feet |
| GeoTracker | geographical environmental information management system |
| HSO | Health and Safety Officer |
| ID | identification |
| IRP | Installation Restoration Program |
| LDC | Laboratory Data Consultants Inc. |
| ug/L | micrograms per liter |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| N/A | not applicable |
| NA | not available |
| NAPL | non-aqueous phase liquid |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| NAVWP | |
| NSTA | Naval Weapons Station |
| PM | Program Manager |
| POC | Point of Contact |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAM | Quality Assurance Manager |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| QSM | Quality Systems Manual |
| RPD | relative percent difference |

| | |
|---|---|
| RWQCB | Regional Water Quality Control Board |
| SAP | Sampling and Analysis Plan |
| SI | Site Inspection |
| Site 75 | Installation Restoration Program Site 75 |
| SOP | standard operating procedure |
| SVOC | semi-volatile organic compound |
| U.S. EPA | United States Environmental Protection Agency |
| VOA | volatile organic analytes |
| VOC | volatile organic compound |

# SAP WORKSHEET #3 – DISTRIBUTION LIST

| Name of SAP Recipients | Title/Role | Organization | Telephone Number | E-mail Address and Mailing Address |
|---|---|---|---|---|
| Brenda Reese | Project RPM | NAVFAC SW | 619.532.4209 | brenda.reese@navy.mil<br>1220 Pacific Highway<br>Bldg. 128, Mail Room<br>San Diego, CA 92132<br>Attn: Code JE30.BR |
| Pei-Fen Tamashiro | IRP Coordinator | NAVFAC SW | 562.626.7897 | pei-fen.tamashiro@navy.mil<br>800 Seal Beach Boulevard, Building 230<br>Seal Beach, CA 90740<br>Attn: Code N45W |
| John Broderick | Agency Representative | RWQCB | 951.782.4494 | jbroderick@waterboards.ca.gov<br>3737 Main St., Suite 500<br>Riverside, CA 92501-3348 |
| Stephen Niou | Agency Representative | DTSC | 714.484.5458 | SNiou@dtsc.gov<br>5796 Corporate Avenue<br>Cypress, CA 90630-4732 |
| Joe Arlauskas | QAO | NAVFAC SW | 619.532.4125 | joseph.arlauskas@navy.mil<br>1220 Pacific Highway,<br>San Diego, CA 92132 |
| Diane Silva | Administrative Records | NAVFAC SW | 619.532.3676 | diane.silva@navy.mil<br>1220 Pacific Highway<br>Bldg. 128, Mail Room<br>San Diego, CA 92132<br>ATTN.: Code EVR.DS<br>FISC Bldg. 1, 3rd Floor |

**Table Continues**

## SAP WORKSHEET #3 - DISTRIBUTION LIST – CONTINUED

| Name of SAP Recipients | Title/Role | Organization | Telephone Number | E-mail Address and Mailing Address |
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| Tara Lieberman | Project Manager | BRADY | 858.634.4520 | tlieberman@rbrady.net<br>3710 Ruffin Road<br>San Diego, CA 92123 |
| Don McHugh | Program Manager | BRADY | 858.634.4550 | dmchugh@rbrady.net<br>3710 Ruffin Road<br>San Diego, CA 92123 |
| Jesse MacNeill | QAM | BRADY | 858.634.4549 | jmacneill@rbrady.net<br>3710 Ruffin Road<br>San Diego, CA 92123 |
| Ye Myint | Project Manager | EMAX Laboratories, Inc. | 310.618.8889 | ymyint@emaxlabs.com<br>1835 W 205th. St.<br>Torrance, CA 90501 |
| Pei Geng | Project Manager | LDC, Inc. | 760.827.1100 | pgeng@lab-data.com<br>2701 Loker Ave. West, Suite 220<br>Carlsbad, CA 92010 |

Acronyms:

| | |
|---|---|
| AR | Administrative Record |
| BRADY | Richard Brady & Associates |
| DTSC | Department of Toxic Substances Control |
| IRP | Installation Restoration Program |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| PM | Project Manager |
| POC | Point of Contact |
| QAM | Quality Assurance Manager |
| QAO | Quality Assurance Officer |
| RPM | Remedial Project Manager |
| RWQCB | Regional Water Quality Control |
| LDC | Laboratory Data Consultants, Inc. |
| SAP | Sampling and Analysis Plan |

## SAP WORKSHEET #4 – PROJECT PERSONNEL SIGN-OFF SHEET

Key personnel will sign this sheet as part of the readiness review conducted prior to field work.

| Name | Organization/Title/Role | Telephone Number (optional) | Signature/E-mail receipt | SAP Section Reviewed | Date SAP Read |
|---|---|---|---|---|---|
| Jason Williams | BRADY / Field Manager / SSHO | 619.571.2358 | | All Worksheets | |
| Tara Lieberman | BRADY / Project Manager | 858.634.4520 | | All Worksheets | |
| Jesse MacNeill | BRADY / QAM | 858.634.4549 | | All Worksheets | |
| Ye Myint | EMAX Laboratories, Inc. / Project Manager | 310.618.8889 | | Worksheets 12, 15,19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 34, 35 | |
| Pei Geng | LDC, Inc. / Project Manager | 760.827.1100 | | Worksheets 12, 15, 20, 22, 23, 24, 25, 28, 30, 34, 35, 36 | |

Acronyms:

BRADY Richard Brady & Associates
LDC Laboratory Data Consultants Inc.
SSHO Site Safety and Health Officer

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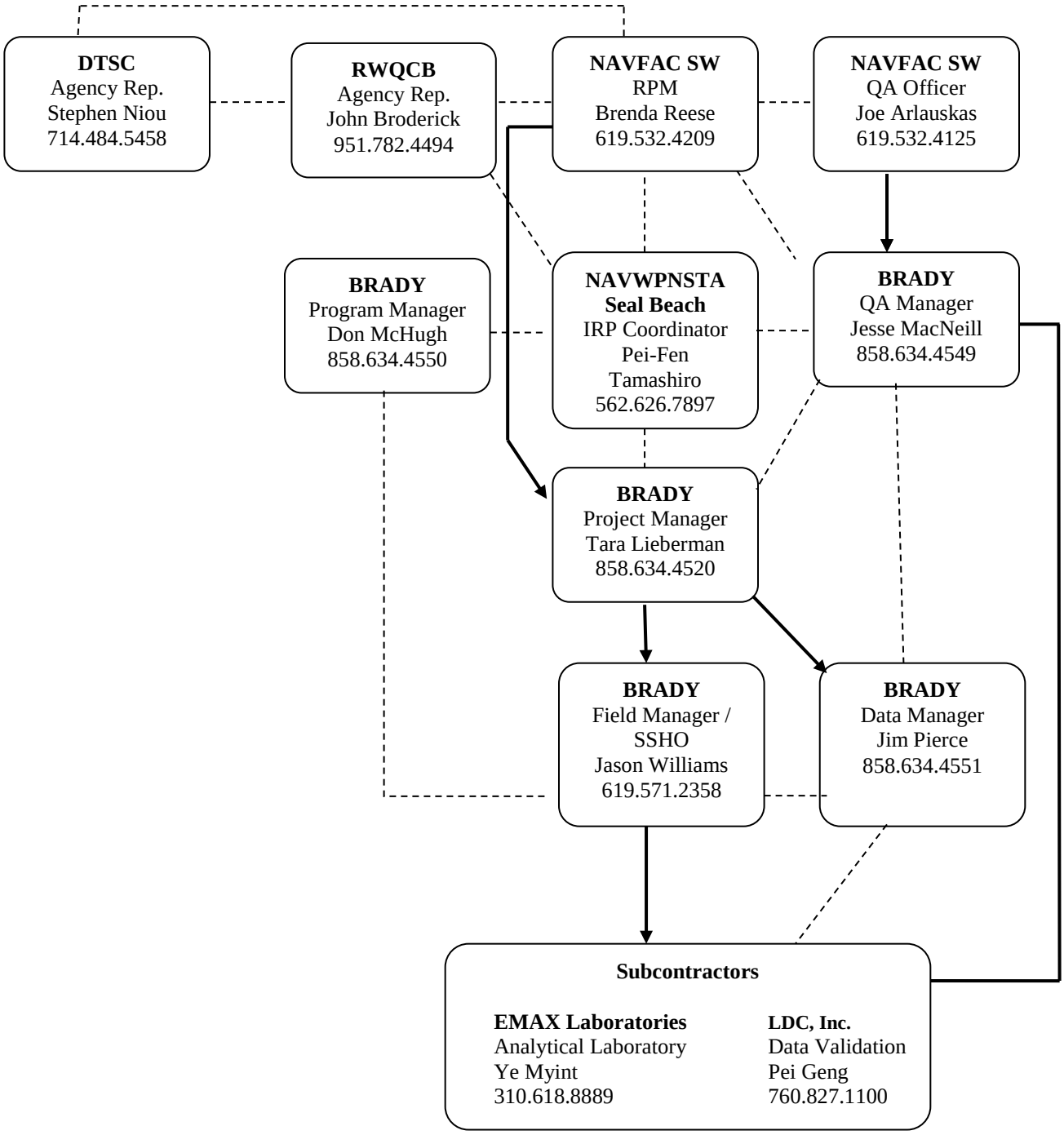
# SAP WORKSHEET #5 – PROJECT ORGANIZATIONAL CHART

Lines of Authority ——— Lines of Communication .....



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## SAP WORKSHEET #6 – COMMUNICATION PATHWAYS

| Communication Drivers | Responsible Affiliation | Name | Phone Number and/or E-mail | Procedure |
|---|---|---|---|---|
| Point of Contact for DoN Quality Issues | NAVFAC SW QAO | Joe Arlauskas | 619.532.4125<br>joseph.arlauskas@navy.mil | QAO will review and approve the SAP and all amendments to the SAP. |
| Project Management for DoN | NAVFAC SW RPM | Brenda Reese | 619.532.4209<br>brenda.reese@navy.mil | RPM will ensure that the requirements from the project scope of work are fulfilled. |
| FCN | BRADY Field Manager | Jason Williams | 619-571-2358<br>jwilliams@rbrady.net | The Field Manager will document any deviation from the original SAP and all amendments, including minor changes, major changes, or significant changes, by notifying the Project Team QAM and PM by phone and e-mail within 24 hours and will submit a FCN within 48 hours. All completed FCNs will be included as an appendix in the final report. The Project Team QAM will inform the NAVFAC SW QAO of any major or significant changes formalized in an FCN. |
| Field Audit | BRADY QAM | Jesse MacNeill | 858.634.4549<br>jmacneill@rbrady.net | The Project Team QAM may conduct a field audit during project fieldwork. Audit results are maintained in Project Team's project and QA files. Any issues requiring corrective action will be documented and assigned an appropriate response period. |
| Coordination and Communication of Fieldwork Activities Related to Sampling | BRADY Field Manager | Jason Williams | 619-571-2358<br>jwilliams@rbrady.net | Sampling personnel will communicate relevant field information to the Brady QAM. |
| Reporting Laboratory Data Quality Issues | Laboratory Project Manager | Ye Myint | 310.618.8889<br>ymyint@emaxlabs.com | All QA/QC issues will be reported by the Laboratory Project Manager to the Brady QAM in writing within 2 business days. |

**Table Continues**

| Communication Drivers | Responsible Affiliation | Name | Phone Number and/or E-mail | Procedure |
|---|---|---|---|---|
| Stop Work | BRADY QAM | Jesse MacNeill | 858.634.4549<br>jmacneill@rbrady.net | The Project Team's QAM, PM, HSO, NAVFAC SW RPM, or NAVFAC SW QAO may stop work in response to any serious quality or safety related issue, if warranted. In this case, the issue and proposed corrective action will be documented with planned timing for implementation. The Stop Work Notice will be submitted to the NAVFAC SW QAO and RPM by e-mail within 24 hours. |
| | BRADY PM | Tara Lieberman | 858-634-4520<br>tlieberman@rbrady.net | |
| | BRADY Field Manager / SSHO | Jason Williams | 619-571-2358<br>jwilliams@rbrady.net | |
| | NAVFAC SW RPM | Brenda Reese | 619.532.4209<br>brenda.reese@navy.mil | |
| | NAVFAC SW POC | Pei-Fen Tamashiro | 562.626.7897<br>pei-fen.tamashiro@navy.mil | |
| | NAVFAC SW QAO | Joe Arlauskas | 619.532.4125<br>joseph.arlauskas@navy.mil | |
| Notification of Non-Usable Analytical Data | Program Chemist | Jesse MacNeill | 858.634.4549<br>jmacneill@rbrady.net | If significant problems are identified by the laboratory or the project team that impact the usability of the data (i.e. the data is rejected or the data quality objectives are not met), the Program Chemist will notify the NAVFACSW RPM and the NAVFACSW QAO within 24 hours or the next business day. |

Acronyms:

| | | | |
|---|---|---|---|
| BRADY | Richard Brady & Associates | QAM | Quality Assurance Manager |
| FCN | Field Change Notice | QAO | Quality Assurance Officer |
| NAVFAC SW | Naval Facilities Engineering Command Southwest | RPM | Remedial Project Manager |
| PM | Project Manager | SAP | Sampling and Analysis Plan |
| QA | Quality Assurance | SSHO | Site Safety and Health Officer |

# SAP WORKSHEET #15A – REFERENCE LIMITS AND EVALUATION TABLES

## VOCs by EPA Method 8260B – Matrix: Water

| Analyte | CAS Number | Project Screening Level (ug/L) | Project Screening Level Reference[a] | Project Quantitation Limit Goal (ug/L) | Laboratory-specific | | |
|---|---|---|---|---|---|---|---|
| | | | | | LOQ (ug/L) | LOD (ug/L) | DL (ug/L) |
| 1,1,1-Trichloroethane | 71-55-6 | 200 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | 1.0 | MCL | 1.0 | 1.0 | 0.2 | 0.112 |
| 1,1,2-Trichloroethane | 79-00-5 | 5.0 | MCL | 1.0 | 1.0 | 0.2 | 0.102 |
| 1,1,2-trichlorotrifluoroethane (Freon 113) | 76-13-1 | 1200 | MCL | 1.0 | 1.0 | 0.3 | 0.17 |
| 1,1-Dichloroethane | 75-34-3 | 5.0 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| 1,1-Dichloroethene | 75-35-4 | 6.0 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| 1,2-Dichloroethane | 107-06-2 | 0.5 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| Acetone | 67-64-1 | NE | NE | 10 | 10 | 5 | 2.6 |
| Chlorobenzene | 108-90-7 | 70 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| Chloroethane | 75-00-3 | NE | NE | 1.0 | 1.0 | 0.3 | 0.268 |
| cis-1,2-Dichloroethene | 156-59-2 | 6.0 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |

**Table Continues**

## SAP WORKSHEET #15 – REFERENCE LIMITS AND EVALUATION TABLE – VOCS BY EPA METHOD 8260B – MATRIX: GROUNDWATER – CONTINUED

| Analyte | CAS Number | Project Screening Level (ug/L) | Project Screening Level Reference[a] | Project Quantitation Limit Goal (ug/L) | Laboratory-specific | | |
|---|---|---|---|---|---|---|---|
| | | | | | LOQ (ug/L) | LOD (ug/L) | DL (ug/L) |
| Dichlorodifluoromethane | 75-71-8 | NE | NE | 1.0 | 1.0 | 0.3 | 0.15 |
| Isopropanol | 67-63-0 | NE | NE | 40 | 40 | 20 | 10 |
| Methylene chloride | 75-09-2 | 5.0 | MCL | 2.0 | 2.0 | 1.0 | 0.5 |
| Tetrachloroethene (PCE) | 127-18-4 | 5.0 | MCL | 1.0 | 1.0 | 0.2 | 0.152 |
| Toluene | 108-88-3 | 150 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| trans-1,2-Dichloroethene | 156-60-5 | 10 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| Trichloroethene (TCE) | 79-01-6 | 5.0 | MCL | 1.0 | 1.0 | 0.2 | 0.1 |
| Trichlorofluoromethane (Freon 11) | 75-69-4 | 150 | MCL | 1.0 | 1.0 | 0.3 | 0.15 |
| Vinyl Chloride | 75-01-4 | 0.5 | MCL | 1.0 | 1.0 | 0.2 | 0.116 |

Notes and Acronyms:

[a] The State of California MCLs for drinking water (September, 2015) were selected as project screening levels for this investigation.

Surrogate parameters for this analytical method and associated QC limits are available in Table 1.

| | | | |
|---|---|---|---|
| CAS | Chemical Abstracts Service | MCL | Maximum Contaminant Level |
| DL | detection limit | NE | Not Established (No MCL is established for this analyte) |
| LOD | limit of detection | ug/L | micrograms per liter |
| LOQ | limit of quantitation | | |

# SAP WORKSHEET #15B – REFERENCE LIMITS AND EVALUATION TABLES

## SVOCs by EPA Method 8270C-SIM – Matrix: Water

| Analyte | CAS Number | Project Screening Level (ug/L) | Project Screening Level Reference[a] | Project Quantitation Limit Goal (ug/L) | Laboratory-specific | | |
|---|---|---|---|---|---|---|---|
| | | | | | LOQ (ug/L) | LOD (ug/L) | DL (ug/L) |
| 1,4-Dioxane | 123-91-1 | 1.0 | NL | 2.0 | 2.0 | 0.5 | 0.35 |

Notes and Acronyms:

[a] The State of California drinking water notification level (November, 2010) was selected as project screening levels for this analyte.

Surrogate parameters for this analytical method and associated QC limits are available in Table 1.

| | | | |
|---|---|---|---|
| CAS | Chemical Abstracts Service | NL | notification level |
| DL | detection limit | ug/L | micrograms per liter |
| LOD | limit of detection | | |
| LOQ | limit of quantitation | | |

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## SAP WORKSHEET #18 – SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| ***Permanent Groundwater Monitoring Well Sampling (1st Event)*** | | | | | |
| SB75MW01A-Q316-01 | Groundwater | 42[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW01B-Q316-01 | Groundwater | 85[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW02A-Q316-01 | Groundwater | 45[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW02C-Q316-01 | Groundwater | 95[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW03A-Q316-01 | Groundwater | 48[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW03B-Q316-01 | Groundwater | 85[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW04A-Q316-01 | Groundwater | 43[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW04B-Q316-01 | Groundwater | 87[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW05A-Q316-01 | Groundwater | 41[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW05B-Q316-01 | Groundwater | 85[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| ***Permanent Groundwater Monitoring Well Sampling (2nd Event)*** | | | | | |
| SB75MW01A-Q117-01 | Groundwater | 42[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW01B-Q117-01 | Groundwater | 85[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW02A-Q117-01 | Groundwater | 45[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW02C-Q117-01 | Groundwater | 95[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |

## SAP WORKSHEET #18 – Sampling Locations and Methods/SOP Requirements Table – CONTINUED

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| ***Permanent Groundwater Monitoring Well Sampling (2nd Event)*** | | | | | |
| SB75MW03A-Q117-01 | Groundwater | 48[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW03B-Q117-01 | Groundwater | 85[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW04A-Q117-01 | Groundwater | 43[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW04B-Q117-01 | Groundwater | 87[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW05A-Q117-01 | Groundwater | 41[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |
| SB75MW05B-Q117-01 | Groundwater | 85[2] | VOCs & 1,4-Dioxane | 1 | AEI F30-002 |

Notes and Acronyms:
[1] SOPs are available in Attachment 1 of the original SAP.
[2] This depth represents the anticipated pump intake depth at or near the mid-point of the 10-foot-long well screen. The groundwater monitoring well designs will be optimized in the field based on lithologic and screening data as described in WS #17 of the original SAP. Refer to well as-built diagrams prior to sampling to confirm pump intake depth.

bgs below ground surface
SOP Standard Operating Procedure
VOC volatile organic compound

## SAP WORKSHEET #19 – ANALYTICAL SOP REQUIREMENTS TABLE

| Matrix | Analytical Group | Analytical and Preparation Method/ SOP Reference | Containers (number, size, and type) | Sample volume (units) | Preservation Requirements (chemical, temperature, light protected) | Maximum Holding Time (preparation / analysis) |
|---|---|---|---|---|---|---|
| Water | SVOC (1,4-Dioxane) | USEPA Method 3520C/8270C-SIM EMAX-M8270SIM | 1-L Amber Glass | 1-Liter | 6 $^{o}$C | 7 days / 40 days |

Notes and Acronyms:
[1] SOPs are available in Attachment 1 of the original SAP.
[2] This depth represents the anticipated pump intake depth at or near the mid-point of the 10-foot-long well screen. The groundwater monitoring well designs will be optimized in the field based on lithologic and screening data as described in WS #17 of the original SAP. Refer to well as-built diagrams prior to sampling to confirm pump intake depth.

bgs below ground surface
SOP Standard Operating Procedure
SVOC semi-volatile organic compound

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## SAP WORKSHEET #20 – FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

| Matrix | Analytical Group | No. of Sampling Locations | No. of Field Duplicates | No. of MS/MSDs | No. of Source Blanks | No. of Equip. Blanks | No. of Trip Blanks | Total No. of Samples to Lab |
|---|---|---|---|---|---|---|---|---|
| Water | VOC<br>SVOC | 10[1] | 1 | 1/1 | 1 | 2[2] | 2[2] | 18[3] |

Notes and Acronyms:

[1] The number of groundwater sampling locations and field quality control samples listed in the table represent ***one sampling event***. Two sampling events are planned, so ***this is the number of water and QC samples that should be collected during each sampling event***.

[2] Sampling is assumed to take place over a two day period. Equipment blanks will be collected daily.

[3] Field sampling crew will maintain custody of all samples until each sampling event is complete. The lab courier service will be utilized at the completion of each sampling event.

MS/MSD matrix spike/matrix spike duplicate
SVOC semi-volatile organic compound
VOC volatile organic compound

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# SAP WORKSHEET #23 – ANALYTICAL SOP REFERENCES TABLE

| Lab SOP Number | Title, Revision Number and Date | Definitive or Screening Data | Matrix and Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? (Y/N) |
|---|---|---|---|---|---|---|
| EMAX-M8270SIM | 1,4-Dioxane By GC/MS, Modified Method 8270SIM, Revision 2, Annual Review Date: 06/0816 | Definitive | Water / SVOCs | GC/MS | EMAX Laboratories Inc. | N |

Notes and Acronyms:
Laboratory analytical SOPs meet the requirements of the DoD *Quality Systems Manual for Environmental Laboratories* (QSM), Version 5.0 (DoD, 2013).

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## SAP WORKSHEET #24 – ANALYTICAL INSTRUMENT CALIBRATION TABLE

| Instrument | Calibration Procedure | Frequency of Calibration | Acceptance Criteria [a] | Corrective Action [b] | Person Responsible for Corrective Action | SOP Reference |
|---|---|---|---|---|---|---|
| GC/MS | Initial calibration (ICAL) for all analytes (including surrogates) | At instrument set-up, prior to sample analysis | Each analyte must meet one of the three options below:<br>Option 1: RSD for each analyte ≤ 15%;<br>Option 2: linear least squares regression for each analyte: $r^2$ ≥ 0.99;<br>Option 3: non-linear least squares regression (quadratic) for each analyte: $r^2$ ≥ 0.99. | Locate the source of the problem. If expected RFs are not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial calibration<br>If SPCC is non-compliant, it could be a result of standard degradation or active presence to active sites in the system. Correct the problem and repeat calibration.<br>If CCC is non-compliant, it could be a result of system leaks, or reactive column sites or standard degradation. Correct the problem and recalibrate.<br>If RSD is non-compliant, check for outlier and repeat that ICAL point; otherwise perform instrument troubleshooting and repeat calibration | Analyst | EMAX-M8270SIM<br>DoD QSM v5 |

**Table Continues**

## SAP Worksheet #24— Analytical Instrument Calibration Table (Cont.)

| Instrument | Calibration Procedure | Frequency of Calibration | Acceptance Criteria [a] | Corrective Action [b] | Person Responsible for Corrective Action | SOP Reference |
|---|---|---|---|---|---|---|
| GC/MS | Initial Calibration Verification (ICV) | Once after each ICAL, analysis of a second source standard prior to sample analysis. | All reported analytes within ± 20% of true value. | Prepare fresh standard and reanalyze second source to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance, and rerun initial calibration and second source verification standard. If problem continues, new standards may need to be purchased, prepared, and analyzed. | Analyst | EMAX-M8270SIM<br>DoD QSM v5 |
| GC/MS | Continuing Calibration Verification (CCV) | Daily before sample analysis; after every 12 hours of analysis time; and at the end of the analytical batch run. | All reported analytes and surrogates within ± 20% of true value.<br>1. All reported analytes and surrogates within ± 50% for end of analytical batch CCV. | Recalibrate, and reanalyze all affected samples since the last acceptable CCV;<br>or<br>Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV. | Analyst | EMAX-M8270SIM<br>DoD QSM v5 |

Notes and Acronyms:

Analytical SOPs are provided in Attachment 1.

[a] Instruments will be calibrated and acceptance criteria met before sample analysis, and calibration will be performed consistent with the DoD *Quality Systems Manual for Environmental Laboratories, version 5.0* (2013) and published USEPA methods.

[b] No averaging or manual integration will be permitted for instrument calibration or method/QC compliance.

[c] Preventive maintenance is always recommended for lab testing equipment and could include daily / weekly ops checks for re-calibration if required.

GC/MS Gas Chromatography/Mass Spectrometry

# SAP WORKSHEET #25—ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

| Instrument/ Equipment | Maintenance Activity | Testing Activity | Inspection Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference |
|---|---|---|---|---|---|---|---|---|
| GC/MS | Parameter Setup | Physical check | Examples: Check that the autosampler is functioning as expected<br><br>Check that temperature program is set at the most recently determined optimum condition.<br><br>IC: Check pressure, effluent, detector, flowrate is set as per SOP. | Initially; prior to each use | Autosampler must move to the expected position when activated.<br>Refer to instrument optimize temperature program setup. | Reset to SOP set-up, if parameter checks reveal deviations. Notate all adjustments in Daily Maintenance Log.<br>Examples: Reset autosampler, if problem persist perform autosampler troubleshooting prior to instrument use.<br>Reset to optimized temperature setup (e.g., if temperature program is optimized at the following conditions:<br>Initial Temp =40ºC, hold for 1 min, Ramp= 6ºC, Final Temp=200ºC,<br>Injection port =160ºC<br>Interface=250ºC,<br>then the instrument setting must be on that condition when checked.) | EMAX Chemist | EMAX-M8270SIM (1,4-Dioxane) |

**Table Continues**

## SAP Worksheet #25— Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (Cont.)

| Instrument/ Equipment | Maintenance Activity | Testing Activity | Inspection Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference |
|---|---|---|---|---|---|---|---|---|
| GC/MS | Tune Check | Instrument Performance | Conformance to instrument tuning. | Initially; prior to DCC | Compliance to ion abundance criteria as specified by the method. | Repeat tune check to rule out standard degradation or inaccurate injection. If problem persist perform retune the instrument and repeat tune check. | EMAX Chemist | EMAX-M8270SIM (1,4-Dioxane) |

Acronyms:

GC/MS Gas Chromatography/Mass Spectrometry

# SAP WORKSHEET #28—LABORATORY QC SAMPLES TABLE

**Matrix:** Water
**Analytical Group:** SVOCs
**Analytical Method / SOP Reference:** EPA Method 8270C-SIM / EMAX-M8270SIM

| QC Sample | Frequency / Number | Method/SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank (MB) | One per preparatory batch. | No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ. | Correct problem. If required, reprep and reanalyze MB and all samples processed with the contaminated blank. | EMAX Chemist | Accuracy/Bias-Contamination | No analytes detected > ½ LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. Common contaminants must not be detected > LOQ. |
| Laboratory Control Sample (LCS) | One per preparatory batch. | A laboratory must use the QSM Appendix C Limits* for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. | Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. | EMAX Chemist | Accuracy/Bias | A laboratory must use the QSM Appendix C Limits* for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. |
| Matrix Spike (MS) | Project designated sample matrix QC. | A laboratory must use the QSM Appendix C Limits* for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. | If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample. | EMAX Chemist | Interferences - Accuracy/Bias - Precision | A laboratory must use the QSM Appendix C Limits* for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. |

**Table Continues**

## SAP Worksheet #28— Laboratory QC Samples Table (Cont.)

**Matrix:** Water
**Analytical Group:** SVOCs
**Analytical Method / SOP Reference:** EPA Method 8270C-SIM / EMAX-M8270SIM

| QC Sample: | Frequency & Number | Method/SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Matrix Spike Duplicate (MSD) or Matrix Duplicate (MD) | Project designated sample matrix QC.batch. | A laboratory must use the QSM Appendix C Limits* for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD). | If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample | EMAX Chemist | Interferences - Accuracy/Bias - Precision | A laboratory must use the QSM Appendix C Limits* for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 20% (between MS and MSD or sample and MD). |
| Surrogate | All field and QC samples | QC acceptance criteria specified by the project, if available; otherwise use QSM Appendix C limits* or in-house LCS limits if analyte(s) are not listed. | Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. | EMAX Chemist | Accuracy/Bias | Refer to QC Limit Table below |

Acronyms:
GC/MS Gas Chromatography/Mass Spectrometry

* DoD *Quality Systems Manual for Environmental Laboratories* (QSM), Version 5.0 (July, 2013).

# Tables

Table 1 LCS Control Limits for EPA Method 8260B & 8270C-SIM
Table 2 Additional References

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# TABLE 1

## LCS Control Limits for EPA Method 8260B & 8270C-SIM

| Analyte | Precision (RPD) | Accuracy (% Recovery) | |
|---|---|---|---|
| | | CL-LL | CL-UL |
| ***Volatile Organic Compounds by EPA Method 8260B*** | ***Water*** | | |
| 1,1,1-trichloroethane (1,1,1-TCA) | 20 | 74 | 131 |
| 1,1,2,2-Tetrachloroethane | 20 | 71 | 121 |
| 1,1,2-Trichloroethane | 20 | 80 | 119 |
| 1,1,2-trichlorotrifluoroethane (Freon 113) | 20 | 70 | 136 |
| 1,1-dichloroethane (1,1-DCA) | 20 | 77 | 125 |
| 1,1-dichloroethene (1,1-DCE) | 20 | 71 | 131 |
| 1,2-dichloroethane (1,2-DCA) | 20 | 73 | 128 |
| Acetone | 20 | 39 | 160 |
| Chlorobenzene | 20 | 82 | 118 |
| Chloroethane | 20 | 60 | 138 |
| cis-1,2-Dichloroethene (cis-1,2-DCE) | 20 | 78 | 123 |
| Dichlorodifluoromethane (Freon 12) | 20 | 32 | 152 |
| Isopropanol | 20 | 56 | 142 |
| Methylene chloride | 20 | 74 | 124 |
| Tetrachloroethylene (PCE) | 20 | 74 | 129 |
| Toluene | 20 | 80 | 121 |
| trans-1,2-Dichloroethene (trans-1,2-DCE) | 20 | 75 | 124 |
| Trichloroethene (TCE) | 20 | 79 | 123 |
| Trichlorofluoromethane (Freon 11) | 20 | 65 | 141 |
| Vinyl Chloride (VC) | 20 | 58 | 137 |
| **Surrogates** | | | |
| 1,2-Dichloroethane-d4 | -- | 81 | 118 |
| Dibromofluoromethane | -- | 80 | 119 |
| Toluene-d8 | -- | 89 | 112 |
| 4-Bromofluorobenzene | -- | 85 | 114 |
| ***Semi-Volatile Organic Compounds by EPA Method 8270C-SIM*** | ***Water*** | | |
| 1,4-Dioxane | 20 | 40 | 130 |
| **Surrogates** | | | |
| Bromobenzene | -- | 30 | 130 |

Notes:
DoD/DOE QSM, Appendix C, July 2013

RPD relative percent difference as calculated by the pair of analytical duplicates
% Recovery percent recovery of spiked compounds
LCS laboratory control sample (blank spike)

# TABLE 2

## Additional References

| Author | Source |
|---|---|
| AMJV and Brady, 2011a | Final Sampling and Analysis Plan, Preliminary Assessment/ Site Inspection, IRP Site 75, Agricultural Well KAYO-SB, Naval Weapons Station Seal Beach, Seal Beach, California. June 30. |
| AMJV and Brady, 2011b | Final Addendum 01 to the Final Sampling and Analysis Plan, Preliminary Assessment/ Site Inspection, IRP Site 75, Agricultural Well KAYO-SB, Naval Weapons Station Seal Beach, Seal Beach, California. June 30. |

# Figure

Figure 1 Site Map

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LEGEND

MONITORING WELL

IR SITE 75
SITE MAP

NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

BRADY

DATE: May 23, 2016
FILE: SiteMap

FIGURE: 1

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# Attachment 1

Analytical Lab DoD Accreditation & State of California Certification

Analytical Standard Operating Procedure for EPA Method 8260B & 8270C-SIM

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LABORATORY ACCREDITATION BUREAU a division of A-S-B

# Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2278

## EMAX Laboratories, Inc.

1835 W. 205th St.
Torrance CA 90501

**has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).***

**The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).**

**Accreditation valid through: January 10, 2017**

**R. Douglas Leonard, Jr., President, COO**
**Laboratory Accreditation Bureau**
**Presented the 9th of January 2014**

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).
Form 403.14 – Rev 1 7/3/13

LABORATORY ACCREDITATION BUREAU

**Certificate # L2278**

# Scope of Accreditation
# For
# EMAX Laboratories, Inc.

1835 W 205th Street
Torrance, CA 90501
Kenette Pimentel
310-618-8889

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (LABPR 403 DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM V5) based on the TNI Standard - Environmental Laboratory Sector, Volume 1 – Management and Technical Requirements for Laboratories Performing Environmental Analysis, Sept 2009 (EL-V1-2009); accreditation is granted to **EMAX Laboratories, Inc.** to perform the following tests:

Accreditation granted through: **January 10, 2017**

**Testing - Environmental**

| **Non-Potable Water** | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | AK101 | GRO |
| GC | AK102 | DRO |
| GFAA | CA 939M | Organo Lead |
| Platinum Electrode | EPA 120.1 | Specific Conductance |
| Titrimetric | EPA 130.2 | Hardness |
| Electrode | EPA 150.1 | pH |
| Gravimetric | EPA 160.1 | TDS |
| Gravimetric | EPA 160.2 | TSS |
| Gravimetric | EPA 160.3 | Total Residue |
| Gravimetric | EPA 160.5 | Settleable Residue |
| Turbidimetric | EPA 180.1 | Turbidity |
| ICP | EPA 200.7 | Aluminum |
| ICP | EPA 200.7 | Antimony |
| ICP | EPA 200.7 | Arsenic |
| ICP | EPA 200.7 | Barium |
| ICP | EPA 200.7 | Beryllium |
| ICP | EPA 200.7 | Boron |
| ICP | EPA 200.7 | Cadmium |
| ICP | EPA 200.7 | Calcium |
| ICP | EPA 200.7 | Chromium |
| ICP | EPA 200.7 | Cobalt |
| ICP | EPA 200.7 | Copper |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| ICP | EPA 200.7 | Iron |
| ICP | EPA 200.7 | Lead |
| ICP | EPA 200.7 | Lithium |
| ICP | EPA 200.7 | Magnesium |
| ICP | EPA 200.7 | Manganese |
| ICP | EPA 200.7 | Molybdenum |
| ICP | EPA 200.7 | Nickel |
| ICP | EPA 200.7 | Potassium |
| ICP | EPA 200.7 | Selenium |
| ICP | EPA 200.7 | Silver |
| ICP | EPA 200.7 | Sodium |
| ICP | EPA 200.7 | Strontium |
| ICP | EPA 200.7 | Thallium |
| ICP | EPA 200.7 | Tin |
| ICP | EPA 200.7 | Titanium |
| ICP | EPA 200.7 | Vanadium |
| ICP | EPA 200.7 | Zinc |
| ICP-MS | EPA 200.8 | Aluminum |
| ICP-MS | EPA 200.8 | Antimony |
| ICP-MS | EPA 200.8 | Arsenic |
| ICP-MS | EPA 200.8 | Barium |
| ICP-MS | EPA 200.8 | Beryllium |
| ICP-MS | EPA 200.8 | Boron |
| ICP-MS | EPA 200.8 | Cadmium |
| ICP-MS | EPA 200.8 | Calcium |
| ICP-MS | EPA 200.8 | Chromium |
| ICP-MS | EPA 200.8 | Cobalt |
| ICP-MS | EPA 200.8 | Copper |
| ICP-MS | EPA 200.8 | Iron |
| ICP-MS | EPA 200.8 | Lead |
| ICP-MS | EPA 200.8 | Lithium |
| ICP-MS | EPA 200.8 | Magnesium |
| ICP-MS | EPA 200.8 | Manganese |
| ICP-MS | EPA 200.8 | Molybdenum |
| ICP-MS | EPA 200.8 | Nickel |
| ICP-MS | EPA 200.8 | Potassium |
| ICP-MS | EPA 200.8 | Selenium |
| ICP-MS | EPA 200.8 | Silver |
| ICP-MS | EPA 200.8 | Sodium |
| ICP-MS | EPA 200.8 | Strontium |
| ICP-MS | EPA 200.8 | Thallium |
| ICP-MS | EPA 200.8 | Tin |
| ICP-MS | EPA 200.8 | Titanium |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| ICP-MS | EPA 200.8 | Uranium |
| ICP-MS | EPA 200.8 | Vanadium |
| ICP-MS | EPA 200.8 | Zinc |
| IC | EPA 218.6 | Hexavalent Chromium |
| COLD VAPOR | EPA 245.1 | Mercury |
| IC | EPA 300.0 | Fluoride |
| IC | EPA 300.0 | Chloride |
| IC | EPA 300.0 | Nitrite |
| IC | EPA 300.0 | Bromide |
| IC | EPA 300.0 | Nitrate |
| IC | EPA 300.0 | Phosphate |
| IC | EPA 300.0 | Sulfate |
| IC | EPA 300.0 | Bromate |
| IC | EPA 300.0 | Chlorate |
| IC | EPA 300M | Lactate |
| IC | EPA 300M | Acetate |
| IC | EPA 300M | Propionate |
| IC | EPA 300M | Butyrate |
| IC | EPA 300M | Pyruvate |
| IC | EPA 310.1 | Alkalinity |
| IC | EPA 314.0 | Perchlorate |
| Titrimetric | EPA 330.3 | Total Residual Chlorine |
| Spectrometric | EPA 352.1 | Nitrate-N |
| Spectrometric | EPA 353.3 | Nitrate-N |
| Spectrometric | EPA 354.1 | Nitrite-N |
| Spectrometric | EPA 365.2 | Ortho-phosphate |
| Spectrometric | EPA 335.2 | Cyanide |
| Spectrometric | EPA 350.2 | Ammonia |
| Spectrometric | EPA 351.3 | TKN |
| Spectrometric | EPA 365.2 | Phosphorus |
| Spectrometric | EPA 370.1 | Silica |
| Titrimetric | EPA 376.1 | Sulfide |
| Spectrometric | EPA 376.2 | Sulfide |
| Titrimetric | EPA 377.1 | Sulfite |
| Electrode | EPA 405.1 | BOD |
| Spectrometric | EPA 410.4 | COD |
| Combustion-IR | EPA 415.1 | TOC |
| Spectrometric | EPA 420.1 | Phenols |
| Spectrometric | EPA 425.1 | MBAS |
| GC | EPA 504.1 | DBCP |
| GC | EPA 504.1 | EDB |
| GC | EPA 608 | Aldrin |
| GC | EPA 608 | alpha-BHC |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 608 | beta-BHC |
| GC | EPA 608 | delta-BHC |
| GC | EPA 608 | gamma-BHC (Lindane) |
| GC | EPA 608 | DDD (4,4) |
| GC | EPA 608 | DDE (4,4) |
| GC | EPA 608 | DDT (4,4) |
| GC | EPA 608 | Dieldrin |
| GC | EPA 608 | Endosulfan I |
| GC | EPA 608 | Endosulfan II |
| GC | EPA 608 | Endosulfan sulfate |
| GC | EPA 608 | Endrin |
| GC | EPA 608 | Endrin Aldehyde |
| GC | EPA 608 | Heptachlor |
| GC | EPA 608 | Heptachlor epoxide |
| GC | EPA 608 | Methoxychlor |
| GC | EPA 608 | alpha-Chlordane |
| GC | EPA 608 | gamma-Chlordane |
| GC | EPA 608 | Endrin Ketone |
| GC | EPA 608 | Toxaphene |
| GC | EPA 608 | Technical Chlordane |
| GC | EPA 608 | cis-Nonachlor |
| GC | EPA 608 | DDD (2,4) |
| GC | EPA 608 | DDE (2,4) |
| GC | EPA 608 | DDT (2,4) |
| GC | EPA 608 | Mirex |
| GC | EPA 608 | Oxychlordane |
| GC | EPA 608 | trans-Nonachlor |
| GC | EPA 608 | PCB1016 |
| GC | EPA 608 | PCB1221 |
| GC | EPA 608 | PCB1232 |
| GC | EPA 608 | PCB1242 |
| GC | EPA 608 | PCB1248 |
| GC | EPA 608 | PCB1254 |
| GC | EPA 608 | PCB1260 |
| GC | EPA 608 | PCB1262 |
| GC | EPA 608 | PCB1268 |
| GC-MS | EPA 624 | Acrolein |
| GC-MS | EPA 624 | Acrylonitrile |
| GC-MS | EPA 624 | Benzene |
| GC-MS | EPA 624 | Bromodichloromethane |
| GC-MS | EPA 624 | Bromoform |
| GC-MS | EPA 624 | Bromomethane |
| GC-MS | EPA 624 | Carbon tetrachloride |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 624 | Chlorobenzene |
| GC-MS | EPA 624 | 2-Chloroethyl vinyl ether |
| GC-MS | EPA 624 | Chloroethane |
| GC-MS | EPA 624 | Chloroform |
| GC-MS | EPA 624 | Chloromethane |
| GC-MS | EPA 624 | Dibromochloromethane |
| GC-MS | EPA 624 | 1,1-Dichloroethane |
| GC-MS | EPA 624 | 1,2-Dichloroethane |
| GC-MS | EPA 624 | 1,2-Dichlorobenzene |
| GC-MS | EPA 624 | 1,3-Dichlorobenzene |
| GC-MS | EPA 624 | 1,4-Dichlorobenzene |
| GC-MS | EPA 624 | Dichlorodifluoromethane |
| GC-MS | EPA 624 | 1,1-Dichloroethene |
| GC-MS | EPA 624 | cis-1,2-Dichloroethene |
| GC-MS | EPA 624 | trans-1,2-Dichloroethene |
| GC-MS | EPA 624 | 1,2-Dichloropropane |
| GC-MS | EPA 624 | cis-1,3-Dichloropropene |
| GC-MS | EPA 624 | trans-1,3-Dichloropropene |
| GC-MS | EPA 624 | Ethylbenzene |
| GC-MS | EPA 624 | Methylene Chloride |
| GC-MS | EPA 624 | tert-Butyl methyl ether |
| GC-MS | EPA 624 | Styrene |
| GC-MS | EPA 624 | 1,1,2,2-Tetrachloroethane |
| GC-MS | EPA 624 | Tetrachloroethene |
| GC-MS | EPA 624 | Toluene |
| GC-MS | EPA 624 | 1,1,1-Trichloroethane |
| GC-MS | EPA 624 | 1,1,2-Trichloroethane |
| GC-MS | EPA 624 | 1,2,4-Trichlorobenzene |
| GC-MS | EPA 624 | Trichloroethene |
| GC-MS | EPA 624 | Trichlorofluoromethane |
| GC-MS | EPA 624 | 1,1,2-Trichloro1,2,2-trifluoroethane |
| GC-MS | EPA 624 | Vinyl Chloride |
| GC-MS | EPA 624 | m-Xylene & p-xylene |
| GC-MS | EPA 624 | o-Xylene |
| GC-MS | EPA 625 | Acenaphthene |
| GC-MS | EPA 625 | Acenaphthylene |
| GC-MS | EPA 625 | Aniline |
| GC-MS | EPA 625 | Anthracene |
| GC-MS | EPA 625 | Azobenzene |
| GC-MS | EPA 625 | Benzidine |
| GC-MS | EPA 625 | Benzo(a)anthracene |
| GC-MS | EPA 625 | benzo(a)pyrene |
| GC-MS | EPA 625 | Benzo(b)fluoranthene |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 625 | Benzo(e)pyrene |
| GC-MS | EPA 625 | Benzo(g,h,i)perylene |
| GC-MS | EPA 625 | Benzo(k)fluoranthene |
| GC-MS | EPA 625 | Benzoic Acid |
| GC-MS | EPA 625 | Benzyl Alcohol |
| GC-MS | EPA 625 | Biphenyl |
| GC-MS | EPA 625 | bis(2-chloroethoxy)methane |
| GC-MS | EPA 625 | bis(2-chloroethyl)ether |
| GC-MS | EPA 625 | bis(2-chloroisopropyl)ether |
| GC-MS | EPA 625 | bis(2-Ethylhexyl)adipate |
| GC-MS | EPA 625 | bis(2-Ethylhexyl)phthalate |
| GC-MS | EPA 625 | 4-Bromophenyl-phenylether |
| GC-MS | EPA 625 | Butylbenzylphthalate |
| GC-MS | EPA 625 | Carbazole |
| GC-MS | EPA 625 | 4-Chloro-3-methylphenol |
| GC-MS | EPA 625 | 4-Chloroaniline |
| GC-MS | EPA 625 | 2-Chloronaphthalene |
| GC-MS | EPA 625 | 2-Chlorophenol |
| GC-MS | EPA 625 | 4-Chlorophenyl-phenylether |
| GC-MS | EPA 625 | Chrysene |
| GC-MS | EPA 625 | Dibenzo(a,h)anthracene |
| GC-MS | EPA 625 | Dibenzofuran |
| GC-MS | EPA 625 | 1,2-Dichlorobenzene |
| GC-MS | EPA 625 | 1,3-Dichlorobenzene |
| GC-MS | EPA 625 | 1,4-Dichlorobenzene |
| GC-MS | EPA 625 | 3,3'-Dichlorobenzidine |
| GC-MS | EPA 625 | 2,4-Dichlorophenol |
| GC-MS | EPA 625 | Diethylphthalate |
| GC-MS | EPA 625 | 2,6-Dimethylnaphthalene |
| GC-MS | EPA 625 | 2,4-Dimethylphenol |
| GC-MS | EPA 625 | Dimethylphthalate |
| GC-MS | EPA 625 | Di-n-butylphthalate |
| GC-MS | EPA 625 | 4,6-Dinitro-2-methylphenol |
| GC-MS | EPA 625 | 2,4-Dinitrophenol |
| GC-MS | EPA 625 | 2,4-Dinitrotoluene |
| GC-MS | EPA 625 | 2,6-Dinitrotoluene |
| GC-MS | EPA 625 | Di-n-octylphthalate |
| GC-MS | EPA 625 | 1,2-Diphenylhydrazine |
| GC-MS | EPA 625 | Fluoranthene |
| GC-MS | EPA 625 | Fluorene |
| GC-MS | EPA 625 | Hexachlorobenzene |
| GC-MS | EPA 625 | Hexachlorobutadiene |
| GC-MS | EPA 625 | Hexachlorocyclopentadiene |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 625 | Hexachloroethane |
| GC-MS | EPA 625 | Indeno(1,2,3-cd)pyrene |
| GC-MS | EPA 625 | Isophorone |
| GC-MS | EPA 625 | 1-Methylnaphthalene |
| GC-MS | EPA 625 | 2-Methylnaphthalene |
| GC-MS | EPA 625 | 1-Methylphenanthrene |
| GC-MS | EPA 625 | 2-Methylphenol |
| GC-MS | EPA 625 | 4-Methylphenol |
| GC-MS | EPA 625 | Naphthalene |
| GC-MS | EPA 625 | 2-Nitroaniline |
| GC-MS | EPA 625 | 3-Nitroaniline |
| GC-MS | EPA 625 | 4-Nitroaniline |
| GC-MS | EPA 625 | Nitrobenzene |
| GC-MS | EPA 625 | 2-Nitrophenol |
| GC-MS | EPA 625 | 4-Nitrophenol |
| GC-MS | EPA 625 | n-Nitrosodimethylamine |
| GC-MS | EPA 625 | n-Nitroso-di-n-propylamine |
| GC-MS | EPA 625 | n-Nitrosodiphenylamine |
| GC-MS | EPA 625 | Pentachlorophenol |
| GC-MS | EPA 625 | Perylene |
| GC-MS | EPA 625 | Phenanthrene |
| GC-MS | EPA 625 | Phenol |
| GC-MS | EPA 625 | Pyrene |
| GC-MS | EPA 625 | Pyridine |
| GC-MS | EPA 625 | 2,3,4,6-Tetrachlorophenol |
| GC-MS | EPA 625 | 1,2,4-Trichlorobenzene |
| GC-MS | EPA 625 | 2,3,4-Trichlorophenol |
| GC-MS | EPA 625 | 2,3,5-Trichlorophenol |
| GC-MS | EPA 625 | 2,4,5-Trichlorophenol |
| GC-MS | EPA 625 | 2,4,6-Trichlorophenol |
| GC-MS | EPA 625 | 2,3,5-Trimethylnaphthalene |
| Gravimetric | EPA 1664A / 1664 B | Oil & Grease |
| Pensky-Martens | EPA 1010 / 1010A | Ignitability |
| ICP | EPA 6010B / 6010C | Aluminum |
| ICP | EPA 6010B / 6010C | Antimony |
| ICP | EPA 6010B / 6010C | Arsenic |
| ICP | EPA 6010B / 6010C | Barium |
| ICP | EPA 6010B / 6010C | Beryllium |
| ICP | EPA 6010B / 6010C | Boron |
| ICP | EPA 6010B / 6010C | Cadmium |
| ICP | EPA 6010B / 6010C | Calcium |
| ICP | EPA 6010B / 6010C | Chromium |
| ICP | EPA 6010B / 6010C | Cobalt |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| ICP | EPA 6010B / 6010C | Copper |
| ICP | EPA 6010B / 6010C | Iron |
| ICP | EPA 6010B / 6010C | Lead |
| ICP | EPA 6010B / 6010C | Lithium |
| ICP | EPA 6010B / 6010C | Magnesium |
| ICP | EPA 6010B / 6010C | Manganese |
| ICP | EPA 6010B / 6010C | Molybdenum |
| ICP | EPA 6010B / 6010C | Nickel |
| ICP | EPA 6010B / 6010C | Potassium |
| ICP | EPA 6010B / 6010C | Selenium |
| ICP | EPA 6010B / 6010C | Silver |
| ICP | EPA 6010B / 6010C | Sodium |
| ICP | EPA 6010B / 6010C | Strontium |
| ICP | EPA 6010B / 6010C | Thallium |
| ICP | EPA 6010B / 6010C | Tin |
| ICP | EPA 6010B / 6010C | Titanium |
| ICP | EPA 6010B / 6010C | Vanadium |
| ICP | EPA 6010B / 6010C | Zinc |
| ICP-MS | EPA 6020A | Aluminum |
| ICP-MS | EPA 6020A | Antimony |
| ICP-MS | EPA 6020A | Arsenic |
| ICP-MS | EPA 6020A | Barium |
| ICP-MS | EPA 6020A | Beryllium |
| ICP-MS | EPA 6020A | Boron |
| ICP-MS | EPA 6020A | Cadmium |
| ICP-MS | EPA 6020A | Calcium |
| ICP-MS | EPA 6020A | Chromium |
| ICP-MS | EPA 6020A | Cobalt |
| ICP-MS | EPA 6020A | Copper |
| ICP-MS | EPA 6020A | Iron |
| ICP-MS | EPA 6020A | Lead |
| ICP-MS | EPA 6020A | Magnesium |
| ICP-MS | EPA 6020A | Manganese |
| ICP-MS | EPA 6020A | Molybdenum |
| ICP-MS | EPA 6020A | Nickel |
| ICP-MS | EPA 6020A | Potassium |
| ICP-MS | EPA 6020A | Selenium |
| ICP-MS | EPA 6020A | Silver |
| ICP-MS | EPA 6020A | Sodium |
| ICP-MS | EPA 6020A | Strontium |
| ICP-MS | EPA 6020A | Thallium |
| ICP-MS | EPA 6020A | Tin |
| ICP-MS | EPA 6020A | Titanium |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| ICP-MS | EPA 6020A | Tungsten |
| ICP-MS | EPA 6020A | Uranium |
| ICP-MS | EPA 6020A | Vanadium |
| ICP-MS | EPA 6020A | Zinc |
| HPLC-MS | EPA 6850 | Perchlorate |
| Spectrometric | EPA 7196A | Hex. Chromium |
| IC | EPA 7199 | Hex. Chromium |
| Cold-Vapor | EPA 7470A | Mercury |
| GC | EPA 8015B / 8015C / 8015D | Gasoline |
| GC | EPA 8015B / 8015C / 8015D | Diesel |
| GC | EPA 8015B / 8015C / 8015D | Motor Oil |
| GC | EPA 8015B / 8015C | Diethylene Glycol |
| GC | EPA 8015B / 8015C | Ethanol |
| GC | EPA 8015B / 8015C | Ethylene Glycol |
| GC | EPA 8015B / 8015C | Isopropanol |
| GC | EPA 8015B / 8015C / 8015D | JP4 |
| GC | EPA 8015B / 8015C | Methanol |
| GC | EPA 8015B / 8015C | Propylene Glycol |
| GC | EPA 8015B / 8015C / 8015D | JP5 |
| GC | EPA 8015B / 8015C | Triethylene Glycol |
| GC | EPA 8081A / 8081B | Aldrin |
| GC | EPA 8081A / 8081B | alpha-BHC |
| GC | EPA 8081A / 8081B | beta-BHC |
| GC | EPA 8081A / 8081B | delta-BHC |
| GC | EPA 8081A / 8081B | gamma-BHC (Lindane) |
| GC | EPA 8081A / 8081B | DDD (4,4) |
| GC | EPA 8081A / 8081B | DDE (4,4) |
| GC | EPA 8081A / 8081B | DDT (4,4) |
| GC | EPA 8081A / 8081B | Dieldrin |
| GC | EPA 8081A / 8081B | Endosulfan I |
| GC | EPA 8081A / 8081B | Endosulfan II |
| GC | EPA 8081A / 8081B | Endosulfan sulfate |
| GC | EPA 8081A / 8081B | Endrin |
| GC | EPA 8081A / 8081B | Endrin Aldehyde |
| GC | EPA 8081A / 8081B | Heptachlor |
| GC | EPA 8081A / 8081B | Heptachlor epoxide |
| GC | EPA 8081A / 8081B | Methoxychlor |
| GC | EPA 8081A / 8081B | alpha-Chlordane |
| GC | EPA 8081A / 8081B | gamma-Chlordane |
| GC | EPA 8081A / 8081B | Endrin Ketone |
| GC | EPA 8081A / 8081B | Toxaphene |
| GC | EPA 8081A / 8081B | Technical Chlordane |
| GC | EPA 8081A / 8081B | cis-Nonachlor |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 8081A / 8081B | DDD (2,4) |
| GC | EPA 8081A / 8081B | DDE (2,4) |
| GC | EPA 8081A / 8081B | DDT (2,4) |
| GC | EPA 8081A / 8081B | Mirex |
| GC | EPA 8081A / 8081B | Oxychlordane |
| GC | EPA 8081A / 8081B | trans-Nonachlor |
| GC | EPA 8082 / 8082A | PCB1016 |
| GC | EPA 8082 / 8082A | PCB1221 |
| GC | EPA 8082 / 8082A | PCB1232 |
| GC | EPA 8082 / 8082A | PCB1242 |
| GC | EPA 8082 / 8082A | PCB1248 |
| GC | EPA 8082 / 8082A | PCB1254 |
| GC | EPA 8082 / 8082A | PCB1260 |
| GC | EPA 8082 / 8082A | PCB1262 |
| GC | EPA 8082 / 8082A | PCB1268 |
| GC | EPA 8082 / 8082A | PCB 8 |
| GC | EPA 8082 / 8082A | PCB 18 |
| GC | EPA 8082 / 8082A | PCB 28 |
| GC | EPA 8082 / 8082A | PCB 44 |
| GC | EPA 8082 / 8082A | PCB 52 |
| GC | EPA 8082 / 8082A | PCB 66 |
| GC | EPA 8082 / 8082A | PCB 77 |
| GC | EPA 8082 / 8082A | PCB 81 |
| GC | EPA 8082 / 8082A | PCB 101 |
| GC | EPA 8082 / 8082A | PCB 105 |
| GC | EPA 8082 / 8082A | PCB 114 |
| GC | EPA 8082 / 8082A | PCB 118 |
| GC | EPA 8082 / 8082A | PCB 123 |
| GC | EPA 8082 / 8082A | PCB 126 |
| GC | EPA 8082 / 8082A | PCB 128 |
| GC | EPA 8082 / 8082A | PCB 138 |
| GC | EPA 8082 / 8082A | PCB 153 |
| GC | EPA 8082 / 8082A | PCB 156 |
| GC | EPA 8082 / 8082A | PCB 157 |
| GC | EPA 8082 / 8082A | PCB 167 |
| GC | EPA 8082 / 8082A | PCB 169 |
| GC | EPA 8082 / 8082A | PCB 170 |
| GC | EPA 8082 / 8082A | PCB 180 |
| GC | EPA 8082 / 8082A | PCB 187 |
| GC | EPA 8082 / 8082A | PCB 189 |
| GC | EPA 8082 / 8082A | PCB 195 |
| GC | EPA 8082 / 8082A | PCB 206 |
| GC | EPA 8082 / 8082A | PCB 209 |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 8082 / 8082A | PCB 110 |
| GC | EPA 8141A / 8141B | Azinphos-methyl |
| GC | EPA 8141A / 8141B | Bolstar |
| GC | EPA 8141A / 8141B | Chlorpyrifos |
| GC | EPA 8141A / 8141B | Coumaphos |
| GC | EPA 8141A / 8141B | Total Demeton |
| GC | EPA 8141A / 8141B | Diazinon |
| GC | EPA 8141A / 8141B | Dichlorvos |
| GC | EPA 8141A / 8141B | Disulfoton |
| GC | EPA 8141A / 8141B | Ethoprop |
| GC | EPA 8141A / 8141B | Fensulfothion |
| GC | EPA 8141A / 8141B | Fenthion |
| GC | EPA 8141A / 8141B | Merphos |
| GC | EPA 8141A / 8141B | Mevinphos |
| GC | EPA 8141A / 8141B | Naled |
| GC | EPA 8141A / 8141B | Methyl Parathion |
| GC | EPA 8141A / 8141B | Phorate |
| GC | EPA 8141A / 8141B | Ronnel |
| GC | EPA 8141A / 8141B | Stirophos |
| GC | EPA 8141A / 8141B | Tokuthion |
| GC | EPA 8141A / 8141B | Trichloronate |
| GC | EPA 8141A / 8141B | Dimethoate |
| GC | EPA 8141A / 8141B | EPN |
| GC | EPA 8141A / 8141B | Famphur |
| GC | EPA 8141A / 8141B | Malathion |
| GC | EPA 8141A / 8141B | Ethyl Parathion |
| GC | EPA 8141A / 8141B | O,O,O-Triethylphosphorothioate |
| GC | EPA 8141A / 8141B | Sulfotepp |
| GC | EPA 8141A / 8141B | Thionazin |
| GC | EPA 8141A / 8141B | Tributyl Phosphate |
| GC | EPA 8151A | Acifluorfen |
| GC | EPA 8151A | Bentazon |
| GC | EPA 8151A | Chloramben |
| GC | EPA 8151A | 2,4-D |
| GC | EPA 8151A | 2,4-DB |
| GC | EPA 8151A | Dacthal |
| GC | EPA 8151A | Dalapon |
| GC | EPA 8151A | Dicamba |
| GC | EPA 8151A | 3,5-Dichlorobenzoic acid |
| GC | EPA 8151A | Dichlorprop |
| GC | EPA 8151A | Dinoseb |
| GC | EPA 8151A | MCPA |
| GC | EPA 8151A | MCPP |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 8151A | 4-Nitrophenol |
| GC | EPA 8151A | Pentachlorophenol |
| GC | EPA 8151A | Picloram |
| GC | EPA 8151A | Silvex |
| GC | EPA 8151A | 2,4,5-T |
| GC-MS | EPA 8260B / 8260C | Acetone |
| GC-MS | EPA 8260B / 8260C | Acetonitrile |
| GC-MS | EPA 8260B / 8260C | Acrolein |
| GC-MS | EPA 8260B / 8260C | Acrylonitrile |
| GC-MS | EPA 8260B / 8260C | Benzene |
| GC-MS | EPA 8260B / 8260C | Bromobenzene |
| GC-MS | EPA 8260B / 8260C | Bromochloromethane |
| GC-MS | EPA 8260B / 8260C | Bromodichloromethane |
| GC-MS | EPA 8260B / 8260C | Bromoform |
| GC-MS | EPA 8260B / 8260C | Bromomethane |
| GC-MS | EPA 8260B / 8260C | tert-Butyl alcohol |
| GC-MS | EPA 8260B / 8260C | 2-Butanone (MEK) |
| GC-MS | EPA 8260B / 8260C | n-Butylbenzene |
| GC-MS | EPA 8260B / 8260C | sec-Butylbenzene |
| GC-MS | EPA 8260B / 8260C | tert-Butylbenzene |
| GC-MS | EPA 8260B / 8260C | Carbon disulfide |
| GC-MS | EPA 8260B / 8260C | Carbon tetrachloride |
| GC-MS | EPA 8260B / 8260C | Chlorobenzene |
| GC-MS | EPA 8260B / 8260C | 2-Chloroethyl vinyl ether |
| GC-MS | EPA 8260B / 8260C | Chloroethane |
| GC-MS | EPA 8260B / 8260C | Chloroform |
| GC-MS | EPA 8260B / 8260C | 1-Chlorohexane |
| GC-MS | EPA 8260B / 8260C | Chloromethane |
| GC-MS | EPA 8260B / 8260C | 2-Chlorotoluene |
| GC-MS | EPA 8260B / 8260C | 4-Chlorotoluene |
| GC-MS | EPA 8260B / 8260C | Isopropyl ether (DIPE) |
| GC-MS | EPA 8260B / 8260C | Dibromochloromethane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dibromo-3-chloropropane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dibromoethane |
| GC-MS | EPA 8260B / 8260C | Dibromomethane |
| GC-MS | EPA 8260B / 8260C | 1,1-Dichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dichlorobenzene |
| GC-MS | EPA 8260B / 8260C | 1,3-Dichlorobenzene |
| GC-MS | EPA 8260B / 8260C | trans-1,4-Dichloro-2-Butene |
| GC-MS | EPA 8260B / 8260C | 1,4-Dichlorobenzene |
| GC-MS | EPA 8260B / 8260C | Dichlorodifluoromethane |
| GC-MS | EPA 8260B / 8260C | 1,1-Dichloroethene |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8260B / 8260C | cis-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C | trans-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C | Dichlorofluoromethane |
| GC-MS | EPA 8260B / 8260C | 1,1-Dichloropropene |
| GC-MS | EPA 8260B / 8260C | 1,2-Dichloropropane |
| GC-MS | EPA 8260B / 8260C | 1,3-Dichloropropane |
| GC-MS | EPA 8260B / 8260C | 2,2-Dichloropropane |
| GC-MS | EPA 8260B / 8260C | cis-1,3-Dichloropropene |
| GC-MS | EPA 8260B / 8260C | trans-1,3-Dichloropropene |
| GC-MS | EPA 8260B / 8260C | tert-Butyl ethyl ether (ETBE) |
| GC-MS | EPA 8260B / 8260C | Ethyl Methacrylate |
| GC-MS | EPA 8260B / 8260C | Ethylbenzene |
| GC-MS | EPA 8260B / 8260C | 2-Hexanone (MBK) |
| GC-MS | EPA 8260B / 8260C | Hexachlorobutadiene |
| GC-MS | EPA 8260B / 8260C | Iodomethane |
| GC-MS | EPA 8260B / 8260C | Isopropylbenzene |
| GC-MS | EPA 8260B / 8260C | p-Isopropyltoluene |
| GC-MS | EPA 8260B / 8260C | Methylene Chloride |
| GC-MS | EPA 8260B / 8260C | 4-Methyl-2-pentanone (MIBK) |
| GC-MS | EPA 8260B / 8260C | tert-Butyl methyl ether |
| GC-MS | EPA 8260B / 8260C | Naphthalene |
| GC-MS | EPA 8260B / 8260C | n-Propylbenzene |
| GC-MS | EPA 8260B / 8260C | Styrene |
| GC-MS | EPA 8260B / 8260C | tert-Amyl methyl ether (TAME) |
| GC-MS | EPA 8260B / 8260C | 1,1,1,2-Tetrachloroethane |
| GC-MS | EPA 8260B / 8260C | 1,1,2,2-Tetrachloroethane |
| GC-MS | EPA 8260B / 8260C | Tetrachloroethene |
| GC-MS | EPA 8260B / 8260C | Toluene |
| GC-MS | EPA 8260B / 8260C | 1,1,1-Trichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,1,2-Trichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,2,3-Trichlorobenzene |
| GC-MS | EPA 8260B / 8260C | 1,2,4-Trichlorobenzene |
| GC-MS | EPA 8260B / 8260C | Trichloroethene |
| GC-MS | EPA 8260B / 8260C | Trichlorofluoromethane |
| GC-MS | EPA 8260B / 8260C | 1,2,3-Trichloropropane |
| GC-MS | EPA 8260B / 8260C | 1,1,2-Trichloro1,2,2-trifluoroethane |
| GC-MS | EPA 8260B / 8260C | 1,2,4-Trimethylbenzene |
| GC-MS | EPA 8260B / 8260C | 1,3,5-Trimethylbenzene |
| GC-MS | EPA 8260B / 8260C | Vinyl Acetate |
| GC-MS | EPA 8260B / 8260C | Vinyl Chloride |
| GC-MS | EPA 8260B / 8260C | m-Xylene & p-xylene |
| GC-MS | EPA 8260B / 8260C | o-Xylene |
| GC-MS | EPA 8260B / 8260C | Allyl Chloride |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8260B / 8260C | Benzyl chloride |
| GC-MS | EPA 8260B / 8260C | Chloroprene |
| GC-MS | EPA 8260B / 8260C | Cyclohexane |
| GC-MS | EPA 8260B / 8260C | 1,4-Dioxane |
| GC-MS | EPA 8260B / 8260C | 2-Chloro-1,1,1-trifluoroethane |
| GC-MS | EPA 8260B / 8260C | Chlorotrifluoroethylene |
| GC-MS | EPA 8260B / 8260C | cis-1,4-Dichloro-2-butene |
| GC-MS | EPA 8260B / 8260C | Ethanol |
| GC-MS | EPA 8260B / 8260C | Ethyl Methacrylate |
| GC-MS | EPA 8260B / 8260C | Isobutyl Alcohol |
| GC-MS | EPA 8260B / 8260C | Methacrylonitrile |
| GC-MS | EPA 8260B / 8260C | Methyl Methacrylate |
| GC-MS | EPA 8260B / 8260C | Pentachloroethane |
| GC-MS | EPA 8260B / 8260C | Propionitrile |
| GC-MS | EPA 8260B / 8260C | Sec-Propyl alcohol |
| GC-MS | EPA 8260B / 8260C | Tetrahydrofuran |
| GC-MS | EPA 8260B / 8260C | trans-1,4-Dichloro-2-butene |
| GC-MS | EPA 8260B / 8260C SIM | Benzene |
| GC-MS | EPA 8260B / 8260C SIM | Carbon tetrachloride |
| GC-MS | EPA 8260B / 8260C SIM | Chloroform |
| GC-MS | EPA 8260B / 8260C SIM | Chloromethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,2-Dibromo-3-chloropropane |
| GC-MS | EPA 8260B / 8260C SIM | 1,2-Dibromoethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,2-Dichloroethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,1-Dichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | cis-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | trans-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | 1,1,2,2-Tetrachloroethane |
| GC-MS | EPA 8260B / 8260C SIM | Tetrachloroethene |
| GC-MS | EPA 8260B / 8260C SIM | 1,1,1-Trichloroethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,1,2-Trichloroethane |
| GC-MS | EPA 8260B / 8260C SIM | Trichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | 1,2,3-Trichloropropane |
| GC-MS | EPA 8260B / 8260C SIM | Vinyl Chloride |
| GC-MS | EPA 8260B / 8260C SIM | 1,4-Dioxane |
| GC-MS | EPA 8270C / 8270D | Acenaphthene |
| GC-MS | EPA 8270C / 8270D | Acenaphthylene |
| GC-MS | EPA 8270C / 8270D | Aniline |
| GC-MS | EPA 8270C / 8270D | Anthracene |
| GC-MS | EPA 8270C / 8270D | Azobenzene |
| GC-MS | EPA 8270C / 8270D | Benzidine |
| GC-MS | EPA 8270C / 8270D | Benzo(a)anthracene |
| GC-MS | EPA 8270C / 8270D | benzo(a)pyrene |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D | Benzo(b)fluoranthene |
| GC-MS | EPA 8270C / 8270D | Benzo(e)pyrene |
| GC-MS | EPA 8270C / 8270D | Benzo(g,h,i)perylene |
| GC-MS | EPA 8270C / 8270D | Benzo(k)fluoranthene |
| GC-MS | EPA 8270C / 8270D | Benzoic Acid |
| GC-MS | EPA 8270C / 8270D | Benzyl Alcohol |
| GC-MS | EPA 8270C / 8270D | Biphenyl |
| GC-MS | EPA 8270C / 8270D | bis(2-chloroethoxy)methane |
| GC-MS | EPA 8270C / 8270D | bis(2-chloroethyl)ether |
| GC-MS | EPA 8270C / 8270D | bis(2-chloroisopropyl)ether |
| GC-MS | EPA 8270C / 8270D | bis(2-Ethylhexyl)adipate |
| GC-MS | EPA 8270C / 8270D | bis(2-Ethylhexyl)phthalate |
| GC-MS | EPA 8270C / 8270D | 4-Bromophenyl-phenylether |
| GC-MS | EPA 8270C / 8270D | Butylbenzylphthalate |
| GC-MS | EPA 8270C / 8270D | Carbazole |
| GC-MS | EPA 8270C / 8270D | 4-Chloro-3-methylphenol |
| GC-MS | EPA 8270C / 8270D | 4-Chloroaniline |
| GC-MS | EPA 8270C / 8270D | 2-Chloronaphthalene |
| GC-MS | EPA 8270C / 8270D | 2-Chlorophenol |
| GC-MS | EPA 8270C / 8270D | 4-Chlorophenyl-phenylether |
| GC-MS | EPA 8270C / 8270D | Chrysene |
| GC-MS | EPA 8270C / 8270D | Dibenzo(a,h)anthracene |
| GC-MS | EPA 8270C / 8270D | Dibenzofuran |
| GC-MS | EPA 8270C / 8270D | 1,2-Dichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 1,3-Dichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 1,4-Dichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 3,3'-Dichlorobenzidine |
| GC-MS | EPA 8270C / 8270D | 2,4-Dichlorophenol |
| GC-MS | EPA 8270C / 8270D | Diethylphthalate |
| GC-MS | EPA 8270C / 8270D | 2,6-Dimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 2,4-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D | Dimethylphthalate |
| GC-MS | EPA 8270C / 8270D | Di-n-butylphthalate |
| GC-MS | EPA 8270C / 8270D | 4,6-Dinitro-2-methylphenol |
| GC-MS | EPA 8270C / 8270D | 2,4-Dinitrophenol |
| GC-MS | EPA 8270C / 8270D | 2,4-Dinitrotoluene |
| GC-MS | EPA 8270C / 8270D | 2,6-Dinitrotoluene |
| GC-MS | EPA 8270C / 8270D | Di-n-octylphthalate |
| GC-MS | EPA 8270C / 8270D | Fluoranthene |
| GC-MS | EPA 8270C / 8270D | Fluorene |
| GC-MS | EPA 8270C / 8270D | Hexachlorobenzene |
| GC-MS | EPA 8270C / 8270D | Hexachlorobutadiene |
| GC-MS | EPA 8270C / 8270D | Hexachlorocyclopentadiene |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D | Hexachloroethane |
| GC-MS | EPA 8270C / 8270D | Indeno(1,2,3-cd)pyrene |
| GC-MS | EPA 8270C / 8270D | Isophorone |
| GC-MS | EPA 8270C / 8270D | 1-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 2-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 1-Methylphenanthrene |
| GC-MS | EPA 8270C / 8270D | 2-Methylphenol |
| GC-MS | EPA 8270C / 8270D | 3/4-Methylphenol |
| GC-MS | EPA 8270C / 8270D | Naphthalene |
| GC-MS | EPA 8270C / 8270D | 2-Nitroaniline |
| GC-MS | EPA 8270C / 8270D | 3-Nitroaniline |
| GC-MS | EPA 8270C / 8270D | 4-Nitroaniline |
| GC-MS | EPA 8270C / 8270D | Nitrobenzene |
| GC-MS | EPA 8270C / 8270D | 2-Nitrophenol |
| GC-MS | EPA 8270C / 8270D | 4-Nitrophenol |
| GC-MS | EPA 8270C / 8270D | n-Nitrosodimethylamine |
| GC-MS | EPA 8270C / 8270D | n-Nitroso-di-n-propylamine |
| GC-MS | EPA 8270C / 8270D | n-Nitrosodiphenylamine |
| GC-MS | EPA 8270C / 8270D | Pentachlorophenol |
| GC-MS | EPA 8270C / 8270D | Perylene |
| GC-MS | EPA 8270C / 8270D | Phenanthrene |
| GC-MS | EPA 8270C / 8270D | Phenol |
| GC-MS | EPA 8270C / 8270D | Pyrene |
| GC-MS | EPA 8270C / 8270D | Pyridine |
| GC-MS | EPA 8270C / 8270D | 2,3,4,6-Tetrachlorophenol |
| GC-MS | EPA 8270C / 8270D | 1,2,4-Trichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 2,3,4-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,3,5-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,4,5-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,4,6-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,3,5-Trimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 1,2,4,5-Tetrachlorobenzene |
| GC-MS | EPA 8270C / 8270D | 1,3,5-Trinitrobenzene |
| GC-MS | EPA 8270C / 8270D | 1,3-Dinitrobenzene |
| GC-MS | EPA 8270C / 8270D | 1,4-Dioxane |
| GC-MS | EPA 8270C / 8270D | 1,4-Naphthoquinone |
| GC-MS | EPA 8270C / 8270D | 1-Chloronaphthalene |
| GC-MS | EPA 8270C / 8270D | 1-Naphthylamine |
| GC-MS | EPA 8270C / 8270D | 2,6-Dichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2-acetylaminofluorene |
| GC-MS | EPA 8270C / 8270D | 2-Naphthylamine |
| GC-MS | EPA 8270C / 8270D | 2-Picoline |
| GC-MS | EPA 8270C / 8270D | 3,3-Dimethylbenzidine |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D | 3,4-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D | 3,5-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D | 3-Methylchlolanthrene |
| GC-MS | EPA 8270C / 8270D | 4-Aminobiphenyl |
| GC-MS | EPA 8270C / 8270D | 4-Nitroquinoline-N-oxide |
| GC-MS | EPA 8270C / 8270D | 5-Nitro-o-toluidine |
| GC-MS | EPA 8270C / 8270D | 7,12-Dimethylbenz(a)anthracene |
| GC-MS | EPA 8270C / 8270D | a,a-dimethylphenethylamine |
| GC-MS | EPA 8270C / 8270D | Acetophenone |
| GC-MS | EPA 8270C / 8270D | Aramite |
| GC-MS | EPA 8270C / 8270D | Atrazine |
| GC-MS | EPA 8270C / 8270D | Biphenyl |
| GC-MS | EPA 8270C / 8270D | Chlorobenzilate |
| GC-MS | EPA 8270C / 8270D | Diallate |
| GC-MS | EPA 8270C / 8270D | Dibenzo(a,j)acridine |
| GC-MS | EPA 8270C / 8270D | Dimethoate |
| GC-MS | EPA 8270C / 8270D | Dinoseb |
| GC-MS | EPA 8270C / 8270D | Diphenyl ether |
| GC-MS | EPA 8270C / 8270D | Disulfoton |
| GC-MS | EPA 8270C / 8270D | Ethyl methacrylate |
| GC-MS | EPA 8270C / 8270D | Ethyl methanesulfonate |
| GC-MS | EPA 8270C / 8270D | Ethyl parathion |
| GC-MS | EPA 8270C / 8270D | Famphur |
| GC-MS | EPA 8270C / 8270D | Hexachlorophene |
| GC-MS | EPA 8270C / 8270D | Hexachloropropene |
| GC-MS | EPA 8270C / 8270D | Isodrin |
| GC-MS | EPA 8270C / 8270D | Isosafrole |
| GC-MS | EPA 8270C / 8270D | kepone |
| GC-MS | EPA 8270C / 8270D | Methapyrilene |
| GC-MS | EPA 8270C / 8270D | Methyl methanesulfonate |
| GC-MS | EPA 8270C / 8270D | Methyl parathion |
| GC-MS | EPA 8270C / 8270D | N-nitrosodiethylamine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosodi-n-butylamine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosomethylethylamine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosomorpholine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosopiperdine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosopyrrolidine |
| GC-MS | EPA 8270C / 8270D | O,O,O-triethyl phosphorothi |
| GC-MS | EPA 8270C / 8270D | o-toluidine |
| GC-MS | EPA 8270C / 8270D | p-Dimethylaminoazobenze |
| GC-MS | EPA 8270C / 8270D | Pentachlorobenzene |
| GC-MS | EPA 8270C / 8270D | Pentachloroethane |
| GC-MS | EPA 8270C / 8270D | Pentachloronitrobenzene |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D | Phenacetin |
| GC-MS | EPA 8270C / 8270D | Phorate |
| GC-MS | EPA 8270C / 8270D | p-phenylenediamine |
| GC-MS | EPA 8270C / 8270D | Pronamide |
| GC-MS | EPA 8270C / 8270D | Safrole |
| GC-MS | EPA 8270C / 8270D | Sulfotepp |
| GC-MS | EPA 8270C / 8270D | Thionazin |
| GC-MS | EPA 8270C / 8270D SIM | Acenaphthene |
| GC-MS | EPA 8270C / 8270D SIM | Acenaphthylene |
| GC-MS | EPA 8270C / 8270D SIM | Anthracene |
| GC-MS | EPA 8270C / 8270D SIM | Azobenzene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(a)anthracene |
| GC-MS | EPA 8270C / 8270D SIM | benzo(a)pyrene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(b)fluoranthene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(e)pyrene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(g,h,i)perylene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(k)fluoranthene |
| GC-MS | EPA 8270C / 8270D SIM | Biphenyl |
| GC-MS | EPA 8270C / 8270D SIM | bis(2-chloroethyl)ether |
| GC-MS | EPA 8270C / 8270D SIM | bis(2-Ethylhexyl)phthalate |
| GC-MS | EPA 8270C / 8270D SIM | Carbazole |
| GC-MS | EPA 8270C / 8270D SIM | 4-Chloro-3-methylphenol |
| GC-MS | EPA 8270C / 8270D SIM | 2-Chlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | Chrysene |
| GC-MS | EPA 8270C / 8270D SIM | Dibenzo(a,h)anthracene |
| GC-MS | EPA 8270C / 8270D SIM | 2,4-Dichlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | 2,6-Dimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 2,4-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D SIM | Fluoranthene |
| GC-MS | EPA 8270C / 8270D SIM | Fluorene |
| GC-MS | EPA 8270C / 8270D SIM | Hexachlorobenzene |
| GC-MS | EPA 8270C / 8270D SIM | Indeno(1,2,3-cd)pyrene |
| GC-MS | EPA 8270C / 8270D SIM | 1-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 2-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 1-Methylphenanthrene |
| GC-MS | EPA 8270C / 8270D SIM | Naphthalene |
| GC-MS | EPA 8270C / 8270D SIM | n-Nitrosodimethylamine |
| GC-MS | EPA 8270C / 8270D SIM | n-Nitroso-di-n-propylamine |
| GC-MS | EPA 8270C / 8270D SIM | Pentachlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | Perylene |
| GC-MS | EPA 8270C / 8270D SIM | Phenanthrene |
| GC-MS | EPA 8270C / 8270D SIM | Phenol |
| GC-MS | EPA 8270C / 8270D SIM | Pyrene |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D SIM | 2,4,5-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | 2,4,6-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | 2,3,5-Trimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 1,4-Dioxane |
| GC-MS | EPA 8270C / 8270D SIM | Butylbenzylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Diethylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Dimethylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Di-n-butylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Di-n-octylphthalate |
| HPLC | EPA 8310 | Acenaphthene |
| HPLC | EPA 8310 | Acenaphthylene |
| HPLC | EPA 8310 | Anthracene |
| HPLC | EPA 8310 | Benzo(a)anthracene |
| HPLC | EPA 8310 | Benzo(a)pyrene |
| HPLC | EPA 8310 | Benzo(b)fluoranthene |
| HPLC | EPA 8310 | Benzo(g,h,i)perylene |
| HPLC | EPA 8310 | Benzo(k)fluoranthene |
| HPLC | EPA 8310 | Chrysene |
| HPLC | EPA 8310 | Dibenzo(a,h)anthracene |
| HPLC | EPA 8310 | Fluoranthene |
| HPLC | EPA 8310 | Fluorene |
| HPLC | EPA 8310 | Indeno(1,2,3-cd)pyrene |
| HPLC | EPA 8310 | 1-Methylnaphthalene |
| HPLC | EPA 8310 | 2-Methylnaphthalene |
| HPLC | EPA 8310 | Naphthalene |
| HPLC | EPA 8310 | Phenanthrene |
| HPLC | EPA 8310 | Pyrene |
| HPLC | EPA 8330A / 8330 B | HMX |
| HPLC | EPA 8330A / 8330 B | RDX |
| HPLC | EPA 8330A / 8330 B | 1,3,5-TNB |
| HPLC | EPA 8330A / 8330 B | 1,3-DNB |
| HPLC | EPA 8330A / 8330 B | Tetryl |
| HPLC | EPA 8330A / 8330 B | Nitrobenzene |
| HPLC | EPA 8330A / 8330 B | 2,4,6-TNT |
| HPLC | EPA 8330A / 8330 B | 4-AM-2,6-DNT |
| HPLC | EPA 8330A / 8330 B | 2-AM-4,6-DNT |
| HPLC | EPA 8330A / 8330 B | 2,6-DNT |
| HPLC | EPA 8330A / 8330 B | 2,4-DNT |
| HPLC | EPA 8330A / 8330 B | 2-Nitrotoluene |
| HPLC | EPA 8330A / 8330 B | 4-Nitrotoluene |
| HPLC | EPA 8330A / 8330 B | 3-Nitrotoluene |
| HPLC | EPA 8330A | 3,5-Dinitroaniline |
| HPLC | EPA 8330A | 2,4-Diamino-6-nitrotoluene |

| **Non-Potable Water** | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| HPLC | EPA 8330A | 2,6-Diamino-4-nitrotoluene |
| HPLC | EPA 8330A | Picric Acid |
| HPLC | EPA 8332 | Nitroglycerine |
| HPLC | EPA 8332 | PETN |
| Spectrometric | EPA 9014 | Cyanide |
| Electrode | EPA 9040 B / 9040C | pH |
| IC | EPA 9056 / 9056A | Bromate |
| IC | EPA 9056 / 9056A | Bromide |
| IC | EPA 9056 / 9056A | Chloride |
| IC | EPA 9056 / 9056A | Fluoride |
| IC | EPA 9056 / 9056A | Nitrate |
| IC | EPA 9056 / 9056A | Nitrite |
| IC | EPA 9056 / 9056A | Phosphate |
| IC | EPA 9056 / 9056A | Sulfate |
| IC | EPA 9056 / 9056A | Chlorate |
| Combustion-IR | EPA 9060A | TOC |
| Spectrometric | EPA 9065 | Phenols |
| Gravimetric | EPA 9070A | Oil & Grease |
| Gravimetric | EPA 9071B | Oil & Grease |
| GC | RSK175 | Methane |
| GC | RSK175 | Acetylene |
| GC | RSK175 | Ethylene |
| GC | RSK175 | Ethane |
| GC | RSK175 | Propane |
| GC | RSK175 | Carbon dioxide |
| Spectrometric | SM 4500-NH3C (18th) | Ammonia |
| Spectrometric | SM 4500-NH3F | Ammonia |
| Spectrometric | SM 4500-NOrgC NH3F | TKN |
| Spectrometric | SM 4500-PE | Phosphorus |
| Turbidimetric | SM 2130B | Turbidity |
| Titrimetric | SM 2310B | Acidity |
| Titrimetric | SM 2320B | Alkalinity |
| Titrimetric | SM 2340C | Hardness |
| Platinum Electrode | SM 2510B | Specific Conductance |
| Electrical Conductivity | SM 2520B | Salinity |
| Gravimetric | SM 2540C | TDS |
| Gravimetric | SM 2540D | TSS |
| Gravimetric | SM 2540B | Total Residue |
| Gravimetric | SM 2540F | Settleable Residue |
| Spectrometric | SM 3500-FeB | Ferrous iron |
| IC | SM 4110B | Bromate |
| IC | SM 4110B | Bromide |
| IC | SM 4110B | Chloride |

| Non-Potable Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| IC | SM 4110B | Fluoride |
| IC | SM 4110B | Nitrate |
| IC | SM 4110B | Nitrite |
| IC | SM 4110B | Phosphate |
| IC | SM 4110B | Sulfate |
| IC | SM 4110B | Chlorate |
| Titrimetric | SM 4500-Cl-B | Chloride |
| Titrimetric | SM 4500-Cl B | Total Residual Chlorine |
| Spectrometric | SM 4500CNE | Cyanide |
| Electrode | SM 4500-FC | Fluoride |
| Electrode | SM 4500 HB | pH |
| Spectrometric | SM4500-NO2B | Nitrite-N |
| Spectrometric | SM4500-NO3E | Nitrate-N |
| Spectrometric | SM4500PE | Ortho-phosphate |
| Spectrometric | SM4500-PE(PB5) | Phosphorus |
| Spectrometric | SM4500-S2D | Sulfide |
| Titrimetric | SM4500-S2F | Sulfide |
| Spectrometric | SM4500-SiO2C | Silica |
| Electrode | SM5210B | BOD |
| Spectrometric | SM 5220D | COD |
| Combustion-IR | SM 5310B | TOC |
| Spectrometric | SM5540C | Surfactants (MBAS) |
| Distillation | EPA 9010C | Cyanide |
| MicroDistillation | QuickChem 10-204-00-1-X | Cyanide |
| ICP/ICP-MS | SM2340B | Hardness |
| **Preparation** | **Method** | **Type** |
| Purge & Trap | EPA 5030B / 5030C | Volatiles Prep |
| Acid Digestion | EPA 3005A / EPA 3010A / EPA 200.8 / EPA 200.7 | Metals Prep |
| Continuous Liquid-Liquid | EPA 3520C | Organic Extraction |
| Waste Dilution | EPA 3580A | Organic Extraction |
| TCLP | EPA 1311 | Leaching |
| SPLP | EPA 1312 | Leaching |

| Drinking Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| Colorimetric | EPA 110.2 | Color |
| Platinum Electrode | EPA 120.1 | Specific Conductance |
| Electrode | EPA 150.1 | pH |
| Gravimetric | EPA 160.1 | TDS |
| Gravimetric | EPA 160.2 | TSS |

| Drinking Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| Gravimetric | EPA 160.3 | Total Residue |
| ICP-MS | EPA 200.8 | Aluminum |
| ICP-MS | EPA 200.8 | Antimony |
| ICP-MS | EPA 200.8 | Arsenic |
| ICP-MS | EPA 200.8 | Barium |
| ICP-MS | EPA 200.8 | Beryllium |
| ICP-MS | EPA 200.8 | Boron |
| ICP-MS | EPA 200.8 | Cadmium |
| ICP-MS | EPA 200.8 | Calcium |
| ICP-MS | EPA 200.8 | Chromium |
| ICP-MS | EPA 200.8 | Cobalt |
| ICP-MS | EPA 200.8 | Copper |
| ICP-MS | EPA 200.8 | Iron |
| ICP-MS | EPA 200.8 | Lithium |
| ICP-MS | EPA 200.8 | Lead |
| ICP-MS | EPA 200.8 | Magnesium |
| ICP-MS | EPA 200.8 | Manganese |
| ICP-MS | EPA 200.8 | Molybdenum |
| ICP-MS | EPA 200.8 | Nickel |
| ICP-MS | EPA 200.8 | Potassium |
| ICP-MS | EPA 200.8 | Selenium |
| ICP-MS | EPA 200.8 | Silver |
| ICP-MS | EPA 200.8 | Sodium |
| ICP-MS | EPA 200.8 | Strontium |
| ICP-MS | EPA 200.8 | Thallium |
| ICP-MS | EPA 200.8 | Tin |
| ICP-MS | EPA 200.8 | Titanium |
| ICP-MS | EPA 200.8 | Uranium |
| ICP-MS | EPA 200.8 | Vanadium |
| ICP-MS | EPA 200.8 | Zinc |
| IC | EPA 218.6 | Hexavalent Chromium |
| Cold Vapor | EPA 245.1 | Mercury |
| IC | EPA 300.0 | Bromate |
| IC | EPA 300.0 | Bromide |
| IC | EPA 300.0 | Chloride |
| IC | EPA 300.0 | Fluoride |
| IC | EPA 300.0 | Nitrate |
| IC | EPA 300.0 | Nitrite |
| IC | EPA 300.0 | Phosphate |
| IC | EPA 300.0 | Sulfate |
| IC | EPA 300.0 | Chlorate |

| Drinking Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| IC | EPA 300M | Acetate |
| IC | EPA 300M | Butyrate |
| IC | EPA 300M | Lactate |
| IC | EPA 300M | Propionate |
| IC | EPA 300M | Pyruvate |
| IC | EPA 314.0 | Perchlorate |
| Titrimetric | EPA 330.3 | Residual Chlorine |
| Spectrometric | EPA 335.2 | Cyanide |
| Spectrometric | EPA 350.2 | Ammonia |
| Spectrometric | EPA 351.3 | TKN |
| Spectrometric | EPA 352.1 | Nitrate-N |
| Spectrometric | EPA 353.3 | Nitrate-N |
| Spectrometric | EPA 354.1 | Nitrite-N |
| Spectrometric | EPA 365.2 | Ortho-phosphate |
| Spectrometric | EPA 365.2 | Phosphorus |
| Spectrometric | EPA 370.1 | Silica |
| Titrimetric | EPA 376.1 | Sulfide |
| Spectrometric | EPA 410.4 | COD |
| Combustion-IR | EPA 415.1 | TOC |
| Spectrometric | EPA 420.1 | Phenols |
| Spectrometric | EPA 425.1 | MBAS |
| GC | EPA 504.1 | DBCP |
| GC | EPA 504.1 | EDB |
| GC-MS | EPA 524.2 | Acetone |
| GC-MS | EPA 524.2 | Benzene |
| GC-MS | EPA 524.2 | Bromobenzene |
| GC-MS | EPA 524.2 | Bromochloromethane |
| GC-MS | EPA 524.2 | Bromodichloromethane |
| GC-MS | EPA 524.2 | Bromoform |
| GC-MS | EPA 524.2 | Bromomethane |
| GC-MS | EPA 524.2 | tert-Butyl alcohol |
| GC-MS | EPA 524.2 | 2-Butanone (MEK) |
| GC-MS | EPA 524.2 | n-Butylbenzene |
| GC-MS | EPA 524.2 | sec-Butylbenzene |
| GC-MS | EPA 524.2 | tert-Butylbenzene |
| GC-MS | EPA 524.2 | Carbon disulfide |
| GC-MS | EPA 524.2 | Carbon tetrachloride |
| GC-MS | EPA 524.2 | Chlorobenzene |
| GC-MS | EPA 524.2 | Chloroethane |
| GC-MS | EPA 524.2 | Chloroform |
| GC-MS | EPA 524.2 | Chloromethane |

| Drinking Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 524.2 | 2-Chlorotoluene |
| GC-MS | EPA 524.2 | 4-Chlorotoluene |
| GC-MS | EPA 524.2 | Dibromochloromethane |
| GC-MS | EPA 524.2 | 1,2-Dibromo-3-chloropropane |
| GC-MS | EPA 524.2 | 1,2-Dibromoethane |
| GC-MS | EPA 524.2 | Dibromomethane |
| GC-MS | EPA 524.2 | 1,1-Dichloroethane |
| GC-MS | EPA 524.2 | 1,2-Dichloroethane |
| GC-MS | EPA 524.2 | 1,2-Dichlorobenzene |
| GC-MS | EPA 524.2 | 1,3-Dichlorobenzene |
| GC-MS | EPA 524.2 | 1,4-Dichlorobenzene |
| GC-MS | EPA 524.2 | Dichlorodifluoromethane |
| GC-MS | EPA 524.2 | 1,1-Dichloroethene |
| GC-MS | EPA 524.2 | cis-1,2-Dichloroethene |
| GC-MS | EPA 524.2 | trans-1,2-Dichloroethene |
| GC-MS | EPA 524.2 | 1,1-Dichloropropene |
| GC-MS | EPA 524.2 | 1,2-Dichloropropane |
| GC-MS | EPA 524.2 | 1,3-Dichloropropane |
| GC-MS | EPA 524.2 | 2,2-Dichloropropane |
| GC-MS | EPA 524.2 | cis-1,3-Dichloropropene |
| GC-MS | EPA 524.2 | trans-1,3-Dichloropropene |
| GC-MS | EPA 524.2 | tert-Butyl ethyl ether (ETBE) |
| GC-MS | EPA 524.2 | Ethylbenzene |
| GC-MS | EPA 524.2 | 2-Hexanone (MBK) |
| GC-MS | EPA 524.2 | Hexachlorobutadiene |
| GC-MS | EPA 524.2 | Isopropyl ether (DIPE) |
| GC-MS | EPA 524.2 | Isopropylbenzene |
| GC-MS | EPA 524.2 | p-Isopropyltoluene |
| GC-MS | EPA 524.2 | Methylene Chloride |
| GC-MS | EPA 524.2 | 4-Methyl-2-pentanone (MIBK) |
| GC-MS | EPA 524.2 | tert-Butyl methyl ether |
| GC-MS | EPA 524.2 | Naphthalene |
| GC-MS | EPA 524.2 | n-Propylbenzene |
| GC-MS | EPA 524.2 | Styrene |
| GC-MS | EPA 524.2 | tert-Amyl methyl ether (TAME) |
| GC-MS | EPA 524.2 | 1,1,1,2-Tetrachloroethane |
| GC-MS | EPA 524.2 | 1,1,2,2-Tetrachloroethane |
| GC-MS | EPA 524.2 | Tetrachloroethene |
| GC-MS | EPA 524.2 | Toluene |
| GC-MS | EPA 524.2 | 1,1,1-Trichloroethane |
| GC-MS | EPA 524.2 | 1,1,2-Trichloroethane |

| Drinking Water | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 524.2 | 1,2,3-Trichlorobenzene |
| GC-MS | EPA 524.2 | 1,2,4-Trichlorobenzene |
| GC-MS | EPA 524.2 | Trichloroethene |
| GC-MS | EPA 524.2 | Trichlorofluoromethane |
| GC-MS | EPA 524.2 | 1,2,3-Trichloropropane |
| GC-MS | EPA 524.2 | 1,1,2-Trichloro1,2,2-trifluoroethane |
| GC-MS | EPA 524.2 | 1,2,4-Trimethylbenzene |
| GC-MS | EPA 524.2 | 1,3,5-Trimethylbenzene |
| GC-MS | EPA 524.2 | Vinyl Chloride |
| GC-MS | EPA 524.2 | m-Xylene & p-xylene |
| GC-MS | EPA 524.2 | o-Xylene |
| Titrimetric | SM 2320B | Alkalinity |
| HPLC-MS | EPA 6850 | Perchlorate |
| Colorimetric | SM 2120B | Color |
| Threshold Odor Test | SM 2150B | Odor |
| ICP/ICP-MS by Calculation | SM 2340B | Hardness |
| Titrimetric | SM 2340C | Hardness |
| Platinum Electrode | SM 2510B | Specific Conductance |
| Gravimetric | SM 2540B | Total Residue |
| Gravimetric | SM 2540C | TDS |
| Gravimetric | SM 2540D | TSS |
| Spectrometric | SM 3500- FeB | Ferrous Iron |
| Titrimetric | SM 4500-ClB | Residual Chlorine |
| Titrimetric | SM 4500-Cl-B | Chloride |
| Spectrometric | SM 4500-CNE | Cyanide |
| Electrode | SM 4500 HB | pH |
| Spectrometric | SM 4500-NH3C (18th) | Ammonia |
| Spectrometric | SM 4500-NH3F | Ammonia |
| Spectrometric | SM 4500-NO2B | Nitrite-N |
| Spectrometric | SM 4500-NO3E | Nitrate-N |
| Spectrometric | SM 4500-NOrgC NH3F | TKN |
| Spectrometric | SM 4500-PE | Ortho-phosphate |
| Spectrometric | SM 4500-PE(PB5) | Phosphorus |
| Titrimetric | SM 4500-S2F | Sulfide |
| Spectrometric | SM 4500-SiO2C | Silica |
| Spectrometric | SM 5220D | COD |
| Combustion-IR | SM 5310B | TOC |
| Spectrometric | SM 5540C | Surfactants |
| MicroDistillation | QuickChem 10-204-00-1-X | Cyanide |

| **Solid and Chemical Materials** | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | AK101 | GRO |
| GC | AK102 | DRO |
| GC | AK103 | RRO |
| GC | AZ8015 | DRO (C10-C22) |
| GC | AZ8015 | ORO (C22-C32) |
| GC | RSK175 | Methane |
| GC | RSK175 | Acetylene |
| GC | RSK175 | Ethylene |
| GC | RSK175 | Ethane |
| GC | RSK175 | Propane |
| GC | RSK175 | Carbon dioxide |
| Visual | s.7.3 SW-846 | Reactive Cyanide |
| Visual | s.7.3 SW-846 | Reactive Sulfide |
| Spectrometric | SM4500-NH3C (18th) | Ammonia |
| Spectrometric | SM4500-NH3F | Ammonia |
| Spectrometric | SM4500-NOrgC NH3F | TKN |
| Spectrometric | SM4500-NO2B | Nitrite-N |
| Spectrometric | SM4500-NO3E | Nitrate-N |
| Spectrometric | SM4500PE | Ortho-phosphate |
| Spectrometric | SM4500-PE(PB5) | Phosphorus |
| Titrimetric | Walkley Black | TOC |
| Electrode | EPA 9045C / 9045D | pH |
| Spectrometric | EPA 9065 | Phenols |
| Penskey-Martens | EPA 1010/ 1010A | Ignitability |
| ICP | EPA 6010B / 6010C | Aluminum |
| ICP | EPA 6010B / 6010C | Antimony |
| ICP | EPA 6010B / 6010C | Arsenic |
| ICP | EPA 6010B / 6010C | Barium |
| ICP | EPA 6010B / 6010C | Beryllium |
| ICP | EPA 6010B / 6010C | Boron |
| ICP | EPA 6010B / 6010C | Cadmium |
| ICP | EPA 6010B / 6010C | Calcium |
| ICP | EPA 6010B / 6010C | Chromium |
| ICP | EPA 6010B / 6010C | Cobalt |
| ICP | EPA 6010B / 6010C | Copper |
| ICP | EPA 6010B / 6010C | Iron |
| ICP | EPA 6010B / 6010C | Lead |
| ICP | EPA 6010B / 6010C | Lithium |
| ICP | EPA 6010B / 6010C | Magnesium |
| ICP | EPA 6010B / 6010C | Manganese |
| ICP | EPA 6010B / 6010C | Molybdenum |
| ICP | EPA 6010B / 6010C | Nickel |
| ICP | EPA 6010B / 6010C | Potassium |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| ICP | EPA 6010B / 6010C | Selenium |
| ICP | EPA 6010B / 6010C | Silver |
| ICP | EPA 6010B / 6010C | Sodium |
| ICP | EPA 6010B / 6010C | Strontium |
| ICP | EPA 6010B / 6010C | Thallium |
| ICP | EPA 6010B / 6010C | Tin |
| ICP | EPA 6010B / 6010C | Titanium |
| ICP | EPA 6010B / 6010C | Vanadium |
| ICP | EPA 6010B / 6010C | Zinc |
| IPC-MS | EPA 6020A | Aluminum |
| IPC-MS | EPA 6020A | Antimony |
| IPC-MS | EPA 6020A | Arsenic |
| IPC-MS | EPA 6020A | Barium |
| IPC-MS | EPA 6020A | Beryllium |
| IPC-MS | EPA 6020A | Boron |
| IPC-MS | EPA 6020A | Cadmium |
| IPC-MS | EPA 6020A | Calcium |
| IPC-MS | EPA 6020A | Chromium |
| IPC-MS | EPA 6020A | Cobalt |
| IPC-MS | EPA 6020A | Copper |
| ICP-MS | EPA 6020A | Iron |
| ICP-MS | EPA 6020A | Lead |
| ICP-MS | EPA 6020A | Lithium |
| ICP-MS | EPA 6020A | Magnesium |
| ICP-MS | EPA 6020A | Manganese |
| ICP-MS | EPA 6020A | Molybdenum |
| ICP-MS | EPA 6020A | Nickel |
| ICP-MS | EPA 6020A | Potassium |
| ICP-MS | EPA 6020A | Selenium |
| ICP-MS | EPA 6020A | Silver |
| ICP-MS | EPA 6020A | Sodium |
| ICP-MS | EPA 6020A | Strontium |
| ICP-MS | EPA 6020A | Thallium |
| ICP-MS | EPA 6020A | Tin |
| ICP-MS | EPA 6020A | Titanium |
| ICP-MS | EPA 6020A | Tungsten |
| ICP-MS | EPA 6020A | Uranium |
| ICP-MS | EPA 6020A | Vanadium |
| ICP-MS | EPA 6020A | Zinc |
| HPLC-MS | EPA 6850 | Perchlorate |
| Spectrometric | EPA 7196A | Hex. Chromium |
| IC | EPA 7199 | Hex. Chromium |
| Cold-Vapor | EPA 7471A / 7471B | Mercury |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 8011 | DBCP |
| GC | EPA 8011 | EDB |
| GC | EPA 8015B / 8015C / 8015D | Gasoline |
| GC | EPA 8015B / 8015C / 8015D | Diesel |
| GC | EPA 8015B / 8015C / 8015D | Motor Oil |
| GC | EPA 8015B / 8015C / 8015D | JP5 |
| GC | EPA 8015B / 8015C | Ethanol |
| GC | EPA 8015B / 8015C | Isopropanol |
| GC | EPA 8015B / 8015C | Diethylene Glycol |
| GC | EPA 8015B / 8015C | Ethylene Glycol |
| GC | EPA 8015B / 8015C | Triethylene Glycol |
| GC | EPA 8015B / 8015C / 8015D | JP4 |
| GC | EPA 8015B / 8015C | Methanol |
| GC | EPA 8015B / 8015C | Propylene Glycol |
| GC | EPA 8081A / 8081B | Aldrin |
| GC | EPA 8081A / 8081B | alpha-BHC |
| GC | EPA 8081A / 8081B | beta-BHC |
| GC | EPA 8081A / 8081B | delta-BHC |
| GC | EPA 8081A / 8081B | gamma-BHC (Lindane) |
| GC | EPA 8081A / 8081B | DDD (4,4) |
| GC | EPA 8081A / 8081B | DDE (4,4) |
| GC | EPA 8081A / 8081B | DDT (4,4) |
| GC | EPA 8081A / 8081B | Dieldrin |
| GC | EPA 8081A / 8081B | Endosulfan I |
| GC | EPA 8081A / 8081B | Endosulfan II |
| GC | EPA 8081A / 8081B | Endosulfan sulfate |
| GC | EPA 8081A / 8081B | Endrin |
| GC | EPA 8081A / 8081B | Endrin Aldehyde |
| GC | EPA 8081A / 8081B | Heptachlor |
| GC | EPA 8081A / 8081B | Heptachlor epoxide |
| GC | EPA 8081A / 8081B | Methoxychlor |
| GC | EPA 8081A / 8081B | alpha-Chlordane |
| GC | EPA 8081A / 8081B | gamma-Chlordane |
| GC | EPA 8081A / 8081B | Endrin Ketone |
| GC | EPA 8081A / 8081B | Toxaphene |
| GC | EPA 8081A / 8081B | Technical Chlordane |
| GC | EPA 8081A / 8081B | cis-Nonachlor |
| GC | EPA 8081A / 8081B | DDD (2,4) |
| GC | EPA 8081A / 8081B | DDE (2,4) |
| GC | EPA 8081A / 8081B | DDT (2,4) |
| GC | EPA 8081A / 8081B | Mirex |
| GC | EPA 8081A / 8081B | Oxychlordane |
| GC | EPA 8081A / 8081B | trans-Nonachlor |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 8082 / 8082A | PCB1016 |
| GC | EPA 8082 / 8082A | PCB1221 |
| GC | EPA 8082 / 8082A | PCB1232 |
| GC | EPA 8082 / 8082A | PCB1242 |
| GC | EPA 8082 / 8082A | PCB1248 |
| GC | EPA 8082 / 8082A | PCB1254 |
| GC | EPA 8082 / 8082A | PCB1260 |
| GC | EPA 8082 / 8082A | PCB1262 |
| GC | EPA 8082 / 8082A | PCB1268 |
| GC | EPA 8082 / 8082A | PCB 8 |
| GC | EPA 8082 / 8082A | PCB 18 |
| GC | EPA 8082 / 8082A | PCB 28 |
| GC | EPA 8082 / 8082A | PCB 44 |
| GC | EPA 8082 / 8082A | PCB 52 |
| GC | EPA 8082 / 8082A | PCB 66 |
| GC | EPA 8082 / 8082A | PCB 77 |
| GC | EPA 8082 / 8082A | PCB 81 |
| GC | EPA 8082 / 8082A | PCB 101 |
| GC | EPA 8082 / 8082A | PCB 105 |
| GC | EPA 8082 / 8082A | PCB 110 |
| GC | EPA 8082 / 8082A | PCB 114 |
| GC | EPA 8082 / 8082A | PCB 118 |
| GC | EPA 8082 / 8082A | PCB 123 |
| GC | EPA 8082 / 8082A | PCB 126 |
| GC | EPA 8082 / 8082A | PCB 128 |
| GC | EPA 8082 / 8082A | PCB 138 |
| GC | EPA 8082 / 8082A | PCB 153 |
| GC | EPA 8082 / 8082A | PCB 156 |
| GC | EPA 8082 / 8082A | PCB 157 |
| GC | EPA 8082 / 8082A | PCB 167 |
| GC | EPA 8082 / 8082A | PCB 169 |
| GC | EPA 8082 / 8082A | PCB 170 |
| GC | EPA 8082 / 8082A | PCB 180 |
| GC | EPA 8082 / 8082A | PCB 187 |
| GC | EPA 8082 / 8082A | PCB 189 |
| GC | EPA 8082 / 8082A | PCB 195 |
| GC | EPA 8082 / 8082A | PCB 206 |
| GC | EPA 8082 / 8082A | PCB 209 |
| GC | EPA 8141A / 8141B | Azinphos-methyl |
| GC | EPA 8141A / 8141B | Bolstar |
| GC | EPA 8141A / 8141B | Chlorpyrifos |
| GC | EPA 8141A / 8141B | Coumaphos |
| GC | EPA 8141A / 8141B | Total Demeton |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 8141A / 8141B | Diazinon |
| GC | EPA 8141A / 8141B | Dichlorvos |
| GC | EPA 8141A / 8141B | Disulfoton |
| GC | EPA 8141A / 8141B | Ethoprop |
| GC | EPA 8141A / 8141B | Fensulfothion |
| GC | EPA 8141A / 8141B | Fenthion |
| GC | EPA 8141A / 8141B | Merphos |
| GC | EPA 8141A / 8141B | Mevinphos |
| GC | EPA 8141A / 8141B | Naled |
| GC | EPA 8141A / 8141B | Methyl Parathion |
| GC | EPA 8141A / 8141B | Phorate |
| GC | EPA 8141A / 8141B | Ronnel |
| GC | EPA 8141A / 8141B | Stirophos |
| GC | EPA 8141A / 8141B | Tokuthion |
| GC | EPA 8141A / 8141B | Trichloronate |
| GC | EPA 8141A / 8141B | Dimethoate |
| GC | EPA 8141A / 8141B | EPN |
| GC | EPA 8141A / 8141B | Famphur |
| GC | EPA 8141A / 8141B | Malathion |
| GC | EPA 8141A / 8141B | Ethyl Parathion |
| GC | EPA 8141A / 8141B | O,O,O-Triethylphosphorothioate |
| GC | EPA 8141A / 8141B | Sulfotepp |
| GC | EPA 8141A / 8141B | Thionazin |
| GC | EPA 8141A / 8141B | Tributyl Phosphate |
| GC-MS | EPA 8260B / 8260C | Acetone |
| GC-MS | EPA 8260B / 8260C | Acrolein |
| GC-MS | EPA 8260B / 8260C | Acrylonitrile |
| GC-MS | EPA 8260B / 8260C | Benzene |
| GC-MS | EPA 8260B / 8260C | Bromobenzene |
| GC-MS | EPA 8260B / 8260C | Bromochloromethane |
| GC-MS | EPA 8260B / 8260C | Bromodichloromethane |
| GC-MS | EPA 8260B / 8260C | Bromoform |
| GC-MS | EPA 8260B / 8260C | Bromomethane |
| GC-MS | EPA 8260B / 8260C | tert-Butyl alcohol |
| GC-MS | EPA 8260B / 8260C | 2-Butanone (MEK) |
| GC-MS | EPA 8260B / 8260C | n-Butylbenzene |
| GC-MS | EPA 8260B / 8260C | sec-Butylbenzene |
| GC-MS | EPA 8260B / 8260C | tert-Butylbenzene |
| GC-MS | EPA 8260B / 8260C | Carbon disulfide |
| GC-MS | EPA 8260B / 8260C | Carbon tetrachloride |
| GC-MS | EPA 8260B / 8260C | Chlorobenzene |
| GC-MS | EPA 8260B / 8260C | 2-Chloroethyl vinyl ether |
| GC-MS | EPA 8260B / 8260C | Chloroethane |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8260B / 8260C | Chloroform |
| GC-MS | EPA 8260B / 8260C | 1-Chlorohexane |
| GC-MS | EPA 8260B / 8260C | Chloromethane |
| GC-MS | EPA 8260B / 8260C | 2-Chlorotoluene |
| GC-MS | EPA 8260B / 8260C | 4-Chlorotoluene |
| GC-MS | EPA 8260B / 8260C | Isopropyl ether (DIPE) |
| GC-MS | EPA 8260B / 8260C | Dibromochloromethane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dibromo-3-chloropropane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dibromoethane |
| GC-MS | EPA 8260B / 8260C | Dibromomethane |
| GC-MS | EPA 8260B / 8260C | 1,1-Dichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,2-Dichlorobenzene |
| GC-MS | EPA 8260B / 8260C | 1,3-Dichlorobenzene |
| GC-MS | EPA 8260B / 8260C | trans-1,4-Dichloro-2-Butene |
| GC-MS | EPA 8260B / 8260C | 1,4-Dichlorobenzene |
| GC-MS | EPA 8260B / 8260C | Dichlorodifluoromethane |
| GC-MS | EPA 8260B / 8260C | 1,1-Dichloroethene |
| GC-MS | EPA 8260B / 8260C | cis-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C | trans-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C | Dichlorofluoromethane |
| GC-MS | EPA 8260B / 8260C | 1,1-Dichloropropene |
| GC-MS | EPA 8260B / 8260C | 1,2-Dichloropropane |
| GC-MS | EPA 8260B / 8260C | 1,3-Dichloropropane |
| GC-MS | EPA 8260B / 8260C | 2,2-Dichloropropane |
| GC-MS | EPA 8260B / 8260C | cis-1,3-Dichloropropene |
| GC-MS | EPA 8260B / 8260C | trans-1,3-Dichloropropene |
| GC-MS | EPA 8260B / 8260C | tert-Butyl ethyl ether (ETBE) |
| GC-MS | EPA 8260B / 8260C | Ethyl Methacrylate |
| GC-MS | EPA 8260B / 8260C | Ethylbenzene |
| GC-MS | EPA 8260B / 8260C | 2-Hexanone (MBK) |
| GC-MS | EPA 8260B / 8260C | Hexachlorobutadiene |
| GC-MS | EPA 8260B / 8260C | Iodomethane |
| GC-MS | EPA 8260B / 8260C | Isopropylbenzene |
| GC-MS | EPA 8260B / 8260C | p-Isopropyltoluene |
| GC-MS | EPA 8260B / 8260C | Methylene Chloride |
| GC-MS | EPA 8260B / 8260C | 4-Methyl-2-pentanone (MIBK) |
| GC-MS | EPA 8260B / 8260C | tert-Butyl methyl ether |
| GC-MS | EPA 8260B / 8260C | Naphthalene |
| GC-MS | EPA 8260B / 8260C | n-Propylbenzene |
| GC-MS | EPA 8260B / 8260C | Styrene |
| GC-MS | EPA 8260B / 8260C | tert-Amyl methyl ether (TAME) |
| GC-MS | EPA 8260B / 8260C | 1,1,1,2-Tetrachloroethane |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8260B / 8260C | 1,1,2,2-Tetrachloroethane |
| GC-MS | EPA 8260B / 8260C | Tetrachloroethene |
| GC-MS | EPA 8260B / 8260C | Toluene |
| GC-MS | EPA 8260B / 8260C | 1,1,1-Trichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,1,2-Trichloroethane |
| GC-MS | EPA 8260B / 8260C | 1,2,3-Trichlorobenzene |
| GC-MS | EPA 8260B / 8260C | 1,2,4-Trichlorobenzene |
| GC-MS | EPA 8260B / 8260C | Trichloroethene |
| GC-MS | EPA 8260B / 8260C | Trichlorofluoromethane |
| GC-MS | EPA 8260B / 8260C | 1,2,3-Trichloropropane |
| GC-MS | EPA 8260B / 8260C | 1,1,2-Trichloro1,2,2-trifluoroethane |
| GC-MS | EPA 8260B / 8260C | 1,2,4-Trimethylbenzene |
| GC-MS | EPA 8260B / 8260C | 1,3,5-Trimethylbenzene |
| GC-MS | EPA 8260B / 8260C | Vinyl Acetate |
| GC-MS | EPA 8260B / 8260C | Vinyl Chloride |
| GC-MS | EPA 8260B / 8260C | m-Xylene & p-xylene |
| GC-MS | EPA 8260B / 8260C | o-Xylene |
| GC-MS | EPA 8260B / 8260C | 2-Butanol |
| GC-MS | EPA 8260B / 8260C | Cyclohexane |
| GC-MS | EPA 8260B / 8260C | 1,4-Dioxane |
| GC-MS | EPA 8260B / 8260C | 2-Chloro-1,1,1-trifluoroethane |
| GC-MS | EPA 8260B / 8260C | Chlorotrifluoroethylene |
| GC-MS | EPA 8260B / 8260C | cis-1,4-Dichloro-2-butene |
| GC-MS | EPA 8260B / 8260C | Ethanol |
| GC-MS | EPA 8260B / 8260C | Ethyl Methacrylate |
| GC-MS | EPA 8260B / 8260C | Isobutyl Alcohol |
| GC-MS | EPA 8260B / 8260C | Methacrylonitrile |
| GC-MS | EPA 8260B / 8260C | Methyl Methacrylate |
| GC-MS | EPA 8260B / 8260C | Pentachloroethane |
| GC-MS | EPA 8260B / 8260C | Propionitrile |
| GC-MS | EPA 8260B / 8260C | Sec-Propyl alcohol |
| GC-MS | EPA 8260B / 8260C | Tetrahydrofuran |
| GC-MS | EPA 8260B / 8260C | trans-1,4-Dichloro-2-butene |
| GC-MS | EPA 8260B / 8260C | Allyl Chloride |
| GC-MS | EPA 8260B / 8260C | Benzyl chloride |
| GC-MS | EPA 8260B / 8260C | Chloroprene |
| GC-MS | EPA 8260B / 8260C | Methyl Acetate |
| GC-MS | EPA 8260B / 8260C | Methylcyclohexane |
| GC-MS | EPA 8260B / 8260C SIM | Benzene |
| GC-MS | EPA 8260B / 8260C SIM | Carbon tetrachloride |
| GC-MS | EPA 8260B / 8260C SIM | Chloroform |
| GC-MS | EPA 8260B / 8260C SIM | Chloromethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,2-Dibromo-3-chloropropane |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8260B / 8260C SIM | 1,2-Dibromoethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,2-Dichloroethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,1-Dichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | cis-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | trans-1,2-Dichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | 1,1,2,2-Tetrachloroethane |
| GC-MS | EPA 8260B / 8260C SIM | Tetrachloroethene |
| GC-MS | EPA 8260B / 8260C SIM | 1,1,1-Trichloroethane |
| GC-MS | EPA 8260B / 8260C SIM | 1,1,2-Trichloroethane |
| GC-MS | EPA 8260B / 8260C SIM | Trichloroethene |
| GC-MS | EPA 8260B / 8260C SIM | 1,2,3-Trichloropropane |
| GC-MS | EPA 8260B / 8260C SIM | Vinyl Chloride |
| GC-MS | EPA 8260B / 8260C SIM | 1,4-Dioxane |
| GC-MS | EPA 8270C / 8270D | Acenaphthene |
| GC-MS | EPA 8270C / 8270D | Acenaphthylene |
| GC-MS | EPA 8270C / 8270D | Aniline |
| GC-MS | EPA 8270C / 8270D | Anthracene |
| GC-MS | EPA 8270C / 8270D | Azobenzene |
| GC-MS | EPA 8270C / 8270D | Benzidine |
| GC-MS | EPA 8270C / 8270D | Benzo(a)anthracene |
| GC-MS | EPA 8270C / 8270D | benzo(a)pyrene |
| GC-MS | EPA 8270C / 8270D | Benzo(b)fluoranthene |
| GC-MS | EPA 8270C / 8270D | Benzo(e)pyrene |
| GC-MS | EPA 8270C / 8270D | Benzo(g,h,i)perylene |
| GC-MS | EPA 8270C / 8270D | Benzo(k)fluoranthene |
| GC-MS | EPA 8270C / 8270D | Benzoic Acid |
| GC-MS | EPA 8270C / 8270D | Benzyl Alcohol |
| GC-MS | EPA 8270C / 8270D | Biphenyl |
| GC-MS | EPA 8270C / 8270D | bis(2-chloroethoxy)methane |
| GC-MS | EPA 8270C / 8270D | bis(2-chloroethyl)ether |
| GC-MS | EPA 8270C / 8270D | bis(2-chloroisopropyl)ether |
| GC-MS | EPA 8270C / 8270D | bis(2-Ethylhexyl)adipate |
| GC-MS | EPA 8270C / 8270D | bis(2-Ethylhexyl)phthalate |
| GC-MS | EPA 8270C / 8270D | 4-Bromophenyl-phenylether |
| GC-MS | EPA 8270C / 8270D | Butylbenzylphthalate |
| GC-MS | EPA 8270C / 8270D | Carbazole |
| GC-MS | EPA 8270C / 8270D | 4-Chloro-3-methylphenol |
| GC-MS | EPA 8270C / 8270D | 4-Chloroaniline |
| GC-MS | EPA 8270C / 8270D | 2-Chloronaphthalene |
| GC-MS | EPA 8270C / 8270D | 2-Chlorophenol |
| GC-MS | EPA 8270C / 8270D | 4-Chlorophenyl-phenylether |
| GC-MS | EPA 8270C / 8270D | Chrysene |
| GC-MS | EPA 8270C / 8270D | Dibenzo(a,h)anthracene |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D | Dibenzofuran |
| GC-MS | EPA 8270C / 8270D | 1,2-Dichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 1,3-Dichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 1,4-Dichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 3,3'-Dichlorobenzidine |
| GC-MS | EPA 8270C / 8270D | 2,4-Dichlorophenol |
| GC-MS | EPA 8270C / 8270D | Diethylphthalate |
| GC-MS | EPA 8270C / 8270D | 2,6-Dimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 2,4-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D | Dimethylphthalate |
| GC-MS | EPA 8270C / 8270D | Di-n-butylphthalate |
| GC-MS | EPA 8270C / 8270D | 4,6-Dinitro-2-methylphenol |
| GC-MS | EPA 8270C / 8270D | 2,4-Dinitrophenol |
| GC-MS | EPA 8270C / 8270D | 2,4-Dinitrotoluene |
| GC-MS | EPA 8270C / 8270D | 2,6-Dinitrotoluene |
| GC-MS | EPA 8270C / 8270D | Di-n-octylphthalate |
| GC-MS | EPA 8270C / 8270D | Fluoranthene |
| GC-MS | EPA 8270C / 8270D | Fluorene |
| GC-MS | EPA 8270C / 8270D | Hexachlorobenzene |
| GC-MS | EPA 8270C / 8270D | Hexachlorobutadiene |
| GC-MS | EPA 8270C / 8270D | Hexachlorocyclopentadiene |
| GC-MS | EPA 8270C / 8270D | Hexachloroethane |
| GC-MS | EPA 8270C / 8270D | Indeno(1,2,3-cd)pyrene |
| GC-MS | EPA 8270C / 8270D | Isophorone |
| GC-MS | EPA 8270C / 8270D | 1-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 2-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 1-Methylphenanthrene |
| GC-MS | EPA 8270C / 8270D | 2-Methylphenol |
| GC-MS | EPA 8270C / 8270D | 3/4-Methylphenol |
| GC-MS | EPA 8270C / 8270D | Naphthalene |
| GC-MS | EPA 8270C / 8270D | 2-Nitroaniline |
| GC-MS | EPA 8270C / 8270D | 3-Nitroaniline |
| GC-MS | EPA 8270C / 8270D | 4-Nitroaniline |
| GC-MS | EPA 8270C / 8270D | Nitrobenzene |
| GC-MS | EPA 8270C / 8270D | 2-Nitrophenol |
| GC-MS | EPA 8270C / 8270D | 4-Nitrophenol |
| GC-MS | EPA 8270C / 8270D | n-Nitrosodimethylamine |
| GC-MS | EPA 8270C / 8270D | n-Nitroso-di-n-propylamine |
| GC-MS | EPA 8270C / 8270D | n-Nitrosodiphenylamine |
| GC-MS | EPA 8270C / 8270D | Pentachlorophenol |
| GC-MS | EPA 8270C / 8270D | Perylene |
| GC-MS | EPA 8270C / 8270D | Phenanthrene |
| GC-MS | EPA 8270C / 8270D | Phenol |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D | Pyrene |
| GC-MS | EPA 8270C / 8270D | Pyridine |
| GC-MS | EPA 8270C / 8270D | 2,3,4,6-Tetrachlorophenol |
| GC-MS | EPA 8270C / 8270D | 1,2,4-Trichlorobenzene |
| GC-MS | EPA 8270C / 8270D | 2,3,4-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,3,5-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,4,5-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,4,6-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2,3,5-Trimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D | 1,2,4,5-Tetrachlorobenzene |
| GC-MS | EPA 8270C / 8270D | 1,3,5-Trinitrobenzene |
| GC-MS | EPA 8270C / 8270D | 1,3-Dinitrobenzene |
| GC-MS | EPA 8270C / 8270D | 1,4-Dioxane |
| GC-MS | EPA 8270C / 8270D | 1,4-Naphthoquinone |
| GC-MS | EPA 8270C / 8270D | 1-Chloronaphthalene |
| GC-MS | EPA 8270C / 8270D | 1-Naphthylamine |
| GC-MS | EPA 8270C / 8270D | 2,6-Dichlorophenol |
| GC-MS | EPA 8270C / 8270D | 2-acetylaminofluorene |
| GC-MS | EPA 8270C / 8270D | 2-Naphthylamine |
| GC-MS | EPA 8270C / 8270D | 2-Picoline |
| GC-MS | EPA 8270C / 8270D | 3,3-Dimethylbenzidine |
| GC-MS | EPA 8270C / 8270D | 3,4-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D | 3,5-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D | 3-Methylchlolanthrene |
| GC-MS | EPA 8270C / 8270D | 4-Aminobiphenyl |
| GC-MS | EPA 8270C / 8270D | 4-Nitroquinoline-N-oxide |
| GC-MS | EPA 8270C / 8270D | 5-Nitro-o-toluidine |
| GC-MS | EPA 8270C / 8270D | 7,12-Dimethylbenz(a)anthracene |
| GC-MS | EPA 8270C / 8270D | Acetophenone |
| GC-MS | EPA 8270C / 8270D | Aramite |
| GC-MS | EPA 8270C / 8270D | Atrazine |
| GC-MS | EPA 8270C / 8270D | Biphenyl |
| GC-MS | EPA 8270C / 8270D | Chlorobenzilate |
| GC-MS | EPA 8270C / 8270D | Diallate |
| GC-MS | EPA 8270C / 8270D | Dibenzo(a,j)acridine |
| GC-MS | EPA 8270C / 8270D | Dimethoate |
| GC-MS | EPA 8270C / 8270D | Dinoseb |
| GC-MS | EPA 8270C / 8270D | Diphenyl ether |
| GC-MS | EPA 8270C / 8270D | Disulfoton |
| GC-MS | EPA 8270C / 8270D | Ethyl methacrylate |
| GC-MS | EPA 8270C / 8270D | Ethyl methanesulfonate |
| GC-MS | EPA 8270C / 8270D | Ethyl parathion |
| GC-MS | EPA 8270C / 8270D | Famphur |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D | Hexachlorophene |
| GC-MS | EPA 8270C / 8270D | Hexachloropropene |
| GC-MS | EPA 8270C / 8270D | Isodrin |
| GC-MS | EPA 8270C / 8270D | Isosafrole |
| GC-MS | EPA 8270C / 8270D | kepone |
| GC-MS | EPA 8270C / 8270D | Methapyrilene |
| GC-MS | EPA 8270C / 8270D | Methyl methanesulfonate |
| GC-MS | EPA 8270C / 8270D | Methyl parathion |
| GC-MS | EPA 8270C / 8270D | N-nitrosodiethylamine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosodi-n-butylamine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosomethylethylamine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosomorpholine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosopiperdine |
| GC-MS | EPA 8270C / 8270D | N-Nitrosopyrrolidine |
| GC-MS | EPA 8270C / 8270D | O,O,O-triethyl phosphorothi |
| GC-MS | EPA 8270C / 8270D | o-toluidine |
| GC-MS | EPA 8270C / 8270D | p-Dimethylaminoazobenze |
| GC-MS | EPA 8270C / 8270D | Pentachlorobenzene |
| GC-MS | EPA 8270C / 8270D | Pentachloroethane |
| GC-MS | EPA 8270C / 8270D | Pentachloronitrobenzene |
| GC-MS | EPA 8270C / 8270D | Phenacetin |
| GC-MS | EPA 8270C / 8270D | Phorate |
| GC-MS | EPA 8270C / 8270D | p-phenylenediamine |
| GC-MS | EPA 8270C / 8270D | Pronamide |
| GC-MS | EPA 8270C / 8270D | Safrole |
| GC-MS | EPA 8270C / 8270D | Sulfotepp |
| GC-MS | EPA 8270C / 8270D | Thionazin |
| GC-MS | EPA 8270C / 8270D SIM | Acenaphthene |
| GC-MS | EPA 8270C / 8270D SIM | Acenaphthylene |
| GC-MS | EPA 8270C / 8270D SIM | Anthracene |
| GC-MS | EPA 8270C / 8270D SIM | Azobenzene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(a)anthracene |
| GC-MS | EPA 8270C / 8270D SIM | benzo(a)pyrene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(b)fluoranthene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(e)pyrene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(g,h,i)perylene |
| GC-MS | EPA 8270C / 8270D SIM | Benzo(k)fluoranthene |
| GC-MS | EPA 8270C / 8270D SIM | Biphenyl |
| GC-MS | EPA 8270C / 8270D SIM | bis(2-chloroethyl)ether |
| GC-MS | EPA 8270C / 8270D SIM | bis(2-Ethylhexyl)phthalate |
| GC-MS | EPA 8270C / 8270D SIM | Carbazole |
| GC-MS | EPA 8270C / 8270D SIM | 4-Chloro-3-methylphenol |
| GC-MS | EPA 8270C / 8270D SIM | 2-Chlorophenol |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | EPA 8270C / 8270D SIM | Chrysene |
| GC-MS | EPA 8270C / 8270D SIM | Dibenzo(a,h)anthracene |
| GC-MS | EPA 8270C / 8270D SIM | 2,4-Dichlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | 2,6-Dimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 2,4-Dimethylphenol |
| GC-MS | EPA 8270C / 8270D SIM | Fluoranthene |
| GC-MS | EPA 8270C / 8270D SIM | Fluorene |
| GC-MS | EPA 8270C / 8270D SIM | Hexachlorobenzene |
| GC-MS | EPA 8270C / 8270D SIM | Indeno(1,2,3-cd)pyrene |
| GC-MS | EPA 8270C / 8270D SIM | 1-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 2-Methylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 1-Methylphenanthrene |
| GC-MS | EPA 8270C / 8270D SIM | Naphthalene |
| GC-MS | EPA 8270C / 8270D SIM | n-Nitrosodimethylamine |
| GC-MS | EPA 8270C / 8270D SIM | n-Nitroso-di-n-propylamine |
| GC-MS | EPA 8270C / 8270D SIM | Pentachlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | Perylene |
| GC-MS | EPA 8270C / 8270D SIM | Phenanthrene |
| GC-MS | EPA 8270C / 8270D SIM | Phenol |
| GC-MS | EPA 8270C / 8270D SIM | Pyrene |
| GC-MS | EPA 8270C / 8270D SIM | 2,4,5-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | 2,4,6-Trichlorophenol |
| GC-MS | EPA 8270C / 8270D SIM | 2,3,5-Trimethylnaphthalene |
| GC-MS | EPA 8270C / 8270D SIM | 1,4-Dioxane |
| GC-MS | EPA 8270C / 8270D SIM | Butylbenzylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Diethylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Dimethylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Di-n-butylphthalate |
| GC-MS | EPA 8270C / 8270D SIM | Di-n-octylphthalate |
| HPLC | EPA 8310 | Acenaphthene |
| HPLC | EPA 8310 | Acenaphthylene |
| HPLC | EPA 8310 | Anthracene |
| HPLC | EPA 8310 | Benzo(a)anthracene |
| HPLC | EPA 8310 | Benzo(a)pyrene |
| HPLC | EPA 8310 | Benzo(b)fluoranthene |
| HPLC | EPA 8310 | Benzo(g,h,i)perylene |
| HPLC | EPA 8310 | Benzo(k)fluoranthene |
| HPLC | EPA 8310 | Chrysene |
| HPLC | EPA 8310 | Dibenzo(a,h)anthracene |
| HPLC | EPA 8310 | Fluoranthene |
| HPLC | EPA 8310 | Fluorene |
| HPLC | EPA 8310 | Indeno(1,2,3-cd)pyrene |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| HPLC | EPA 8310 | 1-Methylnaphthalene |
| HPLC | EPA 8310 | 2-Methylnaphthalene |
| HPLC | EPA 8310 | Naphthalene |
| HPLC | EPA 8310 | Phenanthrene |
| HPLC | EPA 8310 | Pyrene |
| HPLC | EPA 8330A | HMX |
| HPLC | EPA 8330A | RDX |
| HPLC | EPA 8330A | 1,3,5-TNB |
| HPLC | EPA 8330A | 1,3-DNB |
| HPLC | EPA 8330A | Tetryl |
| HPLC | EPA 8330A | Nitrobenzene |
| HPLC | EPA 8330A | 2,4,6-TNT |
| HPLC | EPA 8330A | 4-AM-2,6-DNT |
| HPLC | EPA 8330A | 2-AM-4,6-DNT |
| HPLC | EPA 8330A | 2,6-DNT |
| HPLC | EPA 8330A | 2,4-DNT |
| HPLC | EPA 8330A | 2-Nitrotoluene |
| HPLC | EPA 8330A | 4-Nitrotoluene |
| HPLC | EPA 8330A | 3-Nitrotoluene |
| HPLC | EPA 8330A | 3,5-Dinitroaniline |
| HPLC | EPA 8330A | 2,4-Diamino-6-nitrotoluene |
| HPLC | EPA 8330A | 2,6-Diamino-4-nitrotoluene |
| HPLC | EPA 8330A | Picric Acid |
| HPLC | EPA 8332 | Nitroglycerine |
| HPLC | EPA 8332 | PETN |
| IC | EPA 9056 / 9056A | Bromate |
| IC | EPA 9056 / 9056A | Bromide |
| IC | EPA 9056 / 9056A | Chloride |
| IC | EPA 9056 / 9056A | Fluoride |
| IC | EPA 9056 / 9056A | Nitrate |
| IC | EPA 9056 / 9056A | Nitrite |
| IC | EPA 9056 / 9056A | Phosphate |
| IC | EPA 9056 / 9056A | Sulfate |
| IC | EPA 9056 / 9056A | Chlorate |
| GC | EPA 8151A | Acifluorfen |
| GC | EPA 8151A | Bentazon |
| GC | EPA 8151A | Chloramben |
| GC | EPA 8151A | 2,4-D |
| GC | EPA 8151A | 2,4-DB |
| GC | EPA 8151A | Dacthal |
| GC | EPA 8151A | Dalapon |

| Solid and Chemical Materials | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC | EPA 8151A | Dicamba |
| GC | EPA 8151A | 3,5-Dichlorobenzoic acid |
| GC | EPA 8151A | Dichlorprop |
| GC | EPA 8151A | Dinoseb |
| GC | EPA 8151A | MCPA |
| GC | EPA 8151A | MCPP |
| GC | EPA 8151A | Pentachlorophenol |
| GC | EPA 8151A | Picloram |
| GC | EPA 8151A | Silvex |
| GC | EPA 8151A | 2,4,5-T |
| Spectrometric | EPA 9014 | Cyanide |
| Spectrometric | EPA 9014 | Amenable Cyanide |
| Gravimetric | EPA 9071B | Oil & Grease |
| GFAA | CA 939M | Organo Lead |
| **Preparation** | **Method** | **Type** |
| Purge &Trap | EPA 5030B / EPA 5035 | Volatiles Prep |
| Acid Digestion | EPA 3050B | Metals Prep |
| Alkaline Digestion | EPA 3060A | Hexavalent Chrom |
| Soxhlet | EPA 3540C | Organic Extraction |
| Sonication | EPA 3550C | Organic Extraction |
| Waste Dilution | EPA 3580A | Organic Extraction |
| Microwave | EPA 3546 | Organic Extraction |
| TCLP | EPA 1311 | Leaching |
| SPLP | EPA 1312 | Leaching |
| Floricil Clean-up | EPA 3620C | Extract Clean-Up |
| GPC Clean-up | EPA 3640A | Extract Clean-Up |
| Sulfur Clean-up | EPA 3660B | Extract Clean-Up |
| Acid/Permanganate Clean-up | EPA 3665A | Extract Clean-Up |

| Air and Emissions | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | TO-15 | 1,1,1-trichloroethane |
| GC-MS | TO-15 | 1,1,2,2-tetrachloroethane |
| GC-MS | TO-15 | 1,1,2-Trichloro1,2,2-trifluoroethane |
| GC-MS | TO-15 | 1,1,2-trichloroethane |
| GC-MS | TO-15 | 1,1-dichloroethane |
| GC-MS | TO-15 | 1,1-Dichloroethene |
| GC-MS | TO-15 | 1,2,4-trichlorobenzene |
| GC-MS | TO-15 | 1,2,4-trimethylbenzene |

| Air and Emissions | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | TO-15 | 1,2-dibromoethane |
| GC-MS | TO-15 | 1,2-dichlorobenzene |
| GC-MS | TO-15 | 1,2-dichloroethane |
| GC-MS | TO-15 | 1,2-dichloroethene |
| GC-MS | TO-15 | 1,2-dichloropropane |
| GC-MS | TO-15 | 1,3,5-trimethylbenzene |
| GC-MS | TO-15 | 1,3-Butadiene |
| GC-MS | TO-15 | 1,3-Butadiene, 1,1,2,3,4,Hexachloro |
| GC-MS | TO-15 | 1,3-dichlorobenzene |
| GC-MS | TO-15 | 1,4-dichlorobenzene |
| GC-MS | TO-15 | 1,4-Dioxane |
| GC-MS | TO-15 | 2,2,4-Trimethylpentane |
| GC-MS | TO-15 | 4-Ethyltoluene |
| GC-MS | TO-15 | Acetone |
| GC-MS | TO-15 | Acrylonitrile |
| GC-MS | TO-15 | Allyl Chloride |
| GC-MS | TO-15 | Benzene |
| GC-MS | TO-15 | Benzyl Chloride |
| GC-MS | TO-15 | Bromodichloromethane |
| GC-MS | TO-15 | Bromoform |
| GC-MS | TO-15 | Bromomethane |
| GC-MS | TO-15 | Carbon Disulfide |
| GC-MS | TO-15 | Carbon Tetrachloride |
| GC-MS | TO-15 | Chlorobenzene |
| GC-MS | TO-15 | Chloroethane |
| GC-MS | TO-15 | Chloroethene |
| GC-MS | TO-15 | Chloroform |
| GC-MS | TO-15 | Chloromethane |
| GC-MS | TO-15 | cis-1,3-Dichloropropene |
| GC-MS | TO-15 | Cyclohexane |
| GC-MS | TO-15 | Dibromochloromethane |
| GC-MS | TO-15 | Dichlorodifluoromethane |
| GC-MS | TO-15 | Dichlorotetrafluoroethane |
| GC-MS | TO-15 | Ethyl Acetate |
| GC-MS | TO-15 | Ethylbenzene |
| GC-MS | TO-15 | Isopropyl Alcohol |
| GC-MS | TO-15 | m+p-Xylene |
| GC-MS | TO-15 | Methyl butyl Ketone |
| GC-MS | TO-15 | Methyl Ethyl Ketone |
| GC-MS | TO-15 | Methyl Isobutyl Ketone |
| GC-MS | TO-15 | Methyl Tert-Butyl Ether |

| **Air and Emissions** | | |
|---|---|---|
| **Technology** | **Method** | **Analyte** |
| GC-MS | TO-15 | Methylene Chloride |
| GC-MS | TO-15 | n-Heptane |
| GC-MS | TO-15 | n-Hexane |
| GC-MS | TO-15 | o-Xylene |
| GC-MS | TO-15 | Styrene |
| GC-MS | TO-15 | Tetrachloroethylene |
| GC-MS | TO-15 | Tetrahydrofuran |
| GC-MS | TO-15 | Toluene |
| GC-MS | TO-15 | Trans-1,2-Dichloroethene |
| GC-MS | TO-15 | trans-1,3-Dichloropropene |
| GC-MS | TO-15 | Trichloroethylene |
| GC-MS | TO-15 | Trichloromonofluoromethan |
| GC-MS | TO-15 | Vinyl Acetate |
| GC-MS | TO-15 | Vinyl Bromide |

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: December 7, 2015

R. Douglas Leonard
Chief Technical Officer

Reissued: 1/9/14 Revised: 9/25/14 Revised: 12/7/15

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

# CERTIFICATE OF ENVIRONMENTAL ACCREDITATION

Is hereby granted to

**EMAX Laboratories, Inc.**

1835 West 205th Street

Torrance, CA 90501

Scope of the certificate is limited to the
"Fields of Testing"
which accompany this Certificate.

Continued accredited status depends on successful completion of on-site inspection, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of
Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **2672**

Expiration Date: **6/30/2017**

Effective Date: **7/1/2015**

Sacramento, California
subject to forfeiture or revocation

Christine Sotelo, Chief
Environmental Laboratory Accreditation Program

# CALIFORNIA STATE
# ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
## Accredited Fields of Testing

**EMAX Laboratories, Inc.**

1835 West 205th Street
Torrance, CA 90501
Phone: (310) 618-8889

**Certificate No.:** **2672**
**Renew Date:** **6/30/2017**

**Field of Testing:** 102 - Inorganic Chemistry of Drinking Water

| | | | |
|---|---|---|---|
| 102.015 | 001 | Hydrogen Ion (pH) | EPA 150.1 |
| 102.020 | 001 | Turbidity | EPA 180.1 |
| 102.026 | 001 | Calcium | EPA 200.7 |
| 102.026 | 002 | Magnesium | EPA 200.7 |
| 102.026 | 003 | Potassium | EPA 200.7 |
| 102.026 | 005 | Sodium | EPA 200.7 |
| 102.026 | 006 | Hardness (calculation) | EPA 200.7 |
| 102.030 | 001 | Bromide | EPA 300.0 |
| 102.030 | 002 | Chlorate | EPA 300.0 |
| 102.030 | 003 | Chloride | EPA 300.0 |
| 102.030 | 005 | Fluoride | EPA 300.0 |
| 102.030 | 006 | Nitrate | EPA 300.0 |
| 102.030 | 007 | Nitrite | EPA 300.0 |
| 102.030 | 008 | Phosphate, Ortho | EPA 300.0 |
| 102.030 | 009 | Sulfate | EPA 300.0 |
| 102.045 | 001 | Perchlorate | EPA 314.0 |
| 102.095 | 001 | Turbidity | SM2130B-2001 |
| 102.100 | 001 | Alkalinity | SM2320B-1997 |
| 102.120 | 001 | Hardness (calculation) | SM2340B-1997 |
| 102.121 | 001 | Hardness | SM2340C-1997 |
| 102.130 | 001 | Conductivity | SM2510B-1997 |
| 102.140 | 001 | Residue, Filterable TDS | SM2540C-1997 |
| 102.150 | 001 | Chloride | SM4110B |
| 102.150 | 002 | Fluoride | SM4110B |
| 102.150 | 003 | Nitrate | SM4110B |
| 102.150 | 004 | Nitrite | SM4110B |
| 102.150 | 005 | Phosphate, Ortho | SM4110B |
| 102.150 | 006 | Sulfate | SM4110B |
| 102.170 | 001 | Chloride | SM4500-Cl- B-1997 |
| 102.190 | 001 | Cyanide, Total | SM4500-CN E |
| 102.192 | 001 | Cyanide, amenable | SM4500-CN G |
| 102.200 | 001 | Fluoride | SM4500-F B,C-1997 |
| 102.203 | 001 | Hydrogen Ion (pH) | SM4500-H+ B-2000 |
| 102.220 | 001 | Nitrite | SM4500-NO2- B-2000 |
| 102.232 | 001 | Nitrite | SM4500-NO3- E-2000 |
| 102.232 | 002 | Nitrate | SM4500-NO3- E-2000 |
| 102.240 | 001 | Phosphate, Ortho | SM4500-P E |
| 102.260 | 001 | Total Organic Carbon TOC | SM5310B |

| | | | |
|---|---|---|---|
| 102.270 | 001 | Surfactants | SM5540C |

**Field of Testing:** 103 - Toxic Chemical Elements of Drinking Water

| | | | |
|---|---|---|---|
| 103.130 | 001 | Aluminum | EPA 200.7 |
| 103.130 | 003 | Barium | EPA 200.7 |
| 103.130 | 004 | Beryllium | EPA 200.7 |
| 103.130 | 005 | Cadmium | EPA 200.7 |
| 103.130 | 007 | Chromium | EPA 200.7 |
| 103.130 | 008 | Copper | EPA 200.7 |
| 103.130 | 009 | Iron | EPA 200.7 |
| 103.130 | 011 | Manganese | EPA 200.7 |
| 103.130 | 012 | Nickel | EPA 200.7 |
| 103.130 | 015 | Silver | EPA 200.7 |
| 103.130 | 017 | Zinc | EPA 200.7 |
| 103.130 | 018 | Boron | EPA 200.7 |
| 103.140 | 001 | Aluminum | EPA 200.8 |
| 103.140 | 002 | Antimony | EPA 200.8 |
| 103.140 | 003 | Arsenic | EPA 200.8 |
| 103.140 | 004 | Barium | EPA 200.8 |
| 103.140 | 005 | Beryllium | EPA 200.8 |
| 103.140 | 006 | Cadmium | EPA 200.8 |
| 103.140 | 007 | Chromium | EPA 200.8 |
| 103.140 | 008 | Copper | EPA 200.8 |
| 103.140 | 009 | Lead | EPA 200.8 |
| 103.140 | 010 | Manganese | EPA 200.8 |
| 103.140 | 012 | Nickel | EPA 200.8 |
| 103.140 | 013 | Selenium | EPA 200.8 |
| 103.140 | 014 | Silver | EPA 200.8 |
| 103.140 | 015 | Thallium | EPA 200.8 |
| 103.140 | 016 | Zinc | EPA 200.8 |
| 103.140 | 017 | Boron | EPA 200.8 |
| 103.140 | 018 | Vanadium | EPA 200.8 |
| 103.160 | 001 | Mercury | EPA 245.1 |
| 103.310 | 001 | Chromium (VI) | EPA 218.6 |

**Field of Testing:** 104 - Volatile Organic Chemistry of Drinking Water

| | | | |
|---|---|---|---|
| 104.030 | 001 | 1,2-Dibromoethane | EPA 504.1 |
| 104.030 | 002 | 1,2-Dibromo-3-chloropropane | EPA 504.1 |
| 104.040 | 000 | Volatile Organic Compounds | EPA 524.2 |
| 104.040 | 001 | Benzene | EPA 524.2 |
| 104.040 | 007 | n-Butylbenzene | EPA 524.2 |
| 104.040 | 008 | sec-Butylbenzene | EPA 524.2 |
| 104.040 | 009 | tert-Butylbenzene | EPA 524.2 |
| 104.040 | 010 | Carbon Tetrachloride | EPA 524.2 |
| 104.040 | 011 | Chlorobenzene | EPA 524.2 |
| 104.040 | 015 | 2-Chlorotoluene | EPA 524.2 |
| 104.040 | 016 | 4-Chlorotoluene | EPA 524.2 |
| 104.040 | 019 | 1,3-Dichlorobenzene | EPA 524.2 |

| | | | |
|---|---|---|---|
| 104.040 | 020 | 1,2-Dichlorobenzene | EPA 524.2 |
| 104.040 | 021 | 1,4-Dichlorobenzene | EPA 524.2 |
| 104.040 | 022 | Dichlorodifluoromethane | EPA 524.2 |
| 104.040 | 023 | 1,1-Dichloroethane | EPA 524.2 |
| 104.040 | 024 | 1,2-Dichloroethane | EPA 524.2 |
| 104.040 | 025 | 1,1-Dichloroethene | EPA 524.2 |
| 104.040 | 026 | cis-1,2-Dichloroethene | EPA 524.2 |
| 104.040 | 027 | trans-1,2-Dichloroethene | EPA 524.2 |
| 104.040 | 028 | Dichloromethane | EPA 524.2 |
| 104.040 | 029 | 1,2-Dichloropropane | EPA 524.2 |
| 104.040 | 033 | cis-1,3-Dichloropropene | EPA 524.2 |
| 104.040 | 034 | trans-1,3-Dichloropropene | EPA 524.2 |
| 104.040 | 035 | Ethylbenzene | EPA 524.2 |
| 104.040 | 037 | Isopropylbenzene | EPA 524.2 |
| 104.040 | 039 | Naphthalene | EPA 524.2 |
| 104.040 | 041 | N-propylbenzene | EPA 524.2 |
| 104.040 | 042 | Styrene | EPA 524.2 |
| 104.040 | 043 | 1,1,1,2-Tetrachloroethane | EPA 524.2 |
| 104.040 | 044 | 1,1,2,2-Tetrachloroethane | EPA 524.2 |
| 104.040 | 045 | Tetrachloroethene | EPA 524.2 |
| 104.040 | 046 | Toluene | EPA 524.2 |
| 104.040 | 047 | 1,2,3-Trichlorobenzene | EPA 524.2 |
| 104.040 | 048 | 1,2,4-Trichlorobenzene | EPA 524.2 |
| 104.040 | 049 | 1,1,1-Trichloroethane | EPA 524.2 |
| 104.040 | 050 | 1,1,2-Trichloroethane | EPA 524.2 |
| 104.040 | 051 | Trichloroethene | EPA 524.2 |
| 104.040 | 052 | Trichlorofluoromethane | EPA 524.2 |
| 104.040 | 054 | 1,2,4-Trimethylbenzene | EPA 524.2 |
| 104.040 | 055 | 1,3,5-Trimethylbenzene | EPA 524.2 |
| 104.040 | 056 | Vinyl Chloride | EPA 524.2 |
| 104.040 | 057 | Xylenes, Total | EPA 524.2 |
| 104.040 | 061 | Carbon Disulfide | EPA 524.2 |
| 104.040 | 062 | Methyl Isobutyl Ketone | EPA 524.2 |
| 104.045 | 000 | Trihalomethanes, Total | EPA 524.2 |
| 104.045 | 001 | Bromodichloromethane | EPA 524.2 |
| 104.045 | 002 | Bromoform | EPA 524.2 |
| 104.045 | 003 | Chloroform | EPA 524.2 |
| 104.045 | 004 | Dibromochloromethane | EPA 524.2 |
| 104.050 | 000 | Gasoline Additives | EPA 524.2 |
| 104.050 | 002 | Methyl tert-butyl Ether (MTBE) | EPA 524.2 |
| 104.050 | 003 | tert-Amyl Methyl Ether (TAME) | EPA 524.2 |
| 104.050 | 004 | Ethyl tert-butyl Ether (ETBE) | EPA 524.2 |
| 104.050 | 005 | Trichlorotrifluoroethane | EPA 524.2 |
| 104.050 | 006 | tert-Butyl Alcohol (TBA) | EPA 524.2 |

**Field of Testing:** 108 - Inorganic Chemistry of Wastewater

| | | | |
|---|---|---|---|
| 108.020 | 001 | Conductivity | EPA 120.1 |
| 108.110 | 001 | Turbidity | EPA 180.1 |

| | | | |
|---|---|---|---|
| 108.112 | 001 | Boron | EPA 200.7 |
| 108.112 | 002 | Calcium | EPA 200.7 |
| 108.112 | 003 | Hardness (calculation) | EPA 200.7 |
| 108.112 | 004 | Magnesium | EPA 200.7 |
| 108.112 | 005 | Potassium | EPA 200.7 |
| 108.112 | 007 | Sodium | EPA 200.7 |
| 108.113 | 001 | Boron | EPA 200.8 |
| 108.113 | 002 | Calcium | EPA 200.8 |
| 108.113 | 003 | Magnesium | EPA 200.8 |
| 108.113 | 004 | Potassium | EPA 200.8 |
| 108.113 | 006 | Sodium | EPA 200.8 |
| 108.120 | 001 | Bromide | EPA 300.0 |
| 108.120 | 002 | Chloride | EPA 300.0 |
| 108.120 | 003 | Fluoride | EPA 300.0 |
| 108.120 | 008 | Sulfate | EPA 300.0 |
| 108.120 | 012 | Nitrate (as N) | EPA 300.0 |
| 108.120 | 013 | Nitrate-Nitrite (as N) | EPA 300.0 |
| 108.120 | 014 | Nitrite as N | EPA 300.0 |
| 108.120 | 015 | Phosphate, Ortho (as P) | EPA 300.0 |
| 108.220 | 002 | Nitrite as N | EPA 352.1 |
| 108.323 | 001 | Chemical Oxygen Demand | EPA 410.4 |
| 108.360 | 001 | Phenols, Total | EPA 420.1 |
| 108.381 | 001 | Oil and Grease | EPA 1664A |
| 108.381 | 002 | Oil & Grease Total | EPA 1664 Rev. B |
| 108.385 | 001 | Color | SM2120B-2001 |
| 108.390 | 001 | Turbidity | SM2130B-2001 |
| 108.400 | 001 | Acidity | SM2310B-1997 |
| 108.410 | 001 | Alkalinity | SM2320B-1997 |
| 108.420 | 001 | Hardness (calculation) | SM2340B-1997 |
| 108.421 | 001 | Hardness | SM2340C-1997 |
| 108.430 | 001 | Conductivity | SM2510B-1997 |
| 108.440 | 001 | Residue, Total | SM2540B-1997 |
| 108.441 | 001 | Residue, Filterable TDS | SM2540C-1997 |
| 108.442 | 001 | Residue, Non-filterable TSS | SM2540D-1997 |
| 108.443 | 001 | Residue, Settleable | SM2540F-1997 |
| 108.448 | 001 | Bromide | SM4110B |
| 108.448 | 002 | Chloride | SM4110B |
| 108.448 | 003 | Fluoride | SM4110B |
| 108.448 | 004 | Nitrate | SM4110B |
| 108.448 | 005 | Nitrite | SM4110B |
| 108.448 | 006 | Nitrate-nitrite | SM4110B |
| 108.448 | 007 | Phosphate, Ortho | SM4110B |
| 108.448 | 008 | Sulfate | SM4110B |
| 108.450 | 001 | Chloride | SM4500-ChlorideB-1997 |
| 108.460 | 001 | Chlorine, Total | SM4500-Cl B-2000 |
| 108.472 | 001 | Cyanide, Total | SM4500-CN C,E-1999 |
| 108.473 | 001 | Cyanide, amenable | SM4500-CN G-1999 |

| | | | |
|---|---|---|---|
| 108.480 | 001 | Fluoride | SM4500-F B,C-1997 |
| 108.490 | 001 | Hydrogen Ion (pH) | SM4500-H+ B-2000 |
| 108.504 | 002 | Ammonia (as N) | SM4500-NH3 F-1997 |
| 108.505 | 002 | Kjeldahl Nitrogen, Total (as N) | SM4500-NH3 F-1997 |
| 108.512 | 001 | Kjeldahl Nitrogen, Total (as N) | SM4500-Norg C-1997 |
| 108.514 | 001 | Nitrite as N | SM4500-NO2- B-2000 |
| 108.528 | 001 | Nitrate-Nitrite (as N) | SM4500-NO3- E-2000 |
| 108.528 | 002 | Nitrite as N | SM4500-NO3- E-2000 |
| 108.528 | 003 | Nitrate (as N) | SM4500-NO3- E-2000 |
| 108.540 | 001 | Phosphate, Ortho | SM4500-P E-1999 |
| 108.541 | 001 | Phosphorus, Total | SM4500-P E-1999 |
| 108.552 | 001 | Silica, Dissolved | SM4500-SiO2 C-1997 |
| 108.584 | 001 | Sulfide (as S) | SM4500-S= D-2000 |
| 108.585 | 001 | Sulfide (as S) | SM4500-S= F-2000 |
| 108.592 | 001 | Biochemical Oxygen Demand | SM5210B-2001 |
| 108.595 | 001 | Chemical Oxygen Demand | SM5220D-1997 |
| 108.596 | 001 | Organic Carbon-Total (TOC) | SM5310B-2000 |
| 108.603 | 001 | Oil & Grease Total | SM5520B-2001 |
| 108.605 | 001 | Surfactants | SM5540C-2000 |
| 108.926 | 001 | Cyanide, Total | Quickchem 10-204-00-1-X |

**Field of Testing:** 109 - Toxic Chemical Elements of Wastewater

| | | | |
|---|---|---|---|
| 109.010 | 001 | Aluminum | EPA 200.7 |
| 109.010 | 002 | Antimony | EPA 200.7 |
| 109.010 | 003 | Arsenic | EPA 200.7 |
| 109.010 | 004 | Barium | EPA 200.7 |
| 109.010 | 005 | Beryllium | EPA 200.7 |
| 109.010 | 006 | Boron | EPA 200.7 |
| 109.010 | 007 | Cadmium | EPA 200.7 |
| 109.010 | 009 | Chromium | EPA 200.7 |
| 109.010 | 010 | Cobalt | EPA 200.7 |
| 109.010 | 011 | Copper | EPA 200.7 |
| 109.010 | 012 | Iron | EPA 200.7 |
| 109.010 | 013 | Lead | EPA 200.7 |
| 109.010 | 015 | Manganese | EPA 200.7 |
| 109.010 | 016 | Molybdenum | EPA 200.7 |
| 109.010 | 017 | Nickel | EPA 200.7 |
| 109.010 | 019 | Selenium | EPA 200.7 |
| 109.010 | 021 | Silver | EPA 200.7 |
| 109.010 | 023 | Thallium | EPA 200.7 |
| 109.010 | 024 | Tin | EPA 200.7 |
| 109.010 | 025 | Titanium | EPA 200.7 |
| 109.010 | 026 | Vanadium | EPA 200.7 |
| 109.010 | 027 | Zinc | EPA 200.7 |
| 109.020 | 001 | Aluminum | EPA 200.8 |
| 109.020 | 002 | Antimony | EPA 200.8 |
| 109.020 | 003 | Arsenic | EPA 200.8 |
| 109.020 | 004 | Barium | EPA 200.8 |

| | | | |
|---|---|---|---|
| 109.020 | 005 | Beryllium | EPA 200.8 |
| 109.020 | 006 | Cadmium | EPA 200.8 |
| 109.020 | 007 | Chromium | EPA 200.8 |
| 109.020 | 008 | Cobalt | EPA 200.8 |
| 109.020 | 009 | Copper | EPA 200.8 |
| 109.020 | 010 | Lead | EPA 200.8 |
| 109.020 | 011 | Manganese | EPA 200.8 |
| 109.020 | 012 | Molybdenum | EPA 200.8 |
| 109.020 | 013 | Nickel | EPA 200.8 |
| 109.020 | 014 | Selenium | EPA 200.8 |
| 109.020 | 015 | Silver | EPA 200.8 |
| 109.020 | 016 | Thallium | EPA 200.8 |
| 109.020 | 017 | Vanadium | EPA 200.8 |
| 109.020 | 018 | Zinc | EPA 200.8 |
| 109.020 | 021 | Iron | EPA 200.8 |
| 109.020 | 022 | Tin | EPA 200.8 |
| 109.020 | 023 | Titanium | EPA 200.8 |
| 109.104 | 001 | Chromium (VI) | EPA 218.6 |
| 109.190 | 001 | Mercury | EPA 245.1 |
| 109.449 | 001 | Iron | SM3500-Fe B-1997 |

**Field of Testing:** 110 - Volatile Organic Chemistry of Wastewater

| | | | |
|---|---|---|---|
| 110.040 | 000 | Purgeable Organic Compounds | EPA 624 |

**Field of Testing:** 111 - Semi-volatile Organic Chemistry of Wastewater

| | | | |
|---|---|---|---|
| 111.100 | 000 | Acid/base/neutral Organic Compounds | EPA 625 |
| 111.170 | 000 | Pesticides & PCBs | EPA 608 |

**Field of Testing:** 114 - Inorganic Chemistry of Hazardous Waste

| | | | |
|---|---|---|---|
| 114.010 | 001 | Antimony | EPA 6010B |
| 114.010 | 002 | Arsenic | EPA 6010B |
| 114.010 | 003 | Barium | EPA 6010B |
| 114.010 | 004 | Beryllium | EPA 6010B |
| 114.010 | 005 | Cadmium | EPA 6010B |
| 114.010 | 006 | Chromium | EPA 6010B |
| 114.010 | 007 | Cobalt | EPA 6010B |
| 114.010 | 008 | Copper | EPA 6010B |
| 114.010 | 009 | Lead | EPA 6010B |
| 114.010 | 010 | Molybdenum | EPA 6010B |
| 114.010 | 011 | Nickel | EPA 6010B |
| 114.010 | 012 | Selenium | EPA 6010B |
| 114.010 | 013 | Silver | EPA 6010B |
| 114.010 | 014 | Thallium | EPA 6010B |
| 114.010 | 015 | Vanadium | EPA 6010B |
| 114.010 | 016 | Zinc | EPA 6010B |
| 114.020 | 001 | Antimony | EPA 6020 |
| 114.020 | 002 | Arsenic | EPA 6020 |
| 114.020 | 003 | Barium | EPA 6020 |
| 114.020 | 004 | Beryllium | EPA 6020 |

| | | | |
|---|---|---|---|
| 114.020 | 005 | Cadmium | EPA 6020 |
| 114.020 | 006 | Chromium | EPA 6020 |
| 114.020 | 007 | Cobalt | EPA 6020 |
| 114.020 | 008 | Copper | EPA 6020 |
| 114.020 | 009 | Lead | EPA 6020 |
| 114.020 | 010 | Molybdenum | EPA 6020 |
| 114.020 | 011 | Nickel | EPA 6020 |
| 114.020 | 012 | Selenium | EPA 6020 |
| 114.020 | 013 | Silver | EPA 6020 |
| 114.020 | 014 | Thallium | EPA 6020 |
| 114.020 | 015 | Vanadium | EPA 6020 |
| 114.020 | 016 | Zinc | EPA 6020 |
| 114.103 | 001 | Chromium (VI) | EPA 7196A |
| 114.106 | 001 | Chromium (VI) | EPA 7199 |
| 114.140 | 001 | Mercury | EPA 7470A |
| 114.141 | 001 | Mercury | EPA 7471A |
| 114.222 | 001 | Cyanide | EPA 9014 |
| 114.230 | 001 | Sulfides, Total | EPA 9034 |
| 114.240 | 001 | Corrosivity - pH Determination | EPA 9040B |
| 114.241 | 001 | Corrosivity - pH Determination | EPA 9045C |
| 114.250 | 001 | Fluoride | EPA 9056 |
| 114.270 | 001 | Fluoride | EPA 9214 |
| 114.280 | 001 | Organic Lead | HML 939-M |
| 114.280 | 001 | Organic Lead | HML 939-M |

**Field of Testing:** 115 - Extraction Test of Hazardous Waste

| | | | |
|---|---|---|---|
| 115.020 | 001 | Toxicity Characteristic Leaching Procedure (TCLP) | EPA 1311 |
| 115.021 | 001 | TCLP Inorganics | EPA 1311 |
| 115.022 | 001 | TCLP Extractables | EPA 1311 |
| 115.023 | 001 | TCLP Volatiles | EPA 1311 |
| 115.030 | 001 | Waste Extraction Test (WET) | CCR Chapter11, Article 5, Appendix II |
| 115.040 | 001 | Synthetic Precipitation Leaching Procedure (SPLP) | EPA 1312 |

**Field of Testing:** 116 - Volatile Organic Chemistry of Hazardous Waste

| | | | |
|---|---|---|---|
| 116.010 | 000 | EDB and DBCP | EPA 8011 |
| 116.020 | 030 | Nonhalogenated Volatiles | EPA 8015B |
| 116.020 | 031 | Ethanol and Methanol | EPA 8015B |
| 116.030 | 001 | Gasoline-range Organics | EPA 8015B |
| 116.080 | 000 | Volatile Organic Compounds | EPA 8260B |
| 116.080 | 120 | Oxygenates | EPA 8260B |
| 116.110 | 001 | Total Petroleum Hydrocarbons - Gasoline | LUFT |

**Field of Testing:** 117 - Semi-volatile Organic Chemistry of Hazardous Waste

| | | | |
|---|---|---|---|
| 117.010 | 001 | Diesel-range Total Petroleum Hydrocarbons | EPA 8015B |
| 117.016 | 001 | Diesel-range Total Petroleum Hydrocarbons | LUFT |
| 117.110 | 000 | Extractable Organics | EPA 8270C |
| 117.140 | 000 | Polynuclear Aromatic Hydrocarbons | EPA 8310 |
| 117.170 | 000 | Nitroaromatics and Nitramines | EPA 8330 |
| 117.171 | 000 | Nitroaromatics and Nitramines | EPA 8330A |

| | | | |
|---|---|---|---|
| 117.210 | 000 | Organochlorine Pesticides | EPA 8081A |
| 117.220 | 000 | PCBs | EPA 8082 |
| 117.240 | 000 | Organophosphorus Pesticides | EPA 8141A |
| 117.250 | 000 | Chlorinated Herbicides | EPA 8151A |

**Field of Testing:** 120 - Physical Properties of Hazardous Waste

| | | | |
|---|---|---|---|
| 120.010 | 001 | Ignitability | EPA 1010 |
| 120.040 | 001 | Reactive Cyanide | Section 7.3 SW-846 |
| 120.050 | 001 | Reactive Sulfide | Section 7.3 SW-846 |
| 120.070 | 001 | Corrosivity - pH Determination | EPA 9040B |
| 120.080 | 001 | Corrosivity - pH Determination | EPA 9045C |

SOP REVIEW FORM

| EMAX-8260 | Rev. 10 | VOLATILE ORGANICS BY GC/MS |
|---|---|---|
| SOP No. | Revision Number | Title |

Document the review process and comment. Check the "NA" box if it is not applicable to the SOP, check the "Yes" box if you have fully understood the section, check "No" if you have any questions or if there are discrepancies with the current practice. Discuss the issue with the mentor/supervisor. If you need more space use the allocated space below or attach additional page.

| SECTION | Yes | No | NA | COMMENTS |
|---|---|---|---|---|
| Scope & Application | ✓ | | | |
| Summary of Method | ✓ | | | |
| Detection Limits | ✓ | | | |
| Dynamic Range | ✓ | | | |
| Sample Holding Time & Preservation | ✓ | | | |
| Associated SOPs | ✓ | | | |
| Safety | ✓ | | | I have read all SDS of chemicals listed in this SOP. |
| Instruments, Chemicals & Reagents | ✓ | | | |
| Standards | ✓ | | | |
| Procedures | ✓ | | | |
| - Sample Preparation | ✓ | | | |
| - Instrument Parameters | ✓ | | | |
| - Calibration | ✓ | | | |
| - Analysis | ✓ | | | |
| - Calculations | ✓ | | | |
| - Data Reduction | ✓ | | | |
| - Report Generation | ✓ | | | |
| - Data Review | ✓ | | | |
| - Preventive Maintenance | ✓ | | | |
| Quality Control | ✓ | | | |
| Corrective Action | ✓ | | | |
| Pollution Prevention | ✓ | | | |
| Waste Management | ✓ | | | |
| Supplementary Notes | ✓ | | | |
| References | ✓ | | | |
| Appendices | ✓ | | | |

**This is to acknowledge that I have read, understood and agree to perform the procedures set forth in this SOP. Print your name & affix your signature.**

Reviewed By Souzan S. Gneas Souzan Gneas Date: 6/1/15

STANDARD OPERATING PROCEDURES

**VOLATILE ORGANICS BY GC/MS**

| | | | | | |
|---|---|---|---|---|---|
| SOP No.: | EMAX-8260 | Revision No. | 10 | Effective Date: | 06-Jun-14 |
| Prepared By: | Souzan Greas | | | Date: | 06-04-14 |
| Approved By: | Kenette Pimentel<br>QA Manager | | | Date: | 06.04.14 |
| Approved By: | Caspar Pang<br>Laboratory Director | | | Date: | 06-04-14 |

**Control Number: 8260-10-**

## 1.0 SCOPE AND APPLICATION

1.1. This analytical method is used to determine the concentration of volatile organic compounds whose boiling points are below 200°C and are water insoluble or slightly water-soluble found in solid or liquid samples. The list of compounds is summarized in Tables 6 and 7. Additional analytes may be added after verification.

1.2. This SOP is an adaptation of SW846 Method 8260B.

## 2.0 SUMMARY OF METHOD

2.1. A measured sample is extracted using a purge and trap concentrator system. The extract is introduced to a temperature-programmed GC. The analytes are eluted through the GC column separating each analyte relative to its volatility. These analytes are captured and ionized by the mass spectrometer. The ionized fragments are measured by mass to charge ratio. Analyte qualitative identification is based on the characteristic electron impact mass spectra. Analyte quantitative identification is based on the response of the major ion relative to an internal standard using a multi-point calibration curve.

2.2. **Interferences**

2.2.1. Contamination may occur by diffusion of volatile organics (particularly chlorofluorocarbons and methylene chloride) through sample container septum during shipment and storage. Trip blanks and storage blanks can serve as means of monitoring.

2.2.2. Glassware and other sample processing materials in which the samples come into contact with are possible sources of contamination. All glassware and other materials used must be purchased pre-cleaned or decontaminated prior to use.

2.2.3. Solvents and reagents are possible sources of contamination. All solvents and reagents must be GC grade and must pass the QC checks prior to use.

2.2.4. Contamination by carry-over can occur whenever high concentration samples are analyzed in sequence with a low concentration sample. To reduce potential carry-over, the concentrator must be thoroughly baked-out between samples and the sample syringe and purging device must be thoroughly rinsed with an appropriate solvent between samples.

2.2.5. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

## 3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Table 6 and Table 7 for established DL, LOD and LOQ levels.

## 4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and requires dilution to properly quantitate.

4.2. The concentration in the diluted sample should be at or above the project reporting limit. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. **Typical Dynamic Range**

4.3.1. Water: 5 µg/L to 200 µg/L (5 ml purge)

1 µg/L to 40 µg/L (25 ml purge)

4.3.2. Soil: 5 µg/kg to 200 µg/kg

## 5.0 SAMPLE HOLDING TIME & PRESERVATION

5.1. **Aqueous Samples**

5.1.1. Samples received in the laboratory are expected to be contained in 40 ml vials with teflon lined septa with zero headspace.

***Note: The size of any bubble caused by degassing upon cooling the sample must not exceed 6 mm.***[1]

5.1.2. Samples must be stored at ≤ 6°C without freezing.

5.1.3. Samples preserved in HCL must be analyzed within 14 days from the date of sampling. Samples with no chemical preservative must be analyzed within 7 days from the date of sampling.

5.1.4. If Acrolein and Acrylonitrile are target analytes, samples must be analyzed within 14 days if preserved with $Na_2S_2O_3$ to pH 4-5. Samples received unpreserved must be analyzed with 3 days from sampling date[2].

5.2. **Soil Samples**

5.2.1. Samples received in glass jars or brass tubes must be stored at ≤ 6°C without freezing. Samples for low level and extracted in methanol for high level must be analyzed within 14 days from sampling date.

5.2.2. Samples received in encore tubes may be frozen, preserved with sodium bisulfate or extracted with methanol prior to analysis.

[1] Referenced from SW846 Method 5030B, Section 6.1.
[2] Reference: 40CFR Table 11 Footnote 10

- Encore samples to be frozen must be analyzed within 14 days from sampling date.
- Encore samples to be preserved with sodium bisulfate for low level and extracted with methanol for high level must be done within 48 hours and analyzed within 14 days from sampling date.
- Preserved samples and extracts must be stored at ≤ 6°C without freezing.

## 6.0 ASSOCIATED SOPs

6.1. EMAX-5030 Purge and Trap

6.2. EMAX-5035 Closed-System Purge and Trap

6.3. EMAX-DM01 Data Flow and Review

6.4. EMAX-QA04 Detection Limit (DL)

6.5. EMAX-QA05 Training

6.6. EMAX-QA08 Corrective Action

6.7. EMAX-QC01 Quality Control for Chemicals

6.8. EMAX-QC02 Analytical Standard Preparation

6.9. EMAX-QC07 Glassware Cleaning

6.10. EMAX-SM01 Sample Management

6.11. EMAX-SM03 Waste Disposal

6.12. EMAX-SM04 Analytical and QC Sample Labeling

## 7.0 SAFETY

7.1. Read all SDS of chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, and gloves at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. If for any reason, solvent and/or other reagents get in contact with your skin or any other part of the body, rinse the affected body part thoroughly with copious amounts of water. If irritations or any other discomfort related to the incident persist, inform your supervisor immediately so that proper action can be taken.

## 8.0 INSTRUMENTS, CHEMICALS & REAGENTS

8.1. **Instruments and Supplies**

| | |
|---|---|
| Gas Chromatography | HP 5890 Series II or equivalent |
| Detector | HP 5971 MSD or equivalent |

| | |
|---|---|
| Column | RTX 502.2 (0.32 mm x 60 m), 1.8 µm thickness or equivalent after verification that the four gases (chloromethane, bromomethene, chloroethane, and vinyl chloride) can be resolved > 90% from each other in the total ion chromatogram |
| Data Acquisition Software | ChemStation or equivalent |
| Purge & Trap Device | OI 4560/Encon Evolution/EST or equivalent |
| Multiple purging module | Archon/Centurion or equivalent |
| Gases | Ultra-high purity helium/Air |
| Syringes | 5 ml, 25 ml Luerlok gas-tight |
| Microsyringes | 1, 10, 20, 25, 50, 100 and 1000 µl<br>(Hamilton 702N or equivalent) |
| Volumetric Flasks | 2, 5, 10, 50 and 100 ml with ground glass stopper |
| Heated Sparge | Archon or Automatic sample heating jacket or equivalent |

8.2. **Chemicals and Reagents**

| | |
|---|---|
| Extraction Solvent | Purge & Trap Grade Methanol or equivalent |
| Reagent Water | Organic-free water |
| Reagent Soil | Organic-free Ottawa Sand or equivalent |
| Preservative | Sodium Bisulfate |

## 9.0 STANDARDS

9.1. Standard preparation for VOA is summarized in Tables 1 to 4. Refer to EMAX-QC02 for proper analytical standard preparation and EMAX-SM04 for proper labeling. Other concentration levels may be prepared as long as it complies with the method and/or project requirements.

9.2. **Stock Standard**

9.2.1. Purchase Stock Standards as certified solutions.

9.2.2. Purchase one set of calibration standard (refer to Table 1) for calibration and a secondary source Stock Standard for calibration verification (refer to Table 2).

9.2.3. Purchase Surrogate Mix at 2500 mg/L and Internal Standard at 2500 mg/L (refer to Table 3).

9.2.4. Purchase BromoFluorobenzene (BFB) as Tuning Standard at 5000 mg/L (refer to Table 4).

9.2.5. After opening, transfer in inert vials with minimal headspace and store at -10°C to -20°C.

9.3. **Intermediate Standards**

9.3.1. Using the stock standard solutions, prepare intermediate standards in methanol according to Tables 1 to 4 and store with minimal headspace in an inert vial.

9.4. **Initial Calibration Standards (ICAL)**

9.4.1. ICAL for 5 ml Purge

9.4.1.1. Using intermediate standards (refer to Tables 1 and 3), prepare multi calibration standards (minimum of five different concentrations) in reagent water as suggested below.

| Calibration Pt. | VOA (µg/L)* | Surrogate (µg/L) | Internal Std (µg/L) |
|---|---|---|---|
| 1 | 5 | 5 | 50 |
| 2 | 10 | 10 | 50 |
| 3 | 20 | 20 | 50 |
| 4 | 50 | 50 | 50 |
| 5 | 100 | 100 | 50 |
| 6 | 200 | 200 | 50 |

** Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.*

9.4.2. ICAL for 25 ml Purge

9.4.2.1. Using intermediate standards (refer to Tables 1 and 3), prepare multi calibration standards (minimum of five different concentrations) in reagent water as suggested below:

| Calibration Pt. | VOA (µg/L)* | Surrogate (µg/L) | Internal Std (µg/L) |
|---|---|---|---|
| 1 | 0.5 | 0.5 | 10 |
| 2 | 1 | 1 | 10 |
| 3 | 2 | 2 | 10 |
| 4 | 10 | 10 | 10 |
| 5 | 20 | 20 | 10 |
| 6 | 40 | 40 | 10 |

** Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.*

9.5. **Initial Calibration Verification Standard (ICV)**

9.5.1. Using the Intermediate Standard prepared from the secondary source (refer to Tables 2 and 3), spike into 5 ml or 25 ml purge in reagent water as suggested below.

9.5.1.1. ICV for 5 ml purge

| ICV | VOA* (µg/L) | Surrogate (µg/L) | Internal Standard (µg/L) |
|---|---|---|---|
| 5 ml | 50 | 50 | 50 |

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.5.1.2. ICV for 25 ml purge

| ICV | VOA* (µg/L) | Surrogate (µg/L) | Internal Standard (µg/L) |
|---|---|---|---|
| 25 ml | 10 | 10 | 10 |

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Using the Intermediate Standard prepared from the same source as the ICAL Standard (refer to Tables 1 and 3), spike into 5 ml or 25 ml purge in reagent water as suggested below.

9.6.1.1. DCC for 5 ml purge

| DCC | VOA* (µg/L) | Surrogate (µg/L) | Internal Standard (µg/L) |
|---|---|---|---|
| 5 ml | 50 | 50 | 50 |

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.6.1.2. DCC for 25 ml purge

| DCC | VOA* (µg/L) | Surrogate (µg/L) | Internal Standard (µg/L) |
|---|---|---|---|
| 25 | 10 | 10 | 10 |

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.7. **LCS and Matrix Spike Standard**

9.7.1. For spike standards, use the Intermediate Standard prepared from the secondary source (refer to Tables 2 and 3), spike into the 5 ml or 25 ml purge sample as suggested below (unless otherwise specified by the project). Spike 5 ml or 25 ml reagent water for LCS water or 5 g reagent soil in 5 ml reagent water for LCS soil.

9.7.1.1. LCS and Matrix Spike for 5 ml purge

| LCS or MS/MSD | VOA* (µg/L) | Surrogate (µg/L) | Internal Standard (µg/L) |
|---|---|---|---|
| 5 ml | 50 | 50 | 50 |

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

9.7.1.2. LCS and Matrix Spike for 25 ml purge

| LCS or MS/MSD | VOA* (µg/L) | Surrogate (µg/L) | Internal Standard (µg/L) |
|---|---|---|---|
| 25 ml | 10 | 10 | 10 |

** Ketones, Acrolein, Acrylonitrile and Tert-Butanol are 5x the indicated concentration and M/P-xylene is 2X the indicated concentration.*

## 10.0 PROCEDURES

### 10.1. Sample Preparation

10.1.1. For aqueous samples, refer to EMAX-5030.

10.1.1.1. Check the pH and presence of residual chlorine from remaining sample. Record samples with pH ≥ 2 and residual chlorine ≥ 5 mg/L in the analysis log.

10.1.2. For soil samples, refer to EMAX-5035.

### 10.2. Instrument Parameters

10.2.1. From the main gas supply (gas Tanks) regulate gas pressure at 80 psi.

10.1.1. Fine-tune the instrument guided by the parameter conditions suggested below. Adjust the parameter conditions accordingly to obtain optimum condition. Print the instrument parameter and post it on the instrument for daily routine maintenance check.

10.2.2. Typical GC Parameters

| | |
|---|---|
| Carrier gas flow (column) helium | 1 – 5 ml/min |
| Initial Temp | 35°C; hold for 1 min. |
| Rate 1 | 8°C/min. to 160°C/min |
| Rate 2 | 30°C/min to 230°C/min; hold for 3 min. |
| Inject Port | 200°C |
| Interface | 250°C |

10.2.3. Mass Spectrometer Parameter

| | |
|---|---|
| Scan Start | 0.5 min. |
| Mass Range | 35 to 300 |
| Multiplier | 1200 to 2700 |

10.2.4. Typical Purge and Trap Condition

10.2.4.1. Purge samples at 40°C for 11 minutes, desorbed at 250°C for 2 minutes and then bake the trap at 260°C for 11 minutes.

### 10.3. Calibration

10.3.1. Set GC/MS operating condition as described in Section 10.2.

10.3.2. Perform Tune Check

10.3.2.1. Introduce a BFB to yield 5 – 50 ng by either direct injection or purge and trap in 5 ml or 25 ml organic-free water (using tuning standard). Refer to table 4.

10.3.2.2. Evaluate the tune check by the highest scan on the peak or the average of at least 3 scans (before, at and after the apex) with a background subtraction using a single scan no more than 20 scans prior to the elution of BFB.

10.3.2.3. Check Table 5 for acceptance criteria or follow the manufacturer's recommendation for tuning. A valid tune check expires after 12 hours.

10.3.2.4. If non-compliant refer to Section 12 for corrective action.

10.3.3. Initial Calibration (ICAL)

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Optimize the instrument condition prior to ICAL

- Ensure that instrument parameters are set up properly
- Ensure that there is no evidence of leak
- Ensure that instrument maintenance is performed on schedule
- Ensure that instrument tune check and column performance is not indicative that it is at the threshold of failing the acceptance criteria

10.3.3.3. Analyze a multi-point initial calibration curve as suggested in Figure 3 after a valid tune check.

10.3.3.4. Base quantitation of identified compounds on the integrated abundance from the EICP of the assigned primary characteristic ion (refer to Tables 6 and 7). For optimum output, assign internal standard to each compound based on the nearest retention time or as suggested on Tables (6 and 7).

10.3.3.5. Evaluate the ICAL Acceptance

10.3.3.5.1. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary

10.3.3.5.2. Evaluate retention time of each analyte with respect to the nearest internal standard. The relative retention time (RRT) of each analyte should agree within ± 0.06 RRT units.

10.3.3.5.3. At a minimum, evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.3.5.4. Check RSD and correlation coefficient. If more than 10% of the compounds included with the initial calibration exceed the 15% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Perform necessary instrument maintenance and repeat calibration. Refer to 10.3.3.2, Section 12 for corrective action.

10.3.3.6. Application of ICAL Curve for Quantitation

10.3.3.6.1. Generate a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRFm), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq.-10.5.1.1, Eq.-10.5.1.2, Eq.-10.5.1.6 and Eq.-10.5.1.7 respectively.

10.3.3.6.2. If RSD is ≤ 15% average response factor may be applied.

10.3.3.6.3. Apply Inverse Weighting Factor ($1/y$ or $1/y^2$; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 15% and correlation coefficient of ≥ 0.995.

10.3.3.6.4. Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 15% and correlation coefficient of ≥ 0.995.

10.3.3.6.5. It may be appropriate to force the regression through zero for specific analytes[3]. When exercising this option [as included in the data acquisition software], make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. Initial Calibration Verification (ICV)

10.3.4.1. Analyze ICV to verify the concentration of the ICAL standards (refer to Section 9.5).

10.3.4.2. Check for completeness of analytes as described in Section 10.4.3.

10.3.4.3. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.4.4. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

[3] SW846 Method 8000B, Section 7.5.3

10.3.4.5. Refer to Appendix 1 for ICV acceptance criteria and/or corrective action.

10.3.4.6. When non-compliant refer to Section 12 for corrective action.

10.3.5. Daily Continuing Calibration (DCC)

10.3.5.1. Analyze DCC to check the validity of the ICAL (refer to 9.6).

10.3.5.2. Check for completeness of analytes as described in Section 10.4.3.

10.3.5.3. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.5.4. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.5.5. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.5.6. Establish RRF of each analyte, calculate %D (Eq.-10.5.2.1) against the ICAL.

10.3.5.7. Refer to Appendix 1 for DCC acceptance criteria and/or corrective action.

10.3.5.8. When non-compliant refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. Analytical Sequence

10.4.1.1. Analyze BFB and evaluate tuning

10.4.1.2. Analyze DCC and check ICAL validity

10.4.1.3. Analyze Lab Control Sample

10.4.1.4. Analyze Lab Control Sample Duplicate (if required)

10.4.1.5. Analyze Method Blank

10.4.1.6. Analyze samples to a maximum number of 12-hours from the time of BFB injection.

10.4.1.7. Analyze a pair of matrix spikes (MS/MSD) for every 20 samples of the same matrix.

10.4.1.8. Record analytical sequence in the analysis log.

10.4.2. Sample Result Evaluation

10.4.2.1. Check the QC criteria as soon as the data is available.

- ✓ Check method blank. If result is non-compliant and analyte in question is not detected in any sample or contamination is < 10X of the sample concentration, results maybe reportable. Verify with the PM if results can be reported.
- ✓ Compare the retention times of each Internal Standards (IS) to the ICAL mid point (must be ± 30 seconds).

- ✓ Compare the area of each IS acquired against the mid point of the ICAL. The Extracted Ion Current Profile (EICP) must be within a factor of two (-50 to +100%).
- ✓ Check concentration of target analytes if calibration range is exceeded.
- ✓ Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 QC limits.
- ✓ If any of the above checkpoints indicate a problem, re-analysis is required. Note observations on the analysis log. When results arise to questionable result, e.g. inconsistency from the first analysis, consult the Supervisor for further action.

10.4.2.2. Properly fill up the analysis log.

10.4.3. Qualitative Identification

- The intensities of the characteristic ions maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Investigate visible peaks in the chromatogram that were not identified in the data output. Manually integrate the peak if necessary. For manual integration refer to EMAX-DM01.
- Structural isomers that produce very similar mass spectra should be identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomer peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs.[4]

10.4.3.1. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification[5] (TIC). Execute LSC (Chem Station program) to initiate the library search using NIST/EPA/MSDC mass spectral library. Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting following the guidelines below.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within + 20%. Example: for an ion with an abundance of 50% of the standard spectra, the corresponding sample ion abundance must be between 30 and 70%.

[4] SW846 Method 8260B, Section 7.6.1.4

[5] Library search is performed only when indicated in the PSR.

- Molecular ions present in reference spectrum should be present in sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting analytes.
- Ions present in the reference spectrum but not present in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting analytes. Data system library reduction programs can sometimes create these discrepancies.

10.4.3.2. **Reporting TICs**

- If the library search produces a match at or above 85%, report the analyte.
- If the library search produces more than one analyte at or above 85%, report the first analyte (highest).
- If the library search produces no matches at or above 85%, the compound should be reported as unknown.

10.4.4. Quantitation

10.4.4.1. Apply the appropriate quantitation method (Section 10.3.3.6). Calculate the concentration of any positively identified target analyte using Eq.-10.5.3. Apply the dilution factor for diluted samples to calculate for the final concentration of the sample.

10.4.5. Manual Integration

10.4.5.1. Refer to EMAX-DM01, Manual Integration Section.

10.4.6. Dealing with Carryover

10.4.6.1. Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

10.4.6.2. If there is no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.

10.4.6.3. If there is any target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.6.4. To clean-up the autosampler purge line consider purging a 25 ml or 5 ml sample spiked with 100 µl of methanol and let it run like a blank sample. If improved result is noted repeat this process until no evidence of contamination is observed. Otherwise inform the Supervisor for further instruction.

10.5. **Calculations**

10.5.1. Initial Calibration

10.5.1.1. **Calculate for the Relative Response Factor (RRF)**

$$RRF = \frac{A_X C_{IS}}{A_{IS} C_X}$$ Eq.-10.5.1.1

where:

$A_X$ – Area of characteristic ion for the compound being measured
$A_{IS}$ – Area of characteristic ion for the specific internal standard
$C_X$ – Concentration of the compound being measured
$C_{IS}$ – Concentration of the specific internal standard

10.5.1.2. **Calculate for the Average Relative Response Factor ($RRF_m$)**

$$RRF_m = \frac{\sum RRF}{n}$$ Eq.-10.5.1.2

where:

$\sum RRF$ – Summation of response factors
$n$ – Number of measurements

10.5.1.3. **Calculate for Least Square Linear Regression**

$$y = ax + b$$ Eq.-10.5.1.3

where:

$y$ – Response ratio ($A_X/A_{IS}$)
$x$ – Amount ratio ($C_X/C_{IS}$)
$a$ – x1 = slope of the line

$$a = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$

where:

$\bar{x}$ = average of amount ratios
$\bar{y}$ = average of response ratios

$b$ – x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.5.1.4. **Calculate for Inverse Weighting Factor**

$$y = ax + b$$ Eq.-10.5.1.4

where:

$y$ – Response ratio ($A_X/A_{IS}$)
$x$ – Amount ratio ($C_X/C_{IS}$)
$a$ – x1 = slope of the line

$$a = \frac{\sum (x-x_a)(y-y_a)}{\sum (x-x_a)^2}$$

where:

$$x_a = \sum \left[ x(1/x) / \sum (1/x) \right]$$
$$y_a = \sum \left[ y(1/x) / \sum (1/x) \right]$$

or $x_a = \sum\left[x(1/x^2)/\sum(1/x^2)\right]$

$y_a = \sum\left[y(1/x^2)/\sum(1/x^2)\right]$

$b$ – x0 = intercept of the line

$b = y_a - a * x_a$

10.5.1.5. **Calculate Inverse Quadratic**

$y = ax^2 + bx + c$

where:

$y$ – Resp_Ratio =**x0** + **x1** * Amt_Ratio + **x2** * (Amt_Ratio)$^2$

$x$ – Amt_Ratio

$c$ – **x0**=Det 0/Det b

$b$ – **x1**=Det 1/Det b

$a$ – **x2**=Det 2/Det b

$$W_i = \frac{\frac{1}{x_i}}{\sum_{i=1}^{n}\frac{1}{x_i}}$$

where:

$X_i$ = amount ratio= Conc of Std/Conc of IS

$Y_i$ = response ratio=Resp of Std/Resp of IS

**Wi=** 1/X)/SUM(1/X)

**<X>=** SUM($W_i$*$X_i$)

**<Y>=** SUM($W_i$*$Y_i$)

**<XX>=** SUM($W_i$*($X_i$)$^2$)

**<XXX>=** SUM($W_i$*($X_i$)$^3$)

**<XXXX>=** SUM($W_i$*($X_i$)$^4$)

**<YY>=** SUM($W_i$*($Y_i$)$^2$)

**<XY>=** SUM($W_i$*$X_i$*$Y_i$)

**<XXY>=** SUM($W_i$*($X_i$)$^2$*$Y_i$)

**<Yd2>=** SUM(($Y_i$-<Y>)$^2$*$W_i$)

**Ye=** x0+x1*$X_i$+x2*$X_i^2$-<Y>)

**<Ye2>=** SUM($Ye^2$*$W_i$)

| | | | |
|---|---|---|---|
| Det b | 1 | <X> | <XX> |
| | <X> | <XX> | <XXX> |
| | <XX> | <XXX> | <XXXX> |

| | | | |
|---|---|---|---|
| Det 0 | 1 | <X> | <XX> |
| | <X> | <XX> | <XXX> |
| | <Y> | <XY> | <XXY> |

| | | | |
|---|---|---|---|
| Det 1 | 1 | <X> | <XX> |
| | <Y> | <XY> | <XXY> |
| | <XX> | <XXX> | <XXXX> |

| | | | |
|---|---|---|---|
| Det 2 | <Y> | <XY> | <XXY> |
| | <X> | <XX> | <XXX> |
| | <XX> | <XXX> | <XXXX> |

**r2=** <Ye2>/<Yd2>

**ccf2=** $(r2)^{1/2}$

10.5.1.6. **Calculate the Standard Deviation (SD)**

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \qquad \text{Eq.-10.5.1.6}$$

where:

$x_i$ – Result at $i^{th}$ measurement

$\bar{x}$ – Mean of the n measurements

$n$ – Number of measurements

10.5.1.7. **Calculate the % relative standard deviation (%RSD)**

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \text{Eq.-10.5.1.7}$$

where:

$SD$ – Standard deviation

$RRF_m$ – Average response factor

10.5.1.8. **Calculate the relative retention time (RRT)**

$$\text{RRT} = \frac{\text{Retention Time of the Analyte}}{\text{Retention Time of the Internal Standard}} \qquad \text{Eq.-10.5.1.8}$$

10.5.2. Calibration Check/Continuing Calibration

10.5.2.1. **Calculate Percent Difference (%D)**

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \text{Eq.-10.5.2.1}$$

where:

$RRF_c$ – Response factor from continuing calibration standard
$RRF_m$ – Average response factor

10.5.2.2. **% Drift**

$$\%Drift = \frac{[found\ Conc. - true\ Conc]}{true\ Conc.} * 100\% \qquad \text{Eq.-10.5.2.2}$$

10.5.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples)

10.5.3.1. When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.5.3.2. **Water Samples**

$$Concentration\ (ug/L) = \frac{(Ax)(Is)}{(Ais)(RRF_m)}\ x\ DF \qquad \text{Eq.-10.5.3.2}$$

where:

$A_x$ – Area of characteristic ion for the compound to be measured
$I_s$ – Concentration of internal standard added in µg/L
$A_{is}$ – Area of characteristic ion for the internal standard
$RRF_m$ – Average response factor
$DF$ – Dilution factor = $\frac{purge\ volume\ in\ ml\ \ (5\ ml\ or\ 25\ ml)}{sample\ \ amount\ \ in\ ml}$

10.5.3.3. **Soil/Sediment Samples (Dry weight basis)**

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad \text{Eq.-10.5.3.3}$$

where:

$A_x$ – Area of characteristic ion for the compound to be measured
$I_s$ – Concentration of internal standard added in µg/L
$A_{is}$ – Area of characteristic ion for the internal standard
$RRF_m$ – Average response factor
$DF$ – Dilution factor = $\frac{5\ g}{(sample\ \ amount\ \ in\ g)}$
$DW$ – % solid = $\frac{100 - \%moisture}{100}$

10.5.3.4. **Extracted Soil/Sediment Samples (Dry weight basis)**

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad \text{Eq.-10.5.3.4}$$

where:

$A_x$ – Area of characteristic ion for the compound to be measured

$I_s$ – Concentration of internal standard added in µg/L

$A_{is}$ – Area of characteristic ion for the internal standard

$RRF_m$ – Average response factor

$DF$ – Dilution factor

$$\frac{(purged\ \ volume\ \ in\ \mu L)(5\,g)}{(extract\ \ aliquot\ \ in\ \mu L)(sample\ \ amount\ \ in\ g)}$$

$DW$ – % solid = $\frac{100 - \%moisture}{100}$

10.5.4. Alternatively, the regression line (area ratio of Ax/Ais versus concentration using first degree) fitted to the initial calibration may be used for determination of the sample concentration when RSD of the analyte is greater than 15% (Section 10.3.3.6) .

10.5.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.5.5.1. The area Ax and Ais are derived from total ion chromatogram. Ais refers to the closest internal standard (IS) free of interference.

10.5.5.2. RRF of the TIC is 1.

10.5.6. Method Proficiency

10.5.6.1. **Percent Recovery**

$$\%\,\mathrm{Recovery} = \frac{(C_f - C)}{C_s} \times 100 \qquad \text{Eq.-10.5.6.1}$$

where:

$C_f$ – Concentration found

$C$ – Concentration of sample (use 0 for LCS)

$C_s$ – Concentration of spike

10.5.6.2. **Relative Percent Difference (RPD)**

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.6.2}$$

where:

$C_1$ – Measured concentration of the first sample aliquot

$C_2$ – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Make a copy of the analysis log.

10.6.2. Print a copy of the sample weight log (if any).

10.6.3. Highlight the data to be reported.

10.6.4. Print a copy of the raw data and the QC report.

10.6.5. Collate the reportable raw data separating the QC results from the sample results.

10.6.6. Keep all other data generated with the analytical folder marked with "For record only".

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe.

10.7.2. Generate the sample results using F1NV3C.exe or F1NV3C4.exe.

10.7.3. Generate the QC summary using QCV3CN.exe or QCV3CN4.exe.

10.7.4. Generate the Instrument Performance Check (ICAL and DCC) using F5VOA.exe.

10.7.5. Generate the IS and RT summary using F8VC.exe.

10.7.6. Generate Lab Chronicle using LABCHRN1.exe

10.7.7. Generate Case Narrative using CN1.exe

10.7.8. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

10.7.8.1. Case Narrative

10.7.8.2. Lab Chronicle

10.7.8.3. Sample Results

10.7.8.4. Method Blank Results

10.7.8.5. LCS/LCSD Summary

10.7.8.6. MS/MSD Summary

10.7.8.7. Instrument Performance Check (ICAL)

10.7.8.8. ICAL Summary

10.7.8.9. ICV Summary

10.7.8.10. Instrument Performance Check (DCC)

10.7.8.11. IS and RT Summary

10.7.8.12. DCC Summary

10.7.8.13. Analysis Log

10.7.8.14. Sample Weight Log (if any)

10.7.8.15. Non-Conformance Report (If any)

10.8. **Data Review**

10.8.1. Perform a 100% data review in accordance to EMAX-DM01and the PSR.

10.8.1.1. If any of the checkpoints below indicates a problem, re-analysis is required.

- ✓ Check internal standard area. They should be within -50 to +100% of ICAL midpoint to be acceptable, otherwise follow PSR.

- ✓ Check retention time of each IS to the ICAL midpoint. They should be within ± 30 seconds to be acceptable, otherwise follow PSR.
- ✓ Check surrogate recoveries against project specific criteria (PSR). In the absence of PSR, default to in-house QC limits.
- ✓ Check concentration of target analytes if calibration range is exceeded.

10.8.1.2. Review the attached logs that they are properly filled.

10.8.1.3. Check the generated reports against the raw data. Check that the analytical data generated indicating positive results are qualitatively and quantitatively correct.

10.8.1.4. Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.2. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Perform instrument routine preventive maintenance and record on instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction that may affect data quality.

10.9.2. The table below list suggested routine maintenance schedule.

| **Task** | **Every Day** | **Every Week** | **Every Month** | **Every 3 Months** | **Every 6 Months** | **As Needed** |
|---|---|---|---|---|---|---|
| Tune Check | ✓ | | | | | |
| Check gas cylinders pressure | ✓ | | | | | |
| Check the foreline pump oil level | | ✓ | | | | |
| Check the calibration vial | | | | | | ✓ |
| Check and if necessary, change injection port liners, septa and O-rings. | | | | | ✓ | |
| Replace the foreline pump oil | | | | | ✓ | |
| Replace the diffusion pump fluid | | | | | ✓ | |
| Replace the traps and filters | | | | | ✓ | |
| Clean the ion source | | | | | | ✓ |
| Change the carrier gas trap(s) and purifier | | | | | | ✓ |
| Replace column | | | | | | ✓ |
| AutoTune the MSD | | | | | | ✓ |
| Replace the worn out parts | | | | | | ✓ |

## 11.0 QUALITY CONTROL

11.1. **Analytical Batch QC**

11.1.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.1.2. Perform initial calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest.

11.1.3. Establish retention time window position for each analyte every after ICAL for proper qualitative identification.

11.1.4. Perform initial continuing calibration verification (ICV) every after ICAL to verify accuracy of ICAL.

11.1.5. Perform continuing calibration verification (CCV) every 12 hours to verify that instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.1.6. Evaluate relative retention time for each analytes in every sample to be within ± 0.06 RRT units.

11.1.7. Verify internal standard (IS) for quantitative accuracy and that its Retention time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -50% to +100% of ICAL midpoint standard.

11.1.8. Evaluate surrogate recovery to monitor instrument response on every sample.

11.2. **Preparation Batch QC**

11.2.1. Reagent water used for IB shall be of the same source for all QC samples and sample dilutions.

11.2.2. Analyze MB, LCS, MS/MSD and < 20 field samples.

11.2.3. Solvents and reagents must undergo quality control check prior to its use. Refer to EMAX-QC01 for details.

11.2.4. Properly treat lab wares used in the sample preparation as specified in EMAX-QC07.

11.3. **Method QC**

11.3.1. All analytes reported must have a valid DL, LOD and LOQ as described in EMAX-QA04.

11.3.2. All analysts conducting this analysis must demonstrate capability (IDOC/DOC) as described in EMAX-QA05.

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency and acceptance criteria.

## 12.0 CORRECTIVE ACTION

12.1. Corrective action for each Quality Control procedure is summarized in Appendix 1.

12.2. **Analytical Batch QC**

12.2.1. Tune Check – If tune check is non-compliant consider the following suggestion to correct the problem:

- Check the abundance of mass 95 and 174. If it is significantly less than previous tune checks, it is indicative of insufficient amount of BFB injected. Probable causes are:

improper spiking, leaks, standard degradation or low vacuum system. Repeat tune check ensuring that BFB was properly spiked or rule out leaks, prepare a fresh BFB standard and repeat the tune check.

- If problem persist, re-tune the instrument and repeat tune check.
- If problem is unresolved, inform the supervisor for further action.

12.2.2. Initial Calibration

12.2.2.1. If the %RSD is out of acceptance criteria, consider the following suggestions to correct the problem.

- If one of the standards returns a bias low or bias high on all of the analytes then that point is considered an out-liner. Prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias low or bias high response or the peaks are not distinct and sharp, drop the lowest point.

*Note : The lowest calibration point identifies the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects where the ICAL will be used.*

12.2.2.2. If instrument problem is suspected, consider the following suggestion to correct the problem:

- Check the connection and make sure they are air tight and perform maintenance as needed.
- Check the gas flow.
- Re-tune the MS.
- Prepare a fresh standard and repeat calibration.
- Clean the MS source and repeat calibration.
- If problem is unresolved, inform the supervisor for further action.

12.2.3. Initial Calibration Verification (ICV) – If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Re-analyze ICV to rule out poor purge.
- If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error.
- If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.
- If problem is unresolved, inform the supervisor for further action.

12.2.4. Daily Calibration Check (DCC) – If DCC is non-compliant consider the following suggestions to correct the problem:

- If majority of the analyte response are low and no evidence of leak in the system is apparent, it is indicative of a bad purge or leak in the vial. Re-analyze DCC.
- If problem persist, rule out standard degradation. Prepare a fresh standard and repeat DCC.
- Otherwise execute instrument maintenance and perform ICAL.

12.2.5. Instrument Blank – If instrument blank is non-compliant, consider the following suggestions to correct the problem:

- If trace level of THMs is observed, it is indicative that water filters need replacement. Otherwise, bake the trap at the manufacturer's recommended temperature for about 30 minutes.
- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem is unresolved, inform the supervisor for further action.

12.3. **Preparation Batch QC**

12.3.1. For insufficient amount of sample(s), inform the supervisor immediately for further action.

12.3.2. If MB is non-compliant, consider the suggestions as described in Instrument Blank.

12.3.3. If LCS is non-compliant, consider the following suggestions to correct the problem:

- If result is bias low or high, prepare a fresh standard and re-analyze LCS and the associated samples.
- If problem is unresolved, inform the supervisor for further advice.

12.3.4. If MS is non-compliant consider the following suggestion to correct the problem:

- Check the standard log and analytical log and verify that the spike amount value used for calculation is correct.
- If LCS is within acceptance criteria then and the right amount of spike amount used for calculation is correct, then it is indicative of matrix interference. Discuss the probable matrix interference in the case narrative.

12.4. Discuss water samples that are labeled preserved having a pH ≥ 2 and/or residual chlorine ≥ 5 mg/L in the case narrative.

12.5. A Non-Conformance Report (NCR) is required when the following circumstances occur.

- Anomalies other than specified in Appendix 1, is observed.
- Sample is out of technical holding time.

12.5.1. Refer to EMAX-QA08 for NCR details.

## 13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standards in fume hoods.

## 14.0 WASTE MANAGEMENT

14.1. No samples shall be dumped on the laboratory sink.

14.2. Separate and properly identify all unused and expired analytical standards for proper disposal.

14.3. Place all waste generated during analytical process in properly labeled satellite waste containers for proper collection.

14.4. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

## 15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation Batch** - is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical batch** - is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – is defined as the smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration at the 99% level of confidence. At the DL, the false positive rate (Type I error) is 1%.

15.1.4. Limit of Detection (LOD) – is defined as the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a high level of confidence (99%). At the LOD, the false negative result rate (Type II error) is 1 %.

15.1.5. Limit of Quantitation (LOQ) – is at the lowest concentration that produces a quantitative result within specified limits of precision and bias. For DoD projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard.

15.1.6. Safety Data Sheet (SDS) – is written information concerning a chemical physical properties, toxicity, health hazards, fire hazard and reactivity data including storage, spill and handling precautions.

15.1.7. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.8. Calibration Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.9. Carry-over – are contaminants retained in the instrument/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.10. Calibration Check Compounds (CCC) – evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.11. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.12. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.13. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.14. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.15. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.16. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.17. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.18. Matrix – is a component or form of a sample.

15.1.19. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.20. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.21. Response Factor – is the ratio of the peak area of the target compound in the sample or sample extract.

15.1.22. Surrogate – are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard; used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be detected in environmental media.

15.1.23. SPCC – System performance check compounds are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.1.24. Reagent Water – is purified water free from any target analyte or any other substance that may interfere with the analytical process.

15.1.25. Reagent Soil – organic-free Ottawa sand or equivalent.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP applies to all projects when performing Volatile analysis by GC/MS. The standard analyte list and RL are presented in Tables 6 & 7. In instances where there is a project or program QAPP, the requirements given in the project takes precedence over this SOP.

15.3. **Department of Defense (DoD) and Department of Energy (DoE) Projects**

15.3.1. Samples from DoD and DoE sponsored projects follows the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, is applied.

## 16.0 REFERENCES

16.1. U.S. EPA Method 8260B; SW846, as updated

16.2. EMAX Quality Systems Manual, as updated

## 17.0 APPENDICES

17.1. **Tables**

17.1.1. Table 1 Initial Calibration Intermediate Standards Preparation

17.1.2. Table 2 Initial Calibration Verification/LCS/MS/MSD Intermediate Standards Preparation

17.1.3. Table 3 Surrogate/Internal Standards Preparation

17.1.4. Table 4 Tuning Solution Standards Preparation

17.1.5. Table 5 BFB Key Ion Abundance Criteria

17.1.6. Table 6 Typical Analyte List, Quantitation Ions, IS, Surrogates, Calibration Standards, Detection Limits for 5 ml Purge

17.1.7. Table 7 Typical Analyte List, Quantitation Ions, IS, Surrogates, Calibration Standards, Detection Limits for 25 ml Purge

17.2. **Figures**

17.2.1. Figure 1 Peak Evaluation Techniques

17.2.2. Figure 2 Typical Chromatogram

17.2.3. Figure 3 Typical ICAL Summary

17.2.4. Figure 4 Typical Instrument Performance Check (Tuning)

17.2.5. Figure 5 Typical Instrument Performance Check (Tuning) Summary

17.2.6. Figure 6 Typical Internal Standard Area and Retention Time Summary

17.2.7. Figure 7 Typical Sample Result Summary

17.2.8. Figure 8 Typical LCS/LCSD Summary

17.2.9. Figure 9 Typical MS/MSD Summary

17.2.10. Figure 10 Typical Case Narrative

17.3. **Appendices**

| | | |
|---|---|---|
| 17.3.1. | Appendix 1 | Summary of Quality Control Procedures |
| 17.3.2. | Appendix 2 | Demonstration of Capability for 25 ml |
| 17.3.3. | Appendix 3 | Demonstration of Capability for 5 ml |
| 17.3.4. | Appendix 4 | Demonstration of Capability for 5 g |

17.4. **Forms**

| | | |
|---|---|---|
| 17.4.1. | 8260FS | Sample Preparation Log |
| 17.4.2. | 8260FA | Analytical Run Log |
| 17.4.3. | 8260FM | Instrument Maintenance Log |

## Table 1: INITIAL CALIBRATION INTERMEDIATE STANDARDS PREPARATION

| ICAL/DCC Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µl) | Final Vol. (ml) | |
| I | 1-Chlorohexane | AccuStandard | 2000 | 50 | 2 | 50 |
| | 2-Chloroethylvinylether | CPI | 2000 | 50 | 2 | 50 |
| | Oxygenate Gasoline Additive | AccuStandard | 2000-10000 | 50 | 2 | 50 - 250 |
| | Custom VOA Mix | CPI | 2000, 20000, 40000 | 50 | 2 | 50, 500, 1000 |
| II | VOC Gas Mix | Ultra Scientific | 2000 | 250 | 2 | 250 |
| | Vinyl Acetate | CPI | 2500 | 200 | 2 | 250 |
| III | Carbon Disulfide | CPI | 5000 | 100 | 2 | 250 |
| IV | VOA Calibration Mix 1 | Restek | 5000 | 100 | 2 | 250 |
| | Acrolein / Acrylonitrile | AccuStandard | 5000 | 100 | 2 | 250 |

## Table 2: INITIAL CALIBRATION VERIFICATION/LCS/MS/MSD INTERMEDIATE STANDARDS PREPARATION

| ICV / LCS / MS Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µl) | Final Vol. (ml) | |
| I | 1-Chlorohexane | Ultra Scientific | 1000 | 100 | 2 | 50 |
| | 2-Chloroethylvinylether | AccuStandard | 2000 | 50 | 2 | 50 |
| | California Oxygenate Mix | Restek | 2000 - 10000 | 50 | 2 | 50 – 250 |
| | Custom 8260 Mega Mix | Restek | 2000, 20000, 40000 | 50 | 2 | 50, 500, 1000 |
| II | Volatile Organic Cpds Mix 6 | Supelco | 2000 | 250 | 2 | 250 |
| | Vinyl Acetate | Restek | 2000 | 250 | 2 | 250 |
| III | Carbon Disulfide Solution | Ultra scientific | 5000 | 20 | 2 | 50 |
| IV | TCL Volatile Mix 1 | Supelco | 2000 | 250 | 2 | 250 |
| | Acrolein / Acrylonitrile | Ultra Scientific | 2000 | 250 | 2 | 250 |

## Table 3: SURROGATE / INTERNAL STANDARDS PREPARATION

| Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µl) | Final Vol. (ml) | |
| Surrogate | 8260 Surrogate Mix | Restek | 2500 | 200 | 2 | 250 |
| Internal Standard | Custom 8260 Internal Standard Mix, 3-30 | CPI | 2500 | 200 | 2 | 250 |

## Table 4: TUNING SOLUTION STANDARDS PREPARATION

| BFB Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µl) | Final Vol. (ml) | |
| Tuning Compound | BFB | Restek | 5000 | 20 | 2 | 50 |

## Table 5: BFB KEY ION ABUNDANCE CRITERIA

| M/z | Required Intensity (relative abundance) |
|---|---|
| 50 | 15 to 40% of m/z 95 |
| 75 | 30 to 60% of m/z 95 |
| 95 | Base peak, 100% relative abundance |
| 96 | 5 to 9% of m/z 95 |
| 173 | Less than 2% of m/z 174 |
| 174 | Greater than 50% of m/z 95 |
| 175 | 5 to 9% of m/z 174 |
| 176 | Greater than 95% but less than 101% of m/z 174 |
| 177 | 5 to 9% of m/z 176 |

## Table 6: TYPICAL TARGET ANALYTE LIST FOR 5-ml PURGE

| ANALYTES | CHARACTERISTIC ION(S) | | IS | SURR | ICAL ANALYTE CONCENTRATIONS (µg/L) | | | | | | | | ICV/DCC EV(µg/L) | LCS/MS EV(µg/L) | WATER (µg/L) | | | SOIL (µg/Kg) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY | SECONDARY | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | | DL | LOD | LOQ | DL | LOD | LOQ |
| 1,1,1,2-Tetrachloroethane | 131 | 133, 119, 117 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,1,1-Trichloroethane | 97 | 99, 61 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,1,2,2-Tetrachloroethane | 83 | 85 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 151 | 153 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| 1,1,2-Trichloroethane | 97 | 83, 85, 99 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,1-Dichloroethane | 63 | 65, 83 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,1-Dichloroethene | 61 | 63, 96 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,1-Dichloropropene | 110 | 112 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,2,3-Trichlorobenzene | 180 | 182, 145 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 1 | 2 | 5 |
| 1,2,3-Trichloropropane | 110 | 61, 77 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| 1,2,4-Trichlorobenzene | 180 | 182, 145 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 1 | 2 | 5 |
| 1,2,4-Trimethylbenzene | 105 | 120 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.55 | 1 | 5 |
| 1,2-Dibromo-3-chloropropane | 157 | 155, 75 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| 1,2-Dibromoethane | 107 | 109 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,2-Dichlorobenzene | 146 | 111, 148 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,2-Dichloroethane | 62 | 64 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,2-Dichloropropane | 63 | 41, 76 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,3,5-Trimethylbenzene | 105 | 120, 119 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.59 | 1 | 5 |
| 1,3-Dichlorobenzene | 146 | 111, 148 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.52 | 1 | 5 |
| 1,3-Dichloropropane | 76 | 78 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1,4-Dichlorobenzene | 146 | 111, 148 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| 1-Chlorohexane | 91 | 93, 55, 56 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.58 | 1 | 5 |
| 2,2-Dichloropropane | 77 | 97, 79 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| 2-Butanone (MEK) | 43 | 72 | IS1 | Sur0/1 | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 | 2.5 | 5 | 10 | 2.5 | 5 | 10 |
| 2-Chloroethyl vinyl ether | 63 | 65, 106 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| 2-Chlorotoluene | 91 | 126 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.82 | 1 | 5 |
| 2-Hexanone (MBK) | 43 | 58, 100 | IS2 | Sur3 | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 | 2.5 | 5 | 10 | 2.86 | 5 | 10 |
| 4-Chlorotoluene | 91 | 126 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.61 | 1 | 5 | 0.67 | 1 | 5 |
| 4-Methyl-2-pentanone (MIBK) | 43 | 58, 85, 100 | IS1 | Sur0/1 | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 | 2.5 | 5 | 10 | 2.75 | 5 | 10 |
| Acetone | 43 | 58, 42 | IS1 | Sur0/1 | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 | 2.5 | 5 | 10 | 3.06 | 5 | 10 |
| Acrolein | 56 | 55 | IS1 | Sur0/1 | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 | 2.5 | 5 | 10 | 2.5 | 5 | 10 |
| Acrylonitrile | 53 | 52, 51 | IS1 | Sur0/1 | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 | 2.5 | 5 | 10 | 2.5 | 5 | 10 |
| Benzene | 78 | 77, 52 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Bromobenzene | 156 | 77, 158 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Bromochloromethane | 49 | 128, 130 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Bromodichloromethane | 83 | 85 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Bromoform | 173 | 171, 175 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 1 | 2 | 5 |
| Bromomethane | 94 | 96 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1.1 | 2 | 5 | 1.81 | 2 | 5 |

## Table 6: TYPICAL TARGET ANALYTE LIST FOR 5-ml PURGE

| ANALYTES | CHARACTERISTIC ION(S) | | IS | SURR | ICAL ANALYTE CONCENTRATIONS (µg/L) | | | | | | | | ICV/DCC EV(µg/L) | LCS/MS EV(µg/L) | WATER (µg/L) | | | SOIL (µg/Kg) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY | SECONDARY | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | | DL | LOD | LOQ | DL | LOD | LOQ |
| Carbon disulfide | 76 | 78 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Carbon tetrachloride | 119 | 117 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.54 | 1 | 5 |
| Chlorobenzene | 112 | 51, 77, 114 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Chloroethane | 64 | 49, 66 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| Chloroform | 83 | 85, 47 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Chloromethane | 50 | 52 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1.02 | 2 | 5 |
| cis-1,2-Dichloroethene | 96 | 61, 98 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| cis-1,3-Dichloropropene | 75 | 77, 39, 110 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Dibromochloromethane | 129 | 127 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Dibromomethane | 93 | 95, 174 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Dichlorodifluoromethane | 85 | 87 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1.3 | 2 | 5 | 1.16 | 2 | 5 |
| Dichlorofluoromethane | 67 | 69 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Diisopropyl ether (DIPE) | 45 | 87 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Ethyl Methacrylate | 69 | 99, 41 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| Ethylbenzene | 91 | 106 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Ethyl-tert-butyl ether (ETBE) | 59 | 87 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Hexachlorobutadiene | 225 | 223, 227 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 1 | 2 | 5 |
| Iodomethane | 142 | 127 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 1 | 2 | 5 |
| Isopropylbenzene | 105 | 120, 79, 103 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.64 | 1 | 5 |
| m/p-Xylenes | 91 | 106 | IS2 | Sur3 | 4 | 10 | 20 | 40 | 100 | 160 | 200 | 400 | 100 | 100 | 1 | 2 | 10 | 1 | 2 | 10 |
| Methylene chloride | 49 | 84, 86 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 1 | 2 | 5 |
| Methyl-t-butyl ether (MTBE) | 73 | 57 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| Naphthalene | 128 | 127 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| n-Butylbenzene | 91 | 92, 134 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.73 | 1 | 5 | 0.7 | 1 | 5 |
| n-Propylbenzene | 91 | 65, 120 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.51 | 1 | 5 | 0.65 | 1 | 5 |
| o-Xylene | 91 | 106 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| p-Isopropyltoluene | 119 | 91, 134 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.56 | 1 | 5 | 0.62 | 1 | 5 |
| sec-Butylbenzene | 105 | 134 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.67 | 1 | 5 |
| Styrene | 104 | 78, 103 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| tert-Amylmethyl ether (TAME) | 87 | 55,73 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| tert-Butyl alcohol (TBA) | 59 | 41 | IS1 | Sur0/1 | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 | 7.1 | 10 | 25 | 9.18 | 10 | 20 |
| tert-Butylbenzene | 134 | 91, 119 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.62 | 1 | 5 |
| Tetrachloroethene | 164 | 129, 131, 166 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.52 | 1 | 5 | 0.5 | 1 | 5 |
| Toluene | 91 | 92 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| trans-1,2-Dichloroethene | 61 | 96, 98 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| trans-1,3-Dichloropropene | 75 | 77, 39 | IS2 | Sur3 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |
| trans-1,4-Dichloro-2-butene | 53 | 88 | IS3 | Sur2 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| Trichloroethene | 130 | 97, 132, 95 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.5 | 1 | 5 | 0.5 | 1 | 5 |

## Table 6: TYPICAL TARGET ANALYTE LIST FOR 5-ml PURGE

| ANALYTES | CHARACTERISTIC ION(S) | | IS | SURR | ICAL ANALYTE CONCENTRATIONS (µg/L) | | | | | | | | ICV/DCC EV(µg/L) | LCS/MS EV(µg/L) | WATER (µg/L) | | | SOIL (µg/Kg) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY | SECONDARY | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | | DL | LOD | LOQ | DL | LOD | LOQ |
| Trichlorofluoromethane | 101 | 103 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.86 | 1 | 5 | 1.06 | 2 | 5 |
| Vinyl acetate | 43 | 86 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1.26 | 2 | 5 |
| Vinyl chloride | 62 | 64 | IS1 | Sur0/1 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 0.61 | 1 | 5 | 1 | 2 | 5 |
| Dibromofluoromethane (Sur0) | 111 | 113, 192 | IS1 | | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 0.5 | 1 | 5 |
| 1,2-Dichloroethane-d4 (Sur1) | 65 | 102 | IS1 | | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| 4-Bromofluorobenzene (Sur2) | 95 | 174, 176 | IS3 | | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| Toluene-D8 (Sur3) | 98 | 100 | IS2 | | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 | 1 | 2 | 5 | 1 | 2 | 5 |
| 1,4-Difluorobenzene (IS1) | 114 | 88 | | | | | | | | | | | | | | | | | | |
| Chlorobenzene-d5 (IS2) | 117 | 82, 119 | | | | | | | | | | | | | | | | | | |
| 1,2-Dichlorobenzene-d4 (IS3) | 152 | 150 | | | | | | | | | | | | | | | | | | |

Note: Since, retention time of Dibromofluoromethane (Sur0) and 1,2-Dichloroethane-d4 (Sur1) is too close (~43 sec) hence, Dibromofluoromethane (Sur0) is only used when required by the project.

## Table 7: TYPICAL TARGET ANALYTE LIST FOR 25-ml PURGE

| Analytes | CHARACTERISTIC ION(S) | | IS | SURR | ICAL ANALYTE CONCENTRATIONS (µg/L) | | | | | | | | | ICV/DCC EV(µg/L) | LCS/MS EV(µg/L) | WATER (µg/L) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY | SECONDARY | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | DL | LOD | LOQ |
| 1,1,1,2-Tetrachloroethane | 131 | 133, 119, 117 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,1,1-Trichloroethane | 97 | 99, 61 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,1,2,2-Tetrachloroethane | 83 | 85 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 151 | 153 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.17 | 0.3 | 0.5 |
| 1,1,2-Trichloroethane | 97 | 83, 85, 99 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,1-Dichloroethane | 63 | 65, 83 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,1-Dichloroethene | 61 | 63, 96 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,1-Dichloropropene | 110 | 112 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,2,3-Trichlorobenzene | 180 | 182, 145 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.3 | 0.5 |
| 1,2,3-Trichloropropane | 110 | 61, 77 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.25 | 0.5 | 1 |
| 1,2,4-Trichlorobenzene | 180 | 182, 145 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.3 | 0.5 |
| 1,2,4-Trimethylbenzene | 105 | 120 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| 1,2-Dibromo-3-chloropropane | 157 | 155, 75 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.25 | 0.5 | 1 |
| 1,2-Dibromoethane | 107 | 109 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,2-Dichlorobenzene | 146 | 111, 148 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,2-Dichloroethane | 62 | 64 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,2-Dichloropropane | 63 | 41, 76 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,3,5-Trimethylbenzene | 105 | 120, 119 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.13 | 0.2 | 0.5 |
| 1,3-Dichlorobenzene | 146 | 111, 148 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| 1,3-Dichloropropane | 76 | 78 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1,4-Dichlorobenzene | 146 | 111, 148 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| 1-Chlorohexane | 91 | 93, 55, 56 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.14 | 0.2 | 0.5 |
| 2,2-Dichloropropane | 77 | 97, 79 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.16 | 0.2 | 0.5 |
| 2-Butanone (MEK) | 43 | 72 | IS1 | Sur0/1 | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 | 2 | 4 | 10 |
| 2-Chloroethyl vinyl ether | 63 | 65, 106 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.5 | 1 | 2 |
| 2-Chlorotoluene | 91 | 126 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.12 | 0.2 | 0.5 |
| 2-Hexanone (MBK) | 43 | 58, 100 | IS2 | Sur3 | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 | 2.3 | 4 | 5 |
| 4-Chlorotoluene | 91 | 126 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| 4-Methyl-2-pentanone (MIBK) | 43 | 58, 85, 100 | IS1 | Sur0/1 | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 | 2.2 | 4 | 5 |
| Acetone | 43 | 58, 42 | IS1 | Sur0/1 | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 | 2.6 | 5 | 10 |
| Acrolein | 56 | 55 | IS1 | Sur0/1 | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 | 2.5 | 5 | 10 |
| Acrylonitrile | 53 | 52, 51 | IS1 | Sur0/1 | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 | 2.5 | 5 | 10 |
| Benzene | 78 | 77, 52 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |

## Table 7: TYPICAL TARGET ANALYTE LIST FOR 25-ml PURGE

| Analytes | CHARACTERISTIC ION(S) | | IS | SURR | ICAL ANALYTE CONCENTRATIONS (µg/L) | | | | | | | | | ICV/DCC EV(µg/L) | LCS/MS EV(µg/L) | WATER (µg/L) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY | SECONDARY | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | DL | LOD | LOQ |
| Bromobenzene | 156 | 77, 158 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Bromochloromethane | 49 | 128, 130 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| Bromodichloromethane | 83 | 85 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Bromoform | 173 | 171, 175 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.3 | 0.5 |
| Bromomethane | 94 | 96 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.16 | 0.3 | 0.5 |
| Carbon disulfide | 76 | 78 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Carbon tetrachloride | 119 | 117 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Chlorobenzene | 112 | 51, 77, 114 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Chloroethane | 64 | 49, 66 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.27 | 0.3 | 0.5 |
| Chloroform | 83 | 85, 47 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Chloromethane | 50 | 52 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.3 | 0.5 |
| cis-1,2-Dichloroethene | 96 | 61, 98 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| cis-1,3-Dichloropropene | 75 | 77, 39, 110 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Dibromochloromethane | 129 | 127 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Dibromomethane | 93 | 95, 174 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Dichlorodifluoromethane | 85 | 87 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.3 | 0.5 |
| Dichlorofluoromethane | 67 | 69 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Diisopropyl ether (DIPE) | 45 | 87 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| Ethyl Methacrylate | 69 | 99, 41 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.25 | 0.5 | 1 |
| Ethylbenzene | 91 | 106 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Ethyl-tert-butyl ether (ETBE) | 59 | 87 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| Hexachlorobutadiene | 225 | 223, 227 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.22 | 0.3 | 0.5 |
| Iodomethane | 142 | 127 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.3 | 0.5 |
| Isopropylbenzene | 105 | 120, 79, 103 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| m/p-Xylenes | 91 | 106 | IS2 | Sur3 | 0.6 | 1 | 2 | 4 | 10 | 20 | 40 | 60 | 80 | 20 | 20 | 0.21 | 0.4 | 1 |
| Methylene chloride | 49 | 84, 86 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.25 | 0.5 | 1 |
| Methyl-t-butyl ether (MTBE) | 73 | 57 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.13 | 0.2 | 0.5 |
| Naphthalene | 128 | 127 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.25 | 0.5 | 1 |
| n-Butylbenzene | 91 | 92, 134 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.17 | 0.2 | 0.5 |
| n-Propylbenzene | 91 | 65, 120 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.13 | 0.2 | 0.5 |
| o-Xylene | 91 | 106 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| p-Isopropyltoluene | 119 | 91, 134 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.14 | 0.2 | 0.5 |
| sec-Butylbenzene | 105 | 134 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.13 | 0.2 | 0.5 |

## Table 7: TYPICAL TARGET ANALYTE LIST FOR 25-ml PURGE

| Analytes | CHARACTERISTIC ION(S) | | IS | SURR | ICAL ANALYTE CONCENTRATIONS (µg/L) | | | | | | | | | ICV/DCC EV(µg/L) | LCS/MS EV(µg/L) | WATER (µg/L) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PRIMARY | SECONDARY | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | | DL | LOD | LOQ |
| Styrene | 104 | 78, 103 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| tert-Amylmethyl ether (TAME) | 87 | 55,73 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| tert-Butyl alcohol (TBA) | 59 | 41 | IS1 | Sur0/1 | 1.5 | 2 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 | 2.5 | 5 | 10 |
| tert-Butylbenzene | 134 | 91, 119 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.13 | 0.2 | 0.5 |
| Tetrachloroethene | 164 | 129, 131, 166 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.2 | 0.5 |
| Toluene | 91 | 92 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| trans-1,2-Dichloroethene | 61 | 96, 98 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| trans-1,3-Dichloropropene | 75 | 77, 39 | IS2 | Sur3 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.11 | 0.2 | 0.5 |
| trans-1,4-Dichloro-2-butene | 53 | 88 | IS3 | Sur2 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.5 | 1 | 2 |
| Trichloroethene | 130 | 97, 132, 95 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.1 | 0.2 | 0.5 |
| Trichlorofluoromethane | 101 | 103 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.15 | 0.3 | 0.5 |
| Vinyl acetate | 43 | 86 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.25 | 0.5 | 1 |
| Vinyl chloride | 62 | 64 | IS1 | Sur0/1 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.12 | 0.2 | 0.5 |
| Dibromofluoromethane (Sur0) | 111 | 113, 192 | IS1 | | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.5 | 1 | 2 |
| 1,2-Dichloroethane-d4 (Sur1) | 65 | 102 | IS1 | | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.5 | 1 | 2 |
| 4-Bromofluorobenzene (Sur2) | 95 | 174, 176 | IS3 | | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.5 | 1 | 2 |
| Toluene-D8 (Sur3) | 98 | 100 | IS2 | | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 | 0.5 | 1 | 2 |
| 1,4-Difluorobenzene (IS1) | 114 | 88 | | | | | | | | | | | | | | | | |
| Chlorobenzene-d5 (IS2) | 117 | 82, 119 | | | | | | | | | | | | | | | | |
| 1,2-Dichlorobenzene-d4 (IS3) | 152 | 150 | | | | | | | | | | | | | | | | |

Note: Since retention time of Dibromofluoromethane (Sur0) and 1,2-Dichloroethane-d4 (Sur1) is too close (~43 sec) hence, Dibromofluoromethane (Sur0) is only used when required by the project.

**Figure 1: PEAK EVALUATION TECHNIQUES**

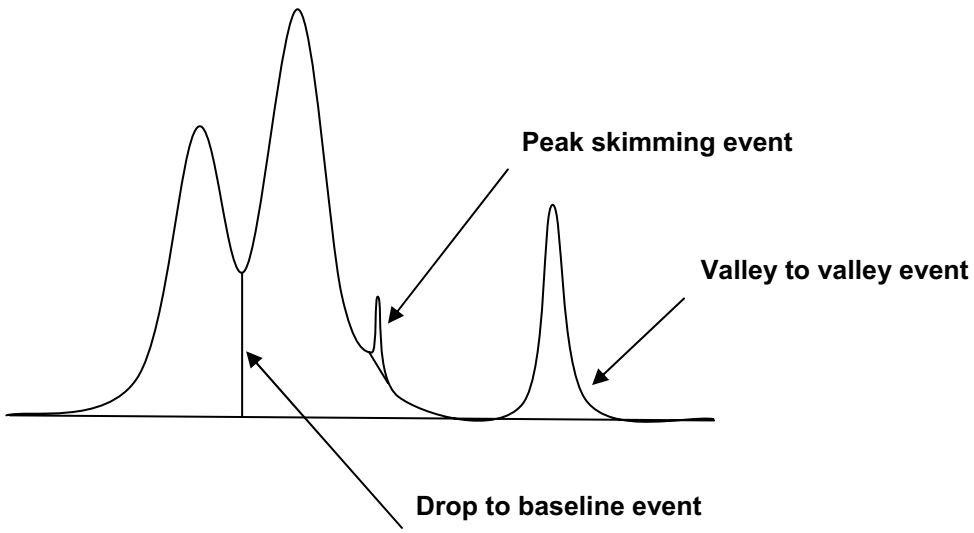
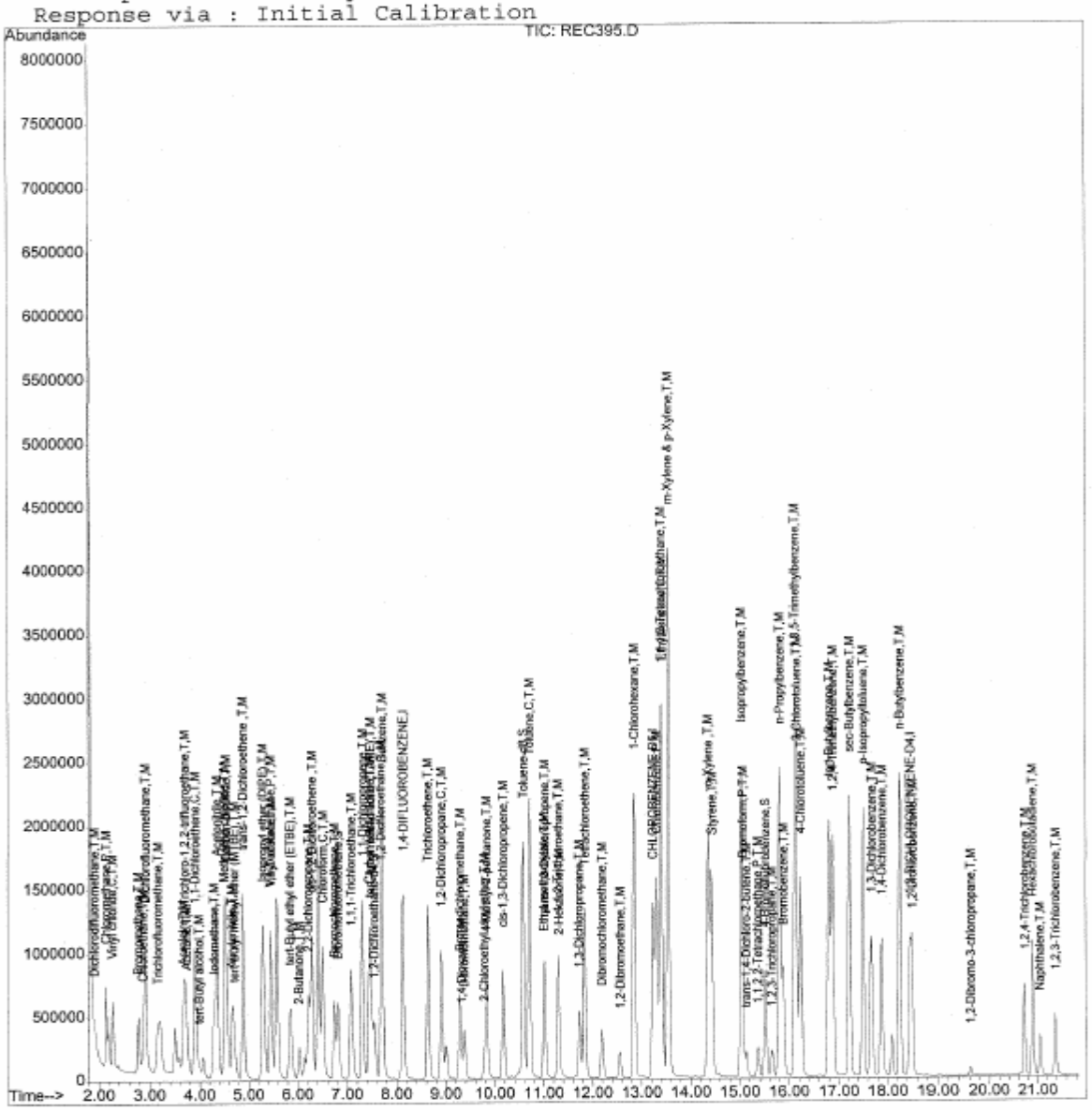


**Figure 2:** **TYPICAL CHROMATOGRAM**

Quantitation Report

Data File : D:\HPCHEM\1\DATA\11E25\REC395.D  Vial: 2
Acq On : 25 May 2011 1:40 pm  Operator: AS
Sample : IV067E2402 10ppb  Inst : TO67
Misc : 10ppb 8260/50ppb KET-ACR-ACN-TBA  Multiplr: 1.00
MS Integration Params: LSCINT1.P
Quant Time: May 25 16:32 2011  Quant Results File: VO67E24.RES

Method : D:\HPCHEM\1\METHODS\VO67E24.M (RTE Integrator)
Title : METHOD 8260B 4.0
Last Update : Wed May 25 16:26:28 2011
Response via : Initial Calibration




REC395.D VO67E24.M Wed May 25 16:38:57 2011 Page 4

**Figure 3:** **TYPICAL ICAL SUMMARY**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :03
Beginning DateTime :03/12/13 07:57
Spike Units :PPB
IC File :RCB023

Column Spec :ZB-624 ID :0.25MM
Ending DateTime :03/12/13 12:58
HPChem Method :V003C12

| M | IDX | Parameters | .3<br>07:57<br>RCB018 | .5<br>08:31<br>RCB019 | 1<br>09:05<br>RCB020 | 2<br>09:39<br>RCB021 | 5<br>10:11<br>RCB022 | 10<br>10:45<br>RCB023 | 20<br>11:18<br>RCB024 | 30<br>11:52<br>RCB025 | 50<br>12:25<br>RCB026 | 100<br>12:58<br>RCB027 | Av_RRF | %_RSD | Av_Rt_M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1,4-DIFLUOROBENZENE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 13.1167 |
| | 2 | Chlorotrifluoroethylene | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 3 | Dichlorodifluoromethane | 0.312 | 0.311 | 0.326 | 0.327 | 0.302 | 0.284 | 0.298 | 0.281 | 0.271 | 0.265 | 0.298 | 7.35 | 4.0527 |
| | 4 | Chloromethane | 0.497 | 0.479 | 0.499 | 0.498 | 0.449 | 0.423 | 0.434 | 0.414 | 0.395 | 0.379 | 0.447 | 10.02 | 4.5516 |
| | 5 | Vinyl chloride | 0.295 | 0.288 | 0.315 | 0.308 | 0.286 | 0.271 | 0.286 | 0.277 | 0.270 | 0.273 | 0.287 | 5.39 | 4.8866 |
| | 6 | 2-Chloro-1,1,1-trifluoroethane | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 7 | Bromomethane | 0.307 | 0.306 | 0.320 | 0.311 | 0.275 | 0.265 | 0.267 | 0.247 | 0.210 | ------ | 0.279 | 12.91 | 5.7735 |
| | 8 | Chloroethane | 0.209 | 0.223 | 0.239 | 0.233 | 0.210 | 0.202 | 0.209 | 0.197 | 0.184 | 0.165 | 0.207 | 10.58 | 6.0466 |
| | 9 | Dichlorofluoromethane | 0.670 | 0.653 | 0.680 | 0.650 | 0.648 | 0.592 | 0.632 | 0.621 | 0.635 | 0.625 | 0.641 | 3.96 | 6.5916 |
| | 10 | Trichlorofluoromethane | 0.321 | 0.351 | 0.385 | 0.402 | 0.365 | 0.363 | 0.384 | 0.376 | 0.364 | 0.363 | 0.367 | 5.95 | 6.6749 |
| 5 | 11 | Acrolein | 0.012 | 0.010 | 0.011 | 0.011 | 0.012 | 0.013 | 0.013 | 0.013 | 0.013 | 0.013 | 0.012 | 9.23 | 7.7679 |
| | 12 | 1,1,2-Trichloro-1,2,2-trifluoroethane | 0.214 | 0.199 | 0.207 | 0.193 | 0.190 | 0.173 | 0.180 | 0.176 | 0.185 | 0.180 | 0.190 | 7.16 | 7.8901 |
| | 13 | 1,1-Dichloroethene | 0.613 | 0.612 | 0.620 | 0.579 | 0.570 | 0.534 | 0.548 | 0.523 | 0.543 | 0.514 | 0.566 | 6.97 | 7.9392 |
| 5 | 14 | Acetone | ------ | ------ | 0.045 | 0.035 | 0.032 | 0.031 | 0.029 | 0.027 | 0.029 | 0.028 | 0.032 | 18.18 | 8.1020 |
| | 15 | Iodomethane | 0.553 | 0.519 | 0.566 | 0.525 | 0.512 | 0.471 | 0.490 | 0.476 | 0.484 | 0.486 | 0.508 | 6.41 | 8.3338 |
| | 16 | Carbon disulfide | 1.259 | 1.220 | 1.291 | 1.367 | 1.204 | 1.194 | 1.218 | 1.179 | 1.183 | 1.151 | 1.227 | 5.20 | 8.4588 |
| | 17 | Methyl acetate | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 18 | Methylene chloride | ------ | ------ | 0.548 | 0.484 | 0.450 | 0.419 | 0.422 | 0.397 | 0.422 | 0.401 | 0.443 | 11.51 | 9.0085 |
| 5 | 19 | tert-Butyl alcohol | 0.009 | 0.009 | 0.011 | 0.010 | 0.010 | 0.009 | 0.010 | 0.009 | 0.010 | 0.009 | 0.010 | 6.11 | 9.2093 |
| | 20 | tert-Butyl methyl ether (MTBE) | 0.430 | 0.405 | 0.440 | 0.420 | 0.409 | 0.367 | 0.381 | 0.371 | 0.404 | 0.374 | 0.400 | 6.43 | 9.4267 |
| | 21 | trans-1,2-Dichloroethene | 0.681 | 0.638 | 0.664 | 0.629 | 0.618 | 0.585 | 0.584 | 0.553 | 0.577 | 0.535 | 0.606 | 7.83 | 9.4834 |
| 5 | 22 | Acrylonitrile | 0.036 | 0.036 | 0.041 | 0.040 | 0.038 | 0.039 | 0.037 | 0.037 | 0.038 | 0.036 | 0.038 | 5.13 | 9.5161 |
| | 23 | Isopropyl ether (DIPE) | 1.387 | 1.263 | 1.335 | 1.285 | 1.234 | 1.171 | 1.151 | 1.110 | 1.121 | 1.024 | 1.208 | 9.29 | 10.2472 |
| | 24 | 1,1-Dichloroethane | 0.768 | 0.739 | 0.749 | 0.730 | 0.706 | 0.676 | 0.668 | 0.644 | 0.653 | 0.605 | 0.694 | 7.62 | 10.2785 |
| | 25 | Vinyl acetate | ------ | 0.332 | 0.283 | 0.324 | 0.337 | 0.355 | 0.379 | 0.413 | 0.347 | 0.317 | 0.343 | 10.92 | 10.3003 |
| | 26 | tert-Butyl ethyl ether (ETBE) | 0.796 | 0.755 | 0.728 | 0.707 | 0.718 | 0.694 | 0.681 | 0.696 | 0.732 | 0.705 | 0.721 | 4.69 | 10.8667 |
| | 27 | 2,2-Dichloropropane | 0.395 | 0.372 | 0.378 | 0.353 | 0.339 | 0.345 | 0.323 | 0.310 | 0.300 | 0.263 | 0.338 | 11.78 | 11.2345 |
| 5 | 28 | 2-Butanone | 0.083 | 0.072 | 0.068 | 0.069 | 0.064 | 0.064 | 0.055 | 0.056 | 0.058 | 0.053 | 0.064 | 14.51 | 11.2761 |
| | 29 | cis-1,2-Dichloroethene | 0.469 | 0.440 | 0.442 | 0.430 | 0.415 | 0.405 | 0.384 | 0.379 | 0.390 | 0.365 | 0.412 | 8.05 | 11.2687 |
| 5 | 30 | 2-Butanol | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 31 | Bromochloromethane | 0.307 | 0.309 | 0.315 | 0.309 | 0.309 | 0.274 | 0.277 | 0.276 | 0.288 | 0.257 | 0.292 | 6.89 | 11.6797 |
| | 32 | Tetrahydrofuran | ------ | ------ | 0.048 | 0.045 | 0.037 | 0.034 | 0.033 | 0.036 | 0.036 | 0.034 | 0.038 | 13.93 | 11.7372 |
| | 33 | Chloroform | 0.705 | 0.690 | 0.687 | 0.691 | 0.672 | 0.607 | 0.605 | 0.606 | 0.620 | 0.579 | 0.646 | 7.24 | 11.7705 |
| | 34 | Dibromofluoromethane | 0.326 | 0.367 | 0.356 | 0.342 | 0.340 | 0.327 | 0.311 | 0.315 | 0.311 | 0.294 | 0.329 | 6.83 | 12.0326 |
| | 35 | 1,1,1-Trichloroethane | 0.523 | 0.515 | 0.500 | 0.484 | 0.512 | 0.471 | 0.477 | 0.472 | 0.470 | 0.435 | 0.486 | 5.50 | 12.0386 |
| | 36 | Cyclohexane | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 37 | 1,1-Dichloropropene | 0.209 | 0.194 | 0.192 | 0.189 | 0.183 | 0.178 | 0.181 | 0.182 | 0.174 | 0.159 | 0.184 | 7.23 | 12.2738 |
| | 38 | Carbon tetrachloride | 0.467 | 0.452 | 0.446 | 0.423 | 0.441 | 0.427 | 0.429 | 0.426 | 0.426 | 0.403 | 0.434 | 4.16 | 12.2857 |
| | 39 | 1,2-Dichloroethane-d4 | 0.270 | 0.266 | 0.275 | 0.269 | 0.258 | 0.251 | 0.225 | ------ | ------ | ------ | 0.259 | 6.60 | 12.5581 |
| | 40 | Benzene | 1.724 | 1.622 | 1.501 | 1.421 | 1.497 | 1.348 | 1.382 | 1.392 | 1.393 | ------ | 1.476 | 8.50 | 12.6150 |
| | 41 | tert-Amyl methyl ether (TAME) | 0.100 | 0.103 | 0.107 | 0.100 | 0.109 | 0.098 | 0.097 | 0.102 | 0.105 | 0.098 | 0.102 | 4.11 | 12.6595 |
| | 42 | 1,2-Dichloroethane | 0.299 | 0.308 | 0.290 | 0.294 | 0.303 | 0.287 | 0.279 | 0.277 | 0.287 | 0.256 | 0.288 | 5.20 | 12.6729 |
| | 43 | Trichloroethene | 0.428 | 0.404 | 0.405 | 0.389 | 0.419 | 0.382 | 0.382 | 0.375 | 0.400 | 0.366 | 0.395 | 4.98 | 13.5291 |
| | 44 | Methylcyclohexane | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 45 | 1,2-Dichloropropane | 0.387 | 0.398 | 0.375 | 0.376 | 0.407 | 0.377 | 0.381 | 0.361 | 0.376 | 0.342 | 0.378 | 4.76 | 13.8776 |
| 20 | 46 | 1,4-Dioxane | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 9.47 | 14.0562 |
| | 47 | Dibromomethane | 0.163 | 0.146 | 0.158 | 0.146 | 0.166 | 0.142 | 0.149 | 0.144 | 0.158 | 0.145 | 0.152 | 5.80 | 14.0935 |
| | 48 | Bromodichloromethane | 0.438 | 0.407 | 0.437 | 0.429 | 0.470 | 0.419 | 0.416 | 0.430 | 0.448 | 0.413 | 0.431 | 4.33 | 14.2617 |

**Figure 3 (cont.):** **TYPICAL ICAL SUMMARY**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | 2-Chloroethyl vinyl ether | ------ | 0.052 | 0.053 | 0.059 | 0.064 | 0.062 | 0.064 | 0.067 | 0.077 | 0.073 | 0.063 | 13.09 | 14.5606 |
| 50 | cis-1,3-Dichloropropene | 0.511 | 0.509 | 0.493 | 0.489 | 0.553 | 0.509 | 0.513 | 0.510 | 0.537 | 0.492 | 0.512 | 3.91 | 14.8291 |
| 5 51 | 4-Methyl-2-pentanone | 0.182 | 0.169 | 0.170 | 0.164 | 0.180 | 0.168 | 0.154 | 0.160 | 0.170 | 0.144 | 0.166 | 6.86 | 14.9541 |
| 52 | CHLOROBENZENE-D5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 17.1073 |
| 53 | Toluene-d8 | 1.471 | 1.484 | 1.407 | 1.468 | 1.417 | 1.414 | 1.426 | 1.350 | 1.404 | ------ | 1.427 | 2.94 | 15.1712 |
| 54 | Toluene | 1.975 | 1.822 | 1.622 | 1.764 | 1.814 | 1.638 | 1.732 | 1.646 | 1.710 | ------ | 1.747 | 6.46 | 15.2622 |
| 55 | Ethyl methacrylate | 0.274 | 0.248 | 0.237 | 0.247 | 0.287 | 0.268 | 0.263 | 0.270 | 0.286 | 0.266 | 0.264 | 6.15 | 15.5111 |
| 56 | trans-1,3-Dichloropropene | 0.383 | 0.368 | 0.358 | 0.376 | 0.420 | 0.392 | 0.406 | 0.404 | 0.429 | 0.403 | 0.394 | 5.77 | 15.5483 |
| 57 | 1,1,2-Trichloroethane | 0.222 | 0.209 | 0.198 | 0.196 | 0.213 | 0.196 | 0.195 | 0.206 | 0.217 | 0.201 | 0.205 | 4.79 | 15.8267 |
| 58 | Tetrachloroethene | 0.438 | 0.389 | 0.368 | 0.385 | 0.382 | 0.355 | 0.371 | 0.366 | 0.383 | 0.352 | 0.379 | 6.42 | 15.9995 |
| 5 59 | 2-Hexanone | 0.119 | 0.137 | 0.116 | 0.121 | 0.117 | 0.125 | 0.112 | 0.121 | 0.125 | 0.106 | 0.120 | 6.87 | 16.0248 |
| 60 | 1,3-Dichloropropane | 0.416 | 0.397 | 0.392 | 0.417 | 0.411 | 0.384 | 0.385 | 0.389 | 0.415 | 0.377 | 0.398 | 3.79 | 16.0531 |
| 61 | Dibromochloromethane | 0.252 | 0.234 | 0.233 | 0.261 | 0.259 | 0.256 | 0.262 | 0.267 | 0.287 | 0.268 | 0.258 | 6.22 | 16.3941 |
| 62 | 1,2-Dibromoethane | 0.207 | 0.208 | 0.195 | 0.197 | 0.212 | 0.193 | 0.202 | 0.205 | 0.224 | 0.208 | 0.205 | 4.47 | 16.5847 |
| 63 | 1-Chlorohexane | 0.897 | 0.862 | 0.785 | 0.803 | 0.835 | 0.761 | 0.806 | 0.779 | 0.829 | 0.757 | 0.811 | 5.53 | 16.9495 |
| 64 | Chlorobenzene | 1.152 | 1.065 | 0.937 | 0.954 | 0.990 | 0.958 | 0.962 | 0.991 | 1.007 | 0.911 | 0.993 | 7.08 | 17.1475 |
| 65 | Ethylbenzene | 2.251 | 2.178 | 2.021 | 1.994 | 2.182 | 1.965 | 2.014 | 2.014 | 1.839 | ------ | 2.051 | 6.29 | 17.1930 |
| 66 | 1,1,1,2-Tetrachloroethane | 0.319 | 0.317 | 0.311 | 0.307 | 0.333 | 0.304 | 0.308 | 0.319 | 0.318 | 0.294 | 0.313 | 3.37 | 17.2264 |
| 2 67 | m-Xylene & p-Xylene | 1.713 | 1.626 | 1.515 | 1.469 | 1.497 | 1.439 | 1.490 | 1.387 | ------ | ------ | 1.517 | 6.90 | 17.3227 |
| 68 | o-Xylene | 1.694 | 1.653 | 1.478 | 1.477 | 1.519 | 1.428 | 1.437 | 1.428 | 1.440 | ------ | 1.506 | 6.65 | 17.8581 |
| 69 | Styrene | 1.028 | 1.012 | 0.971 | 0.933 | 1.027 | 0.971 | 0.981 | 0.978 | 0.998 | 0.874 | 0.977 | 4.73 | 17.8787 |
| 70 | 1,2-DICHLOROBENZENE-D4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 20.6245 |
| 71 | Bromoform | 0.330 | 0.326 | 0.329 | 0.333 | 0.339 | 0.334 | 0.362 | 0.385 | 0.425 | 0.401 | 0.356 | 9.92 | 18.2613 |
| 72 | Isopropylbenzene | 5.562 | 5.517 | 5.180 | 5.026 | 5.022 | 4.609 | 5.010 | 5.013 | 5.337 | ------ | 5.142 | 5.76 | 18.2767 |
| 73 | 4-Bromofluorobenzene | 1.603 | 1.546 | 1.384 | 1.356 | 1.335 | 1.258 | 1.308 | 1.333 | 1.419 | 1.324 | 1.386 | 7.83 | 18.5621 |
| 74 | 1,1,2,2-Tetrachloroethane | 0.746 | 0.756 | 0.716 | 0.675 | 0.696 | 0.618 | 0.665 | 0.707 | 0.749 | 0.704 | 0.703 | 6.08 | 18.7036 |
| 75 | trans-1,4-Dichloro-2-butene | 0.187 | 0.180 | 0.176 | 0.186 | 0.198 | 0.177 | 0.197 | 0.205 | 0.223 | 0.201 | 0.193 | 7.69 | 18.7438 |
| 76 | n-Propylbenzene | 8.651 | 8.030 | 7.852 | 7.211 | 7.500 | 6.892 | 7.592 | 7.274 | ------ | ------ | 7.625 | 7.21 | 18.7857 |
| 77 | 1,2,3-Trichloropropane | 0.177 | 0.170 | 0.160 | 0.153 | 0.158 | 0.140 | 0.147 | 0.149 | 0.157 | 0.138 | 0.155 | 7.93 | 18.8019 |
| 78 | Bromobenzene | 1.165 | 1.071 | 1.055 | 1.014 | 1.052 | 0.931 | 0.983 | 1.022 | 1.109 | 1.010 | 1.041 | 6.31 | 18.8227 |
| 79 | 1,3,5-Trimethylbenzene | 4.694 | 4.553 | 4.332 | 4.080 | 4.256 | 3.733 | 4.106 | 4.10[illegible] | 4.355 | 3.299 | 4.151 | 9.67 | 18.9612 |
| 80 | 2-Chlorotoluene | 5.150 | 4.552 | 4.413 | 4.224 | 4.372 | 3.923 | 4.126 | 4.108 | 4.517 | 3.691 | 4.308 | 9.28 | 18.9999 |
| 81 | 4-Chlorotoluene | 4.441 | 3.866 | 3.719 | 3.646 | 3.838 | 3.506 | 3.604 | 3.728 | 4.047 | 3.296 | 3.769 | 8.31 | 19.1265 |
| 82 | tert-Butylbenzene | 1.011 | 0.999 | 0.944 | 0.893 | 0.936 | 0.837 | 0.894 | 0.889 | 0.955 | 0.865 | 0.922 | 6.14 | 19.4213 |
| 83 | 1,2,4-Trimethylbenzene | 4.627 | 4.271 | 3.973 | 4.095 | 4.026 | 3.564 | 3.677 | 3.874 | 4.208 | 3.401 | 3.972 | 9.12 | 19.4794 |
| 84 | sec-Butylbenzene | 6.845 | 6.467 | 6.537 | 6.165 | 6.138 | 5.570 | 5.934 | 5.860 | 6.013 | ------ | 6.170 | 6.32 | 19.6962 |
| 85 | p-Isopropyltoluene | 4.982 | 4.670 | 4.483 | 4.208 | 4.407 | 4.011 | 4.268 | 4.060 | 4.454 | ------ | 4.394 | 6.93 | 19.8402 |
| 86 | 1,3-Dichlorobenzene | 2.358 | 2.168 | 2.115 | 2.002 | 2.047 | 1.927 | 2.037 | 1.985 | 2.204 | 2.008 | 2.085 | 6.15 | 19.9961 |
| 87 | 1,4-Dichlorobenzene | 2.379 | 2.019 | 1.958 | 1.903 | 1.942 | 1.756 | 1.873 | 1.837 | 2.027 | 1.854 | 1.955 | 8.73 | 20.1063 |
| 88 | n-Butylbenzene | 5.550 | 4.899 | 5.079 | 4.650 | 4.817 | 4.593 | 4.886 | 4.619 | 4.980 | ------ | 4.897 | 6.06 | 20.3928 |
| 89 | 1,2-Dichlorobenzene | 1.816 | 1.636 | 1.646 | 1.560 | 1.576 | 1.448 | 1.505 | 1.471 | 1.578 | 1.464 | 1.570 | 7.08 | 20.6528 |
| 90 | 1,2-Dibromo-3-chloropropane | 0.063 | 0.069 | 0.073 | 0.072 | 0.076 | 0.068 | 0.073 | 0.073 | 0.078 | 0.074 | 0.072 | 6.04 | 21.7696 |
| 91 | 1,2,4-Trichlorobenzene | 0.972 | 0.844 | 0.786 | 0.841 | 0.831 | 0.798 | 0.763 | 0.733 | 0.817 | 0.766 | 0.815 | 8.11 | 23.0070 |
| 92 | Hexachlorobutadiene | ------ | 0.740 | 0.722 | 0.700 | 0.678 | 0.604 | 0.560 | 0.503 | 0.559 | 0.527 | 0.621 | 14.43 | 23.1360 |
| 93 | Naphthalene | 1.249 | 1.099 | 1.013 | 1.042 | 1.036 | 0.961 | 0.917 | 0.843 | 0.957 | 0.895 | 1.001 | 11.58 | 23.4983 |
| 94 | 1,2,3-Trichlorobenzene | 0.700 | 0.631 | 0.619 | 0.614 | 0.617 | 0.556 | 0.499 | 0.460 | 0.505 | 0.476 | 0.568 | 14.08 | 23.9168 |

Spike Amount = Nominal Amount * M
Ave_%RSD : 7.5 Max_%RSD : 18.2

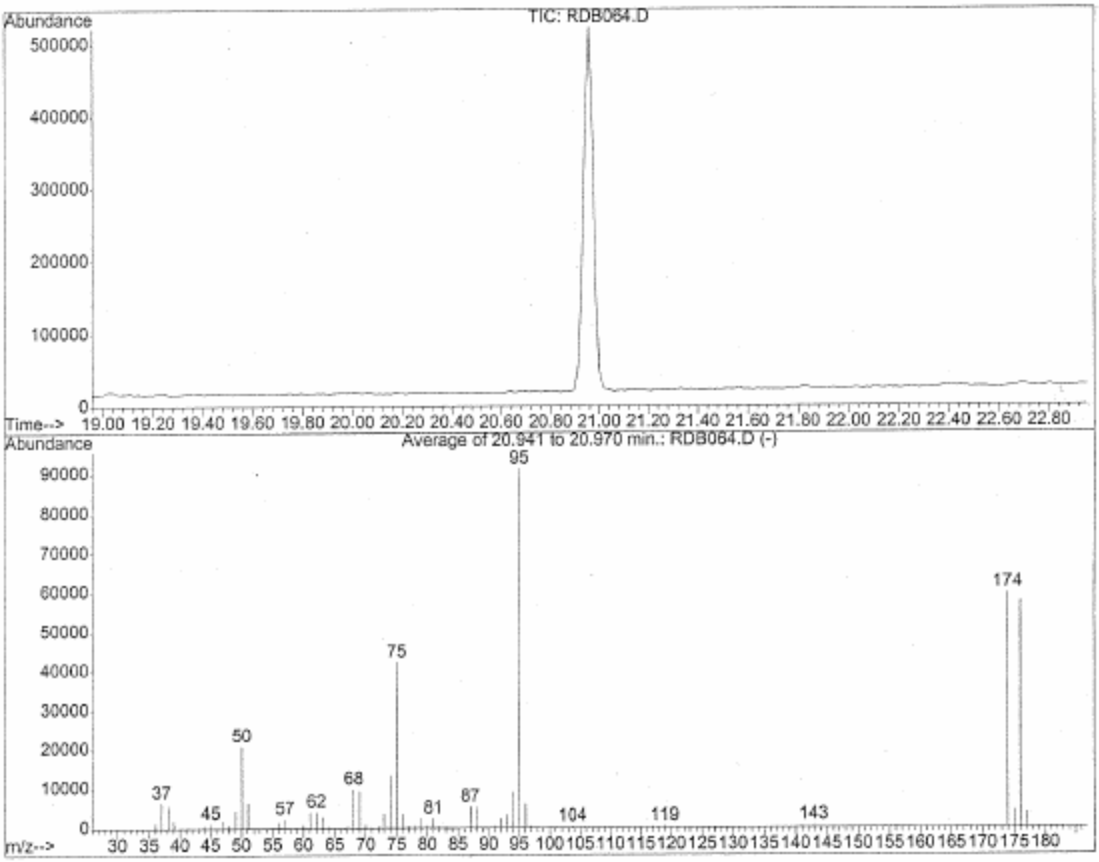
Use Least Square Linear Regression with weighting factor of inverse concentration for comps with %_RSD > 15
Resp_Ratio = xo + x1 * Amt_Ratio

| IDX | Parameter | x0 | x1 | CCF |
|---|---|---|---|---|
| 14 | Acetone | 0.00872 | 0.02772 | 0.9996 |

**Figure 4: TYPICAL INSTRUMENT PERFORMANCE CHECK (TUNING)**

BFB

```
Data File : D:\HPCHEM\1\DATA\11D07\RDB064.D                Vial: 2
Acq On    :  7 Apr 2011   7:43 pm                       Operator: MW
Sample    : BFB03D04                                    Inst    : TO03
Misc      : T/CHECK                                     Multiplr: 1.00
MS Integration Params: 524INT.P
Method    : D:\HPCHEM\1\METHODS\VO03D07.M (RTE Integrator)
Title     : METHOD 8260    25mL
```




AutoFind: Scans 1163, 1164, 1165; Background Corrected with Scan 1156

| Target Mass | Rel. to Mass | Lower Limit% | Upper Limit% | Rel. Abn% | Raw Abn | Result Pass/Fail |
|---|---|---|---|---|---|---|
| 50 | 95 | 15 | 40 | 22.9 | 20916 | PASS |
| 75 | 95 | 30 | 60 | 46.4 | 42347 | PASS |
| 95 | 95 | 100 | 100 | 100.0 | 91301 | PASS |
| 96 | 95 | 5 | 9 | 6.6 | 6055 | PASS |
| 173 | 174 | 0.00 | 2 | 0.0 | 0 | PASS |
| 174 | 95 | 50 | 100 | 65.3 | 59619 | PASS |
| 175 | 174 | 5 | 9 | 7.4 | 4406 | PASS |
| 176 | 174 | 95 | 101 | 96.7 | 57635 | PASS |
| 177 | 176 | 5 | 9 | 6.7 | 3884 | PASS |

RDB064.D  VO03D07.M  Fri Apr 08 09:01:53 2011

## Figure 5: TYPICAL INSTRUMENT PERFORMANCE CHECK (TUNING) SUMMARY

5A
VOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: EMAX Inc — Contract: CLEAN WATER PROJECT
Lab Code: EMXT — Case No.: — SAS No.: — SDG No.: YYMNNN
Lab File ID: RDC521 — BFB Injection Date : 04/29/14
Instrument ID: 67 — BFB Injection Time : 09:52
GC Column:RTX502.2ID:0.25mm (mm) — Heated Purge: (Y/N) N

| m/e | ION ABUNDANCE CRITERIA | % RELATIVE ABUNDANCE |
|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 20.69 |
| 75 | 30.0 - 60.0% of mass 95 | 45.82 |
| 95 | Base peak, 100% relative abundance | 100.00 |
| 96 | 5.0 - 9.0% of mass 95 | 6.39 |
| 173 | Less than 2.0% of mass 174 | 0.00( 0.0)1 |
| 174 | Greater than 50% of mass 95 | 70.43 |
| 175 | 5.0 - 9.0% of mass 174 | 5.04( 7.2)1 |
| 176 | 95.0 - 101.0% of mass 174 | 67.25( 95.5)1 |
| 177 | 5.0 - 9.0% of mass 176 | 4.57( 6.8)2 |

1-Value is % mass 174 — 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

| | EPA SAMPLE NO. | LAB SAMPLE ID | LAB FILE ID | DATE ANALYZED | TIME ANALYZED |
|---|---|---|---|---|---|
| 1 | VSTD010 | CVO67D0914 | RDC523 | 04/29/14 | 11:14 |
| 2 | MBLK1W | VO67D21B | RDC527 | 04/29/14 | 13:15 |
| 3 | LCS1W | VO67D21L | RDC524 | 04/29/14 | 11:44 |
| 4 | LCD1W | VO67D21C | RDC525 | 04/29/14 | 12:15 |
| 5 | XXX-59XX001 | MNNN-02 | RDC534 | 04/29/14 | 16:55 |
| 6 | XXX-59XX001MS | MNNN-02M | RDC535 | 04/29/14 | 17:26 |
| 7 | XXX-59XX001MSD | MNNN-02S | RDC536 | 04/29/14 | 18:57 |

## Figure 6: TYPICAL INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY

8A
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name : EMAX INC.
Lab Code : EMXT
Lab File ID : RDC168
Instrument ID: 67
GC Column : RTX502.2ID:0.25mm (mm)

Project : CLEAN WATER PROJECT
SDG No. : YYMNNN
Date Analyzed : 04/09/14
Time Analyzed : 18:54
Heated Purge : No

| | | IS1(DBF) | | IS2(CBZ) | | IS3(DCB) | |
|---|---|---|---|---|---|---|---|
| | | AREA # | RT # | AREA # | RT # | AREA # | RT # |
| | 12 HOUR STD | 1321331 | 8.08 | 1022177 | 13.17 | 321226 | 18.40 |
| | UPPER LIMIT | 2642662 | 8.58 | 2044354 | 13.67 | 642452 | 18.90 |
| | LOWER LIMIT | 660666 | 7.58 | 511089 | 12.67 | 160613 | 17.90 |
| | SAMPLE ID | | | | | | |
| 1 | VSTD010 | 1155410 | 8.07 | 908594 | 13.15 | 276831 | 18.38 |
| 2 | MBLK1W | 1259632 | 8.07 | 956984 | 13.15 | 261376 | 18.38 |
| 3 | LCS1W | 1216852 | 8.07 | 957974 | 13.15 | 290568 | 18.38 |
| 4 | LCD1W | 1262335 | 8.07 | 983468 | 13.15 | 300886 | 18.38 |
| 5 | XXX-59GW001 | 1202358 | 8.07 | 934767 | 13.16 | 277693 | 18.38 |
| 6 | XXX-59GW001MS | 1216852 | 8.07 | 957974 | 13.17 | 290568 | 18.38 |
| 7 | XXX-59GW001MSD | 1262335 | 8.07 | 983468 | 13.17 | 300886 | 18.38 |

IS1 (DFB) = 1,4-Difluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,2-Dichlorobenzene-d4

AREA UPPER LIMIT = + 100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = + 0.5 minutes (30 sec) of internal standard RT
RT LOWER LIMIT = - 0.5 minutes (30 sec) of internal standard RT

# Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

**Figure 7:** **TYPICAL SAMPLE RESULT SUMMARY**

METHOD SW5030C/8260B
VOLATILE ORGANICS BY GC/MS

| | | | |
|---|---|---|---|
| Client | : XYZ INC. | Date Collected: | 04/28/14 |
| Project | : CLEAN WATER PROJECT | Date Received: | 04/29/14 |
| Batch No. | : YYMNNN | Date Extracted: | 04/29/14 16:55 |
| Sample ID: | XX-59XX001 | Date Analyzed: | 04/29/14 16:55 |
| Lab Samp ID: | MNNN-02 | Dilution Factor: | 1 |
| Lab File ID: | RDC534 | Matrix | : WATER |
| Ext Btch ID: | VO67D21 | % Moisture | : NA |
| Calib. Ref.: | RDC168 | Instrument ID | : 67 |

| PARAMETERS | RESULTS (ug/L) | LOQ (ug/L) | DL (ug/L) | LOD (ug/L) |
|---|---|---|---|---|
| BENZENE | 0.11J | 1.0 | 0.10 | 0.20 |
| BROMODICHLOROMETHANE | ND | 1.0 | 0.10 | 0.20 |
| BROMOFORM | 1.5 | 1.0 | 0.15 | 0.30 |
| BROMOMETHANE | ND | 1.0 | 0.16 | 0.30 |
| CARBON TETRACHLORIDE | ND | 1.0 | 0.10 | 0.20 |
| CHLOROBENZENE | ND | 1.0 | 0.10 | 0.20 |
| CHLOROETHANE | ND | 1.0 | 0.27 | 0.30 |
| CHLOROFORM | ND | 1.0 | 0.10 | 0.20 |
| CHLOROMETHANE | ND | 2.0 | 0.15 | 0.30 |
| DIBROMOCHLOROMETHANE | 0.20J | 1.0 | 0.10 | 0.20 |
| 1,2-DICHLOROBENZENE | ND | 1.0 | 0.10 | 0.20 |
| 1,3-DICHLOROBENZENE | ND | 1.0 | 0.11 | 0.20 |
| 1,4-DICHLOROBENZENE | ND | 1.0 | 0.10 | 0.20 |
| DICHLORODIFLUOROMETHANE (FREON 12) | ND | 1.0 | 0.15 | 0.30 |
| 1,1-DICHLOROETHANE | ND | 1.0 | 0.10 | 0.20 |
| 1,2-DICHLOROETHANE | ND | 1.0 | 0.10 | 0.20 |
| 1,1-DICHLOROETHENE | ND | 1.0 | 0.10 | 0.20 |
| 1,2-DICHLOROETHENE (TOTAL) | 0.30J | 1.0 | 0.10 | 0.20 |
| 1,2-DICHLOROPROPANE | ND | 1.0 | 0.10 | 0.20 |
| TRANS-1,3-DICHLOROPROPENE | ND | 1.0 | 0.11 | 0.20 |
| CIS-1,3-DICHLOROPROPENE | ND | 1.0 | 0.10 | 0.20 |
| ETHYLBENZENE | ND | 1.0 | 0.10 | 0.20 |
| METHYLENE CHLORIDE | ND | 5.0 | 0.25 | 0.50 |
| 1,1,2,2-TETRACHLOROETHANE | ND | 1.0 | 0.11 | 0.20 |
| TETRACHLOROETHENE | 0.19J | 1.0 | 0.15 | 0.20 |
| TOLUENE | 62 | 1.0 | 0.10 | 0.20 |
| 1,1,1-TRICHLOROETHANE | ND | 1.0 | 0.10 | 0.20 |
| 1,1,2-TRICHLOROETHANE | ND | 1.0 | 0.10 | 0.20 |
| TRICHLOROFLUOROMETHANE (FREON 11) | ND | 1.0 | 0.15 | 0.30 |
| TRICHLOROETHENE | 14 | 1.0 | 0.10 | 0.20 |
| VINYL CHLORIDE | ND | 2.0 | 0.12 | 0.20 |
| XYLENES (TOTAL) | ND | 1.0 | 0.10 | 0.50 |

| SURROGATE PARAMETERS | RESULTS | SPK_AMT | % RECOVERY | QC LIMIT |
|---|---|---|---|---|
| 1,2-DICHLOROETHANE-D4 | 8.44 | 10.00 | 84.4 | 70-120 |
| 4-BROMOFLUOROBENZENE | 9.41 | 10.00 | 94.1 | 75-120 |
| TOLUENE-D8 | 10.3 | 10.00 | 103 | 85-120 |
| DIBROMOFLUOROMETHANE | 9.95 | 10.00 | 99.5 | 85-115 |

## Figure 8: TYPICAL LCS/LCSD SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: YYMNNN
METHOD: SW5030C/8260B

| | | | | | |
|---|---|---|---|---|---|
| MATRIX: | WATER | | | % MOISTURE: | NA |
| DILUTION FACTOR: | 1 | 1 | 1 | | |
| SAMPLE ID: | MBLK1W | | | | |
| LAB SAMP ID: | VO67D21B | VO67D21L | VO67D21C | | |
| LAB FILE ID: | RDC527 | RDC524 | RDC525 | | |
| DATE EXTRACTED: | 04/29/1413:15 | 04/29/1411:44 | 04/29/1412:15 | DATE COLLECTED: | NA |
| DATE ANALYZED: | 04/29/1413:15 | 04/29/1411:44 | 04/29/1412:15 | DATE RECEIVED: | 04/29/14 |
| PREP. BATCH: | VO67D21 | VO67D21 | VO67D21 | | |
| CALIB. REF: | RDC168 | RDC168 | RDC168 | | |

ACCESSION:

| PARAMETER | BLNK RSLT (ug/L) | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | RPD ( % ) | QC LIMIT ( % ) | MAX RPD ( % ) |
|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | ND | 10.0 | 9.32 | 93 | 10.0 | 9.17 | 92 | 2 | 80-120 | 30 |
| Bromodichloromethane | ND | 10.0 | 9.65 | 97 | 10.0 | 9.37 | 94 | 3 | 75-120 | 30 |
| Bromoform | ND | 10.0 | 10.1 | 101 | 10.0 | 9.80 | 98 | 3 | 70-130 | 30 |
| Bromomethane | ND | 10.0 | 10.6 | 106 | 10.0 | 9.80 | 98 | 7 | 30-145 | 30 |
| Carbon Tetrachloride | ND | 10.0 | 8.35 | 83 | 10.0 | 8.20 | 82 | 2 | 65-140 | 30 |
| Chlorobenzene | ND | 10.0 | 9.78 | 98 | 10.0 | 9.68 | 97 | 1 | 80-120 | 30 |
| Chloroethane | ND | 10.0 | 11.0 | 110 | 10.0 | 10.1 | 101 | 8 | 60-135 | 30 |
| Chloroform | ND | 10.0 | 9.84 | 98 | 10.0 | 9.56 | 96 | 3 | 65-135 | 30 |
| Chloromethane | ND | 10.0 | 10.2 | 102 | 10.0 | 9.58 | 96 | 7 | 40-125 | 30 |
| Dibromochloromethane | ND | 10.0 | 9.64 | 96 | 10.0 | 9.49 | 95 | 2 | 60-135 | 30 |
| 1,2-Dichlorobenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 10.1 | 101 | 2 | 70-120 | 30 |
| 1,3-Dichlorobenzene | ND | 10.0 | 10.1 | 101 | 10.0 | 9.91 | 99 | 2 | 75-125 | 30 |
| 1,4-Dichlorobenzene | ND | 10.0 | 10.0 | 100 | 10.0 | 9.87 | 99 | 1 | 75-125 | 30 |
| Dichlorodifluoromethane (Freon 12) | ND | 10.0 | 9.93 | 99 | 10.0 | 9.39 | 94 | 6 | 30-155 | 30 |
| 1,1-Dichloroethane | ND | 10.0 | 9.27 | 93 | 10.0 | 8.99 | 90 | 3 | 70-135 | 30 |
| 1,2-Dichloroethane | ND | 10.0 | 7.97 | 80 | 10.0 | 7.88 | 79 | 1 | 70-130 | 30 |
| 1,1-Dichloroethene | ND | 10.0 | 7.58 | 76 | 10.0 | 7.41 | 74 | 2 | 70-130 | 30 |
| 1,2-Dichloroethene (Total) | ND | 20.0 | 17.1 | 85 | 20.0 | 16.6 | 83 | 3 | 70-125 | 30 |
| 1,2-Dichloropropane | ND | 10.0 | 9.90 | 99 | 10.0 | 9.70 | 97 | 2 | 75-125 | 30 |
| Trans-1,3-Dichloropropene | ND | 10.0 | 8.39 | 84 | 10.0 | 8.49 | 85 | 1 | 55-140 | 30 |
| cis-1,3-Dichloropropene | ND | 10.0 | 9.23 | 92 | 10.0 | 8.93 | 89 | 3 | 70-130 | 30 |
| Ethylbenzene | ND | 10.0 | 9.84 | 98 | 10.0 | 9.67 | 97 | 2 | 75-125 | 30 |
| Methylene Chloride | ND | 10.0 | 8.28 | 83 | 10.0 | 8.40 | 84 | 1 | 55-140 | 30 |
| 1,1,2,2-Tetrachloroethane | ND | 10.0 | 10.5 | 105 | 10.0 | 10.3 | 103 | 2 | 65-130 | 30 |
| Tetrachloroethene | ND | 10.0 | 9.31 | 93 | 10.0 | 9.20 | 92 | 1 | 45-150 | 30 |
| Toluene | ND | 10.0 | 9.57 | 96 | 10.0 | 9.47 | 95 | 1 | 75-120 | 30 |
| 1,1,1-Trichloroethane | ND | 10.0 | 8.74 | 87 | 10.0 | 8.56 | 86 | 2 | 65-130 | 30 |
| 1,1,2-Trichloroethane | ND | 10.0 | 10.3 | 103 | 10.0 | 10.3 | 103 | 0 | 75-125 | 30 |
| Trichlorofluoromethane (Freon 11) | ND | 10.0 | 10.8 | 108 | 10.0 | 9.93 | 99 | 9 | 60-145 | 30 |
| Trichloroethene | ND | 10.0 | 9.46 | 95 | 10.0 | 9.19 | 92 | 3 | 70-125 | 30 |
| Vinyl Chloride | ND | 10.0 | 10.3 | 103 | 10.0 | 9.61 | 96 | 7 | 50-145 | 30 |
| Xylenes (Total) | ND | 30.0 | 28.5 | 95 | 30.0 | 28.0 | 93 | 2 | 80-120 | 30 |

| SURROGATE PARAMETER | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | QC LIMIT ( % ) |
|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane-d4 | 10.0 | 8.20 | 82 | 10.0 | 8.24 | 82 | 70-120 |
| 4-Bromofluorobenzene | 10.0 | 9.69 | 97 | 10.0 | 9.70 | 97 | 75-120 |
| Toluene-d8 | 10.0 | 10.4 | 104 | 10.0 | 10.4 | 104 | 85-120 |
| Dibromofluoromethane | 10.0 | 9.92 | 99 | 10.0 | 9.85 | 98 | 85-115 |

## Figure 9: TYPICAL MS/MSD SUMMARY

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: YYMNNN
METHOD: SW5030C/8260B

| | | | | | |
|---|---|---|---|---|---|
| MATRIX: | WATER | | | % MOISTURE: | NA |
| DILUTION FACTOR: | 1 | 1 | 1 | | |
| SAMPLE ID: | XXX-59XX001 | XXX-59XX001MS | XXX-59XX001MSD | | |
| LAB SAMP ID: | MNNN-02 | MNNN-02M | MNNN-02S | | |
| LAB FILE ID: | RDC534 | RDC535 | RDC536 | | |
| DATE EXTRACTED: | 04/29/1416:55 | 04/29/1417:26 | 04/29/1418:15 | DATE COLLECTED: | NA |
| DATE ANALYZED: | 04/29/1416:55 | 04/29/1417:26 | 04/29/1418:15 | DATE RECEIVED: | 04/29/14 |
| PREP. BATCH: | VO67D21 | VO67D21 | VO67D21 | | |
| CALIB. REF: | RDC168 | RDC168 | RDC168 | | |

ACCESSION:

| PARAMETER | BLNK RSLT (ug/L) | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | RPD ( % ) | QC LIMIT ( % ) | MAX RPD ( % ) |
|---|---|---|---|---|---|---|---|---|---|---|
| Benzene | ND | 10.0 | 9.32 | 93 | 10.0 | 9.17 | 92 | 2 | 80-120 | 30 |
| Bromodichloromethane | ND | 10.0 | 9.65 | 97 | 10.0 | 9.37 | 94 | 3 | 75-120 | 30 |
| Bromoform | ND | 10.0 | 10.1 | 101 | 10.0 | 9.80 | 98 | 3 | 70-130 | 30 |
| Bromomethane | ND | 10.0 | 10.6 | 106 | 10.0 | 9.80 | 98 | 7 | 30-145 | 30 |
| Carbon Tetrachloride | ND | 10.0 | 8.35 | 83 | 10.0 | 8.20 | 82 | 2 | 65-140 | 30 |
| Chlorobenzene | ND | 10.0 | 9.78 | 98 | 10.0 | 9.68 | 97 | 1 | 80-120 | 30 |
| Chloroethane | ND | 10.0 | 11.0 | 110 | 10.0 | 10.1 | 101 | 8 | 60-135 | 30 |
| Chloroform | ND | 10.0 | 9.84 | 98 | 10.0 | 9.56 | 96 | 3 | 65-135 | 30 |
| Chloromethane | ND | 10.0 | 10.2 | 102 | 10.0 | 9.58 | 96 | 7 | 40-125 | 30 |
| Dibromochloromethane | ND | 10.0 | 9.64 | 96 | 10.0 | 9.49 | 95 | 2 | 60-135 | 30 |
| 1,2-Dichlorobenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 10.1 | 101 | 2 | 70-120 | 30 |
| 1,3-Dichlorobenzene | ND | 10.0 | 10.1 | 101 | 10.0 | 9.91 | 99 | 2 | 75-125 | 30 |
| 1,4-Dichlorobenzene | ND | 10.0 | 10.0 | 100 | 10.0 | 9.87 | 99 | 1 | 75-125 | 30 |
| Dichlorodifluoromethane (Freon 12) | ND | 10.0 | 9.93 | 99 | 10.0 | 9.39 | 94 | 6 | 30-155 | 30 |
| 1,1-Dichloroethane | ND | 10.0 | 9.27 | 93 | 10.0 | 8.99 | 90 | 3 | 70-135 | 30 |
| 1,2-Dichloroethane | ND | 10.0 | 7.97 | 80 | 10.0 | 7.88 | 79 | 1 | 70-130 | 30 |
| 1,1-Dichloroethene | ND | 10.0 | 7.58 | 76 | 10.0 | 7.41 | 74 | 2 | 70-130 | 30 |
| 1,2-Dichloroethene (Total) | ND | 20.0 | 17.1 | 85 | 20.0 | 16.6 | 83 | 3 | 70-125 | 30 |
| 1,2-Dichloropropane | ND | 10.0 | 9.90 | 99 | 10.0 | 9.70 | 97 | 2 | 75-125 | 30 |
| Trans-1,3-Dichloropropene | ND | 10.0 | 8.39 | 84 | 10.0 | 8.49 | 85 | 1 | 55-140 | 30 |
| cis-1,3-Dichloropropene | ND | 10.0 | 9.23 | 92 | 10.0 | 8.93 | 89 | 3 | 70-130 | 30 |
| Ethylbenzene | ND | 10.0 | 9.84 | 98 | 10.0 | 9.67 | 97 | 2 | 75-125 | 30 |
| Methylene Chloride | ND | 10.0 | 8.28 | 83 | 10.0 | 8.40 | 84 | 1 | 55-140 | 30 |
| 1,1,2,2-Tetrachloroethane | ND | 10.0 | 10.5 | 105 | 10.0 | 10.3 | 103 | 2 | 65-130 | 30 |
| Tetrachloroethene | ND | 10.0 | 9.31 | 93 | 10.0 | 9.20 | 92 | 1 | 45-150 | 30 |
| Toluene | ND | 10.0 | 9.57 | 96 | 10.0 | 9.47 | 95 | 1 | 75-120 | 30 |
| 1,1,1-Trichloroethane | ND | 10.0 | 8.74 | 87 | 10.0 | 8.56 | 86 | 2 | 65-130 | 30 |
| 1,1,2-Trichloroethane | ND | 10.0 | 10.3 | 103 | 10.0 | 10.3 | 103 | 0 | 75-125 | 30 |
| Trichlorofluoromethane (Freon 11) | ND | 10.0 | 10.8 | 108 | 10.0 | 9.93 | 99 | 9 | 60-145 | 30 |
| Trichloroethene | ND | 10.0 | 9.46 | 95 | 10.0 | 9.19 | 92 | 3 | 70-125 | 30 |
| Vinyl Chloride | ND | 10.0 | 10.3 | 103 | 10.0 | 9.61 | 96 | 7 | 50-145 | 30 |
| Xylenes (Total) | ND | 30.0 | 28.5 | 95 | 30.0 | 28.0 | 93 | 2 | 80-120 | 30 |

| SURROGATE PARAMETER | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | QC LIMIT ( % ) |
|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane-d4 | 10.0 | 8.20 | 82 | 10.0 | 8.24 | 82 | 70-120 |
| 4-Bromofluorobenzene | 10.0 | 9.69 | 97 | 10.0 | 9.70 | 97 | 75-120 |
| Toluene-d8 | 10.0 | 10.4 | 104 | 10.0 | 10.4 | 104 | 85-120 |
| Dibromofluoromethane | 10.0 | 9.92 | 99 | 10.0 | 9.85 | 98 | 85-115 |

**Figure 10: TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ INC.

Project : CLEAN WATER PROJECT

SDG : YYDNNN

METHOD SW5030C/8260B
VOLATILE ORGANICS BY GC/MS

A total of two (2) water samples were received on 04/29/14 for Volatile Organics by GC/MS analysis, Method 5030C/8260B in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods and Project QAPP Clean Water Project.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms of ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Results were compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for VO67D21L/C were all within QC limits.

Matrix QC Sample
Matrix QC sample was analyzed at the frequency prescribed by the project.
Percent recoveries and RPDs for MNNN-02M/S were within project QC limits.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within project QC limits. Refer to sample result forms for details.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met; otherwise, anomalies were discussed within the associated QC parameter.

## Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

| QC PROCEDURE | FREQUENCY | ACCEPTANCE CRITERIA | CORRECTIVE ACTION | 1st Rvw | 2nd Rvw |
|---|---|---|---|---|---|
| Check of mass spectral ion intensities using BFB | Prior to initial calibration and calibration verification | Refer to criteria listed in Table 5 | Retune instrument and verify | | |
| Multi point Initial Calibration(ICAL) minimum of 5 points | Initially; as needed | SPCCs :<br>RF ≥ 0.1 for Bromoform, Chloromethane and 1,1-Dichloroethane<br>RF ≥ 0.3 for Chlorobenzene and 1,1,2,2-Tetrachloroethane<br>CCCs: RSD ≤ 30% for the following analytes:<br>Chloroform, 1,1-DCE, 1,2-DCP, Ethylbenzene, Toluene and Vinyl Chloride.<br>1.) if RRF is applied, then RSD ≤ 15%<br>2.) If 1st order is applied, then r ≥ 0.995 with min 5 pt ICAL<br>3.) If 2nd order is applied, then r ≥ 0.99 with min 6 pt ICAL | Check for outliers. Otherwise, optimize the instrument then repeat initial calibration. | | |
| Initial calibration verification (ICV) | After initial calibration | All analytes within ± 20% of expected value except for the following compounds due to erratic chromatographic behavior: Bromomethane, Chloroethane, Chloromethane, Dichlorodifluoromethane but must be within ± 35% of expected value. | Verify second source standard. Prepare fresh standard and rerun ICV. If that fails, Optimize instrument and repeat ICAL. | | |
| Evaluation of relative retention times (RRT) | Each sample | Within ± 0.06 RRT units | Correct the problem then reanalyze all samples analyzed since the last retention time check | | |
| Continuing Calibration verification (CCV) | Daily, before sample analysis and every 12 hours of analysis time | SPCCs: Min. RF same as ICAL<br>CCC : %Diff ≤ 20% (when using RFs) or drift (when using least squares regression or non-linear calibration) | Correct the problem then repeat initial calibration | | |
| Internal Standard (IS) | All samples | Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL;<br>EICP area within -50% to +100% of ICAL midpoint standard | Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning | | |
| Method blank (MB) | One per preparation batch | No analytes detected > ½ LOQ | Rule out instrument contamination by re-analyzing the MB. If problem persist refer to PSR. In the absence of PSR, report NDs and results >10X of the MB concentration. Otherwise, cure contamination source, re-prep and re-analyze method blank and all associated samples. | | |
| LCS | One LCS per preparation | Within project QC Limits | Re-prep and re-analyze the LCS and all associated samples | | |
| MS/MSD | One MS/MSD per every 20 project samples per matrix | Within project QC Limits | Check if sample was properly spiked. If indicative of matrix interference, discuss in case narrative, otherwise re-prep and re-analyze the sample | | |
| Surrogate | Every Sample, MB, LCS, MS/MSD, DCC | Within project QC Limits | Correct the problem then re-analyze | | |
| **Comments:**<br>This QCP is applicable in the absence of the PSR<br>Report values between LOD and LOQ. Refer to PSR for Flagging Criteria. | | | Reviewed by:<br>Date: | | |

## Appendix 2: DEMONSTRATION OF CAPABILITY for 25 ml

**DEMONSTRATION OF CAPABILITY**
**METHOD: SW 8260**

Unit: µg/L
Sample Amount(ml): 25
Sample Purge(ml): 25

Date Analyzed: 01/31 & 02/01/12
Analyzed by: D. Nguyen

| PARAMETER | RAY133 | RAY134 | RBY004 | RBY005 | True Value | Ave. Conc. | Ave. % Rec. | Std. Dev. | RSD | QC Criteria | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOF5A10L | VOF5A10C | VOF5B01L | VOF5B01C | | | | | | | |
| Acetone | 46.2 | 49.8 | 45.0 | 49.4 | 50 | 47.6 | 95 | 2.378 | 5 | 60 - 130 | Passed |
| Acetonitrile | 83.4 | 86.1 | 88.7 | 83.0 | 100 | 85.3 | 85 | 2.632 | 3 | 50 - 130 | Passed |
| Acrolein | 47.0 | 50.2 | 42.0 | 48.0 | 50 | 46.8 | 94 | 3.502 | 7 | 10 - 160 | Passed |
| Acrylonitrile | 50.0 | 52.1 | 45.0 | 51.3 | 50 | 49.6 | 99 | 3.188 | 6 | 60 - 150 | Passed |
| Benzene | 9.39 | 10.0 | 9.71 | 9.62 | 10 | 9.69 | 97 | 0.255 | 3 | 70 - 130 | Passed |
| Bromobenzene | 9.65 | 10.4 | 9.85 | 10.1 | 10 | 10.0 | 100 | 0.344 | 3 | 70 - 130 | Passed |
| Bromochloromethane | 9.08 | 9.78 | 9.18 | 9.48 | 10 | 9.4 | 94 | 0.315 | 3 | 70 - 130 | Passed |
| Bromodichloromethane | 9.58 | 10.1 | 9.81 | 10.0 | 10 | 9.9 | 99 | 0.239 | 2 | 70 - 130 | Passed |
| Bromoform | 9.70 | 10.3 | 9.00 | 10.0 | 10 | 9.76 | 98 | 0.568 | 6 | 60 - 130 | Passed |
| Bromomethane | 9.49 | 10.2 | 10.6 | 10.3 | 10 | 10.14 | 101 | 0.465 | 5 | 50 - 140 | Passed |
| tert-Butyl alcohol | 51.8 | 54.4 | 42.6 | 48.4 | 50 | 49.3 | 99 | 5.096 | 10 | 50 - 150 | Passed |
| 2-Butanone (MEK) | 49.3 | 51.8 | 42.1 | 50.5 | 50 | 48.4 | 97 | 4.344 | 9 | 70 - 130 | Passed |
| n-Butylbenzene | 10.0 | 10.8 | 11.1 | 10.4 | 10 | 10.6 | 106 | 0.472 | 4 | 70 - 130 | Passed |
| sec-Butylbenzene | 9.94 | 10.8 | 10.8 | 10.5 | 10 | 10.5 | 105 | 0.397 | 4 | 70 - 130 | Passed |
| tert-Butylbenzene | 8.78 | 9.46 | 9.31 | 8.95 | 10 | 9.1 | 91 | 0.315 | 3 | 70 - 130 | Passed |
| Carbon disulfide | 9.24 | 10.2 | 8.45 | 8.74 | 10 | 9.15 | 92 | 0.755 | 8 | 50 - 130 | Passed |
| Carbon tetrachloride | 9.24 | 10.0 | 10.0 | 9.65 | 10 | 9.7 | 97 | 0.343 | 4 | 60 - 130 | Passed |
| Chlorobenzene | 9.08 | 9.68 | 9.39 | 9.22 | 10 | 9.3 | 93 | 0.257 | 3 | 70 - 130 | Passed |
| 2-Chloroethyl vinyl ether | 9.55 | 9.91 | 8.16 | 9.38 | 10 | 9.3 | 93 | 0.760 | 8 | 10 - 160 | Passed |
| Chloroethane | 9.11 | 9.81 | 9.89 | 10.1 | 10 | 9.72 | 97 | 0.414 | 4 | 60 - 130 | Passed |
| Chloroform | 9.02 | 9.65 | 9.54 | 9.39 | 10 | 9.4 | 94 | 0.272 | 3 | 70 - 130 | Passed |
| 1-Chlorohexane | 8.77 | 9.38 | 9.10 | 8.85 | 10 | 9.0 | 90 | 0.278 | 3 | 70 - 130 | Passed |
| Chloromethane | 9.12 | 9.52 | 9.39 | 9.53 | 10 | 9.39 | 94 | 0.191 | 2 | 50 - 130 | Passed |
| 2-Chlorotoluene | 9.86 | 10.7 | 10.1 | 10.7 | 10 | 10.3 | 103 | 0.433 | 4 | 70 - 130 | Passed |
| 4-Chlorotoluene | 9.70 | 10.4 | 11.1 | 9.9 | 10 | 10.3 | 103 | 0.611 | 6 | 70 - 130 | Passed |
| Isopropyl ether (DIPE) | 9.76 | 10.4 | 9.33 | 9.68 | 10 | 9.8 | 98 | 0.435 | 4 | 70 - 130 | Passed |
| Dibromochloromethane | 9.85 | 10.4 | 9.62 | 10.2 | 10 | 10.0 | 100 | 0.346 | 3 | 70 - 130 | Passed |
| 1,2-Dibromo-3-chloropropane | 9.14 | 9.80 | 8.25 | 8.90 | 10 | 9.02 | 90 | 0.641 | 7 | 60 - 130 | Passed |
| 1,2-Dibromoethane | 9.90 | 10.5 | 9.39 | 10.2 | 10 | 10.0 | 100 | 0.487 | 5 | 70 - 130 | Passed |
| Dibromomethane | 9.82 | 10.3 | 8.87 | 9.58 | 10 | 9.6 | 96 | 0.584 | 6 | 70 - 130 | Passed |
| 1,1-Dichloroethane | 9.15 | 9.83 | 9.42 | 9.31 | 10 | 9.4 | 94 | 0.292 | 3 | 70 - 130 | Passed |
| 1,2-Dichloroethane | 9.45 | 10.0 | 9.52 | 9.89 | 10 | 9.7 | 97 | 0.261 | 3 | 70 - 130 | Passed |
| 1,2-Dichlorobenzene | 8.98 | 9.68 | 9.33 | 9.26 | 10 | 9.3 | 93 | 0.290 | 3 | 70 - 130 | Passed |
| 1,3-Dichlorobenzene | 9.61 | 10.4 | 9.92 | 9.88 | 10 | 9.9 | 99 | 0.327 | 3 | 70 - 130 | Passed |
| trans-1,4-Dichloro-2-Butene | 10.6 | 11.5 | 9.58 | 10.8 | 10 | 10.6 | 106 | 0.812 | 8 | 50 - 140 | Passed |
| 1,4-Dichlorobenzene | 9.82 | 10.6 | 10.1 | 10.1 | 10 | 10.2 | 102 | 0.340 | 3 | 70 - 130 | Passed |
| Dichlorodifluoromethane | 9.14 | 10.0 | 9.22 | 9.67 | 10 | 9.50 | 95 | 0.383 | 4 | 50 - 140 | Passed |
| 1,1-Dichloroethene | 9.17 | 9.8 | 9.40 | 9.27 | 10 | 9.4 | 94 | 0.289 | 3 | 60 - 130 | Passed |
| cis-1,2-Dichloroethene | 9.40 | 10.1 | 9.71 | 9.60 | 10 | 9.7 | 97 | 0.285 | 3 | 70 - 130 | Passed |
| trans-1,2-Dichloroethene | 9.27 | 9.83 | 9.34 | 9.21 | 10 | 9.4 | 94 | 0.282 | 3 | 60 - 130 | Passed |
| Dichlorofluoromethane | 8.27 | 9.12 | 9.84 | 9.25 | 10 | 9.12 | 91 | 0.646 | 7 | 70 - 130 | Passed |
| 1,1-Dichloropropene | 9.42 | 10.2 | 9.79 | 9.72 | 10 | 9.8 | 98 | 0.319 | 3 | 70 - 130 | Passed |
| 1,2-Dichloropropane | 9.43 | 10.0 | 9.48 | 9.68 | 10 | 9.6 | 96 | 0.256 | 3 | 70 - 130 | Passed |
| 1,3-Dichloropropane | 9.82 | 10.4 | 9.54 | 10.1 | 10 | 10.0 | 100 | 0.359 | 4 | 70 - 130 | Passed |

## Appendix 2 (cont.): DEMONSTRATION OF CAPABILITY for 25 ml

DEMONSTRATION OF CAPABILITY
METHOD: SW 8260

Unit: µg/L
Sample Amount(ml): 25
Sample Purge(ml): 25

Date Analyzed: 01/31 & 02/01/12
Analyzed by: D. Nguyen

| PARAMETER | RAY133 | RAY134 | RBY004 | RBY005 | True Value | Ave. Conc. | Ave. % Rec. | Std. Dev. | RSD | QC Criteria | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | VOF5A10L | VOF5A10C | VOF5B01L | VOF5B01C | | | | | | | |
| 2,2-Dichloropropane | 9.07 | 10.4 | 10.2 | 9.65 | 10 | 9.8 | 98 | 0.598 | 6 | 60 - 140 | Passed |
| cis-1,3-Dichloropropene | 10.0 | 10.7 | 10.0 | 10.3 | 10 | 10.3 | 103 | 0.339 | 3 | 70 - 130 | Passed |
| trans-1,3-Dichloropropene | 9.30 | 9.75 | 9.06 | 9.42 | 10 | 9.4 | 94 | 0.288 | 3 | 70 - 130 | Passed |
| tert-Butyl ethyl ether (ETB | 11.1 | 11.8 | 10.1 | 10.8 | 10 | 11.0 | 110 | 0.685 | 6 | 70 - 130 | Passed |
| Ethyl Methacrylate | 9.30 | 9.68 | 8.15 | 9.21 | 10 | 9.1 | 91 | 0.656 | 7 | 70 - 130 | Passed |
| Ethylbenzene | 9.47 | 10.1 | 10.0 | 9.68 | 10 | 9.8 | 98 | 0.300 | 3 | 70 - 130 | Passed |
| 2-Hexanone (MBK) | 50.6 | 52.3 | 42.7 | 50.6 | 50 | 49.0 | 98 | 4.298 | 9 | 70 - 140 | Passed |
| Hexachlorobutadiene | 8.21 | 8.92 | 8.99 | 8.08 | 10 | 8.6 | 86 | 0.469 | 5 | 70 - 130 | Passed |
| Iodomethane | 9.16 | 10.0 | 9.31 | 9.21 | 10 | 9.43 | 94 | 0.417 | 4 | 50 - 150 | Passed |
| Isopropylbenzene | 10.4 | 11.2 | 11.0 | 10.8 | 10 | 10.9 | 109 | 0.380 | 3 | 70 - 130 | Passed |
| p-Isopropyltoluene | 10.1 | 11.0 | 11.0 | 10.4 | 10 | 10.6 | 106 | 0.423 | 4 | 70 - 130 | Passed |
| Methylene Chloride | 8.56 | 9.09 | 8.74 | 8.87 | 10 | 8.8 | 88 | 0.225 | 3 | 60 - 130 | Passed |
| 4-Methyl-2-pentanone (MIBK) | 52.9 | 54.7 | 45.5 | 53.6 | 50 | 51.7 | 103 | 4.184 | 8 | 70 - 130 | Passed |
| tert-Butyl methyl ether | 10.1 | 10.7 | 8.99 | 10.1 | 10 | 10.0 | 100 | 0.723 | 7 | 60 - 130 | Passed |
| Naphthalene | 10.3 | 10.7 | 9.41 | 9.88 | 10 | 10.07 | 101 | 0.565 | 6 | 50 - 140 | Passed |
| n-Propylbenzene | 10.6 | 11.4 | 11.2 | 11.1 | 10 | 11.1 | 111 | 0.369 | 3 | 70 - 130 | Passed |
| Styrene | 9.63 | 10.4 | 10.0 | 9.8 | 10 | 10.0 | 100 | 0.311 | 3 | 70 - 130 | Passed |
| tert-Amyl methyl ether (TAME) | 11.3 | 12.0 | 10.2 | 11.1 | 10 | 11.1 | 111 | 0.747 | 7 | 60 - 140 | Passed |
| 1,1,1,2-Tetrachloroethane | 9.32 | 9.91 | 9.59 | 9.54 | 10 | 9.6 | 96 | 0.246 | 3 | 70 - 130 | Passed |
| 1,1,2,2-Tetrachloroethane | 9.92 | 10.6 | 9.52 | 10.5 | 10 | 10.1 | 101 | 0.501 | 5 | 60 - 130 | Passed |
| Tetrachloroethene | 9.08 | 9.77 | 9.50 | 9.01 | 10 | 9.3 | 93 | 0.356 | 4 | 60 - 130 | Passed |
| Toluene | 9.68 | 10.3 | 10.1 | 9.94 | 10 | 10.0 | 100 | 0.262 | 3 | 70 - 130 | Passed |
| 1,1,1-Trichloroethane | 8.83 | 10.0 | 10.2 | 9.52 | 10 | 9.6 | 96 | 0.591 | 6 | 70 - 130 | Passed |
| 1,1,2-Trichloroethane | 9.67 | 10.1 | 9.45 | 10.1 | 10 | 9.8 | 98 | 0.346 | 4 | 70 - 130 | Passed |
| 1,2,3-Trichlorobenzene | 8.77 | 9.14 | 8.46 | 8.40 | 10 | 8.7 | 87 | 0.339 | 4 | 60 - 130 | Passed |
| 1,2,4-Trichlorobenzene | 9.04 | 9.63 | 8.93 | 8.60 | 10 | 9.1 | 91 | 0.432 | 5 | 60 - 140 | Passed |
| Trichloroethene | 9.21 | 9.93 | 9.42 | 9.29 | 10 | 9.5 | 95 | 0.326 | 3 | 70 - 130 | Passed |
| Trichlorofluoromethane | 9.06 | 9.62 | 10.1 | 10.3 | 10 | 9.76 | 98 | 0.544 | 6 | 60 - 140 | Passed |
| 1,2,3-Trichloropropane | 9.93 | 10.5 | 9.45 | 10.6 | 10 | 10.1 | 101 | 0.524 | 5 | 70 - 130 | Passed |
| 1,1,2-Trichloro1,2,2-trifluoroethane | 8.70 | 9.49 | 9.45 | 9.05 | 10 | 9.2 | 92 | 0.376 | 4 | 60 - 150 | Passed |
| 1,2,4-Trimethylbenzene | 9.8 | 10.6 | 10.6 | 10.2 | 10 | 10.3 | 103 | 0.374 | 4 | 70 - 130 | Passed |
| 1,3,5-Trimethylbenzene | 9.9 | 10.7 | 10.5 | 10.2 | 10 | 10.3 | 103 | 0.335 | 3 | 70 - 130 | Passed |
| Vinyl Acetate | 10.9 | 11.0 | 9.68 | 11.1 | 10 | 10.66 | 107 | 0.662 | 6 | 40 - 150 | Passed |
| Vinyl Chloride | 8.26 | 8.56 | 9.02 | 9.01 | 10 | 8.71 | 87 | 0.372 | 4 | 60 - 130 | Passed |
| m-Xylene & p-xylene | 19.2 | 20.6 | 20.4 | 19.6 | 20 | 19.9 | 100 | 0.633 | 3 | 60 - 140 | Passed |
| o-Xylene | 8.80 | 9.41 | 9.18 | 8.93 | 10 | 9.1 | 91 | 0.270 | 3 | 70 - 130 | Passed |
| 1,2-Dichloroethane-d4 | 10.0 | 10.0 | 9.9 | 10.3 | 10 | 10.05 | 101 | 0.200 | 2 | 70 - 130 | Passed |
| Toluene-d8 | 10.3 | 10.3 | 10.4 | 10.3 | 10 | 10.32 | 103 | 0.046 | 0.5 | 70 - 130 | Passed |
| 4-Bromofluorobenzene | 10.6 | 10.6 | 10.5 | 10.9 | 10 | 10.68 | 107 | 0.189 | 2 | 70 - 130 | Passed |
| Dibromofluoromethane | 10.0 | 9.93 | 10.1 | 10.2 | 10 | 10.06 | 101 | 0.106 | 1 | 70 - 130 | Passed |

## Appendix 3: DEMONSTRATION OF CAPABILITY for 5 ml

**DEMONSTRATION OF CAPABILITY**
**METHOD: SW 8260**

Unit: µg/L
Sample Amount(ml): 5
Sample Purge(ml): 5

Date Analyzed: 01/07/13 & 01/08/13
Analyzed by: C. Mendoza

| PARAMETER | RAN044 VSF4A07L | RAN045 VSF4A07C | RAN058 VSF4A08L | RAN059 VSF4A08C | True Value | Ave. Conc. | Ave. % Rec. | Std. Dev. | RSD | QC Criteria | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acetone | 261 | 261 | 275 | 272 | 250 | 267 | 107 | 7.569 | 3 | 60 130 | Passed |
| Acetonitrile | 540 | 546 | 510 | 533 | 500 | 532 | 106 | 15.685 | 3 | 30 160 | Passed |
| Acrolein | 334 | 330 | 337 | 325 | 250 | 331 | 133 | 5.396 | 2 | 30 160 | Passed |
| Acrylonitrile | 269 | 270 | 278 | 271 | 250 | 272 | 109 | 4.119 | 2 | 70 130 | Passed |
| Benzene | 51.0 | 52.3 | 48.2 | 49.6 | 50 | 50.3 | 101 | 1.744 | 3 | 70 130 | Passed |
| Bromobenzene | 46.8 | 48.0 | 45.4 | 46.2 | 50 | 46.6 | 93 | 1.104 | 2 | 70 130 | Passed |
| Bromochloromethane | 51.7 | 52.2 | 50.7 | 51.2 | 50 | 51.5 | 103 | 0.611 | 1 | 70 130 | Passed |
| Bromodichloromethane | 49.5 | 50.8 | 48.4 | 49.2 | 50 | 49.5 | 99 | 1.022 | 2 | 70 130 | Passed |
| Bromoform | 47.8 | 48.6 | 45.6 | 47.5 | 50 | 47.4 | 95 | 1.282 | 3 | 70 130 | Passed |
| Bromomethane | 54.8 | 51.5 | 50.4 | 50.5 | 50 | 51.8 | 104 | 2.076 | 4 | 60 130 | Passed |
| tert-Butyl alcohol | 281 | 286 | 255 | 271 | 250 | 273 | 109 | 13.989 | 5 | 60 140 | Passed |
| 2-Butanone (MEK) | 279 | 278 | 284 | 282 | 250 | 281 | 112 | 3.049 | 1 | 70 130 | Passed |
| n-Butylbenzene | 53.8 | 54.5 | 49.7 | 50.6 | 50 | 52.2 | 104 | 2.387 | 5 | 70 130 | Passed |
| sec-Butylbenzene | 52.0 | 52.5 | 47.9 | 49.4 | 50 | 50.5 | 101 | 2.181 | 4 | 70 130 | Passed |
| tert-Butylbenzene | 52.4 | 52.3 | 48.2 | 49.6 | 50 | 50.6 | 101 | 2.047 | 4 | 70 130 | Passed |
| Carbon disulfide | 48.2 | 46.9 | 44.2 | 46.0 | 50 | 46.4 | 93 | 1.669 | 4 | 60 130 | Passed |
| Carbon tetrachloride | 52.9 | 53.1 | 49.7 | 51.2 | 50 | 51.7 | 103 | 1.588 | 3 | 70 130 | Passed |
| Chlorobenzene | 49.3 | 50.2 | 47.1 | 47.9 | 50 | 48.6 | 97 | 1.402 | 3 | 70 130 | Passed |
| 2-Chloroethyl vinyl ether | 50.1 | 49.7 | 36.4 | 38.4 | 50 | 43.7 | 87 | 7.258 | 17 | 50 150 | Passed |
| Chloroethane | 58.5 | 52.1 | 53.0 | 53.1 | 50 | 54.2 | 108 | 2.944 | 5 | 70 130 | Passed |
| Chloroform | 52.1 | 52.6 | 50.9 | 51.3 | 50 | 51.7 | 103 | 0.749 | 1 | 70 130 | Passed |
| 1-Chlorohexane | 56.0 | 56.6 | 50.6 | 51.8 | 50 | 53.7 | 107 | 2.974 | 6 | 70 130 | Passed |
| Chloromethane | 53.8 | 48.8 | 48.5 | 50.0 | 50 | 50.3 | 101 | 2.456 | 5 | 60 130 | Passed |
| 2-Chlorotoluene | 49.0 | 48.9 | 45.9 | 46.6 | 50 | 47.6 | 95 | 1.619 | 3 | 70 130 | Passed |
| 4-Chlorotoluene | 51.9 | 53.0 | 49.5 | 49.8 | 50 | 51.1 | 102 | 1.675 | 3 | 70 130 | Passed |
| 2-Chloro-1,1,1-trifluoroethane | 54.6 | 53.8 | 51.2 | 54.3 | 50 | 53.5 | 107 | 1.562 | 3 | 30 160 | Passed |
| Chlorotrifluoroethylene | 46.4 | 44.7 | 41.6 | 45.6 | 50 | 44.6 | 89 | 2.093 | 5 | 30 160 | Passed |
| Dibromochloromethane | 48.4 | 49.7 | 47.4 | 47.9 | 50 | 48.4 | 97 | 1.017 | 2 | 70 130 | Passed |
| 1,2-Dibromo-3-chloropropane | 47.1 | 47.9 | 44.3 | 45.6 | 50 | 46.2 | 92 | 1.577 | 3 | 60 130 | Passed |
| 1,2-Dibromoethane | 49.2 | 50.7 | 47.3 | 48.4 | 50 | 48.9 | 98 | 1.452 | 3 | 70 130 | Passed |
| Dibromomethane | 48.1 | 49.6 | 47.1 | 48.3 | 50 | 48.3 | 97 | 1.022 | 2 | 70 130 | Passed |
| 1,1-Dichloroethane | 55.3 | 55.9 | 52.7 | 53.4 | 50 | 54.3 | 109 | 1.554 | 3 | 70 130 | Passed |
| 1,2-Dichloroethane | 49.5 | 50.1 | 48.7 | 49.8 | 50 | 49.5 | 99 | 0.593 | 1 | 70 130 | Passed |
| 1,2-Dichlorobenzene | 47.0 | 47.6 | 45.5 | 45.6 | 50 | 46.4 | 93 | 1.084 | 2 | 70 130 | Passed |
| 1,3-Dichlorobenzene | 48.6 | 49.3 | 45.9 | 46.2 | 50 | 47.5 | 95 | 1.704 | 4 | 70 130 | Passed |
| trans-1,4-Dichloro-2-Butene | 51.0 | 50.7 | 48.7 | 50.0 | 50 | 50.1 | 100 | 1.012 | 2 | 70 130 | Passed |
| 1,4-Dichlorobenzene | 49.0 | 49.7 | 46.6 | 46.7 | 50 | 48.0 | 96 | 1.599 | 3 | 70 130 | Passed |
| Dichlorodifluoromethane | 51.3 | 47.0 | 46.7 | 47.4 | 50 | 48.1 | 96 | 2.151 | 4 | 60 130 | Passed |
| 1,1-Dichloroethene | 58.3 | 58.5 | 54.2 | 55.1 | 50 | 56.5 | 113 | 2.189 | 4 | 70 130 | Passed |
| cis-1,2-Dichloroethene | 53.3 | 53.5 | 50.9 | 51.2 | 50 | 52.2 | 104 | 1.358 | 3 | 70 130 | Passed |
| trans-1,2-Dichloroethene | 55.7 | 55.7 | 51.9 | 52.8 | 50 | 54.0 | 108 | 1.960 | 4 | 70 130 | Passed |
| Dichlorofluoromethane | 56.9 | 57.0 | 54.7 | 55.1 | 50 | 55.9 | 112 | 1.234 | 2 | 70 130 | Passed |
| 1,1-Dichloropropene | 53.1 | 53.5 | 48.5 | 49.7 | 50 | 51.2 | 102 | 2.483 | 5 | 70 130 | Passed |
| 1,2-Dichloropropane | 51.0 | 52.2 | 48.8 | 50.4 | 50 | 50.6 | 101 | 1.413 | 3 | 70 130 | Passed |

## Appendix 3 (cont.): DEMONSTRATION OF CAPABILITY for 5 ml

**DEMONSTRATION OF CAPABILITY**
**METHOD: SW 8260**

Unit: µg/L
Sample Amount(ml): 5
Sample Purge(ml): 5

Date Analyzed: 01/07/13 & 01/08/13
Analyzed by: C. Mendoza

| PARAMETER | RAN044 VSF4A07L | RAN045 VSF4A07C | RAN058 VSF4A08L | RAN059 VSF4A08C | True Value | Ave. Conc. | Ave. % Rec. | Std. Dev. | RSD | QC Criteria | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,3-Dichloropropane | 49.4 | 50.8 | 47.8 | 49.3 | 50 | 49.3 | 99 | 1.251 | 3 | 70 130 | Passed |
| 2,2-Dichloropropane | 57.2 | 57.1 | 54.0 | 54.5 | 50 | 55.7 | 111 | 1.706 | 3 | 70 140 | Passed |
| cis-1,3-Dichloropropene | 51.3 | 52.8 | 49.1 | 50.4 | 50 | 50.9 | 102 | 1.548 | 3 | 70 130 | Passed |
| trans-1,3-Dichloropropene | 51.2 | 52.4 | 49.6 | 50.5 | 50 | 50.9 | 102 | 1.191 | 2 | 70 130 | Passed |
| tert-Butyl ethyl ether (ETB | 56.5 | 57.2 | 53.8 | 55.1 | 50 | 55.7 | 111 | 1.523 | 3 | 70 130 | Passed |
| Ethyl Methacrylate | 52.9 | 53.6 | 49.9 | 51.0 | 50 | 52 | 104 | 1.679 | 3 | 30 160 | Passed |
| Ethylbenzene | 51.6 | 52.9 | 48.5 | 49.6 | 50 | 50.7 | 101 | 1.946 | 4 | 70 130 | Passed |
| 2-Hexanone (MBK) | 275 | 275 | 284 | 277 | 250 | 278.0 | 111 | 4.403 | 2 | 70 130 | Passed |
| Hexachlorobutadiene | 47.3 | 49.2 | 45.7 | 45.1 | 50 | 46.8 | 94 | 1.814 | 4 | 70 130 | Passed |
| Iodomethane | 40.7 | 39.4 | 36.9 | 39.0 | 50 | 39.0 | 78 | 1.595 | 4 | 60 130 | Passed |
| Isopropyl ether (DIPE) | 57.2 | 58.2 | 54.5 | 56.0 | 50 | 56.5 | 113 | 1.595 | 3 | 70 130 | Passed |
| Isopropylbenzene | 52.1 | 52.3 | 48.0 | 49.5 | 50 | 50.5 | 101 | 2.093 | 4 | 70 130 | Passed |
| p-Isopropyltoluene | 52.4 | 53.0 | 48.7 | 49.2 | 50 | 51 | 102 | 2.199 | 4 | 70 130 | Passed |
| Methyl acetate | 52.9 | 52.1 | 54.2 | 55.6 | 50 | 53.7 | 107 | 1.525 | 3 | 30 160 | Passed |
| Methylene Chloride | 50.4 | 51.6 | 49.6 | 50.2 | 50 | 50.5 | 101 | 0.856 | 2 | 70 130 | Passed |
| 4-Methyl-2-pentanone (MIBK) | 278 | 279 | 283 | 276 | 250 | 278.7 | 111 | 2.713 | 1 | 70 130 | Passed |
| tert-Butyl methyl ether | 54.7 | 55.3 | 52.6 | 53.8 | 50 | 54.1 | 108 | 1.140 | 2 | 70 130 | Passed |
| Naphthalene | 43.7 | 44.3 | 40.8 | 39.8 | 50 | 42.2 | 84 | 2.180 | 5 | 60 140 | Passed |
| n-Propylbenzene | 51.9 | 52.3 | 47.9 | 49.3 | 50 | 50.4 | 101 | 2.098 | 4 | 70 130 | Passed |
| Styrene | 51.6 | 53.2 | 49.6 | 50.4 | 50 | 51.2 | 102 | 1.553 | 3 | 70 130 | Passed |
| tert-Amyl methyl ether (TAME) | 55.3 | 56.0 | 53.3 | 54.2 | 50 | 54.7 | 109 | 1.212 | 2 | 70 130 | Passed |
| 1,1,1,2-Tetrachloroethane | 48.7 | 50.4 | 47.5 | 48.2 | 50 | 48.7 | 97 | 1.250 | 3 | 30 160 | Passed |
| 1,1,2,2-Tetrachloroethane | 49.1 | 49.2 | 45.7 | 47.4 | 50 | 47.9 | 96 | 1.652 | 3 | 30 160 | Passed |
| Tetrachloroethene | 50.6 | 51.2 | 47.0 | 48.0 | 50 | 49.2 | 98 | 2.014 | 4 | 70 130 | Passed |
| Toluene | 51.3 | 52.4 | 48.6 | 49.7 | 50 | 50.5 | 101 | 1.718 | 3 | 70 130 | Passed |
| 1,1,1-Trichloroethane | 55.0 | 55.2 | 52.6 | 52.9 | 50 | 53.9 | 108 | 1.405 | 3 | 30 160 | Passed |
| 1,1,2-Trichloroethane | 48.3 | 50.1 | 46.3 | 48.0 | 50 | 48.2 | 96 | 1.553 | 3 | 30 160 | Passed |
| 1,2,3-Trichlorobenzene | 48.0 | 49.6 | 46.0 | 44.8 | 50 | 47.1 | 94 | 2.140 | 5 | 70 130 | Passed |
| 1,2,4-Trichlorobenzene | 50.8 | 51.5 | 46.7 | 45.5 | 50 | 48.6 | 97 | 2.965 | 6 | 70 130 | Passed |
| Trichloroethene | 50.7 | 51.5 | 47.7 | 48.3 | 50 | 49.5 | 99 | 1.834 | 4 | 70 130 | Passed |
| Trichlorofluoromethane | 61.7 | 55.1 | 54.8 | 55.3 | 50 | 56.7 | 113 | 3.322 | 6 | 70 140 | Passed |
| 1,2,3-Trichloropropane | 47.8 | 47.7 | 45.6 | 47.4 | 50 | 47.1 | 94 | 1.036 | 2 | 70 130 | Passed |
| 1,1,2-Trichloro1,2,2-trifluoroethane | 57.4 | 56.8 | 52.9 | 53.6 | 50 | 55.2 | 110 | 2.264 | 4 | 70 - 130 | Passed |
| 1,2,4-Trimethylbenzene | 51.5 | 52.0 | 48.2 | 49.2 | 50 | 50.2 | 100 | 1.810 | 4 | 70 130 | Passed |
| 1,3,5-Trimethylbenzene | 51.7 | 52.3 | 48.0 | 49.2 | 50 | 50.3 | 101 | 2.016 | 4 | 70 130 | Passed |
| Vinyl Acetate | 65.3 | 59.2 | 58.1 | 58.5 | 50 | 60.3 | 121 | 3.366 | 6 | 50 140 | Passed |
| Vinyl Chloride | 59.8 | 52.9 | 54.5 | 54.5 | 50 | 55.4 | 111 | 3.040 | 5 | 70 140 | Passed |
| m-Xylene & p-xylene | 103 | 105 | 97.0 | 98.7 | 100 | 101.0 | 101 | 3.765 | 4 | 70 130 | Passed |
| o-Xylene | 52.3 | 53.5 | 49.4 | 50.7 | 50 | 51.5 | 103 | 1.786 | 3 | 70 130 | Passed |
| Allyl Chloride | 57.3 | 58.3 | 54.1 | 55.5 | 50 | 56.3 | 113 | 1.869 | 3 | 30 160 | Passed |

## Appendix 4: DEMONSTRATION OF CAPABILITY for 5 g

**DEMONSTRATION OF CAPABILITY**
**METHOD: SW 8260**

Unit: µg/Kg
Sample Amount(g): 5
Sample Purge(ml): 5

Date Analyzed: 03/20 & 03/21/12
Analyzed by: C. Mendoza

| PARAMETER | RCP061 VO02C04L | RCP062 VO02C04C | RCP086 VO02C06L | RCP087 VO02C06C | True Value | Ave. Conc. | Ave. % Rec. | Std. Dev. | RSD | QC Criteria | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acetone | 259 | 264 | 288 | 281 | 250 | 273 | 109 | 14.006 | 5 | 40 - 140 | Passed |
| Acetonitrile | 480 | 506 | 528 | 546 | 500 | 515 | 103 | 28.361 | 6 | 50 - 150 | Passed |
| Acrylonitrile | 240 | 245 | 275 | 268 | 250 | 257 | 103 | 17.133 | 7 | 10 - 160 | Passed |
| Benzene | 50.1 | 49.3 | 49.9 | 49.6 | 50 | 49.7 | 99 | 0.364 | 1 | 70 - 130 | Passed |
| Bromobenzene | 49.3 | 47.4 | 48.9 | 49.1 | 50 | 48.7 | 97 | 0.838 | 2 | 70 - 130 | Passed |
| Bromochloromethane | 52.6 | 53.3 | 55.0 | 56.1 | 50 | 54.2 | 108 | 1.592 | 3 | 70 - 130 | Passed |
| Bromodichloromethane | 50.1 | 49.8 | 51.8 | 52.2 | 50 | 51.0 | 102 | 1.207 | 2 | 70 - 130 | Passed |
| Bromoform | 49.2 | 49.2 | 50.3 | 49.6 | 50 | 49.6 | 99 | 0.501 | 1 | 70 - 130 | Passed |
| Bromomethane | 46.4 | 46.6 | 45.4 | 46.7 | 50 | 46.3 | 93 | 0.585 | 1 | 60 - 130 | Passed |
| tert-Butyl alcohol | 254 | 266 | 274 | 285 | 250 | 270 | 108 | 13.169 | 5 | 40 - 150 | Passed |
| 2-Butanone (MEK) | 246 | 251 | 271 | 260 | 250 | 257 | 103 | 11.327 | 4 | 60 - 140 | Passed |
| n-Butylbenzene | 53.2 | 51.3 | 52.5 | 53.9 | 50 | 52.7 | 105 | 1.105 | 2 | 70 - 130 | Passed |
| sec-Butylbenzene | 52.1 | 51.3 | 51.9 | 52.3 | 50 | 51.9 | 104 | 0.441 | 1 | 70 - 130 | Passed |
| tert-Butylbenzene | 48.4 | 48.0 | 48.7 | 49.4 | 50 | 48.6 | 97 | 0.572 | 1 | 70 - 130 | Passed |
| Carbon disulfide | 48.1 | 49.8 | 52.1 | 42.5 | 50 | 48.1 | 96 | 4.087 | 8 | 60 - 130 | Passed |
| Carbon tetrachloride | 52.5 | 51.2 | 52.2 | 51.2 | 50 | 51.8 | 104 | 0.666 | 1 | 70 - 130 | Passed |
| Chlorobenzene | 51.3 | 51.3 | 49.8 | 51.2 | 50 | 50.9 | 102 | 0.728 | 1 | 70 - 130 | Passed |
| 2-Chloroethyl vinyl ether | 57.8 | 57.8 | 51.8 | 51.2 | 50 | 54.6 | 109 | 3.681 | 7 | 50 - 140 | Passed |
| Chloroethane | 55.0 | 56.1 | 52.3 | 53.3 | 50 | 54.2 | 108 | 1.696 | 3 | 70 - 140 | Passed |
| Chloroform | 55.4 | 55.5 | 53.0 | 54.3 | 50 | 54.5 | 109 | 1.171 | 2 | 70 - 130 | Passed |
| 1-Chlorohexane | 53.3 | 51.9 | 51.8 | 52.2 | 50 | 52.3 | 105 | 0.678 | 1 | 70 - 130 | Passed |
| Chloromethane | 49.5 | 51.4 | 50.8 | 52.4 | 50 | 51.0 | 102 | 1.201 | 2 | 60 - 130 | Passed |
| 2-Chlorotoluene | 44.7 | 48.4 | 45.5 | 48.0 | 50 | 46.6 | 93 | 1.814 | 4 | 70 - 130 | Passed |
| 4-Chlorotoluene | 57.2 | 51.0 | 56.4 | 52.5 | 50 | 54.3 | 109 | 3.031 | 6 | 60 - 130 | Passed |
| Dibromochloromethane | 49.5 | 49.7 | 51.1 | 52.9 | 50 | 50.8 | 102 | 1.574 | 3 | 70 - 130 | Passed |
| 1,2-Dibromo-3-chloropropane | 44.9 | 46.0 | 47.8 | 48.2 | 50 | 46.7 | 93 | 1.570 | 3 | 60 - 130 | Passed |
| 1,2-Dibromoethane | 47.2 | 48.1 | 50.3 | 50.4 | 50 | 49.0 | 98 | 1.600 | 3 | 70 - 130 | Passed |
| Dibromomethane | 48.8 | 48.5 | 49.8 | 50.6 | 50 | 49.4 | 99 | 0.957 | 2 | 70 - 130 | Passed |
| 1,1-Dichloroethane | 55.4 | 55.2 | 54.5 | 55.8 | 50 | 55.2 | 110 | 0.518 | 1 | 70 - 130 | Passed |
| 1,2-Dichloroethane | 51.3 | 50.9 | 51.7 | 51.1 | 50 | 51.3 | 103 | 0.310 | 1 | 70 - 130 | Passed |
| 1,2-Dichlorobenzene | 50.3 | 50.3 | 49.0 | 50.0 | 50 | 49.9 | 100 | 0.602 | 1 | 70 - 130 | Passed |
| 1,3-Dichlorobenzene | 50.6 | 50.0 | 50.0 | 50.8 | 50 | 50.3 | 101 | 0.429 | 1 | 70 - 130 | Passed |
| trans-1,4-Dichloro-2-Butene | 48.8 | 47.7 | 53.8 | 52.2 | 50 | 50.6 | 101 | 2.848 | 6 | 60 - 140 | Passed |
| 1,4-Dichlorobenzene | 51.7 | 51.0 | 49.8 | 50.8 | 50 | 50.8 | 102 | 0.775 | 2 | 70 - 130 | Passed |
| Dichlorodifluoromethane | 66.9 | 67.2 | 58.9 | 59.2 | 50 | 63.1 | 126 | 4.620 | 7 | 60 - 130 | Passed |
| 1,1-Dichloroethene | 51.9 | 53.0 | 52.1 | 54.3 | 50 | 52.8 | 106 | 1.104 | 2 | 60 - 130 | Passed |
| cis-1,2-Dichloroethene | 49.5 | 49.2 | 53.0 | 54.8 | 50 | 51.6 | 103 | 2.725 | 5 | 70 - 130 | Passed |
| trans-1,2-Dichloroethene | 53.2 | 52.2 | 54.2 | 55.1 | 50 | 53.7 | 107 | 1.267 | 2 | 70 - 130 | Passed |
| Dichlorofluoromethane | 49.3 | 51.4 | 53.2 | 56.7 | 50 | 52.6 | 105 | 3.134 | 6 | 70 - 130 | Passed |
| 1,1-Dichloropropene | 51.5 | 49.7 | 50.8 | 50.5 | 50 | 50.6 | 101 | 0.753 | 1 | 70 - 130 | Passed |
| 1,2-Dichloropropane | 50.5 | 49.7 | 52.0 | 51.8 | 50 | 51.0 | 102 | 1.108 | 2 | 70 - 130 | Passed |
| 1,3-Dichloropropane | 47.6 | 47.9 | 50.9 | 51.5 | 50 | 49.5 | 99 | 2.010 | 4 | 70 - 130 | Passed |
| 2,2-Dichloropropane | 56.3 | 55.0 | 54.4 | 55.9 | 50 | 55.4 | 111 | 0.857 | 2 | 60 - 140 | Passed |
| cis-1,3-Dichloropropene | 51.7 | 51.3 | 52.3 | 52.4 | 50 | 52.0 | 104 | 0.517 | 1 | 70 - 130 | Passed |

## Appendix 4 (cont.): DEMONSTRATION OF CAPABILITY for 5 g

**DEMONSTRATION OF CAPABILITY**
**METHOD: SW 8260**

Unit: µg/Kg
Sample Amount(g): 5
Sample Purge(ml): 5

Date Analyzed: 03/20 & 03/21/12
Analyzed by: C. Mendoza

| PARAMETER | RCP061 | RCP062 | RCP086 | RCP087 | True Value | Ave. Conc. | Ave. % Rec. | Std. Dev. | RSD | QC Criteria | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | VO02C04L | VO02C04C | VO02C06L | VO02C06C | | | | | | | |
| trans-1,3-Dichloropropene | 52.6 | 52.3 | 53.1 | 53.7 | 50 | 52.9 | 106 | 0.623 | 1 | 70 - 130 | Passed |
| 1,4-Dioxane | 878 | 878 | 947 | 958 | 1000 | 915 | 92 | 43.314 | 5 | 50 - 150 | Passed |
| tert-Butyl ethyl ether (ETBE) | 54.0 | 53.9 | 54.2 | 55.2 | 50 | 54.3 | 109 | 0.617 | 1 | 70 - 130 | Passed |
| Ethyl Methacrylate | 49.5 | 49.8 | 51.2 | 51.4 | 50 | 50.5 | 101 | 0.964 | 2 | 70 - 130 | Passed |
| Ethylbenzene | 50.5 | 50.8 | 50.7 | 51.3 | 50 | 50.8 | 102 | 0.355 | 1 | 70 - 130 | Passed |
| 2-Hexanone (MBK) | 241 | 247 | 270 | 256 | 250 | 253 | 101 | 12.291 | 5 | 20 - 160 | Passed |
| Hexachlorobutadiene | 52.6 | 48.4 | 49.6 | 49.2 | 50 | 49.9 | 100 | 1.873 | 4 | 70 - 130 | Passed |
| Iodomethane | 61.3 | 61.7 | 50.7 | 52.5 | 50 | 56.6 | 113 | 5.760 | 10 | 60 - 140 | Passed |
| Isopropyl ether (DIPE) | 53.2 | 53.2 | 54.7 | 55.5 | 50 | 54.2 | 108 | 1.156 | 2 | 70 - 130 | Passed |
| Isopropylbenzene | 55.9 | 53.8 | 51.7 | 50.4 | 50 | 52.9 | 106 | 2.417 | 5 | 70 - 130 | Passed |
| p-Isopropyltoluene | 53.6 | 52.7 | 51.5 | 51.5 | 50 | 52.3 | 105 | 1.040 | 2 | 70 - 130 | Passed |
| Methylene Chloride | 48.6 | 49.4 | 49.9 | 51.6 | 50 | 49.9 | 100 | 1.276 | 3 | 70 - 130 | Passed |
| 4-Methyl-2-pentanone (MIBK) | 243 | 249 | 266 | 253 | 250 | 253 | 101 | 9.792 | 4 | 50 - 150 | Passed |
| tert-Butyl methyl ether | 51.2 | 51.8 | 52.3 | 53.4 | 50 | 52.2 | 104 | 0.957 | 2 | 70 - 130 | Passed |
| Naphthalene | 49.7 | 47.2 | 48.9 | 48.7 | 50 | 48.6 | 97 | 1.018 | 2 | 60 - 140 | Passed |
| n-Propylbenzene | 50.2 | 48.4 | 51.1 | 49.9 | 50 | 49.9 | 100 | 1.136 | 2 | 70 - 130 | Passed |
| Styrene | 52.6 | 53.1 | 51.7 | 53.0 | 50 | 52.6 | 105 | 0.637 | 1 | 70 - 130 | Passed |
| tert-Amyl methyl ether (TAME) | 51.9 | 52.9 | 52.4 | 53.9 | 50 | 52.8 | 106 | 0.850 | 2 | 70 - 130 | Passed |
| 1,1,1,2-Tetrachloroethane | 50.7 | 51.8 | 50.8 | 52.0 | 50 | 51.3 | 103 | 0.670 | 1 | 70 - 130 | Passed |
| 1,1,2,2-Tetrachloroethane | 48.3 | 48.6 | 50.5 | 49.7 | 50 | 49.3 | 99 | 1.013 | 2 | 70 - 130 | Passed |
| Tetrachloroethene | 52.5 | 50.5 | 50.0 | 50.2 | 50 | 50.8 | 102 | 1.184 | 2 | 70 - 130 | Passed |
| Toluene | 49.9 | 49.3 | 50.1 | 50.1 | 50 | 49.9 | 100 | 0.359 | 1 | 70 - 130 | Passed |
| 1,1,1-Trichloroethane | 55.4 | 55.0 | 53.7 | 54.8 | 50 | 54.7 | 109 | 0.756 | 1 | 70 - 130 | Passed |
| 1,1,2-Trichloroethane | 49.6 | 49.4 | 50.3 | 51.7 | 50 | 50.2 | 100 | 1.049 | 2 | 70 - 130 | Passed |
| 1,2,3-Trichlorobenzene | 52.9 | 49.1 | 50.9 | 50.8 | 50 | 50.9 | 102 | 1.545 | 3 | 70 - 130 | Passed |
| 1,2,4-Trichlorobenzene | 56.6 | 52.9 | 52.3 | 54.2 | 50 | 54.0 | 108 | 1.911 | 4 | 70 - 140 | Passed |
| Trichloroethene | 51.4 | 50.6 | 49.6 | 49.4 | 50 | 50.3 | 101 | 0.955 | 2 | 70 - 130 | Passed |
| Trichlorofluoromethane | 63.3 | 61.5 | 57.5 | 55.8 | 50 | 59.6 | 119 | 3.486 | 6 | 70 - 140 | Passed |
| 1,2,3-Trichloropropane | 45.2 | 45.3 | 48.9 | 48.3 | 50 | 46.9 | 94 | 1.942 | 4 | 70 - 130 | Passed |
| 1,1,2-Trichloro1,2,2-trifluoroethane | 57.2 | 58.5 | 50.7 | 54.4 | 50 | 55.2 | 110 | 3.450 | 6 | 70 - 140 | Passed |
| 1,2,4-Trimethylbenzene | 52.6 | 51.3 | 51.3 | 51.4 | 50 | 51.7 | 103 | 0.647 | 1 | 70 - 130 | Passed |
| 1,3,5-Trimethylbenzene | 50.7 | 49.9 | 51.0 | 51.1 | 50 | 50.7 | 101 | 0.516 | 1 | 70 - 130 | Passed |
| Vinyl Acetate | 50.9 | 47.8 | 59.8 | 57.1 | 50 | 53.9 | 108 | 5.524 | 10 | 20 - 160 | Passed |
| Vinyl Chloride | 55.2 | 57.3 | 51.7 | 52.9 | 50 | 54.3 | 109 | 2.495 | 5 | 60 - 140 | Passed |
| m-Xylene & p-xylene | 102 | 101 | 101 | 104 | 100 | 102.0 | 102 | 1.343 | 1 | 70 - 130 | Passed |
| o-Xylene | 49.9 | 50.3 | 51.3 | 52.6 | 50 | 51.0 | 102 | 1.217 | 2 | 70 - 130 | Passed |

**8260FS:** **SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

PRESERVATION LOG FOR VOLATILES

VP.xls

| PrepBatchID | Lab Sample ID | W1 (g) | DateTime | Wf (g) | DateTime | ExpWs(g) | Ws(g) | PrepFactor | Comments |
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☐ EMAX-5035 Rev. ☐ Balance Calibration Check performed prior to use Surrogate ID: Prepared By:

☐ Encore+$NaHSO_4 \cdot H_2O$ ☐ BalanceID 25451062 BlankSoil Lot#: Standard Added By:

☐ Frozen Sample ☐ BalanceID 25650797 NaHSO4H2O: Witnessed By:

☐ Pre-weighed vial Expected Ws(g): 5 Extract Rcvd By:

☐ Volumetric dispenser was checked with 5-ml volumetric flask Sample Location:

W1=Weight of Vial + Stirrer+NaHSO4•H2O+Solvent Wf=W1 + Sample

**8260FA:** **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

Page 1

# ANALYSIS LOG FOR VOLATILES

SOP ☐ EMAX-8260 Rev.No. __ ☐ EMAX-624 Rev.No. __ ☐ EMAX-8260SIM Rev.No. __ ☐ EMAX-TCPSIM Rev.No. __ ☐ EMAX-M8260SIM Rev.No. __ ☐ EMAX-8260C Rev. No. __

Start Date: ☐ 5-mL Purge ☐ 10-mL Purge ☐ 25-mL Purge

Book # A06 -053

BATCH _____

| Sample Prep ID | Data File Name | Lab Sample ID | Sample Amount | DF | Matrix W pH < 2 | Matrix W $Cl_2$ < 5ppm | Matrix S | Notes |
|---|---|---|---|---|---|---|---|---|
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| Instrument No. | 06 |
|---|---|
| INITIAL CALIBRATION REFERENCE | |
| DATE | |
| ICAL ID | |

STANDARDS

| NAME | ID | Amount (µl) | Conc. (mg/L) |
|---|---|---|---|
| DCC | | | |
| DCC | | | |
| DCC | | | |
| DCC | | | |
| BFB | | | |
| IS/SURR. | | | |
| ICV/LCS | | | |
| ICV/LCS | | | |
| ICV/LCS | | | |
| ICV/LCS | | | |
| Data File Folder | | | |
| | LOT # | | |
| pH strip | | | |
| Chlorine strip | | | |
| Methanol | | | |
| $NaHSO_4$ | | | |
| Reagent Water | | | |
| Sand | | | |

| Electronic Data Archival Location | Date |
|---|---|
| HPCHEM_VOA/TO06 | |

Comments: _____

☐ Refer to sample weight log

Analyzed By: _____

Date Disposed: _____ Disposed By: _____

**8260FM: INSTRUMENT MAINTENANCE LOG**

EMAX LABORATORIES, INC.

Page 1

## INSTRUMENT MAINTENANCE LOG

Instrument No: 05 Month: Year: 201_ Book # : MD3-005

| DATE | | | | | | |
|---|---|---|---|---|---|---|
| Bake Trap (210°C-260°C) | | | | | | |
| Column Head Pressure (2-60 psi) | | | | | | |
| Injector Port Temperature (160°C-220°C) | | | | | | |
| Interface Temperature (250°C-280°C) | | | | | | |
| Verify Computer Date and Time | | | | | | |
| Check Gas Pressure (Daily) | | | | | | |
| Check IS/Surrogate auto injection vial as appropriate (Daily) | | | | | | |
| Check the foreline pump oil level (Weekly) | | | | | | |
| AutoTune the MSD (As needed) | | | | | | |
| Analyst's initial | | | | | | |
| **Trouble Shooting** | | | | | | |
| Problem(s) Encountered | | | | | | |
| Return-to-Control (Analyst Initial) | | | | | | |

| Code | Problems Encountered | Code | Corrrective Action |
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SOP REVIEW FORM

| EMAX-M8270SIM | Rev. 2 | 1,4- DIOXANE BY GC/MS-MODIFIED METHOD 8270SIM |
|---|---|---|
| SOP No. | Revision Number | Title |

Document the review process and comment. Check the "NA" box if it is not applicable to the SOP, check the "Yes" box if you have fully understood the section, check "No" if you have any questions or if there are discrepancies with the current practice. Discuss the issue with the mentor/supervisor. If you need more space use the allocated space below or attach additional page.

| SECTION | Yes | No | NA | COMMENTS |
|---|---|---|---|---|
| Scope & Application | ✓ | | | |
| Summary of Method | ✓ | | | |
| Detection Limits | ✓ | | | |
| Dynamic Range | ✓ | | | |
| Sample Holding Time & Preservation | ✓ | | | |
| Associated SOPs | ✓ | | | |
| Safety | ✓ | | | I have read all MSDS of chemicals listed in this SOP. |
| Instruments, Chemicals & Reagents | ✓ | | | |
| Standards | ✓ | | | |
| Procedures | ✓ | | | |
| - Sample Preparation | ✓ | | | |
| - Instrument Parameters | ✓ | | | |
| - Calibration | ✓ | | | |
| - Analysis | ✓ | | | |
| - Calculations | ✓ | | | |
| - Data Reduction | ✓ | | | |
| - Report Generation | ✓ | | | |
| - Data Review | ✓ | | | |
| - Preventive Maintenance | ✓ | | | |
| Quality Control | ✓ | | | |
| Corrective Action | ✓ | | | |
| Pollution Prevention | ✓ | | | |
| Waste Management | ✓ | | | |
| Supplementary Notes | ✓ | | | |
| References | ✓ | | | |
| Appendices | ✓ | | | |

**This is to acknowledge that I have read, understood and agree to perform the procedures set forth in this SOP. Print your name & affix your signature.**

Reviewed By KHOA VAN VU Khoa Van Vu Date: 6/8/18

STANDARD OPERATING PROCEDURES

**1,4-DIOXANE BY GC/MS SIM**
**MODIFIED METHOD 8270SIM**

| | | | | | |
|---|---|---|---|---|---|
| SOP No.: | EMAX-M8270SIM | | Revision No. 2 | Date: | 31-Oct-11 |
| Prepared By: | Souzan Greas | Souzan Greas | | Date: | 10-27-11 |
| Approved By: | Kenette Pimentel<br>QA Manager | | | Date: | 10.27.11 |
| Approved By: | Caspar Pang<br>Laboratory Director | | | Date: | 10-27-11 |

**Control Number:** **M8270SIM-02-**

## 1.0 SCOPE AND APPLICATION

1.1. This method is used to determine the trace levels of 1,4-Dioxane extracted from many types of solid waste matrices, soil and water samples. Analytes that are listed in Table 6 were determined when this SOP was established. Additional analytes may be added upon completion of similar validation as the analytes that are listed in Table 6. The quadruple MS was operated in Selected Ion Monitoring (SIM) mode to achieve the required sensitivity of the analytes. This SOP is an adaptation of method SW846 8270D. Since 8270D is an update and enhancement of 8270C, this SOP is also applicable to 8270C.

## 2.0 SUMMARY OF METHOD

2.1. Samples are extracted with methylene chloride. Extracts are concentrated and appropriate clean-up procedure is applied if necessary.

2.2. Internal standards are added to an aliquot of the final extract and are qualitatively and quantitatively analyzed by gas chromatography equipped with mass spectrometry (GC/MS).

2.3. **Interference**

2.3.1. Solvents, reagents, glassware, and other sample processing devices are all possible sources of artifacts and/or interferences to sample analysis. Hence, quality control of chemicals and proper decontamination of re-usable glassware and proofing the analytical instrument to be free from contamination shall be observed.

2.3.2. Raw GC/MS data from all blanks, samples and spikes must be evaluated for interference. Determine source of interference in the preparation and/or cleanup of the samples and perform corrective action to eliminate the problem.

2.3.3. Contamination by carry-over can occur whenever high-concentration and low-concentration samples are sequentially analyzed. To reduce carry-over, rinse the sample syringe with solvent between sample injections. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross-contamination.

2.3.4. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

## 3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Table 6 for established limits.

## 4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point. All samples analyzed above this concentration are considered "over-range" and shall require dilution for proper quantitation.

4.2. Likewise, the lowest quantifiable concentration of diluted samples is equal to the lowest calibration point. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required for proper quantitation.

4.3. The dynamic range established for this method are:

| Water (µg/L) | Soil (µg/kg) |
|---|---|
| 0.2 - 100 µg/L | 13 - 6700 µg/kg |

## 5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Sample Preservation**

5.1.1. Store water and soil samples at ≤ 6°C away from light without freezing.

5.1.2. Store all extracts at ≤ 6°C without freezing.

5.2. **Holding Time**

5.2.1. Extract water samples within 7 days from sampling date.

5.2.2. Extract soil samples within 14 days from sampling date.

5.2.3. Analyze all extracts within 40 days from extraction completion date.

## 6.0 ASSOCIATED SOPs

6.1. EMAX-3510 Extraction of Organic Compounds by Separatory Funnel

6.2. EMAX-3520 Extraction of Organic Compounds by Continuous Liquid/Liquid Extraction

6.3. EMAX-3540 Soxhlet Extraction

6.4. EMAX-3550 Extraction of Organic Compounds from Solid Samples by Pulse Sonication

6.5. EMAX-3580 Waste Dilution

6.6. EMAX-3640 Clean Up, GPC

6.7. EMAX-DM01 Data Flow and Review

6.8. EMAX-QA05 Training

6.9. EMAX-QA04 Detection Limit Study

6.10. EMAX-QA08 Corrective Action

6.11. EMAX-QC01 Quality Control for Chemicals

6.12. EMAX-QC02 Analytical Standard Preparation

6.13. EMAX-QC07 Glassware Cleaning

6.14. EMAX-SM01 Sample Management

6.15. EMAX-SM03 Waste Disposal

6.16. EMAX-SM04 Analytical and QC Sample Labeling

## 7.0 SAFETY

7.1. Read all MSDS for all chemicals listed in this SOP.

7.2. Treat all reagents, standards, and samples as potential hazards. Observe the standard laboratory safety procedures. Wear protective gear, i.e., lab coat, safety glasses, gloves, at all times when performing this procedure. Perform all sample and standard handling in the fume hood.

7.3. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

## 8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

| | |
|---|---|
| Gas Chromatography | Agilent Technologies 7890A with split/splitless injection, Shimadzu GC-17A, or equivalent |
| Mass Spectrometer | Agilent Technologies 5975C MSD or Shimadzu GCMS – GP 5000 capable of scanning from 1.6 to 1050 amu every 1 second using 70 volts electrode energy in the electron impact ionization mode or equivalent |
| GC/MS Interface | Capillary-direct into the mass spectrometer source or equivalent |
| Chromatographic Column | ZB-5MS (20m x 0.18 mm x 0.32 µm) or equivalent |
| Data System | MS-ChemStation with Enviroquant software or equivalent |
| GC Autosampler | Agilent Technologies 7683B series injector or Shimadzu AOC-20i capable of direct injection of 1 µl and 10 µl of extract. |
| Gases | Ultra high purity helium |
| Syringes | 10 µl, 25 µl, 50 µl, 100 µl, 250 µl, 500 µl and 1000 µl syringe Hamilton 202N or equivalent |
| Vials | Autosampler vials with teflon lined septa |

8.2. **Chemicals and Reagents**

| | |
|---|---|
| Solvents | Methylene chloride pesticides grade, high purity methanol |
| Reagents | $Na_2SO_4$ reagent grade |

## 9.0 STANDARDS

### 9.1. Standard Preparation

9.1.1. Follow procedures for all standard preparations and labeling as described in EMAX-QC02 and EMAX-SM04, respectively.

9.1.2. Other concentration levels may be prepared to meet the data quality objective of a project.

### 9.2. Stock Standard

9.2.1. Purchase stock standards as certified solutions from CPI, RESTEK or other reputable vendor (refer to Table 1 for the listing of all certified solutions). The standard is expected to be at 96% purity. Read vendor's note if correction has been applied to certified values otherwise corrections must be applied.

9.2.2. Transfer the stock standard solutions into 2 ml amber vial with Teflon lined screw caps and store at -10°C to -20°C.

### 9.3. Intermediate Standard

9.3.1. Using stock standard solutions, prepare the intermediate standard in Methylene Chloride according to table 1.

### 9.4. Internal Standard

9.4.1. The internal standard shall include 1,4-Dioxane-$d_8$.

9.4.2. Purchase internal standard solutions as certified solution from CPI or other reputable vendor at 1,000 µg/ml.

9.4.3. Transfer the stock standard solutions into 2 ml amber vial with Teflon lined screw caps and store at -10°C to -20°C.

### 9.5. GC/MS Tuning

9.5.1. The tuning standard shall include 4-Bromofluorobenzene.

9.5.2. Purchase tuning standard solution as certified standard at 2500 µg/ml from RESTEK or other reputable vendor.

9.5.3. Prepare a 500 µl of 50 µg/ml of working standard tuning solution (refer to Table 2). Transfer the solution in a 1 ml amber vial and store in -10°C to -20°C.

### 9.6. Surrogate Standard

9.6.1. Purchase a surrogate bromobenzene standard as certified solution from CPI or other reputable vendor at 10,000 µg/ml.

9.6.2. Prepare the surrogate spiking solution by adding 1 ml of 10,000 µg/ml surrogate standard in 25 ml of methylene chloride. Transfer in a amber bottle, store at -10°C to -20°C and label the

solution according to EMAX-SM04. The resulting spiking solution will contain 400 µg/ml of surrogate.

9.6.3. For typical extraction [soil: 30 g - 2 ml or water: 1000 ml - 2 ml], add 0.1 ml of surrogate spiking standard to the sample prior to extraction. Spike volume may be adjusted to normalize with the final extract and yield the same concentration.

9.7. **Calibration Standard**

9.7.1. Prepare working standard solutions for initial calibration and daily calibration (refer to Table 2 for details). Transfer the solutions in 1 ml amber vial and store them at ≤ 6°C without freezing.

9.8. **ICAL Verification Standard (Second Source Verification) (ICV)**

9.8.1. Purchase a certified ICV standard from a different vendor. The ICV standard contains the same list of compounds as the stock standard (refer to Table 1b for the standard mix and the corresponding vendors).

9.8.2. Prepare a 500 µl of 20 µg/ml check standard solution (refer to Table 2). Transfer the solution in a properly labeled 1 ml amber vial and store at ≤ 6°C without freezing.

9.9. **LCS/MS Spiking Standards**

9.9.1. Purchase spiking standards as certified solutions at 1000 µg/ml from RESTEK or other reputable vendor. The spiking solution may be from the same source as the initial calibration standard[1].

9.9.2. From the stock standard prepare the matrix spike working solution as follows: transfer 2 ml of matrix spike stock solution at 1000 µg/ml into 50 ml volumetric flask, then dilute to volume with methylene chloride resulting 40 µg/ml of spike solution.

9.9.3. Store the working matrix spike in properly labeled amber bottle and store at ≤ 6°C without freezing.

9.9.4. Spike MS/MSD/LCS/LCD samples with 1 ml of full spiking solution prior to sample extraction.

9.9.5. Spike volume may be adjusted to normalize with the final extract volume and yield the same concentration.

## 10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. For aqueous samples, refer to EMAX-3510 or EMAX-3520. Check the extraction log for presence of residual chlorine.

10.1.2. For solid samples, refer to EMAX-3550 or EMAX-3540.

10.1.3. For waste samples, refer to EMAX-3580.

[1] SW846 Method 8270D, Section 7.9

10.1.4. After extraction, examine the color and consistency of the extract. If the extract appears to be opaque and/or viscous, it is advisable to perform extract cleanup preferably GPC. Refer to EMAX-3640.

10.2. **Instrument Parameters**

10.2.1. Set the instrument parameters as suggested in Table 3. Fine tune the instrument to obtain optimum instrument condition.

10.2.2. Print and display current condition on the instrument for easy access when performing daily instrument routine check.

10.2.3. In the event that instruments parameters necessitate a change, replace the instrument parameter print-out with the new parameter setup and archive the previous instrument parameters in the instrument maintenance log.

10.2.4. Set injection volume to 1 µl to 2 µl.

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

10.3.2. Perform Tune Check

10.3.2.1. Analyze a solution containing 50 µg/ml of tuning standard working solution, 4-BFB.

10.3.2.2. Evaluate the tune check by averaging of three scans (the peak apex scan and the scan immediately preceding and the scan immediately following the apex). Apply a background subtraction using a single scan no more than 20 scans prior to the elution of BFB. Do not subtract part of the BFB peak or any other discrete peak that does not coelute with BFB. Use the BFB mass intensity criteria in the manufacturer's instructions as primary tuning acceptance criteria otherwise refer to Table 4 for acceptance criteria.

10.3.2.3. If tune check is non-compliant, refer to Section 12 for corrective action.

10.3.3. Initial Calibration (ICAL)

10.3.3.1. Perform ICAL when one of the conditions occurs:

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Optimize the instrument condition prior to ICAL:

- Ensure that instrument parameters are set up properly
- Ensure that there is no evidence of leak
- Ensure that instrument maintenance as scheduled is performed
- Ensure that instrument tune check and column performance is not indicative that it is at the threshold of failing the acceptance criteria

10.3.3.3. Analyze a multi-point initial calibration curve as suggested in Figure 3 after a valid tune check.

10.3.3.4. Generate a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor (RRFm), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq-10.5.1.1, Eq-10.5.1.2, Eq-10.5.1.5 and Eq-10.5.1.6, respectively.

10.3.3.5. **Evaluate the ICAL Acceptance**

10.3.3.5.1. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.5.2. Evaluate retention time of each analyte with respect to the nearest internal standard. The relative retention time (RRT) of each analyte should agree within ± 0.06 RRT units.

10.3.3.5.3. Check the average relative response factor (RF ≥ 0.05).

10.3.3.5.4. Check RSD and correlation coefficient. If more than 10% of the compounds included with the initial calibration exceed the 20% RSD limit and do not meet the minimum correlation coefficient (0.99) for alternate curve fits, then the chromatographic system is considered too reactive for analysis to begin. Perform necessary instrument maintenance and repeat calibration. Refer to 10.3.3.2., Section 12 for corrective action.

10.3.3.6. **Application of ICAL Curve for Quantitation**

10.3.3.6.1. If RSD is ≤20% average response factor may be applied.

10.3.3.6.2. Apply Inverse Weighting Factor ($1/y$ or $1/y^2$; y being the instrument response) if it is determined to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.99.

10.3.3.6.3. Apply linear least squares regression if past experience or prior knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of ≤ 20% and correlation coefficient of ≥ 0.99.

10.3.3.6.4. It may be appropriate to force the regression through zero for specific analytes[2]. When exercising this option (as included in the data acquisition software), make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.6.5. Re-quantitate the calibration point near or at LOQ and calculate for percent recovery. Percent recovery within ± 30%[3] of their expected values is indicative that calibration accuracy at the lower calibration range is good.

[2] SW846 Method 8000B, Section 7.5.3
[3] SW846 Method 8270D, Section 11.4.5.6

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. Initial Calibration Verification (ICV)

10.3.4.1. Verify the concentration of the ICAL by analyzing the ICV from a secondary source (refer to Table 2 for standard preparation). Result should be within ± 30% of expected value unless otherwise specified by the project.

10.3.4.2. Evaluate the ICV for minimum response factor, internal standard retention time and internal standard response as described in 10.3.5.2.

10.3.4.3. If any of above criteria is non-compliant, refer to Section 12 for corrective action.

10.3.5. Daily Continuing Calibration (DCC)

10.3.5.1. Analyze DCC (refer to Table 2 for standard preparation) to check the validity of the ICAL every 12 hour shift unless otherwise specified by the project.

10.3.5.2. **DCC Evaluation**

- Check for minimum response factor (≥ 0.05).
- Check that all analytes are ≤ 20 %D (% Difference for ARF and %Drift for other quantitation technique) unless otherwise specified by the project.
- Check Internal Standard Retention time. Expected retention time is within ± 30 seconds from that of the midpoint of the ICAL.
- Check Internal Standard Response. Expected response of Extracted Ion Current Profile (EICP) is no greater that a factor of two (-50% to +100%).
- If any of the above criteria is non-compliant, refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. Extract Preparation

10.4.1.1. Allow extracts to equilibrate with room temperature.

10.4.1.2. Measure 300 µl of extract, transfer into an autosampler vial.

10.4.1.3. Add 6 µl of 1000 µg/ml of internal standard (refer to 9.4.3).

10.4.1.4. Seal the vial with Teflon-lined septa cap.

10.4.2. Analytical Sequence

10.4.2.1. Analyze instrument blank.

10.4.2.2. Analyze BFB and evaluate tuning.

10.4.2.3. Analyze DCC and check ICAL validity.

10.4.2.4. Analyze Method Blank.

10.4.2.5. Analyze Lab Control Sample and Lab Control Sample Duplicate (optional).

10.4.2.6. Analyze matrix spikes (MS/MSD) as per project requirement.

10.4.2.7. Analyze samples to a maximum of 12-hours from the time of BFB injection.

10.4.3. Sample Result Evaluation

10.4.3.1. **Check QC criteria**

- Check method blank. If result is non-compliant and analyte in question is not detected in any sample or contamination is < 10X of the sample concentration, results maybe reportable. Verify with the PM if results can be reported.
- Check surrogate recoveries against PSR. In the absence of PSR, default to EMAX QC limits.
- Check concentration of target analytes. Dilute and re-analyze samples having result(s) exceeding calibration range unless otherwise specified by the project. Maintain IS concentration on diluted samples.
- Check Internal Standard Response. Expected response of EICP is no greater that a factor of two (-50% to +100%).
- Check Internal Standard Retention Time. Expected retention time is within ± 30 seconds of the ICAL midpoint.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.4.3.2. **Qualitative Identification**

- The intensities of the characteristic ions must maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Manually integrate the peak if necessary in accordance to EMAX-DM01.
- Investigate visible peaks in the chromatogram that were not identified in the data output. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification[4] (TIC).
- Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting.

10.4.3.3. **Quantitation**

- Apply the appropriate quantitation method (refer to Section 10.5.3) to calculate the concentration of any positively identified target analyte. Apply the sample preparation and dilution factor to calculate for the final concentration of the sample.

[4] Library search is performed only when indicated in the PSR.

10.4.3.4. **Manual Integration**

10.4.3.4.1. Refer to EMAX-DM01 for details of manual integration.

10.4.3.5. **Dealing with Carryover**

- Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.
- If there was no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction. Otherwise, clean up the system and re-analyze the sample suspected to contain carryover.

10.5. **Calculations**

10.5.1. Initial Calibration

10.5.1.1. **Calculate for Relative Response Factor (RRF)**

$$RRF = \frac{(AX)(CIS)}{(AIS)(CX)} \qquad \text{Eq.-10.5.1.1}$$

where:

*AX* – Area of characteristic ion for the compound being measured

*AIS* – Area of characteristic ion for the specific internal standard

*CX* – Concentration of the compound being measured

*CIS* – Concentration of the specific internal standard

10.5.1.2. **Calculate for Average Relative Response Factor (RRFm)**

$$RRFm = \frac{\sum RRF}{n} \qquad \text{Eq.-10.5.1.2}$$

where:

*RRFm* – average response factor

$\sum RRF$ – summation of response factors

*n* – number of measurements

10.5.1.3. **Calculate for Least Square Linear Regression**

$$y = ax + b \qquad \text{Eq.-10.5.1.3}$$

where:

*y* – Response Ratio *(AX/AIS)*

*x* – Amount Ratio (CX/CIS)

*a* – x1 = slope of the line

$$a = \frac{\sum\left(x-\bar{x}\right)\left(y-\bar{y}\right)}{\left(x-\bar{x}\right)^2}$$

where:

$\bar{x}$ – Average of amount rations

$\bar{y}$ – Average of response ratios

$b$ = x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.5.1.4. **Calculate for Inverse Weighting Factor**

$$y = ax + b \qquad \text{Eq.-10.5.1.4}$$

where:

$y$ – Response Ratio *(AX/AIS)*

$x$ – Amount Ratio *(CX/CIS)*

$a$ – x1 = slope of the line

$$a = \frac{\sum\left[\left(x-x_a\right)\left(y-y_a\right)\right]}{\sum\left(x-x_a\right)^2}$$

where:

$x_a$ – $\sum\left[x\left(1/x\right)/\sum\left(1/x\right)\right]$

$y_a$ – $\sum\left[y\left(1/x\right)/\sum\left(1/x\right)\right]$ or

$x_a$ – $\sum\left[x\left(1/x^2\right)/\sum\left(1/x^2\right)\right]$

$y_a$ – $\sum\left[y\left(1/x^2\right)/\sum\left(1/x^2\right)\right]$

b = x0 = intercept of the line

$$b = y_a - a * x_a$$

10.5.1.5. **Calculate for Standard Deviation**

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(x_i-\bar{x})^2}{n-1}} \qquad \text{Eq.-10.5.1.5}$$

where:

$SD$ – standard deviation

$x_i$ – result at i$^{th}$ measurement

$\bar{x}$ – mean

$n$ – number of measurements

10.5.1.6. **Calculate for % relative standard deviation (%RSD)**

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \text{Eq.-10.5.1.6}$$

where:

*SD* – standard deviation

*RRFm* – average response factor

10.5.2. Calibration Check/Continuing Calibration

10.5.2.1. **Calculate Percent Difference (%D) when RRFm is used for quantitation**

$$\%D = \frac{\left[RRF_c - RRF_m\right]}{RRF_m} * 100\% \qquad \text{Eq.-10.5.2.1}$$

where:

*RRFc* – response factor from continuing calibration standard

*RRFm* – average response factor

10.5.2.2. **Calculate Percent Deviation (%$D_t$) when applied calculation is other than ARF**

$$\%D_t = \frac{\left|T_t - T_f\right|}{T_t} * 100\% \qquad \text{Eq.-10.5.2.2}$$

where:

$T_t$ – true value of standard in µg/L

$T_f$ – found value of standard in µg/L

10.5.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.5.3.1. **Water Samples**

$$Concentration\ (ug/L) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(V_t)} \qquad \text{Eq.-10.5.3.1}$$

where:

$A_x$ – area of characteristic ion for the compound to be measured

$I_s$ – amount of internal standard added

$V_e$ – extract final volume from sample extraction, usually 1 ml

$DF$ – dilution factor = $\frac{aliquot(\mu l) + solvent(\mu l)}{aliquot(\mu l)}$

$A_{is}$ – area of characteristic ion for the internal standard

$RRF_m$ – average response factor

$V_i$ – volume of extract injected in µl, usually 1 µl

$V_t$ – volume of water extracted in ml, usually 1000 ml

10.5.3.2. **Soil/Sediment Samples (Dry weight basis)**

$$Concentration(\mu g / Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} \qquad \text{Eq.-10.5.3.2}$$

where:

$A_x$ – area of characteristic ion for the compound to be measured

$I_s$ – amount of internal standard injected in ng

$V_e$ – volume of extract in ml, usually 1 ml[5]

$DF$ – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

$A_{is}$ – area of characteristic ion for the internal standard

$RRF_m$ – average response factor

$V_i$ – volume of extract injected in µl, usually 1 µl

$W_s$ – wet soil weight in kg

$DW$ – % solid = $\frac{100 - \%moisture}{100}$

10.5.3.3. **Calculation for results subjected to cleanup by GPC**

$$Concentration(\mu g / Kg) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(W_s)(DW)} * \frac{V_{bg}}{V_{ig}} \qquad \text{Eq.-10.5.3.3.1}$$

$$Concentration(\mu g / L) = \frac{(A_x)(I_s)(V_e)(DF)}{(A_{is})(RRF_m)(V_i)(V_t)} * \frac{V_{bg}}{V_{ig}} \qquad \text{Eq.-10.5.3.3.2}$$

where:

$A_x$ – area of characteristic ion for the compound to be measured

$I_s$ – amount of internal standard injected in ng

[5] For extracts subjected to GPC $V_i$ = 0.5 ml

$V_e$ – volume of extract in ml

$DF$ – dilution factor = $\frac{aliquot(\mu L) + solvent(\mu L)}{aliquot(\mu L)}$

$A_{is}$ – area of characteristic ion for the internal standard

$RF_m$ – average response factor

$V_i$ – volume of extract injected in µl, usually 1 µl

$W_s$ – wet soil weight in kg

$DW$ – % solid = $\frac{100 - \%moisture}{100}$

$V_t$ –volume of water extracted in ml

$V_{bg}$ – total volume of extract before GPC clean-up in ml

$V_{ig}$ – injected volume of extract to GPC in ml

10.5.4. Base all sample result calculations on the ICAL curve, e.g., area ratio of Ax/Ais versus concentration using inverse weighting factor fitted to the initial calibration is also used for determination of sample concentration.

10.5.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.5.5.1. The area "Ax" and "Ais" are derived from total ion chromatogram. "Ais" refers to the closest internal standard (IS) free of interference.

10.5.5.2. RRF of the TIC is 1.

10.5.6. Accuracy and Precision

10.5.6.1. **Percent Recovery**

$$\%\ Recovery = \frac{Cf - C}{Cs} * 100 \qquad \text{Eq.-10.5.6.1}$$

where:

$Cf$ – concentration found

$C$ – concentration of sample (use 0 for LCS)

$Cs$ – concentration of spike

10.5.6.2. **Relative Percent Difference (RPD)**

$$RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \text{Eq.-10.5.6.2}$$

where:

*RPD* – Relative Percent Difference

$C_1$ – Measured concentration of the first sample aliquot

$C_2$ – Measured concentration of the second sample aliquot

10.6. **Data Reduction**

10.6.1. Make a copy of the analytical run log and highlight the data to be reported.

10.6.2. Print a copy of the raw data and the QC report.

10.6.3. Check that all positively identified analytes are within the calibration range.

10.6.4. Collate the reportable raw data separating the QC results from the sample results.

10.6.5. Keep all other data generated with the analytical folder marked with “For Record Only”.

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WDB1C.exe

10.7.2. Generate the sample results using F1NV3C.exe

10.7.3. Generate the QC summary using QCV3CN.exe

10.7.4. Generate the Instrument Performance Check (ICAL and DCC) using F5DIOX.exe

10.7.5. Generate the IS and RT Summary using F8DIOX.exe

10.7.6. Generate Lab Chronicle using LABCHRN1.exe

10.7.7. Generate the Case Narrative using CN1.exe

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration(s) and re-analyses.

- Case Narrative
- Lab Chronicle
- Sample Results
- Method Blank Results
- LCS/LCSD Summary
- MS/MSD Summary
- Instrument Performance Check (ICAL)
- ICAL Summary
- ICV Summary
- Instrument Performance Check (DCC)
- IS and RT Summary
- DCC Summary

- Analytical Run Log
- Sample Preparation Log
- Non-Conformance Report (if any)

10.8.2. Perform a 100% data review in accordance to EMAX-DM01 and the PSR.

- Check internal standard area. They should be within -50 to +100% of the ICAL midpoint to be acceptable, otherwise follow PSR.
- Check retention time of each IS to the ICAL midpoint. They should be within ± 30 seconds to be acceptable, otherwise follow PSR.
- Check surrogate recoveries against Project Specific Requirements (PSR). In the absence of PSR, default to in-house QC limits.
- Check concentrations of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.3. Check the generated reports against the raw data.

10.8.4. Review the case narrative and check that it accurately describes what transpired in the analytical process. Edit as necessary to reflect essential issues not captured by the case narrative generator program.

10.8.5. Submit the analytical folder for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Refer to form M8270SIMFM for daily routine maintenance check points.

10.9.2. Record instrument maintenance performed in the instrument maintenance log. Initial the column corresponding to the date when the instrument was back to control.

10.9.3. Instruments should receive routine preventive maintenance and recorded in instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction and consequently affecting data quality. The table below is a list of preventive maintenance activities that are essential to consider in performing this SOP.

| **Maintenance Activity** | **Description** | **Frequency** |
|---|---|---|
| Autosampler | Inspect and clean syringe. Check autosampler response. | Daily prior to analysis |
| Vacuum System Verification | Verify pressure. Perform system tune check. | Daily prior to analysis |
| Verification | Check instrument parameters to ensure normal operating conditions. Check instrument performance (e.g., Daily calibration check, instrument blank, BFB). | Daily prior to analysis |
| Source Cleaning | Remove and clean the Mass Spec | Every 6 months or as |

| | | |
|---|---|---|
| | ion source. | necessary |
| Vacuum System Maintenance | Inspect vacuum pumps, and replace mechanical/diffusion pump oil | Every 6 months |
| Documentation | Record maintenance in instrument service logs. | Daily prior to analysis to include services done by third party. |

## 11.0 QUALITY CONTROL

### 11.1. Sample Preparation Batch QC

11.1.1. Analyze Method Blank (MB) to demonstrate that preparation of sample was free from contamination.

11.1.2. Analyze Lab Control Sample (LCS) to assess preparative batch accuracy.

11.1.3. Analyze Matrix Spike (MS/MSD) to assess matrix interference (when required by the project) and a maximum of 20 field samples of similar matrix.

11.1.4. In the absence of MS/MSD prepare LCS/LCSD to check for precision.

11.1.5. All lab wares used in the sample preparation shall be properly treated as specific in EMAX-QC07.

11.1.6. All solvents and reagents shall undergo quality control check in the stationary laboratory prior to its use.

- Verify that the spike amount is accurate by checking the record.
- If LCS is within acceptance criteria and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the problem matrix interference in the case narrative.

### 11.2. Analytical Batch QC

11.2.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.2.2. Perform Initial Calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest.

11.2.3. Establish Retention Time window position for each analyte every after ICAL for proper qualitative identification.

11.2.4. Perform Initial Calibration Verification (ICV) every after ICAL to verify accuracy of ICAL.

11.2.5. Perform Daily Continuing Calibration (DCC) every 12 hours to verify that the instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.2.6. Evaluate Relative Retention Time for each analytes in every sample to be within ± 0.06 RRT units.

11.2.7. Verify Internal Standards (IS) for quantitative accuracy and that its Retention Time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -

50 to +100% of ICAL midpoint standard.

11.2.8. Evaluate Surrogate recovery to monitor instrument response on every sample.

11.3. **Method QC**

11.3.1. Establish Detection Limit (DL) to determine the smallest analyte concentration that can be demonstrated to be different from zero.

11.3.2. Establish Limit of Detection (LOD) to determine the smallest concentration of an analyte that can be qualitatively identified in a sample with 99% confidence level.

11.3.3. Establish Limit of Quantitation (LOQ) to determine the lowest concentration that produces a quantitative result within specified limits of precision and bias.

11.3.4. All analysts conducting this analysis must have an established Demonstration of Capability (DOC) as described in EMAX-QA05.

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency, acceptance criteria and corrective action.

## 12.0 CORRECTIVE ACTIONS

12.1. Corrective actions associated with this analytical procedure are described in the Summary of Quality Control Procedures in Appendix 1. Document out-of-control event and corrective action in the analytical logbook. If the problem persists, consult the supervisor.

12.2. **Sample Preparation QC**

12.2.1. If the instrument blank is non-compliant, consider the following suggestions to correct the problem:

12.2.1.1. Rule out instrument contamination by performing the instrument daily maintenance, such as changing septum, cleaning liner, cleaning or using new autosampler syringe.

12.2.1.2. Rule out reagent contamination by testing solvent used for analysis and working internal standard.

12.2.1.3. Rule out preparation contamination by preparing a new instrument blank.

12.2.1.4. If the problem persists, inform the supervisor for further advice.

12.2.2. If Method Blank is non-compliant, consider the following suggestions to correct the problem:

12.2.2.1. Rule out instrument contamination by checking instrument blank.

12.2.2.2. Rule out reagent contamination by testing each reagent used for extraction as described in EMAX-QC01.

12.2.2.3. Rule out glassware contamination used for extraction as described in EMAX-QC07.

12.2.2.4. Re-extract MB and the associated samples with reagents free of contamination or with newly opened reagents.

12.2.2.5. If the problem persists, inform the supervisor for further advice.

12.2.3. If LCS is non-compliant, perform the following suggestions to correct the problem:

12.2.3.1. If result is bias-high or bias low, check the LCS Standard by analyzing at the spike level.

12.2.3.2. If LCS Check is within 80-120% of expected value, check calibration of the micropipette or syringe used for spiking. Re-extract and re-analyze the LCS and the associated samples.

12.2.3.3. If LCS check is not within 80-120% of expected value, prepare a fresh LCS Standard, re-extract and re-analyze LCS and the associated samples.

12.2.3.4. If LCS is within acceptance then and the right amount of spike is added into sample then it is indicative of matrix interference. Discuss the probable matrix interference in Case Narrative.

12.2.4. If MS is non-compliant consider the following suggestions to correct the problem:

12.2.4.1. Verify that the spike amount added is accurate by checking the record and the micropipette calibration.

12.2.4.2. If LCS is within acceptance criteria then and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the probable matrix interference in the Case Narrative.

12.3. **Analytical Batch QC**

12.3.1. Tune Check

12.3.1.1. If tune check is non-complaint consider the following suggestion to correct the problem:

- Check the instrument settings and make sure that the instrument parameters are properly set up.
- Check gas flow.
- Perform autotune or visual optimization.
- If the problem persists, inform the supervisor for further actions.

12.3.1.2. If instrument performance is non-compliant, consider the following suggestions to correct the problem:

- Poor chromatography demonstrated by too much tailing are indications of dirty injection port. Clean or replace the injection port. If problem persist, cut off the first 6-12 inches of the capillary column.

12.3.2. Initial Calibration (ICAL)

12.3.2.1. If initial calibration is non-compliant, consider the following suggestions to correct the problem:

- If RSD% is out of acceptance criteria, review result and identify presence of an outlier.
- If one of the standard returns a bias-low or bias-high on all of the analytes, then that point is considered an outlier, prepare a standard at that ICAL point

and re-analyze.

- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias-low response or the peaks are not distinct and sharp, consider the point not usable.

*Note: The lowest calibration point identifies the limit of quantitation (LOQ). Therefore, check that the LOQ is in conformance to the current projects where the ICAL will be used.*

12.3.2.2. If instrumentation problem is suspected, consider the following suggestions to correct the problem:

- Check the connections and make sure they are air-tight and perform maintenance as needed.
- Check the gas flow.
- Re-tune the MS.
- Prepare a fresh standard and repeat calibration.
- Clean the MS source and repeat the calibration.

12.3.2.3. If the problem persists, inform the supervisor for further action.

12.3.3. Initial Calibration Verification (ICV)

12.3.3.1. If the ICV is non-compliant, consider the following suggestions to correct the problem:

- Re-analyze ICV to rule out poor injection.
- If ICV is still out of acceptance criteria, prepare a fresh standard and re-analyze to rule out any preparation error.
- If ICV is still out of acceptance criteria, prepare a fresh ICAL standard and repeat calibration.
- If problem persist, inform the supervisor for further action.

12.3.4. Daily Calibration Check (DCC)

12.3.4.1. If DCC is non-compliant consider the following suggestions to correct the problem:

- If majority of the analyte response are low and no evidence of leak in the system is apparent, it is indicative of a poor injection or leak in the vial. Re-analyze DCC
- If problem persist, rule out standard degradation. Prepare a fresh standard and repeat DCC.

12.3.4.2. If Continuing Calibration is non-compliant, consider the following suggestions to correct the problem:

- Change the liner.
- Clean the injection port.

- Prepare a new standard.
- Cut or replace column.
- Rule out leaks by checking all connections.
- If continuing calibration is still non-compliant, prepare a new standard and repeat the ICAL.

12.3.5. Instrument Blank. If instrument blank is non-compliant, consider the following suggestions to correct the problem:

- Rule out instrument contamination.
- Rule out reagent contamination by testing each reagent used as described in EMAX-QC01.
- Rule vials and glassware contamination as described in EMAX-QC07.
- If the problem persists, inform the supervisor for further advice.

12.4. Execute a Non-Conformance Report (NCR) when the following circumstances occur:

12.4.1. If corrective action needs the function of the department; e.g. if the sample needs to be re-extracted, refer to EMAX-QA08 for details of completing an NCR.

12.4.2. If corrective action needs the assistance of the project manager; e.g. if the sample is non-compliant to the technical holding time requirement, insufficient amount of sample, or other non-conforming issues.

12.5. For other problems encountered, inform the supervisor immediately for further instructions.

## 13.0 POLLUTION PREVENTION

13.1. Observe all necessary precautions to avoid spillage of solvent that may go to wastewater drains.

13.2. Prepare all standards in fume hoods.

13.3. All unused samples shall be endorsed to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.4. Separate and properly identify all unused expired analytical standards for proper disposal.

## 14.0 WASTE MANAGEMENT

14.1. Practice the "Less is Better" strategies when preparing for analytical standards. This will minimize the production of surplus chemical wastes.

14.2. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM03.

## 15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Analyte – The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together.

15.1.2. Batch – is a group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.2.1. **Preparation Batch** – is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.2.2. **Analytical Batch** – is composed of prepared samples (extracts, digestates or concentrates) which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.3. Detection Limit (DL) – The lowest concentration or amount of the target analyte that can be identified, measured and reported with confidence that the analyte concentration is not false positive.

15.1.4. Limit of Detection (LOD) – An estimate of the minimum amount of substance that an analytical process can reliably detect.

15.1.5. Limit of Quantitation (LOQ) – The minimum levels, concentrations or quantities of target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

15.1.6. Material Safety Data Sheet (MSDS) – is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.7. Calibration – is a determinant measured from a standard to obtain the correct value of an instrument output.

15.1.8. Carry-over – are contaminants retained in the instruments/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.9. Calibration Check Compounds (CCC) – evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.10. Instrument Method – is a file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.11. Instrument Blank – is a target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.12. Method Blank – is a target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.13. Lab Control Sample (LCS) – is a target-analyte-free sample spiked with verified known amount of target analyte(s) or a reference material with a certified known value subjected to the entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.14. Lab Control Sample Duplicate (LCSD) – is a replicate of LCS analyzed to monitor precision in the absence of MS/MSD sample.

15.1.15. Sample – is a specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise

specified by the project.

15.1.16. Sample Duplicate – is a replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.17. Sub-sample – is an aliquot taken from a sample for analysis. Each sub-sample is uniquely identified by the sample preparation ID.

15.1.18. Matrix – is a component or form of a sample.

15.1.19. Matrix Spike (MS) – is a sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.20. Matrix Spike Duplicate (MSD) – is a replicate of MS analyzed to monitor precision or recovery.

15.1.21. Response Factor – is the ratio of the peak area of the target compound in the sample or sample extract.

15.1.22. Surrogate – are compounds added to every blank, sample, matrix spike, matrix spike duplicate and standard used to evaluate analytical efficiency by measuring recovery. Compounds not expected to be expected to be detected in environmental media.

15.1.23. System Performance Check Compounds (SPCC) – are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.2. **Application of QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing Semi Volatile analysis by GC/MS SIM unless otherwise other directive is specified by the project requirements.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied.

15.4. **Department of Energy (DoE) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

## 16.0 REFERENCES

16.1. "Test Methods for Evaluation of Solid Wastes", EPA SW846, Methods 8000B and 8270D.

16.2. EMAX Quality Systems Manual (EMAX-QS00), as updated.

## 17.0 APPENDICES

17.1. **Tables**

17.1.1. Table 1 Intermediate Standard Preparation

17.1.2. Table 2a Working Standard Preparation

17.1.3. Table 2b Working Secondary Source Standard

17.1.4. Table 2c Working GC/MS Tuning (BFB) Standard

17.1.5. Table 3 Instrument Parameters

17.1.6. Table 4 BFB Key Ions and Ion Abundance Criteria

17.1.7. Table 5 Analyte Lists, Quantitation Ions, Internal Standards & Surrogates

17.1.8. Table 6 Established DL, LOD and LOQ

17.2. **Figures**

17.2.1. Figure 1 Peak Evaluation Technique

17.2.2. Figure 2 Typical Chromatogram

17.2.3. Figure 3 Typical ICAL Summary

17.2.4. Figure 4 Typical BFB Tune Summary

17.2.5. Figure 4a Typical Instrument Performance Check Summary

17.2.6. Figure 5 Typical Continuing Summary

17.2.7. Figure 6 Typical Internal Standard and Retention Time Summary

17.2.8. Figure 7 Typical Sample Result Summary

17.2.9. Figure 8 Typical LCS/LCSD Report Summary

17.2.10. Figure 9 Typical MS/MSD Report Summary

17.2.11. Figure 10 Typical Case Narrative

17.3. **Appendices**

17.3.1. Appendix 1 Summary of Quality Control Procedures

17.3.2. Appendix 2 Demonstration of Capability

17.4. **Forms**

17.4.1. M8270SIMFS Sample Preparation Log

17.4.2. M8270SIMFA Analytical Run Log

17.4.3. M8270SIMFM Instrument Maintenance Log

## Table 1: INTERMEDIATE STANDARD PREPARATION

**A. Primary Source: CPI or equivalent**

| Compound Name | Stock / Internal Soln. Conc. (µg/ml) | Source | Preparation | | | Final Conc. (µg/ml) |
|---|---|---|---|---|---|---|
| | | | Aliquot (µl) | Dil. Solution | Final Vol. (ml) | |
| 1,4-Dioxane | 1000 | CPI | 500 | MeCl2 | 5 | 100 |
| Bromobenzene*(Surrogate) | 10000 | CPI | 50 | MeCl2 | 5 | 100 |

**B. Secondary Source: RESTEK, CPI**

| Compound Name | Stock Soln. Conc. (µg/ml) | Source |
|---|---|---|
| 1,4-Dioxane Custom | 1000 | RESTEK |
| Bromobenzene*(Surrogate) | 10000 | CPI |

**C. Internal Standard: CPI**

| Compound Name | Stock Soln. Conc. (µg/ml) | Source |
|---|---|---|
| 1,4-Dioxane-d8 (IS) | 1000 | CPI |

## Table 2a: WORKING STANDARD PREPARATION

| Standard Name | Intermediate Standard µl of 100 µg/ml | Internal Standard µl of 1000 µg/ml | Dil. Solvent | Final Volume (µl) | Final Conc. |
|---|---|---|---|---|---|
| 1 | 1 | 10 | $MeCl_2$ | 500 | 0.2 µg/ml of Cal. Std.<br>20 µg/ml of Internal Std. |
| 2 | 2.5 | 10 | $MeCl_2$ | 500 | 0.5 µg/ml of Cal. Std.<br>20 µg/ml of Internal Std. |
| 3 | 5 | 10 | $MeCl_2$ | 500 | 1 µg/ml of Cal. Std.<br>20 µg/ml of Internal Std. |
| 4 | 25 | 10 | $MeCl_2$ | 500 | 5 µg/ml of Cal. Std.<br>20 µg/ml of Internal Std. |
| 5 | 100 | 10 | $MeCl_2$ | 500 | 20 µg/ml of Cal. Std.<br>20 µg/ml of Internal Std. |
| 6 | 300 | 10 | $MeCl_2$ | 500 | 60 µg/ml of Cal. Std.<br>20 µg/ml of Internal Std. |
| 7 | 500 | 10 | $MeCl_2$ | 500 | 100 µg/ml of Cal. Std.<br>20 µg/ml of Internal Std. |

## Table 2b: WORKING SECONDARY SOURCE STANDARD

| Standard Name | Soln. Conc. (µg/ml) | Preparation | | | Final Conc. (µg/ml) |
|---|---|---|---|---|---|
| | | Aliquot (µl) | Dil. Solvent | Final Vol. (µl) | |
| Custom 1,4-Dioxane | 1000 | 10 | $MeCl_2$ | 500 | 20 |
| Bromobenzene (Surrogate) | 10000 | 1 | $MeCl_2$ | 500 | 20 |
| 1,4-Dioxane-d8 (Internal Standard) | 1000 | 10 | $MeCl_2$ | 500 | 20 |

## Table 2c: WORKING GC/MS TUNING (BFB) STANDARD

| Standard Name | Soln. Conc. (µg/ml) | Preparation | | | Final Conc. (µg/ml) |
|---|---|---|---|---|---|
| | | Aliquot (µl) | Dil. Solvent | Final Vol. (µl) | |
| GC/MS Tuning (4-BFB) | 2500 | 10 | $MeCl_2$ | 500 | 50 |

## Table 3: INSTRUMENT PARAMETERS

| | Inst. E4 / Inst. E7 | Inst. 052 |
|---|---|---|
| Carrier Gas | Helium at 90 psi at outlet | Helium at 90 psi at outlet |
| Column head pressure | 15 - 35 psi at 40°C | 10-15 psi at 40°C |
| Injection port temperature | 280-300°C | 260°C |
| Interface | Direct column interference at 280-300°C | Direct column interference at 280°C |
| Valve time | Split 0.2 minute | Split 0.5 minutes |
| **Oven Temperature Program** | | |
| Initial Temperature | 40°C/min; hold for 0min. | 40°C/min; hold for 1 min. |
| Rate | 25°C/min to 270°C; hold for 0.0 min.; 38°C/min to 300°C; hold for 0.0 min. | 10°C/min to 100°C 25°C/min to 320°C |
| Run Time | 9.9895 minutes | 9.94 minutes |
| **Scan Parameters** | | |
| Scan start time | After solvent peak | After solvent peak |
| Mass range | 10 to 1050 AMU | 40 to 500 AMU |
| Multiplier voltage | 1000-3000 | 0.7-3 |
| Dwell (msec) | 20-100 | 2 |
| Threshold | NA | 500-1500 |
| Tuning File | BFB | BFB |

## Table 4: BFB KEY IONS AND ION ABUNDANCE CRITERIA

| Mass | Ion Abundance Criteria |
|---|---|
| 50 | 15 to 40% of m/z 95 |
| 75 | 30 to 60% of m/z 95 |
| 95 | Base peak, 100% of relative abundance |
| 96 | 5 to 9% of m/z 95 |
| 173 | Less than 2.0% of m/z 174 |
| 174 | Greater than 50% of m/z 95 |
| 175 | 5 to 9% of m/z 174 |
| 176 | Greater than 95%, but less than 101% of m/z 174 |
| 177 | 5 to 9% of m/z 176 |

## Table 5: ANALYTE LISTS, QUANTITATION IONS, INTERNAL STANDARDS & SURROGATES

| Analyte | Type | Quantitation Ions | |
|---|---|---|---|
| | | Primary | Secondary |
| 1,4-Dioxane | T | 88 | 58 |
| Bromobenzene | S | 77 | 156, 158 |
| 1,4-Dioxane-$d_8$ | IS | 96 | 64 |

Notes: T – Target Compound

S – Surrogate

IS –Internal Standard

## Table 6: ESTABLISHED DL, LOD AND LOQ

| Parameter | Water (µg/L) | | | Soil (µg/Kg) | | |
|---|---|---|---|---|---|---|
| | DL | LOD | LOQ | DL | LOD | LOQ |
| 1,4-Dioxane (T) | 0.345 | 0.5 | 1 | 33 | 50 | 100 |
| Bromobenzene (S) | 0.25 | 0.5 | 1 | 35 | 50 | 100 |

Note:

T – Target Compound

S - Surrogate

1. PSR supersedes Table 6
2. LOD and LOQ were established at the time this SOP is written

**Figure 1: PEAK EVALUATION TECHNIQUE**

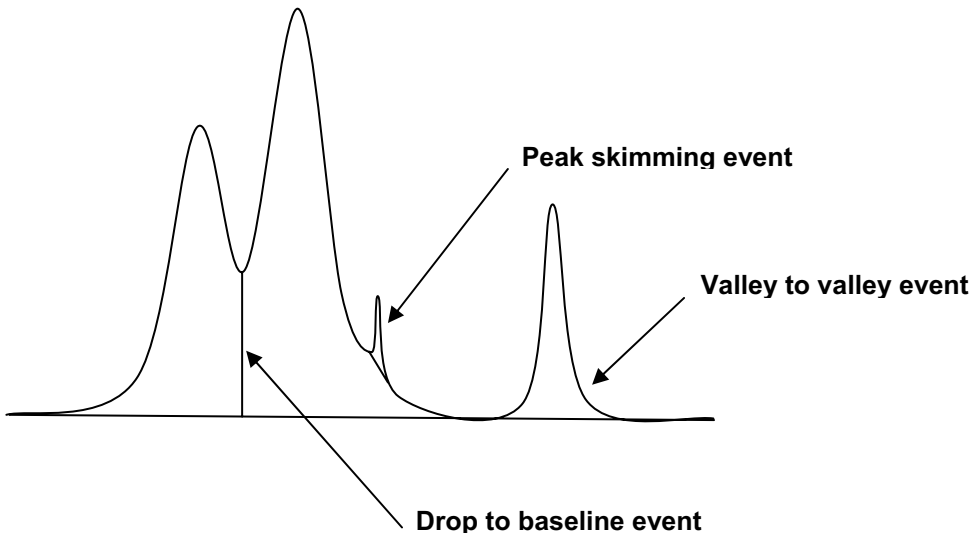


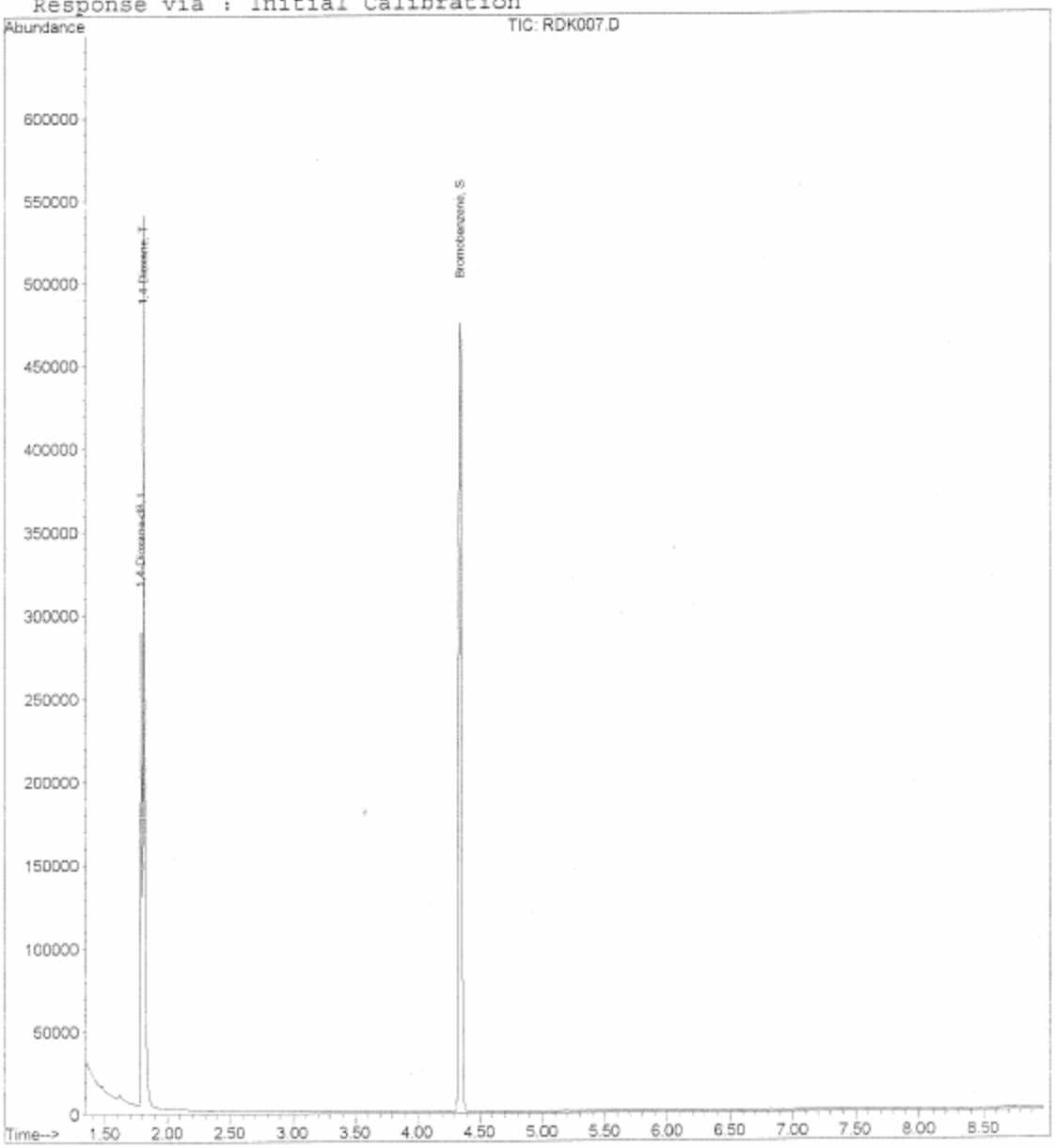
**Figure 2:** **TYPICAL CHROMATOGRAM**

Quantitation Report

Data File : D:\CHEMDATA\11D13\RDK007.D
Acq On : 13 APR 2011 16:29
Sample : SV52D135 20PPM
Misc :
MS Integration Params: RTEINTT.P
Quant Time: Apr 14 10:37 2011

Vial: 7
Operator: DC
Inst : TO52
Multiplr: 1.00
Quant Results File: SV52D13.RES

Method : C:\HPCHEM\1\METHODS\SV52D13.M (RTE Integrator)
Title : DIOXANE 8270D SHIMADZU GCMS-QP5000
Last Update : Thu Apr 14 10:34:08 2011
Response via : Initial Calibration




RDK007.D SV52D13.M Thu Apr 14 10:37:57 2011 TO52 Page 2

**Figure 3:** **TYPICAL ICAL SUMMARY**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :TO52
Beginning DateTime :04/13/11 15:25
Spike Units :PPM
IC File :RDK007

Column Spec :HP-5MS ID :0.25MM
Ending DateTime :04/13/11 17:01
HPChem Method :SV52D13

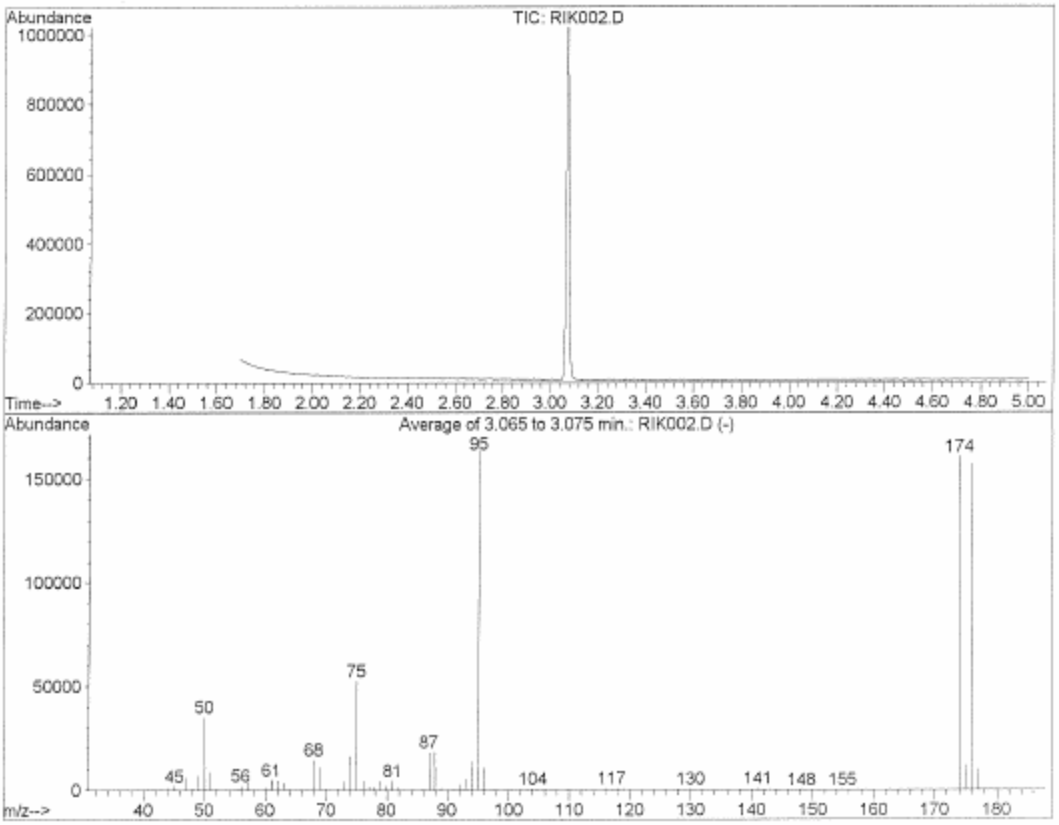
| | | .2 | .5 | 1 | 5 | 20 | 60 | 100 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 15:25 | 15:41 | 15:57 | 16:13 | 16:29 | 16:45 | 17:01 | | | |
| IDX | Parameters | RDK003 | RDK004 | RDK005 | RDK006 | RDK007 | RDK008 | RDK009 | Av_RRF | %_RSD | Av_Rt_M |
| 1 | 1,4-Dioxane-d8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1.7967 |
| 2 | 1,4-Dioxane | 1.934 | 2.037 | 1.905 | 1.955 | 1.985 | 1.947 | 1.995 | 1.965 | 2.22 | 1.8176 |
| 3 | Bromobenzene | 1.855 | 1.829 | 1.749 | 1.793 | 1.802 | 1.772 | 1.819 | 1.803 | 1.98 | 4.3471 |

Ave_%RSD : 2.1 Max_%RSD : 2.2

**Figure 4:** **TYPICAL BFB TUNE SUMMARY**

BFB

```
Data File : D:\CHEMDATA\11I07\RIK002.D                    Vial: 2
Acq On    :  7 SEP 2011  14:50                         Operator: DC
Sample    : BFB52D1337                                 Inst    : TO52
Misc      :                                            Multiplr: 1.00
MS Integration Params: rteint.p
Method    : C:\HPCHEM\1\METHODS\BFB.M (RTE Integrator)
Title     : BFB TUNE 8270D SHIMADZU GCMS-QP5000
```




AutoFind: Scans 274, 275, 276; Background Corrected with Scan 269

| Target Mass | Rel. to Mass | Lower Limit% | Upper Limit% | Rel. Abn% | Raw Abn | Result Pass/Fail |
|---|---|---|---|---|---|---|
| 50 | 95 | 15 | 40 | 21.5 | 35088 | PASS |
| 75 | 95 | 30 | 60 | 32.1 | 52512 | PASS |
| 95 | 95 | 100 | 100 | 100.0 | 163523 | PASS |
| 96 | 95 | 5 | 9 | 6.6 | 10841 | PASS |
| 173 | 174 | 0.00 | 2 | 0.0 | 0 | PASS |
| 174 | 95 | 50 | 100 | 98.2 | 160576 | PASS |
| 175 | 174 | 5 | 9 | 7.5 | 11984 | PASS |
| 176 | 174 | 95 | 101 | 97.9 | 157184 | PASS |
| 177 | 176 | 5 | 9 | 6.3 | 9965 | PASS |

RIK002.D  BFB.M  Tue Sep 13 14:53:33 2011  TO52

## Figure 4a: TYPICAL INSTRUMENT PERFORMANCE CHECK SUMMARY

5B
SEMIVOLATILE ORGANIC INSTRUMENT PERFORMANCE CHECK
BROMOFLUOROBENZENE (BFB)

Lab Name: EMAX Inc
Lab Code: EMXT Case No.:
Lab File ID: RHK002
Instrument ID: TO52
GC Column: HP-5MS ID:0.25mm (mm)

Project: CLEAN WATER PROJECT
SAS No.: SDG No.: 11H011
BFB Injection Date : 08/05/11
BFB Injection Time : 14:42

| m/e | ION ABUNDANCE CRITERIA | % RELATIVE ABUNDANCE |
|---|---|---|
| 50 | 15.0 - 40.0% of mass 95 | 23.85 |
| 75 | 30.0 - 60.0% of mass 95 | 34.59 |
| 95 | Base peak, 100% relative abundance | 100.00 |
| 96 | 5.0 - 9.0% of mass 95 | 6.60 |
| 173 | Less than 2.0% of mass 174 | 0.00( 0.0)1 |
| 174 | 50.0- 100.0% of mass 95 | 91.57 |
| 175 | 5.0 - 9.0% of mass 174 | 7.05( 7.7)1 |
| 176 | 95.0 - 101.0% of mass 174 | 91.81(100.3)1 |
| 177 | 5.0 - 9.0% of mass 176 | 5.65( 6.2)2 |

1-Value is % mass 174 2-Value is % mass 176

THIS CHECK APPLIES TO THE FOLLOWING SAMPLES, MS, MSD,BLANKS, AND STANDARDS:

| | EPA SAMPLE NO. | LAB SAMPLE ID | LAB FILE ID | DATE ANALYZED | TIME ANALYZED |
|---|---|---|---|---|---|
| 1 | SSTD020 | CSV52D1331 | RHK003 | 08/05/11 | 15:24 |
| 2 | MBLK1W | SVH004WB | RHK004 | 08/05/11 | 15:59 |
| 3 | LCS1W | SVH004WL | RHK005 | 08/05/11 | 16:15 |
| 4 | LCD1W | SVH004WC | RHK006 | 08/05/11 | 16:31 |
| 5 | 44-M-30-MS-080211 | H011-03M | RHK007 | 08/05/11 | 16:47 |
| 6 | 44-M-30-SD-080211 | H011-03S | RHK008 | 08/05/11 | 17:02 |
| 7 | 44-M-30-N-080211 | H011-03 | RHK013 | 08/05/11 | 18:22 |
| 8 | 44-M-30-FD-080211 | H011-04 | RHK014 | 08/05/11 | 18:38 |
| 9 | 44-VM-507-C-N-080211 | H011-05 | RHK015 | 08/05/11 | 18:54 |

page 1 of 1

FORM V VOA OLM02.0

## Figure 5: TYPICAL CONTINUING CALIBRATION SUMMARY

CONTINUE_CALIBRATION - CALIBRATION VERIFICATION

Instrument ID :T052
IC_Beginning DateTime :04/13/11 15:25
Spike Amount :20 PPM
CC/CV File :RHK067
IC File :RDK007

Column Spec :HP-5MS ID :0.25MM
IC_Ending DateTime :04/13/11 17:01
HPChem Method :SV52D13
Date_Time :08/23/11 13:41

| M IDX | Parameters | CC_Con | CC%_D | CC_Resp | CCRRF | AvRRF | CC_Rtm | AvRtm | %_RSD | Co_X0 | Co_X1 | Co_X2 | Co_Cor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,4-Dioxane-d8 | 20.000 | 0 | 139395 | 1 | 1 | 1.833 | 1.797 | 0 | | | | |
| 2 | 1,4-Dioxane | 19.932 | -0.3 | 273038 | 1.959 | 1.965 | 1.860 | 1.818 | 2.22 | | | | |
| 3 | Bromobenzene | 21.571 | 7.9 | 271010 | 1.944 | 1.803 | 4.373 | 4.347 | 1.98 | | | | |

## Figure 6: TYPICAL INTERNAL STANDARD AND RETENTION TIME SUMMARY

8B
SEMIVOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: RDK007
Instrument ID: TO52

Project:CLEAN WATER PROJECT
SDG No.: 11H011
Date Analyzed: 04/13/11
Time Analyzed: 16:29

| | | IS1(DD8) AREA # | RT # |
|---|---|---|---|
| | 12 HOUR STD | 138721 | 1.80 |
| | UPPER LIMIT | 277442 | 2.30 |
| | LOWER LIMIT | 69361 | 1.30 |
| | SAMPLE ID | | |
| 1 | SSTD020 | 130131 | 1.83 |
| 2 | MBLK1W | 117643 | 1.83 |
| 3 | LCS1W | 103299 | 1.83 |
| 4 | LCD1W | 108083 | 1.83 |
| 5 | 44-M-30-MS-080211 | 138721 | 1.80 |
| 6 | 44-M-30-SD-080211 | 106863 | 1.83 |
| 7 | 44-M-30-N-080211 | 107701 | 1.82 |
| 8 | 44-M-30-FD-080211 | 105743 | 1.83 |
| 9 | 44-VM-507-C-N-080211 | 108551 | 1.82 |

IS1 (DD8) = 1,4-Dioxane-d8

AREA UPPER LIMIT = +100% of internal satndard area
AREA LOWER LIMIT = - 50% of internal standard area
RT UPPER LIMIT = +0.50 minutes of internal standard RT
RT LOWER LIMIT = -0.50 minutes of internal standard RT

# Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.

page 1 of 1

FORM VIII DIOX OLM02.0

**Figure 7:** **TYPICAL SAMPLE RESULT SUMMARY**

METHOD 3520C/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

| | |
|---|---|
| Client : XYZ, INC. | Date Collected: 08/02/11 |
| Project : CLEAN WATER PROJECT | Date Received: 08/03/11 |
| Batch No. : 11H011 | Date Extracted: 08/04/11 16:00 |
| Sample ID: 44-M-30-N-080211 | Date Analyzed: 08/05/11 18:22 |
| Lab Samp ID: H011-03 | Dilution Factor: .97 |
| Lab File ID: RHK013 | Matrix : WATER |
| Ext Btch ID: SVH004W | % Moisture : NA |
| Calib. Ref.: RDK007 | Instrument ID : T-052 |

| PARAMETERS | RESULTS (ug/L) | RL (ug/L) | MDL (ug/L) |
|---|---|---|---|
| 1,4-DIOXANE | 1.7 | 0.97 | 0.49 |

| SURROGATE PARAMETERS | RESULTS | SPK_AMT | % RECOVERY | QC LIMIT |
|---|---|---|---|---|
| BROMOBENZENE | 25.4 | 38.80 | 65.5 | 30-130 |

## Figure 8: TYPICAL LCS/LCSD REPORT SUMMARY

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 11H011
METHOD: METHOD 3520C/8270C SIM

| | | | | | |
|---|---|---|---|---|---|
| MATRIX: | WATER | | | % MOISTURE: | NA |
| DILUTION FACTOR: | 1 | 1 | 1 | | |
| SAMPLE ID: | MBLK1W | | | | |
| LAB SAMP ID: | SVH004WB | SVH004WL | SVH004WC | | |
| LAB FILE ID: | RHK004 | RHK005 | RHK006 | | |
| DATE EXTRACTED: | 08/04/1116:00 | 08/04/1116:00 | 08/04/1116:00 | DATE COLLECTED: | NA |
| DATE ANALYZED: | 08/05/1115:59 | 08/05/1116:15 | 08/05/1116:31 | DATE RECEIVED: | 08/04/11 |
| PREP. BATCH: | SVH004W | SVH004W | SVH004W | | |
| CALIB. REF: | RDK007 | RDK007 | RDK007 | | |

ACCESSION:

| PARAMETER | BLNK RSLT (ug/L) | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | RPD ( % ) | QC LIMIT ( % ) | MAX RPD ( % ) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,4-Dioxane | ND | 40.0 | 28.5 | 71 | 40.0 | 24.7 | 62 | 14 | 30-130 | 30 |

| SURROGATE PARAMETER | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | QC LIMIT ( % ) |
|---|---|---|---|---|---|---|---|
| Bromobenzene | 40.0 | 30.5 | 76 | 40.0 | 26.4 | 66 | 30-130 |

## Figure 9: TYPICAL MS/MSD REPORT SUMMARY

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 11H011
METHOD: METHOD 3520C/8270C SIM

| | | | | | |
|---|---|---|---|---|---|
| MATRIX: | WATER | | | % MOISTURE: | NA |
| DILUTION FACTOR: | .97 | .94 | 1.01 | | |
| SAMPLE ID: | 44-M-30-N-080211 | | | | |
| LAB SAMP ID: | H011-03 | H011-03M | H011-03S | | |
| LAB FILE ID: | RHK013 | RHK007 | RHK008 | | |
| DATE EXTRACTED: | 08/04/1116:00 | 08/04/1116:00 | 08/04/1116:00 | DATE COLLECTED: | 08/02/11 |
| DATE ANALYZED: | 08/05/1118:22 | 08/05/1116:47 | 08/05/1117:02 | DATE RECEIVED: | 08/03/11 |
| PREP. BATCH: | SVH004W | SVH004W | SVH004W | | |
| CALIB. REF: | RDK007 | RDK007 | RDK007 | | |

ACCESSION:

| PARAMETER | SMPL RSLT (ug/L) | SPIKE AMT (ug/L) | MS RSLT (ug/L) | MS % REC | SPIKE AMT (ug/L) | MSD RSLT (ug/L) | MSD % REC | RPD ( % ) | QC LIMIT ( % ) | MAX RPD ( % ) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,4-Dioxane | 1.66 | 37.6 | 20.0 | 49 | 40.4 | 24.0 | 55 | 12 | 30-130 | 30 |

| SURROGATE PARAMETER | SPIKE AMT (ug/L) | MS RSLT (ug/L) | MS % REC | SPIKE AMT (ug/L) | MSD RSLT (ug/L) | MSD % REC | QC LIMIT ( % ) |
|---|---|---|---|---|---|---|---|
| Bromobenzene | 37.6 | 23.2 | 62 | 40.4 | 24.2 | 60 | 30-130 |

**Figure 10: TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER PROJECT

SDG : 11H011

METHOD 3520C/8270C SIM
SEMI VOLATILE ORGANICS BY GC/MS

A total of three (3) water samples were received on 08/03/11 for 1,4-Dioxane by 8270 SIM analysis, Method 3520C/8270C SIM in accordance with USEPA SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods.

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios were evaluated and results were within acceptance criteria. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source (ICV). Continuing calibration (CCV) was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blank was analyzed at the frequency required by the project. For this SDG, one method blank was analyzed with the samples. Result was compliant to project requirement.

Lab Control Sample
A set of LCS/LCD was analyzed with the samples in this SDG.
Percent recoveries for SVH004WL/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries for H011-03M/S were within project QC limits.

Surrogate
Surrogate was added on QC and field samples. Surrogate recoveries were within project QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.

## Appendix 1: SUMMARY OF QUALITY CONTROL PROCEDURES

| QC PROCEDURE | FREQUENCY | ACCEPTANCE CRITERIA | CORRECTIVE ACTION | 1st Rvw | 2nd Rvw |
|---|---|---|---|---|---|
| BFB Tune Check | Prior to calibration (ICAL, ICV or CCV) | Refer to criteria listed in the method description (Table 4) | Retune instrument and verify | | |
| ICAL: Multi-point calibration for all analytes | Initially; as needed | Average relative response factor (RF) ≥ 0.05.<br>%RSD ≤ 20%<br>1) for analytes with RSD ≤ 20% use RRFm<br>2) for analytes with RSD > 20% and r ≥ 0.990 use either inverse weighting factor or linear least squares with minimum of 6 ICAL points | Rule out outlier(s)/ bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL | | |
| ICV: Second-source calibration verification | After initial calibration | RRF ≥ 0.05 and All analytes within ± 30% of expected value | Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL | | |
| DCC: Calibration Check | Daily, before sample analysis and every 12 hours of analysis time | RRF ≥ 0.05 and All analytes ≤ 20% diff. | Rule out bad injection/standard degradation, leak, etc. Correct as necessary otherwise repeat the ICAL | | |
| Retention time window calculated for each analyte | Each sample | Relative retention time (RRT) of the analyte within ± 0.06 RRT units of the RRT | Correct the problem then reanalyze all samples analyzed since the last retention time check | | |
| Internal Standard | Every sample, spiked sample, standard, and method blank | Retention time ± 30 seconds from retention time of the mid-point std. In the ICAL. EICP area within -50% to +100% of ICAL mid-point std. | Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning | | |
| Method blank | One per preparation batch (≤ 20 samples per matrix) | In the absence of PSR apply<br>No analytes detected > ½ LOQ | Rule out instrument contamination by re-analyzing the MB. If problem persist refer to PSR. In the absence of PSR, report NDs and results > 10X of the MB concentration. Otherwise, cure contamination source, re-prep and re-analyze method blank and all associated samples. | | |
| LCS | One LCS per preparation (≤ 20 samples per matrix) | In the absence of PSR default to EMAX QC Limits | Cure probable source of LCS failure, re-prep and reanalyze the LCS and all associated samples | | |
| MS/MSD | One MS/MSD per every 20 project samples per matrix | In the absence of PSR default to EMAX QC Limits | Ensure that spike concentration and spike addition was accurate. If chromatogram exhibits matrix interference narrate observation in the case narrative. | | |
| Surrogate spike | Every sample, spiked sample, standard, and method blank | In the absence of PSR default to EMAX QC Limits. | If non-compliant and no apparent matrix interference is observed, re-extract and analyze sample. Otherwise inform the client for further instruction. | | |
| Comments: Project specific requirements (PSR) supersede EMAX QCP. In the absence of PSR, apply "J" flag to results between LOD and LOQ, "B" flag to results associated with MB contamination. | | | Reviewed By: | | |
| | | | Date: | | |

## Appendix 2: DEMONSTRATION OF CAPABILITY

### DEMONSTRATION OF CAPABILITY
### METHOD: SW 3520C / SW 8270SIM

Sample Prep SOP: EMAX-3520
Analytical SOP: EMAX-M8270SIM
Conc Unit: µg/L
Sample Amt(mL): 1000
Extract Volume (mL): 2

Instrument ID: 2/21/1900
Extraction date: 9/6/11 & 9/13/11
Extracted by: J. delos Santos
Analysis date: 9/7/11 & 9/14/11
Analyzed by: D. Cheung

| PARAMETER | RIK005 | RIK006 | RIK013 | RIK014 | TV | Ave. Conc. | Ave. %Rec | SD | RSD (%) | QC Criteria | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | SVI007WL | SVI007WC | SVI015WL | SVI015WC | | | | | | | |
| 1,4-Dioxane | 27.4 | 27.6 | 30.0 | 26.3 | 40.0 | 27.8 | 70 | 1.5 | 6 | 20 - 130 | PASSED |
| Bromobenzene | 30.6 | 31.6 | 34.4 | 29.4 | 40.0 | 31.5 | 79 | 2.1 | 7 | 10 - 130 | PASSED |

**M8270SIMFS: SAMPLE PREPARATION LOG**

EMAX LABORATORIES, INC.

# EXTRACTION LOG *for* SEMIVOLATILES

Page 1

| SOP | Rev. # |
|---|---|
| ☐ EMAX-3510 | |
| ☐ EMAX-3520 | |
| ☐ EMAX-3540 | |
| ☐ EMAX-3550 | |
| ☐ EMAX-3580 | |
| ☐ EMAX-CLP-SVOA | |
| ☐ EMAX- | |

Note: For samples and relevant QCs/Standards extracted, refer to attached extraction sequence.

Comments:

| Lab Sample ID | Sonicator # | Concentrator # (35°C) |
|---|---|---|
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Book #: ESV-062

Preparation Batch:

Matrix:

Micropipette ID:

Micropipette ID:

| Standards | ID | Amount Added (ml) |
|---|---|---|
| Surrogate | | |
| LCS/MS | | |
| LCS/MS | | |

| Reagent | Lot# / ID |
|---|---|
| $CH_2Cl_2$ | |
| $Na_2SO_4$ | |
| $H_2SO_4$ | |
| NaOH | |
| Silica Sand | |
| Silica Gel | |

TUNING

| Sonicator # | Reading |
|---|---|
| | |
| | |
| | |
| | |

| Concentrator | Water Bath Temperature Setting (°C) | Thermometer Reading (°C) |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |

Thermometer ID = $T_1$

Prepared By: Witnessed By:

Standard Added By: Checked By:

Extract Received By: Location:

Disposed By: Disposed On:

**M8270SIMFA:** **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

Page 1

## ANALYSIS LOG FOR SEMIVOLATILES

SOP ☐ EMAX-8270 Rev. No. __ ☐ EMAX-8270SIM Rev. No. __ ☐ EMAX-CLPSVOA ☐ EMAX-M8270SIM Rev. No. __ ☐ EMAX-625 Rev. No. __ ☐ Book #AE7 -006

Method File: Tune File: Start Date/Time: End Date/Time:

ANALYTICAL BATCH : _____

| Preparative Batch | Data File Name | Run ID | DF | Matrix | | Notes |
|---|---|---|---|---|---|---|
| | | | | S | W | |
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| Instrument No: | E7 |
|---|---|
| INITIAL CALIBRATION REFERENCE | |
| Date | |
| ICAL ID | |

| Standards | | |
|---|---|---|
| Name | ID | Conc. (mg/L) |
| DFTPP | | |
| INT. STD. | | |
| ICV | | |
| DCC | | |
| BENZIDINE | | |
| APP 9 | | |
| APP 9 ADD | | |
| | | |
| | | |

| Solvent | ID | |
|---|---|---|
| $CH_2Cl_2$ | | |

| DATA FILE | |
|---|---|

| Electronic Data Archival | |
|---|---|
| Location | Date |
| HPCHEM_SVOA/TOE7 | |

Comments: _____

Analyzed By: _____

Date Disposed: _____

Disposed By: _____

This page is checked during data review.

**M8270SIMFM: INSTRUMENT MAINTENANCE LOG**

EMAX LABORATORIES, INC.

Page 1

## INSTRUMENT MAINTENANCE LOG

Instrument No: E7 Month: Year: 201_ Book #: ME7 -003

| Date | | | | | | | |
|---|---|---|---|---|---|---|---|
| Column Head Pressure: 70 - 100 (KPa) | | | | | | | |
| Run Instrument Blank | | | | | | | |
| Column Temperature | | | | | | | |
| Autosampler | | | | | | | |
| Calibration curve updated | | | | | | | |
| Verify computer date & clock | | | | | | | |
| Check printer paper | | | | | | | |
| Change Septa | | | | | | | |
| Clean Linear | | | | | | | |
| Analyst Initial | | | | | | | |
| **TroubleShooting** | | | | | | | |
| Problems Encountered | | | | | | | |
| Return to Control (Analyst Initial) | | | | | | | |

| Code | Problems Encountered | Code | Corrective Action |
|---|---|---|---|
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# SAP WORKSHEET #1 – TITLE AND APPROVAL PAGE

**Final**
**Addendum 01 to the**
**Final Sampling and Analysis Plan**
**(Field Sampling Plan/Quality Assurance Project Plan)**

**PRELIMINARY ASSESSMENT/SITE INSPECTION**
**INSTALLATION RESTORATION PROGRAM SITE 75**
**AGRICULTURAL WELL KAYO-SB**
**NAVAL WEAPONS STATION SEAL BEACH**
**SEAL BEACH, CALIFORNIA**

**September 2011**

**Prepared for:**

DEPARTMENT OF THE NAVY
Naval Facilities Engineering Command Southwest
1220 Pacific Highway, San Diego, California 92132-5190

**Prepared by:**

**Accord MACTEC Joint Venture**
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**(858) 771-2588**

**and**

**Richard Brady and Associates**
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**(858) 496-0500**

**Prepared under:**
Contract No. N62473-09-D-2613
**Delivery Order No. 0018**
DCN: AMJV-2613-0018-0006.A1

Reviewed by: _____ Date: 9/14/11
Jesse MacNeill, Brady QA Manager

Approved by: _____ Date: 9/19/2011
Narciso Ancog, NAVFAC SW QA Officer

# Executive Summary

This addendum 01 to the *Final Sampling and Analysis Plan (Field Sampling Plan/Quality Assurance Project Plan) for the Preliminary Assessment (PA) and Site Inspection (SI) at Installation Restoration Program Site 75 (Site 75), Naval Weapons Station (NAVWPNSTA) Seal Beach, California, 6/30/11* (AMJV and Brady, 2011) was prepared to present planned activities to sample an additional monitoring well. This document was prepared by the project team of the Accord MACTEC Joint Venture (AMJV), which is comprised of Accord Engineering, Inc. (AEI) and MACTEC Engineering and Consulting, Inc. (MACTEC) and Richard Brady & Associates (BRADY) for the Department of the Navy (DoN), Naval Facility Engineering Command Southwest (NAVFAC SW) under Contract Number N62473-09-D-2613, Delivery Order No. 0018. The DoN is the lead agency on this project, with regulatory oversight by the California Environmental Protection Agency Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) - Santa Ana Region.

This addendum will be used in conjunction with the original SAP indicated above. All policies and procedures set forth in the original SAP that were not modified in this addendum will remain in effect where applicable.

The original SAP addressed the installation and sampling of up to nine groundwater monitoring wells. This SAP addendum is required to add a tenth monitoring well to the investigation.

The only changes to the original SAP for this project are:

- The groundwater monitoring program was changed from well pairs at two groundwater monitoring well locations and individual wells at seven locations, to well pairs at five groundwater monitoring well locations (See Figure 5 in the Final SAP and Figure 1A in the SAP Addendum). The total number of monitoring wells was changed to ten.
- The analyses to be performed on water samples from the ten monitoring wells are the same as those for the nine monitoring wells listed in WS #15 and #18 of the Final SAP. The water samples from the ten monitoring wells will be collected at different depths than those for the nine monitoring wells listed in WS #18 of the Final SAP because of the discovery of two distinct contaminated water bearing units at boring SB75MW01 during the implementation of the original SAP. See revised WS #15 and #18 of the SAP Addendum.

The changes are a result of the discovery of two distinct contaminated water-bearing units at boring SB75MW01 during the implementation of the original SAP. The paired wells at five locations will allow both water-bearing units to be investigated in accordance with the project data quality objectives in the original SAP.

This addendum includes sections of the original SAP that have been changed or needed updating, but also includes the applicable administrative worksheets. Worksheet #18 presents the sample IDs to be used for the wells, and Figure 1A shows their locations. All policies and procedures set forth in the original SAP that were not modified in this addendum will remain in effect for this investigation.

# SAP WORKSHEETS

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## FIGURE

Figure 1A Proposed Boring/Well Locations

# ACRONYMS / ABBREVIATIONS

| | |
|---|---|
| AEI | Accord Engineering, Inc. |
| AMJV | Accord MACTEC Joint Venture |
| AR | Administrative Record |
| bgs | below ground surface |
| BRADY | Richard Brady and Associates |
| CAS | Chemical Abstracts Service |
| CSM | conceptual site model |
| DCN | document control number |
| DoN | Department of the Navy |
| DQO | Data Quality Objective |
| DSITMS | direct sampling ion trap mass spectrometry |
| DTSC | Department of Toxic Substance Control |
| EDR | Environmental Data Resources |
| EPA | Environmental Protection Agency |
| FCN | Field Change Notice |
| ft | feet |
| GeoTracker | geographical environmental information management system |
| HSO | Health and Safety Officer |
| ID | identification |
| IRP | Installation Restoration Program |
| LDC | Laboratory Data Consultants Inc. |
| MACTEC | MACTEC Engineering and Consulting, Inc. |
| ug/L | micrograms per liter |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| N/A | not applicable |
| NA | not available |
| NAPL | non-aqueous phase liquid |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| NAVWP | |
| NSTA | Naval Weapons Station |
| PM | Program Manager |
| POC | Point of Contact |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAM | Quality Assurance Manager |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |

| | |
|---|---|
| QSM | Quality Systems Manual |
| RPD | relative percent difference |
| RWQCB | Regional Water Quality Control Board |
| SAP | Sampling and Analysis Plan |
| SI | Site Inspection |
| Site 75 | Installation Restoration Program Site 75 |
| SOP | standard operating procedure |
| U.S. EPA | United States Environmental Protection Agency |
| VOA | volatile organic analytes |
| VOC | volatile organic compounds |

## SAP WORKSHEET #3 – DISTRIBUTION LIST

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| Ms. Brenda Reese | Project RPM | NAVFAC SW | 619.532.4209 | brenda.reese@navy.mil<br>1220 Pacific Highway<br>Bldg. 128, Mail Room<br>San Diego, CA 92132<br>Attn: Code JE30.BR |
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| Mr. Stephen Niou | Agency Representative | DTSC | 714.484.5458 | SNiou@dtsc.gov<br>5796 Corporate Avenue<br>Cypress, CA 90630-4732 |
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**Table Continues**

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| Mr. Jesse MacNeill | QAM | BRADY | 858.634.4549 | jmacneill@rbrady.net<br>3710 Ruffin Road<br>San Diego, CA 92123 |
| Mr. Ye Myint | Project Manager | EMAX Laboratories, Inc. | 310.618.8889 | ymyint@emaxlabs.com<br>1835 W 205th. St.<br>Torrance, CA 90501 |
| Ms. Linda Rauto | Operations Manger | LDC, Inc. | 760.634.0437 | lrauto@lab-data.com<br>7750 El Camino Real, Ste 2L<br>Carlsbad, CA 92009 |

**Table Continues**

Acronyms:

| | | | |
|---|---|---|---|
| AR | Administrative Record | POC | Point of Contact |
| AMJV | Accord MACTEC Joint Venture | QAM | Quality Assurance Manager |
| BRADY | Richard Brady & Associates | QAO | Quality Assurance Officer |
| DTSC | Department of Toxic Substances Control | RPM | Remedial Project Manager |
| IRP | Installation Restoration Program | RWQCB | Regional Water Quality Control Board Santa Ana Region |
| LDC | Laboratory Data Consultants, Inc. | | |
| NAVFAC SW | Naval Facilities Engineering Command Southwest | SAP | Sampling and Analysis Plan |
| PM | Project Manager | | |

## SAP WORKSHEET #4 – PROJECT PERSONNEL SIGN-OFF SHEET

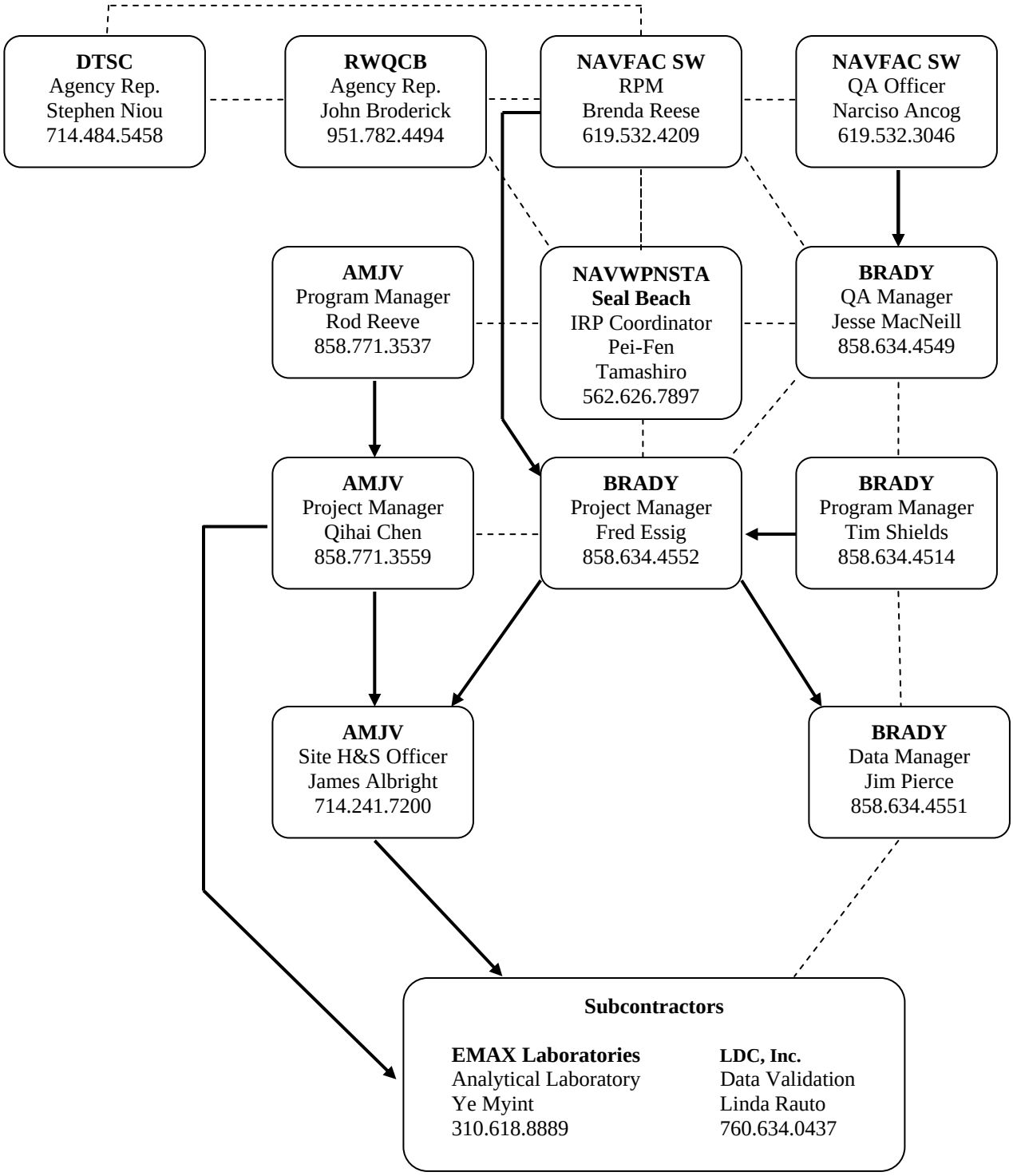
Key personnel will sign this sheet as part of the readiness review conducted prior to field work.

| Name | Organization/Title/Role | Telephone Number (optional) | Signature/E-mail receipt | SAP Section Reviewed | Date SAP Read |
|---|---|---|---|---|---|
| Mr. James Albright | AMJV Site HSO | 714.241.7200 | | All Worksheets | |
| Mr. Fred Essig | BRADY Project Manager | 858.634.4552 | | All Worksheets | |
| Mr. Ye Myint | EMAX Laboratories, Inc. Project Manager | 310.618.8889 | | Worksheets 12, 15,19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 34, 35 | |
| Ms. Linda Rauto | LDC, Inc. Operations Manger | 760.634.0437 | | Worksheets 12, 15, 20, 22, 23, 24, 25, 28, 30, 34, 35, 36 | |

Acronyms:
AMJV Accord-MACTEC Joint Venture
BRADY Richard Brady & Associates
HSO Health and Safety Officer
LDC Laboratory Data Consultants Inc.

# SAP WORKSHEET #5 – PROJECT ORGANIZATIONAL CHART

Lines of Authority ———— Lines of Communication .....



## SAP WORKSHEET #6 – COMMUNICATION PATHWAYS

| Communication Drivers | Responsible Affiliation | Name | Phone Number and/or E-mail | Procedure |
|---|---|---|---|---|
| Point of Contact for DoN Quality Issues | NAVFAC SW QAO | Narciso Ancog | 619.532.3046<br>narciso.ancog@navy.mill | QAO will review and approve the SAP and all amendments to the SAP. |
| Project Management for DoN | NAVFAC SW RPM | Brenda Reese | 619.532.4209<br>brenda.reese@navy.mil | RPM will ensure that the requirements from the project scope of work are fulfilled. |
| FCN | BRADY PM<br><br>AMJV PM | Fred Essig<br><br>Qihai Chen | 858.634.4552<br>fessig@rbrady.net<br><br>858.771.3559<br>qchen@accordeng.com | The field team leader will document any deviation from the original SAP and all amendments, including minor changes, major changes, or significant changes, by notifying the Project Team QAM and PM by phone and e-mail within 24 hours and will submit a FCN within 48 hours. All completed FCNs will be included as an appendix in the final report. The Project Team QAM will inform the NAVFAC SW QAO of any major or significant changes formalized in an FCN. |
| Field Audit | BRADY QAM | Jesse MacNeill | 858.634.4549<br>jmacneill@rbrady.net | The Project Team QAM may conduct a field audit during project fieldwork. Audit results are maintained in Project Team's project and QA files. Any issues requiring corrective action will be documented and assigned an appropriate response period. |
| Coordination and Communication of Fieldwork Activities Related to Sampling | BRADY PM | Fred Essig | 858.634.4552<br>fessig@rbrady.net | Sampling personnel will communicate relevant field information to the Brady QAM. |
| | AMJV PM | Qihai Chen | 858.771.3559<br>qchen@accordeng.com | |
| Reporting Laboratory Data Quality Issues | Laboratory Project Manager | Ye Myint | 310.618.8889<br>ymyint@emaxlabs.com | All QA/QC issues will be reported by the Laboratory Project Manager to the Brady QAM in writing within 2 business days. |

**Table Continues**

| Communication Drivers | Responsible Affiliation | Name | Phone Number and/or E-mail | Procedure |
|---|---|---|---|---|
| Stop Work | BRADY QAM | Jesse MacNeill | 858.634.4549 jmacneill@rbrady.net | The Project Team's QAM, PM, HSO, NAVFAC SW RPM, or NAVFAC SW QAO may stop work in response to any serious quality or safety related issue, if warranted. In this case, the issue and proposed corrective action will be documented with planned timing for implementation. The Stop Work Notice will be submitted to the NAVFAC SW QAO and RPM by e-mail within 24 hours. |
| | BRADY PM | Fred Essig | 858.634.4552 fessig@rbrady.net | |
| | AMJV PM | Qihai Chen | 858.771.3559 qchen@accordeng.com | |
| | AMJV HSO | James Albright | 714.241.7200 JAlbright@accordeng.com | |
| | NAVFAC SW RPM | Brenda Reese | 619.532.4209 brenda.reese@navy.mil | |
| | NAVFAC SW POC | Pei-Fen Tamashiro | 562.626.7897 pei-fen.tamashiro@navy.mil | |
| | NAVFAC SW QAO | Narciso Ancog | 619.532.3046 narciso.ancog@navy.mil | |
| Notification of Non-Usable Analytical Data | Program Chemist | Jesse MacNeill | 858.634.4549 jmacneill@rbrady.net | If significant problems are identified by the laboratory or the project team that impact the usability of the data (i.e. the data is rejected or the data quality objectives are not met), the Program Chemist will notify the NAVFACSW RPM and the NAVFACSW QAO within 24 hours or the next business day. |

Acronyms:

| | | | |
|---|---|---|---|
| AMJV | Accord MACTEC Joint Venture | | |
| BRADY | Richard Brady & Associates | QA | Quality Assurance |
| FCN | Field Change Notice | QAM | Quality Assurance Manager |
| HSO | Health and Safety Officer | QAO | Quality Assurance Officer |
| NAVFAC SW | Naval Facilities Engineering Command Southwest | RPM | Remedial Project Manager |
| PM | Project Manager | SAP | Sampling and Analysis Plan |

# SAP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/ SYSTEMATIC PLANNING PROCESS STATEMENTS

This worksheet provides Steps 2 through 7 of the DQO process as detailed by the U.S. EPA (U.S. EPA, 2006). The process is used to determine the type, quantity, and quality of the data necessary to support decision-making regarding current site conditions and future site management decisions.

Inherent in the development of DQOs is a systematic and logical approach intended to yield an efficient sampling design based on accepted levels of potential decision errors. The following subsections provide the primary study goal of the proposed assessment, the information inputs and analytical approach that will be used to achieve the study goal, as well as the performance criteria that will be used to assure that the data used to make project decisions is of sufficient quality.

## Step 2 – Identify the Goals of the Study

**Primary Goal: Evaluate whether the PCE, TCE, DCE, TCA, DCA, and/or VC previously discovered in groundwater from a former agricultural well located on Navy property originated from a source within the Navy property line.**

The primary goal will be achieved by answering the following decision questions:

1. Are target VOC concentrations increasing in an off-property direction from former Well KAYO-SB?
2. Are target VOC concentrations greater than 100 mg/kg (Westinghouse, 2001), thereby indicating potential residual soil contamination (NAPL)?

## Step 3 – Identify Information Inputs

The purpose of this step is to identify sources of additional data to support project decisions. Inputs to project decisions include regulatory data, existing hydrogeologic data, and new data to be collected under this SAP.

**Existing data inputs include:**

- November 2010 Environmental FirstSearch report (Work Plan, Appendix C)
- Decisions made in stakeholder planning meetings (Final Sampling and Analysis Plan, Worksheet #9) (AMJV and Brady, 2011)
- Historical air photos documenting site use since the 1930s (Work Plan, Appendix C)
- Hydrogeologic data from the Final Well Decommissioning Report, Naval Weapons Station Seal Beach, California. (Tetra Tech, 2007)
- Information from the California RWQCB geographical environmental information management system (GeoTracker) database.

**New data inputs will consist of:**

- Lithologic data produced during continuous coring. Detailed geologic logs will identify transmissive water-bearing units that are potential pathways for dissolved VOC migration.
- Validated soil data to confirm residual soil contamination or non-aqueous phase liquid (NAPL), if present, that is logged by the project geologist.
- Screening data collected using field screening EPA Method 8265 to obtain a log of concentrations of VOC constituents. A detailed log of VOC concentrations will be produced by collecting samples of the continuous core approximately every 2 feet and analyzing them onsite with the direct sampling ion trap mass spectrometry (DSITMS). The VOC screening data and geologic logs will be used to optimize the design of up to ten permanent groundwater monitoring wells so that they target water-bearing units with the highest VOC concentrations.
- Validated groundwater data collected from up to ten permanent monitoring wells in the vicinity of former agricultural well KAYO-SB. Wells designs will be optimized dynamically based on geologic and VOC screening data. Groundwater samples will be collected during two monitoring events and analyzed for target VOCs using EPA Method 8260B. The purpose of this data is to assess the migration direction of target VOCs in groundwater.
- Groundwater elevation data collected from up to ten permanent monitoring wells to evaluate groundwater elevation and flow gradient in up to two separate water-bearing units with the highest VOC screening concentrations.

## Step 4 – Define the Boundaries of the Study

The preliminary horizontal boundary for this investigation has been chosen based on hydrogeologic and chemical data provided by the Navy and during agency file reviews. Proposed well locations are displayed on Figure 1A. The actual horizontal boundary may be adjusted based on hydraulic and VOC concentration gradients identified during the field investigation.

The planned vertical boundary for this investigation is 310 feet bgs; which is approximately 10 feet below were the Beta Aquifer was encountered in former Well KAYO-SB. This is the maximum total depth that monitoring wells are anticipated to be set. The actual vertical boundary will be adjusted dynamically based on geologic logs and VOC screening data generated during the field investigation.

The temporal boundary of the field investigation is defined by the completion of the second proposed groundwater sampling event, currently planned for November 2011.

## Step 5 – Develop the Analytical Approach

EPA Method 8265 will be used to screen for target VOC constituents (including PCE, TCE, DCE, TCA, DCA, and VC). A detailed log of VOC screening concentrations will be

produced by making a measurement of the continuous core approximately every 2 feet to a depth of 310 feet bgs adjacent to former Well KAYO-SB. If the geologist observes stains, odors, or a photoionization detector (PID) reading in the soil core that is interpreted as residual soil contamination or NAPL, a soil sample will be collected for fixed base laboratory analysis by EPA Method 8260B.

The geologic and VOC logs will be examined to identify the two transmissive units with the highest VOC screening concentrations. These two water bearing units will be proposed to be the targets of wells at other locations shown on Figure 1A. Paired wells will be bored separately, although as close together as practical. The deeper well will be drilled first, and the continuous core will be logged by a Professional Geologist and field screened approximately every 2 feet for VOCs using EPA Method 8265. This data will be used to confirm that the target well depths intersect the targeted water bearing units. The shallower well will be drilled second, using the geologic and VOC logs from the deeper well to confirm the planned depth. Groundwater samples will be collected from permanent monitoring wells for two consecutive quarters and analyzed for target VOCs by EPA Method 8260B; in accordance with worksheet #14 of the original SAP (AMJV and Brady, 2011) and worksheet #18 of this SAP addendum. Because the resulting data set will likely be at or below the minimum number of observations (8 to 10 per population) recommended for statistical two-sample hypothesis testing, point-by-point comparisons and graphical presentation methods will be the primary method used to evaluate whether or not concentrations are increasing in a particular spatial direction. Statistical two-sample hypothesis testing using ProUCL computer software will be used as a secondary comparison method, subject to qualification due to the potential constraints of the data set.

Based on the analytical approach, the following decision rules are proposed:

1. **Are PCE, TCE, DCE, TCA, DCA, and/or VC concentrations increasing in an off-property direction?**

   **Yes:** Conclude that target VOCs in groundwater are migrating from an upgradient non-Navy source. Based on the updated CSM resulting from the sampling and the file reviews, evaluate the need for additional sampling to resolve data gaps.

   **No:** Conclude that the Navy is the likely source of target VOCs identified in groundwater in the vicinity of former agricultural well KAYO-SB. Plan appropriate future actions.

2. **Are PCE, TCE, DCE, TCA, DCA, and/or VC present at concentrations greater than 100 mg/kg (Westinghouse, 2001), thereby indicating potential residual soil contamination (NAPL)?**

   **Yes:** Conclude that the residual soil contamination (NAPL) is located near a source area, evaluate whether or not the source area is within Navy property.

**No:** Conclude that residual soil contamination (NAPL) was not encountered during the investigation. Refer to decision rule #1 to evaluate source.

## Step 6 – Specify Performance or Acceptance Criteria

There are two types of decision errors: sampling design errors and measurement errors. Sampling design errors are a function of the selection of sample locations or analytical methods used to characterize the site to be studied. Measurement errors are a function of the procedures used to collect and analyze the samples.

In sampling designs that use a statistical approach to evaluate the data using decision rules, numerical limits on allowable error can be set and controlled by the sampling design (e.g., the number of samples). The use of classical statistics for this project would require a significant number of sampling locations to systematically examine the area potentially affected by the identified release. A random statistically defined sample grid would not meet the DQOs established for this project. This proposed investigation is focused on evaluating if target VOCs are migrating onto NAVWPNSTA Seal Beach from an offsite source, not on identifying the complete distribution of chemicals for which the source may or may not be originating from the facility. Although this project is planned using a judgmental approach, the sampling design proposed in the original SAP (AMJV and Brady, 2011) and this SAP addendum will yield an adequate data set to address the DQOs established for this investigation.

Measurement errors that arise during the various steps of the sample-measurement process (e.g., sample collection, sample handling, sample preparation, sample analysis, data reduction, and data handling) are possible regardless of the sampling design. Neither measurement errors nor variability can be eliminated, but they can be controlled by selecting appropriate procedures and using properly trained personnel. Measurement error will be minimized by using a trained and experienced field team under the guidance of the Project Team's QAM. Each field sampler will be familiar with project DQOs and sampling requirements.

Measurement error is further managed by using Standard Operating Procedures (SOPs) and data quality management. Attachment 1 of the original SAP (AMJV and Brady, 2011) presents SOPs that will be followed to minimize and control measurement error. The analytical methods and method reporting limits for groundwater samples are listed in Worksheet #15 of this addendum.

Decision uncertainty is managed by increasing the density of sampling points, especially in areas where there is high uncertainty about the correctness of a decision. This is cost-effectively accomplished by using field screening methods such as EPA Method 8265 to build a detailed CSM in near real-time. By collecting and analyzing data in near real-time, critical data gaps are identified and filled, an accurate and complete CSM is developed, and field mobilizations and work plan cycles are reduced.

The following table presents possible decision errors, identifies associated consequences, and addresses related uncertainties. The most severe error in judgmental sampling would be to

conclude that action is not required when, in reality, an unacceptable risk to human-health and/or the environment exists. The judgmental sampling approach is designed to limit the probability of this error.

**Possible Decision Errors**

| Possible Error | Associated Consequences | Uncertainty |
|---|---|---|
| Concluding that target VOCs are present in groundwater when not present. | Incorrectly identifying groundwater as contaminated and improperly determining that target VOCs are originating from NAVWPNSTA Seal Beach, or migrating onto the facility from an offsite source. | Low: Conclusions will be based on permanent monitoring wells sampled in accordance with SOPs that follow NAVFAC requirements, samples will be analyzed by an approved fixed base laboratory, and laboratory data validated by a third party. See Decision Rules. |
| Concluding that target VOCs are not present in groundwater when in fact they are present. | Failing to identify groundwater as contaminated and consequently failing to correctly identify whether target VOCs originate from the facility or an offsite source. | Low: Conclusions will be based on permanent monitoring wells sampled in accordance with SOPs that follow NAVFAC requirements, samples analyzed by an approved fixed base laboratory, and laboratory data validated by a third party. See Decision Rules. |

Decision uncertainty will be managed by specific targeting of initial screening points, especially in areas where there is high uncertainty about the correctness of a decision. This is cost-effectively accomplished by targeting appropriate and discrete intervals and screening analytical methods, and building out a detailed CSM during the field deployment. By compiling and modeling data while still in the field, critical data gaps will be identified and filled, an accurate preliminary CSM developed based on geologic and VOC screening data, and all critical data required to optimize the design of permanent monitoring wells that will answer the data quality objectives will be collected within one Work Plan/field sampling/reporting cycle.

## Step 7 – Develop the Detailed Plan for Obtaining Data

This investigation was designed using chemical and hydrogeologic data from previous investigations in the study area, information from a current EDR report, limited review of agency files, and discussions with Navy and regulatory agency representatives. This investigation involves the collection of groundwater samples for chemical analysis to determine whether target VOCs in groundwater in the vicinity of former agricultural Well KAYO-SB originate from a Navy or non-Navy source. The data collected during this investigation, along with existing data from previous investigations, will be used to make this determination.

During this investigation, sonic drilling technology; or equivalent, will be used to collect continuous core samples at predetermined boring locations (Figure 1A). The borings will subsequently be used to install permanent groundwater monitoring wells. The proposed boring locations were selected based on the preliminary CSM (Figures 3 and 4 of the original

SAP (AMJV and Brady, 2011)). The first proposed boring (SB75-MW01; Figure 1A) will be advanced to approximately 310 feet bgs, adjacent to former Well KAYO-SB. The lithology will be logged by a Professional Geologist and VOC concentration measurements will be collected approximately every 2 lineal feet using DSITMS by EPA Method 8265. Since soil impact is not expected, DSITMS will be used to screen pore water captured within the sediment column. Following logging, two separate 4-inch-diameter groundwater monitoring wells will be installed within 15 feet of the location of boring SB75-MW01 at the depth where contaminant screening shows the two water-bearing units with the highest concentrations.

The results of the detailed geologic and VOC log of boring SB75-MW01 will be used to identify the depth and water-bearing unit(s) through which VOCs are migrating, and will preliminarily guide the boring depths and subsequent monitoring well designs and casing diameter at other proposed locations (Figure 1A). The depths of the additional wells will be adjusted based on the detailed geologic logs and targeted VOC screening performed during advancement of each proposed boring.

Permanent groundwater wells will be constructed with 4-inch-diameter Schedule 80 polyvinyl chloride (PVC) casing with 0.010 slotted well screen, or equivalent. After completion and development, representative groundwater samples will be collected from each permanent monitoring well using low-flow methods described in Worksheet #14 of the original SAP and in Accord Engineering, Inc. (AEI) SOP F30-002 (Attachment 1 of the original SAP (AMJV and Brady, 2011)). Groundwater samples will be collected for two consecutive quarterly monitoring events and analyzed for target VOCs by a fixed-base analytical laboratory. All groundwater samples for off-site analysis will be handled in accordance with Worksheet #27 of the original SAP.

# SAP WORKSHEET #15 – REFERENCE LIMITS AND EVALUATION TABLES

## VOCs by EPA Method 8260B – Matrix: Soil

| Analyte | CAS Number | Project Screening Level (ug/kg) | Project Screening Level Reference[a] | Project Quantitation Limit Goal (ug/kg) | Laboratory-specific | | |
|---|---|---|---|---|---|---|---|
| | | | | | LOQ (ug/kg) | LOD (ug/kg) | DL (ug/kg) |
| 1,1,1-Trichloroethane | 71-55-6 | 100,000 | Westinghouse | 10 | 5 | 1 | 0.5 |
| 1,1-Dichloroethane | 75-34-3 | 100,000 | Westinghouse | 10 | 5 | 1 | 0.5 |
| 1,1-Dichloroethene | 75-35-4 | 100,000 | Westinghouse | 10 | 5 | 1 | 0.5 |
| 1,2-Dichloroethane | 107-06-2 | 100,000 | Westinghouse | 10 | 5 | 1 | 0.5 |
| cis-1,2-Dichloroethene | 156-59-2 | 100,000 | Westinghouse | 10 | 5 | 1 | 0.5 |
| Tetrachloroethene (PCE) | 127-18-4 | 100,000 | Westinghouse | 10 | 5 | 1 | 0.5 |
| Trichloroethene (TCE) | 79-01-6 | 100,000 | Westinghouse | 10 | 5 | 1 | 0.5 |
| Vinyl Chloride | 75-01-4 | 100,000 | Westinghouse | 10 | 6 | 2 | 1 |

Notes and Acronyms:

| | | | |
|---|---|---|---|
| CAS | Chemical Abstracts Service | LOQ | limit of quantitation |
| DL | detection limit | ug/kg | micrograms per kilogram |
| LOD | limit of detection | | |

[a] Evaluating DNAPL Source and Migration Zones: M-Area Settling Basin and the Western Sector of A/M Area, Savannah River Site (U). Prepared for the United States Department of Energy. Westinghouse Savannah River Company (Westinghouse). 2001.

Surrogate parameters for this analytical method and associated QC limits are available in Table 1.

## VOCs by EPA Method 8260B – Matrix: Water

| Analyte | CAS Number | Project Screening Level (ug/L) | Project Screening Level Reference[a] | Project Quantitation Limit Goal (ug/L) | Laboratory-specific | | |
|---|---|---|---|---|---|---|---|
| | | | | | LOQ (ug/L) | LOD (ug/L) | DL (ug/L) |
| 1,1,1-Trichloroethane | 71-55-6 | 200 | MCL | 1 | 1 | 0.2 | 0.1 |
| 1,1-Dichloroethane | 75-34-3 | 5.0 | MCL | 1 | 1 | 0.2 | 0.1 |
| 1,1-Dichloroethene | 75-35-4 | 6.0 | MCL | 1 | 1 | 0.2 | 0.1 |
| 1,2-Dichloroethane | 107-06-2 | 0.5[b] | MCL | 1 | 1 | 0.2 | 0.1 |
| cis-1,2-Dichloroethene | 156-59-2 | 6.0 | MCL | 1 | 1 | 0.2 | 0.1 |
| Tetrachloroethene (PCE) | 127-18-4 | 5.0 | MCL | 1 | 1 | 0.2 | 0.15 |
| Trichloroethene (TCE) | 79-01-6 | 5.0 | MCL | 1 | 1 | 0.2 | 0.1 |
| Vinyl Chloride | 75-01-4 | 0.5[b] | MCL | 1 | 1 | 0.2 | 0.1 |

| | | | |
|---|---|---|---|
| CAS | Chemical Abstracts Service | MCL | Maximum Contaminant Level |
| DL | detection limit | ug/L | micrograms per liter |
| LOD | limit of detection | | |
| LOQ | limit of quantitation | | |

[a] The State of California MCLs for drinking water (November, 2008) were selected as project screening levels for this investigation.

[b] The analytical method selected provides the lowest reporting limits available using routinely accepted methodology. Since the Project Screening Level is less than the laboratory-specific LOQ, this analyte will be reported to the LOD.

Surrogate parameters for this analytical method and associated QC limits are available in Table 1.

# SAP WORKSHEET #18 – SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| ***Permanent Groundwater Monitoring Well Sampling (1st Event)*** | | | | | |
| SB75MW01A-Q311-01 | Groundwater | 42[5] | VOCs | 1 | AEI F30-002 |
| SB75MW01B-Q311-01 | Groundwater | 85[5] | VOCs | 1 | AEI F30-002 |
| SB75MW02A-Q311-01 | Groundwater | 45[5] | VOCs | 1 | AEI F30-002 |
| SB75MW02B-Q311-01 | Groundwater | 95[5] | VOCs | 1 | AEI F30-002 |
| SB75MW03A-Q311-01 | Groundwater | 48[5] | VOCs | 1 | AEI F30-002 |
| SB75MW03B-Q311-01 | Groundwater | 85[5] | VOCs | 1 | AEI F30-002 |
| SB75MW04A-Q311-01 | Groundwater | 43[5] | VOCs | 1 | AEI F30-002 |
| SB75MW04B-Q311-01 | Groundwater | 87[5] | VOCs | 1 | AEI F30-002 |
| SB75MW05A-Q311-01 | Groundwater | 41[5] | VOCs | 1 | AEI F30-002 |
| SB75MW05B-Q311-01 | Groundwater | 85[5] | VOCs | 1 | AEI F30-002 |
| ***Permanent Groundwater Monitoring Well Sampling (2nd Event)*** | | | | | |
| SB75MW01A-Q411-01 | Groundwater | 42[5] | VOCs | 1 | AEI F30-002 |
| SB75MW01B-Q411-01 | Groundwater | 85[5] | VOCs | 1 | AEI F30-002 |
| SB75MW02A-Q411-01 | Groundwater | 45[5] | VOCs | 1 | AEI F30-002 |
| SB75MW02B-Q411-01 | Groundwater | 95[5] | VOCs | 1 | AEI F30-002 |
| SB75MW03A-Q411-01 | Groundwater | 48[5] | VOCs | 1 | AEI F30-002 |

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| SB75MW03B-Q411-01 | Groundwater | 85[5] | VOCs | 1 | AEI F30-002 |
| SB75MW04A-Q411-01 | Groundwater | 43[5] | VOCs | 1 | AEI F30-002 |
| SB75MW04B-Q411-01 | Groundwater | 87[5] | VOCs | 1 | AEI F30-002 |
| SB75MW05A-Q411-01 | Groundwater | 41[5] | VOCs | 1 | AEI F30-002 |
| SB75MW05B-Q411-01 | Groundwater | 85[5] | VOCs | 1 | AEI F30-002 |

Notes and Acronyms:
[1] SOPs are available in Attachment 1 of the original SAP.
[2] Screening sample identifications will include the sample depth as described in WS #27 of the original SAP.
[3] Screening samples will be collected approximately every 2 feet to a maximum depth of 310 feet bgs. Prior to drilling activities, each boring location will be cleared with a non-intrusive method (i.e air-knife, hand-auger) to a depth of approximately 5 ft bgs.
[4] Confirmatory soil samples may be collected for fixed-base laboratory analysis if the geologist observes stains, odors, or PID readings in the soil core that are interpreted as residual soil contamination or NAPL. Soil sample identifications will include the sample depth as described in WS #27 of the original SAP.
[5] This depth represents the anticipated pump intake depth at or near the mid-point of the 10-foot-long well screen. The groundwater monitoring well designs will be optimized in the field based on lithologic and screening data as described in WS #17 of the original SAP. Refer to well as-built diagrams prior to sampling to confirm pump intake depth.

| | |
|---|---|
| bgs | below ground surface |
| SOP | Standard Operating Procedure |
| VOC | volatile organic compound |
| WS | worksheet |

## SAP WORKSHEET #20 – FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

| Matrix | Analytical Group | No. of Sampling Locations | No. of Field Duplicates | No. of MS/MSDs | No. of Field Blanks | No. of Equip. Blanks | No. of Trip Blanks | No. of PT Samples[1] | Total No. of Samples to Lab |
|---|---|---|---|---|---|---|---|---|---|
| Soil | VOCs | 35 | 0[2] | 2/2 | 1 | 3 | 1 | 0 | 44 |
| Water | VOCs | 10[3] | 1 | 1/1 | 1 | 4[4] | 1[5] | 0 | 19 |

Notes and Acronyms:

[1] PT samples will not be collected during this project.

[2] Soil duplicate samples will not be collected as part of the sampling efforts since assessment of spatial heterogeneity is not an objective of this project.

[3] The number of groundwater sampling locations and field quality control samples listed in the table represent ***one sampling event***. Up to two sampling events are planned, so ***this is the number of water and QC samples that should be collected during each sampling event***.

[4] Sampling is assumed to take place over a four day period. Equipment blanks will be collected daily.

[5] Field sampling crew will maintain custody of all samples until each sampling event is complete. The lab courier service will be utilized at the completion of each sampling event.

MS/MSD matrix spike/matrix spike duplicate
PT proficiency testing
VOCs volatile organic compounds

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# SAP Tables

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# TABLE 1

## Precision and Accuracy Requirements for U.S. EPA Method 8260B

| Analyte | Precision (RPD) | Accuracy (% Recovery) | |
|---|---|---|---|
| | | MS | LCS |
| ***Volatile Organic Compounds by EPA Method 8260B*** | ***Soil*** | | |
| 1,1,1-trichloroethane (1,1,1-TCA) | 50 | 60-130 | 60-130 |
| 1,1-dichloroethane (1,1-DCA) | 50 | 70-140 | 70-130 |
| 1,1-dichloroethene (1,1-DCE) | 50 | 50-140 | 60-130 |
| 1,2-dichloroethane (1,2-DCA) | 50 | 60-160 | 60-140 |
| cis-1,2-Dichloroethene (cis-1,2-DCE) | 50 | 70-140 | 70-130 |
| Tetrachloroethylene (PCE) | 50 | 70-130 | 70-130 |
| Trichloroethene (TCE) | 50 | 60-140 | 70-130 |
| Vinyl Chloride (VC) | 50 | 60-150 | 60-150 |
| **Surrogates** | | | |
| 1,2-Dichloroethane -d 4 | -- | 60-160 | 70-140 |
| Toluene-d8 | -- | 70-140 | 70-130 |
| 4-Bromofluorobenzene | -- | 70-150 | 70-130 |
| ***Volatile Organic Compounds by EPA Method 8260B*** | ***Water*** | | |
| 1,1,1-trichloroethane (1,1,1-TCA) | 30 | 70-130 | 70-130 |
| 1,1-dichloroethane (1,1-DCA) | 30 | 70-130 | 70-130 |
| 1,1-dichloroethene (1,1-DCE) | 30 | 60-140 | 60-130 |
| 1,2-dichloroethane (1,2-DCA) | 30 | 70-140 | 70-130 |
| cis-1,2-Dichloroethene (cis-1,2-DCE) | 30 | 70-140 | 70-130 |
| Tetrachloroethylene (PCE) | 30 | 70-130 | 70-130 |
| Trichloroethene (TCE) | 30 | 60-140 | 70-130 |
| Vinyl Chloride (VC) | 30 | 60-160 | 60-150 |
| **Surrogates** | | | |
| 1,2-Dichloroethane -d 4 | -- | 70-140 | 70-140 |
| Toluene-d8 | -- | 70-140 | 70-130 |
| 4-Bromofluorobenzene | -- | 70-130 | 70-130 |

Notes:

| | |
|---|---|
| RPD | relative percent difference as calculated by the pair of analytical duplicates |
| % Recovery | percent recovery of spiked compounds |
| MS | matrix spike |
| LCS | laboratory control sample (blank spike) |

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# TABLE 2
## Additional References

| Author | Source |
|---|---|
| AMJV and Brady, 2011 | Final Sampling and Analysis Plan, Preliminary Assessment/ Site Inspection, IRP Site 75, Agricultural Well KAYO-SB, Naval Weapons Station Seal Beach, Seal Beach, California. June 30. |
| Tetra Tech EC, Inc., 2007 | Final Well Decommissioning Report. February 12. |
| Westinghouse Savannah River Company (Westinghouse). 2001. | Evaluating DNAPL Source and Migration Zones: M-Area Settling Basin and the Western Sector of A/M Area, Savannah River Site (U). Prepared for the United States Department of Energy. June 15. |

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# SAP Figures

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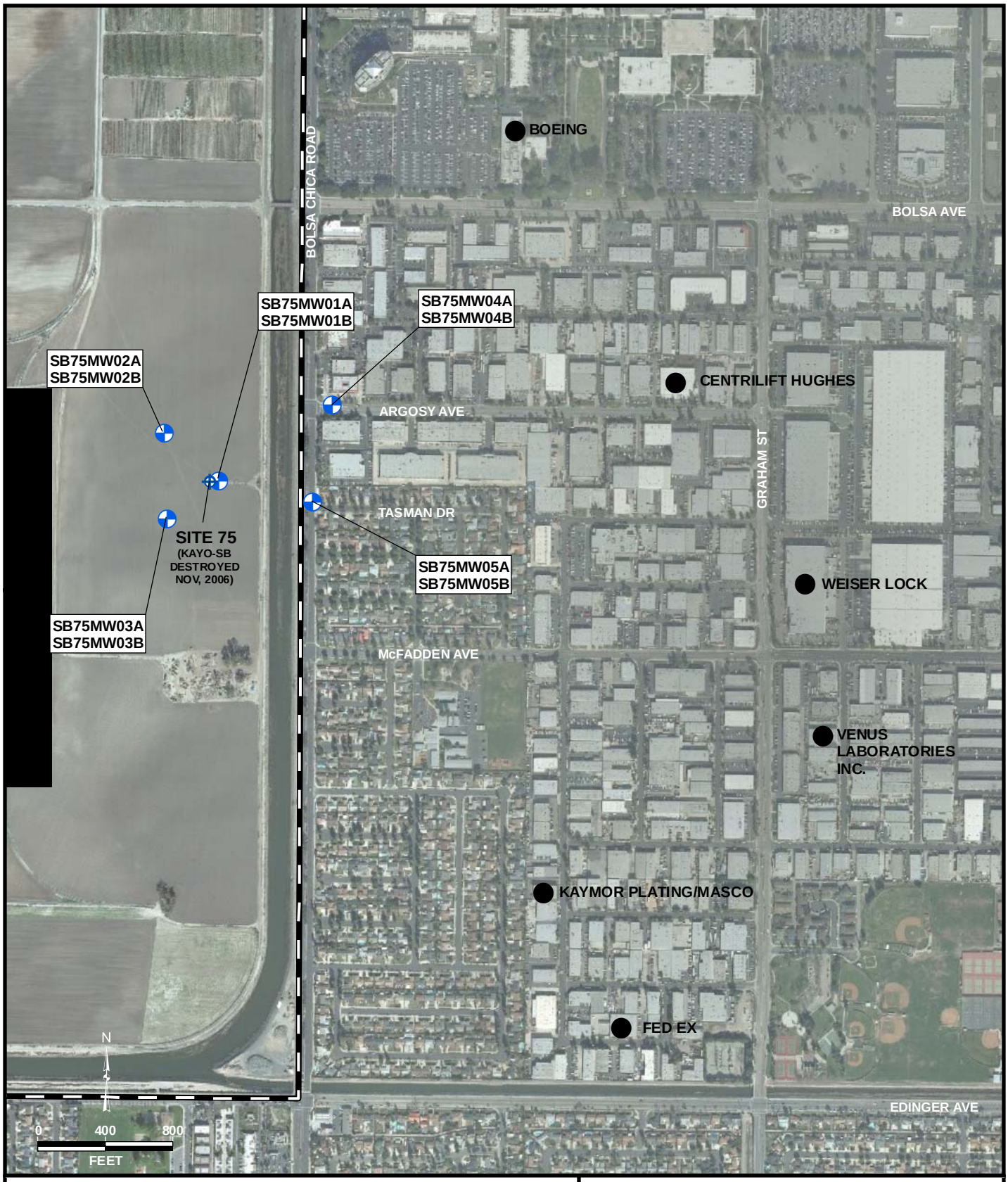


LEGEND

- WELL PAIR LOCATION
- SITE 75, FORMER AGRICULTURAL WELL KAYO-SB
- NON-NAVY SITE NEARBY SITE 75
  NOTE: DOES NOT INDICATE LOCATION
  OF GROUNDWATER MONITORING WELLS
- BASE BOUNDARY

WELL LOCATIONS

SITE 75
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

AMJV/BRADY

DATE: Aug 1, 2011
FILE: Loc_110801

FIGURE: 1A

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## 1.0 SAP WORKSHEET #1 – TITLE AND APPROVAL PAGE

**FINAL**
**SAMPLING AND ANALYSIS PLAN**
**(Field Sampling Plan and Quality Assurance Project Plan)**

# PRELIMINARY ASSESSMENT/SITE INSPECTION
# INSTALLATION RESTORATION PROGRAM SITE 75
# AGRICULTURAL WELL KAYO-SB
# NAVAL WEAPONS STATION SEAL BEACH
# SEAL BEACH, CALIFORNIA

**June 30, 2011**

**Prepared for:**
**DEPARTMENT OF THE NAVY**
**Naval Facilities Engineering Command Southwest**
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**Prepared under:**
**Contract No. N62473-09-D-2613**
**Delivery Order No. 0018**
**DCN: AMJV-2613-0018-0006**

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## 1.1 Executive Summary

This Sampling and Analysis Plan (SAP) presents a planned groundwater assessment that will be conducted to support a Preliminary Assessment (PA) and Site Inspection (SI) at Installation Restoration Program Site 75 (Site 75), Naval Weapons Station (NAVWPNSTA) Seal Beach, California. This document was prepared by the project team of the Accord MACTEC Joint Venture (AMJV), which is comprised of Accord Engineering, Inc. (AEI) and MACTEC Engineering and Consulting, Inc. (MACTEC) and Richard Brady & Associates (BRADY) for the Department of the Navy (DoN), Naval Facility Engineering Command Southwest (NAVFAC SW) under Contract Number N62473-09-D-2613, Delivery Order No. 0018.

The DoN is the lead agency on this project, with regulatory oversight by the California Environmental Protection Agency Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) - Santa Ana Region.

The objective of this PA/SI is to evaluate whether or not volatile organic compounds (VOCs) previously discovered in groundwater from the former agricultural well, KAYO-SB, located on Navy property, originate from a source within the Navy property line. To achieve this goal, this investigation is designed to use a dynamic work strategy to screen target contaminants of potential concern (COPCs) in “real time”, the data from which will be used to optimize the design of permanent groundwater monitoring wells. Additionally, this investigation will provide characterization data to refine the nature and extent of contamination, assess the exposure pathways to human health and the environment, and refine the conceptual site model (CSM) for Site 75 sufficient to determine if there is a need for further investigation or cleanup.

To achieve the goals of this investigation, up to nine permanent wells will be designed and installed based on site lithology and proposed screening data obtained from continuous-cored soil borings. It is anticipated that the first proposed boring will be advanced to approximately 310 feet below ground surface (bgs), adjacent to the former agricultural well KAYO-SB. The lithology will be logged by a Professional Geologist and VOC concentration screening measurements will be collected approximately every 2 lineal feet using direct sampling ion trap mass spectrometry (DSITMS) by EPA Method 8265. While performing the VOC screening on the continuous geologic cores, if the geologist observes stains, odors, or a PID reading in the soil core that is interpreted as residual soil contamination or NAPL, a confirmation soil sample may be collected and analyzed for target VOCs by a fixed-base analytical laboratory. The results of the detailed geologic and VOC log will be used to identify the depth and water-bearing unit(s) through which VOCs are migrating, and will preliminarily guide the boring depths and subsequent monitoring well designs at the other proposed locations. The depths of the additional wells will be adjusted based on the detailed geologic logs and targeted VOC screening performed during advancement of each proposed boring.

After completion and development, groundwater samples will be collected from the newly installed wells using low-flow methodology and analyzed for target VOCs by a fixed-base analytical laboratory. Two consecutive quarterly groundwater monitoring events are planned. Analytical data will be validated by an independent third party reviewer.

The overall quality of tasks performed for this assessment will be assured by conformance to protocols established for sample collection, analytical procedures, and data management. A summary of the quality assurance/quality control (QA/QC) protocols that will be implemented throughout the investigation is provided in detail in this SAP. QA objectives and detail regarding data management, verification, and validation are also provided in this SAP. Data collected for this assessment will be compiled and the multiple lines of evidence will be reviewed to determine whether previously detected target VOCs in groundwater originate from a Navy or non-Navy source.

# SAP WORKSHEETS

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Table 2 Additional References

## FIGURES

Figure 1 Facility Location Map
Figure 2 Site Location Map
Figure 3 General CSM Cross Section
Figure 4 Historical VOC Groundwater Data at Nearby Sites
Figure 5 Proposed Boring/Well Locations

## ATTACHMENTS

Attachment 1 Standard Operating Procedures
Attachment 2 Form Examples
Attachment 3 Analytical Standard Operating Procedures

# ACRONYMS / ABBREVIATIONS

| | |
|---|---|
| AEI | Accord Engineering, Inc. |
| AMJV | Accord MACTEC Joint Venture |
| APP | Accident Prevention Plan |
| AR | Administrative Record |
| bgs | below ground surface |
| BRADY | Richard Brady and Associates |
| °C | degrees Celsius |
| CA | Corrective Action |
| CAS | Chemical Abstracts Service |
| CCC | criteria continuing concentration |
| CCV | continuing calibration verification |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| CFR | Code of Federal Regulations |
| CLP | Contract Laboratory Program |
| COC | Chain of Custody |
| COD | coefficient of determination |
| COPCs | chemicals of potential concern |
| CPR | cardiopulmonary resuscitation |
| CSM | conceptual site model |
| 1,1-DCA | 1,1-dichloroethane |
| 1,2-DCA | 1,2-dichloroethane |
| DCC | daily calibration check |
| 1,1-DCE | 1,1-dichloroethene |
| DCN | document control number |
| cis-1,2-DCE | cis-1,2-dichloroethylene |
| DI | de-ionized |
| DO | dissolved oxygen |
| DoD | Department of Defense |
| DoN | Department of the Navy |
| DQI | Data Quality Indicator |
| DQO | Data Quality Objective |
| DSITMS | direct sampling ion trap mass spectrometry |
| DTSC | Department of Toxic Substance Control |
| EDD | electronic data deliverable |
| EDR | Environmental Data Resources |
| ELAP | Environmental Laboratory Accreditation Program |
| EPA | Environmental Protection Agency |
| EWI | Environmental Work Instruction |
| FCN | Field Change Notice |
| ft | feet |
| ft/ft | foot vertical/foot horizontal |
| GC | gas chromatograph |
| GC/MS | gas chromatograph/mass spectrometer |
| GeoTracker | geographical environmental information management system |

| | |
|---|---|
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| HCl | hydrochloric acid |
| HSO | Health and Safety Officer |
| IATA | International Air Transportation Association |
| ICAL | initial calibration |
| ICV | initial calibration verification |
| ID | identification |
| IR | Installation Restoration |
| IRP | Installation Restoration Program |
| LCS | laboratory control sample |
| LDC | Laboratory Data Consultants Inc. |
| LQAP | Laboratory Quality Assurance Program |
| MACTEC | MACTEC Engineering and Consulting, Inc. |
| ug/L | micrograms per liter |
| MDL | method detection limit |
| mL | milliliter |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| MSL | mean sea level |
| mV | millivolts |
| N/A | not applicable |
| NA | not available |
| NAPL | non-aqueous phase liquid |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| NAVWPNSTA | Naval Weapons Station |
| NEDD | Navy Electronic Data Deliverable |
| NFESC | Naval Facilities Engineering Service Center |
| NIRIS | Naval Installation Restoration Information Solution |
| NTU | nephelometric turbidity units |
| OCHCA | Orange County Health Care Agency |
| ORP | oxidation reduction potential |
| OSHA | Occupational Safety and Health Administration |
| PA | Preliminary Assessment |
| PCE | tetrachloroethylene |
| pH | potential of hydrogen |
| PID | photoionization detector |
| PM | Program Manager |
| POC | Point of Contact |
| PPE | personal protective equipment |
| PT | proficiency testing (previously known as performance evaluation sample) |
| PVC | polyvinyl chloride |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAM | Quality Assurance Manager |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| QL | quantitation limit |

| | |
|---|---|
| QSM | Quality Systems Manual |
| RPD | relative percent difference |
| RPM | Remedial Project Manager |
| RTM | Remedial Technical Manager |
| %RSD | percent relative standard deviation |
| RSD | relative standard deviation |
| RSL | Regional Screening Level |
| RWQCB | Regional Water Quality Control Board |
| SAP | Sampling and Analysis Plan |
| SI | Site Inspection |
| Site 75 | Installation Restoration Program Site 75 |
| SOP | standard operating procedure |
| SPCC | system performance check compound |
| SSHP | site safety and health plan |
| 1,1,1-TCA | 1,1,1-trichloroethane |
| TCE | trichloroethylene |
| TPH | total petroleum hydrocarbon; quantified as diesel (-d), motor oil (-mo), and gasoline (-g) |
| TSA | technical systems audit |
| UFGU | upper fine grained unit |
| UFP-QAPP | Uniform Federal Policy for Quality Assurance Project Plans |
| U.S. EPA | United States Environmental Protection Agency |
| VC | vinyl chloride |
| VOA | volatile organic analytes |
| VOC | volatile organic compounds |
| WP | Work Plan |

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# 2.0 SAP WORKSHEET #2 – SAP IDENTIFYING INFORMATION

**Site Name/Number:** Site 75, Naval Weapons Station (NAVWPNSTA) Seal Beach, Seal Beach, California

**Operable Unit:** N/A

**Contractor Name**: Accord MACTEC Joint Venture (AMJV)

**Contract Number:** N62473-09-D-2613

**Contract Title:** Indefinite Delivery, Indefinite Quantity Architect/Engineering Contract for storm water, incidental potable water, ground water, and waste water environmental compliance at Naval and Marine Corps installations at various locations in CA, AZ, NV, NM, UT, CO and other Federal and Department of Defense installations nationwide.

**Work Assignment Number (optional):** Delivery Order No. 0018

**Document Control Number:** AMJV-2613-0018-0002

## 2.1 Reference Documents

This SAP was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (U.S. Environmental Protection Agency [EPA], 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS* (EPA, 2002), and with additional guidance from:

Department of Defense Environmental Data Quality Workgroup. 2000. *Best Practices for Data Quality Oversight of Environmental Sampling and Testing Activities*. November.

_____. 2010. *Quality Systems Manual for Environmental Laboratories*, Version 4.2. October.

Department of the Navy (DoN). 2006. *Environmental Restoration Program Manual (NERP)*. August.

_____. 2009. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual, Rev. 1*. NAVSEA T0300-AZ-PRO-010. August.

Navy Facilities Engineering Command Southwest (NAVFAC SW). 2001. *Environmental Work Instruction No. 1 (3EN2.1). Chemical Data Validation*. November.

_____. 2005. *Environmental Work Instruction No. 6 (EVR.6). Environmental Data Management and Required Electronic Delivery Standards*. April.

_____. 2006. *Environmental Work Instruction No. 2 (EVR.2). Review, Approval, Revision and Amendment of Sampling and Analysis Plans (SAPs)*. April.

_____. 2007. *Environmental Work Instruction No. 4 (EVR.4). Implementing and Maintaining the Comprehensive Response, Compensation and Liability Act (CERCLA) Administrative Record (AR) and Compendium at NAVFAC Southwest*. May.

_____. 2010. *Environmental Work Instruction No. 3 (EV3.3). Selecting an Environmental Laboratory That Meets Environmental Restoration Program Requirements*. August.

_____. 2011. *Environmental Work Instruction No. 2 (EV3.2). Review, Approval, Revision and Amendment of Sampling and Analysis Plans (SAPs)*. January.

Naval Facilities Engineering Service Center (NFESC). 1999. *Navy Installation Restoration (IR) Chemical Data Quality Manual (CDQM)*. September.

U.S. Environmental Protection Agency (EPA). 1988. *CERCLA Compliance with Other Laws Manual, Draft Guidance*. EPA/540/G-89/006. Office of Emergency and Remedial Response, Washington, DC. August.

_____. 1994. *Guidance for the Data Quality Objectives (DQO) Process*, EPA QA/G-4, Final, September 1994.

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_____. 2002. *Guidance for Quality Assurance Project Plans*, EPA QA/G-5. December.

_____. 2004. *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/012. February.

_____. 2005. *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)*, EPA-505-B-04-900A. March.

_____. 2006. *Guidance on Systematic Planning Using the DQO Process.* EPA QA/G-4. Office of Environmental Information EPA/240/B-06/001. February.

_____. 2007. *Test Methods for Evaluation of Solid Wastes*, SW-846, Update IV.

_____. 2008. *Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, June.

## 2.2 Regulatory Program

The Navy conducts site investigations at NAVWPNSTA Seal Beach under the Installation Restoration (IR) Program, in accordance with Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act. The lead federal agency is the Department of the Navy (DoN). The California Environmental Protection Agency Department of Toxic Substance Control (DTSC) and the California Regional Water Quality Control Board - Santa Ana Region (RWQCB) are the lead regulatory agencies providing project support and oversight.

## 2.3 Type of SAP

This is a Project-Specific SAP.

## 2.4 Scoping Sessions

| Scoping Session | Date |
|---|---|
| Project Kickoff Meeting | October 12, 2010 |
| Partnering Meeting to Resolve Comments | June 1, 2011 |

## 2.5 Relevant SAP

List dates and titles of any SAP documents written for previous site work that are relevant to the current assessment.

| Title | Date |
|---|---|
| No Previous SAP Applicable | |

## 2.6 Project Stakeholders

Primary stakeholders in this project include the DoN, RWQCB and DTSC. Additional stakeholders may be identified during the course of this assessment.

## 2.7 Lead organization

As lead agency, NAVFAC SW will be responsible for ensuring the collection of representative media samples, accurate analysis of samples, verification and independent third-party validation of data, and archival and reporting of data in accordance with this SAP (see Worksheet #7 for detailed list of data users).

## 2.8 Omitted SAP Elements

SAP elements or required information that has been omitted because they are either not applicable to this project or are provided elsewhere, are listed below:

No special training is required for this SAP (Worksheet #8).

## 2.9 Not Applicable SAP Worksheets

SAP elements and required information that are not applicable to the project are noted below. Further explanation is provided on the previous page and in the appropriate SAP worksheet(s).

| UFP-QAPP Worksheet # | Required Information | Crosswalk to Related Information |
|---|---|---|
| **A. Project Management** | | |
| *Documentation* | | |
| **1** | Title and Approval Page | |
| **2** | Table of Contents<br>SAP Identifying Information | |
| **3** | Distribution List | |
| **4** | Project Personnel Sign-Off Sheet | |
| *Project Organization* | | |
| **5** | Project Organizational Chart | |
| **6** | Communication Pathways | |
| **7** | Personnel Responsibilities and Qualifications Table | |
| **8** | Special Personnel Training Requirements Table | Worksheet #2, Subsection 2.8 |
| *Project Planning/ Problem Definition* | | |
| **9** | Project Planning Session Documentation (including Data Needs tables)<br>Project Scoping Session Participants Sheet | |
| **10** | Problem Definition, Site History, and Background.<br>Site Maps (historical and present) | |
| **11** | Site-Specific Project Quality Objectives | |
| **12** | Measurement Performance Criteria Table | |
| **13** | Sources of Secondary Data and Information<br>Secondary Data Criteria and Limitations Table | |
| **14** | Summary of Project Tasks | |
| **15** | Reference Limits and Evaluation Table | |
| **16** | Project Schedule/Timeline Table | |
| **B. Measurement Data Acquisition** | | |
| *Sampling Tasks* | | |
| **17** | Sampling Design and Rationale | |
| **18** | Sampling Locations and Methods/<br>SOP Requirements Table<br>Sample Location Map(s) | |
| **19** | Analytical Methods/SOP Requirements Table | |
| **20** | Field QC Sample Summary Table | |
| **21** | Project Sampling SOP References Table<br>Sampling SOPs | |
| **22** | Field Equipment Calibration, Maintenance, Testing, and Inspection Table | |

**Table Continues**

## TABLE 2.9 CONTINUED

| UFP-QAPP Worksheet # | Required Information | Crosswalk to Related Information |
|---|---|---|
| *Analytical Tasks* | | |
| **23** | Analytical SOPs<br>Analytical SOP References Table | |
| **24** | Analytical Instrument Calibration Table | |
| **25** | Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table | |
| *Sample Collection* | | |
| **26** | Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal<br>Sample Handling Flow Diagram | |
| **27** | Sample Custody Requirements, Procedures/SOPs Sample Container Identification<br>Example COC Form and Seal | |
| *QC Samples* | | |
| **28** | QC Samples Table<br>Screening/Confirmatory Analysis Decision Tree | |
| *Data Management Tasks* | | |
| **29** | Project Documents and Records Table | |
| **30** | Analytical Services Table<br>Analytical and Data Management SOPs | |
| **C. Assessment Oversight** | | |
| **31** | Planned Project Assessments Table<br>Audit Checklists | |
| **32** | Assessment Findings and CA Responses Table | |
| **33** | QA Management Reports Table | |
| **D. Data Review** | | |
| **34** | Verification (Step I) Process Table | |
| **35** | Validation (Steps IIa and IIb) Process Table | |
| **36** | Validation (Steps IIa and IIb) Summary Table | |
| **37** | Usability Assessment | |

Acronyms:

| | |
|---|---|
| CA | Corrective Action |
| COC | Chain of Custody |
| SOP | Standard Operating Procedure |
| QA | Quality Assurance |
| QC | Quality Control |

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## 3.0 SAP WORKSHEET #3 – DISTRIBUTION LIST

| Name of SAP Recipients | Title/Role | Organization | Telephone Number (Optional) | E-mail Address or Mailing Address |
|---|---|---|---|---|
| Ms. Brenda Reese | Project RPM | NAVFAC SW | 619.532.4209 | brenda.reese@navy.mil<br>1220 Pacific Highway<br>Bldg. 128, Mail Room<br>San Diego, CA 92132<br>Attn: Code JE30.BR |
| Ms. Pei-Fen Tamashiro | IRP Coordinator | NAVFAC SW | 562.626.7897 | pei-fen.tamashiro@navy.mil<br>800 Seal Beach Boulevard, Building 230<br>Seal Beach, CA 90740<br>Attn: Code N45W |
| Mr. John Broderick | Agency Representative | RWQCB | 951.782.4494 | jbroderick@waterboards.ca.gov<br>3737 Main St., Suite 500<br>Riverside, CA 92501-3348 |
| Mr. Stephen Niou | Agency Representative | DTSC | 714.484.5458 | SNiou@dtsc.gov<br>5796 Corporate Avenue<br>Cypress, CA 90630-4732 |
| Mr. Narciso Ancog | QAO | NAVFAC SW | 619.532.3046 | narciso.ancog@navy.mil<br>1220 Pacific Highway<br>Bldg. 128, Mail Room<br>San Diego, CA 92132<br>Attn: Code EVR.NA |
| Ms. Diane Silva | Administrative Records | NAVFAC SW | 619.532.3676 | diane.silva@navy.mil<br>1220 Pacific Highway<br>Bldg. 128, Mail Room<br>San Diego, CA 92132<br>ATTN.: Code EVR.DS<br>FISC Bldg. 1, 3rd Floor |

**Table Continues**

## SAP WORKSHEET #3 - DISTRIBUTION LIST – CONTINUED

| Name of SAP Recipients | Title/Role | Organization | Telephone Number (Optional) | E-mail Address and/or Mailing Address |
|---|---|---|---|---|
| Mr. Qihai Chen | Project Manager | AMJV | 858.771.3559 | qchen@accordeng.com<br>6050 Santo Road, Suite 175<br>San Diego, CA 92124 |
| Mr. Rod Reeve | Program Manager | AMJV | 858.771.3537 | rreeve@accordeng.com<br>6050 Santo Road, Suite 175<br>San Diego, CA 92124 |
| Mr. Tim Shields | Program Manager | BRADY | 858.634.4514 | tshields@rbrady.net<br>3710 Ruffin Road<br>San Diego, CA 92123 |
| Mr. Jesse MacNeill | QAM | BRADY | 858.634.4549 | jmacneill@rbrady.net<br>3710 Ruffin Road<br>San Diego, CA 92123 |
| Mr. Ye Myint | Project Manager | EMAX Laboratories, Inc. | 310.618.8889 | ymyint@emaxlabs.com<br>1835 W 205th. St.<br>Torrance, CA 90501 |
| Ms. Linda Rauto | Operations Manger | LDC, Inc. | 760.634.0437 | lrauto@lab-data.com<br>7750 El Camino Real, Ste 2L<br>Carlsbad, CA 92009 |

Acronyms:

| | |
|---|---|
| AR | Administrative Record |
| AMJV | Accord MACTEC Joint Venture |
| BRADY | Richard Brady & Associates |
| DTSC | Department of Toxic Substances Control |
| IRP | Installation Restoration Program |
| LDC | Laboratory Data Consultants, Inc. |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| PM | Project Manager |
| POC | Point of Contact |
| QAM | Quality Assurance Manager |
| QAO | Quality Assurance Officer |
| RPM | Remedial Project Manager |
| RTM | Remedial Technical Manager |
| RWQCB | Regional Water Quality Control Board Santa Ana Region |
| SAP | Sampling and Analysis Plan |

## 4.0 SAP WORKSHEET #4 – PROJECT PERSONNEL SIGN-OFF SHEET

Key personnel will sign this sheet as part of the readiness review conducted prior to field work.

| Name | Organization/Title/Role | Telephone Number (optional) | Signature/E-mail receipt | SAP Section Reviewed | Date SAP Read |
|---|---|---|---|---|---|
| Mr. James Albright | AMJV Site HSO | 714.241.7200 | | All Worksheets | |
| Mr. Fred Essig | BRADY Project Manager | 858.634.4552 | | All Worksheets | |
| Mr. Ye Myint | EMAX Laboratories, Inc. Project Manager | 310.618.8889 | | Worksheets 12, 15,19, 20, 22, 23, 24, 25, 26, 27, 28, 30, 34, 35 | |
| Ms. Linda Rauto | LDC, Inc. Operations Manger | 760.634.0437 | | Worksheets 12, 15, 20, 22, 23, 24, 25, 28, 30, 34, 35, 36 | |

Acronyms:
AMJV Accord-MACTEC Joint Venture
BRADY Richard Brady & Associates
HSO Health and Safety Officer
LDC Laboratory Data Consultants Inc.

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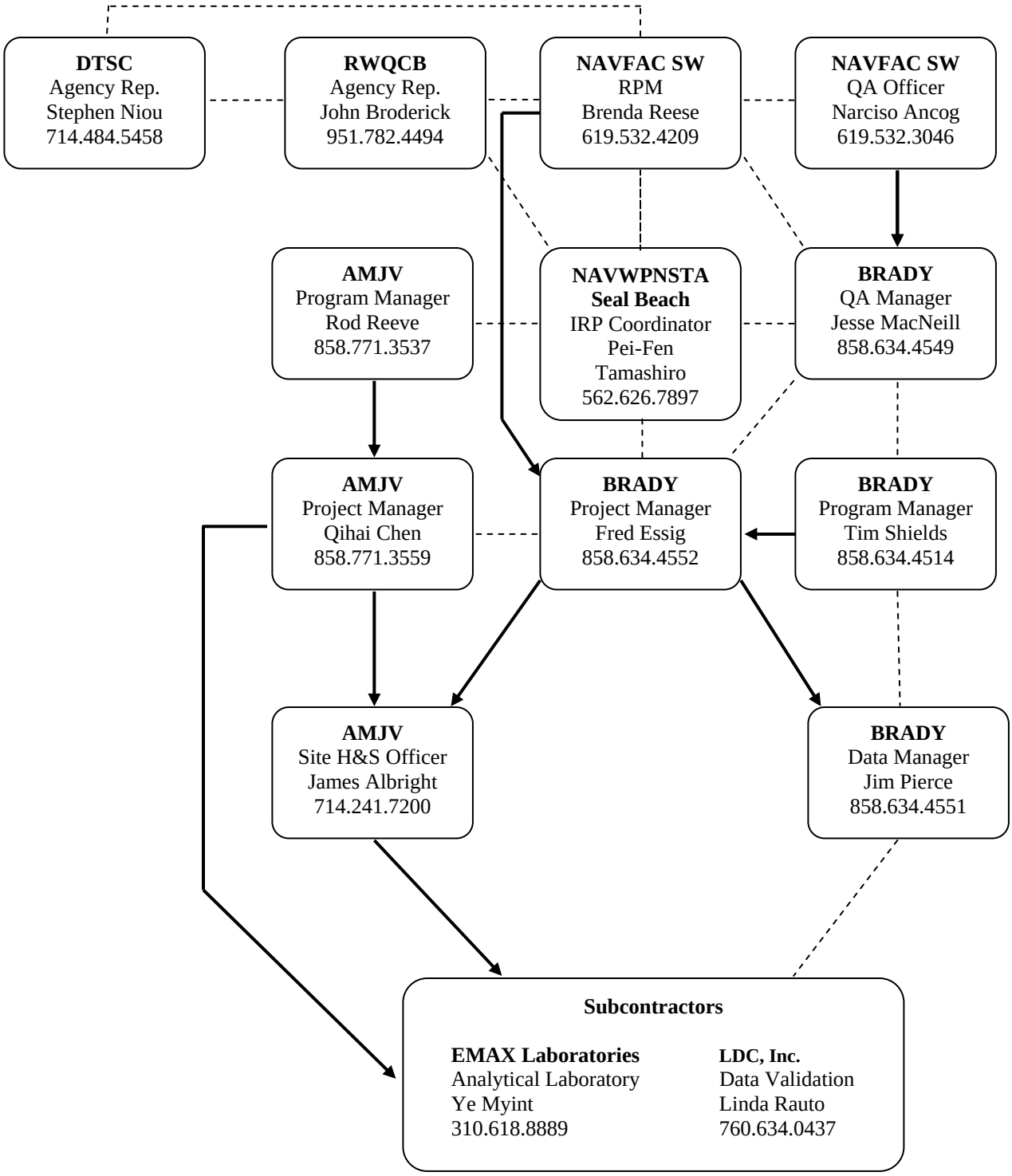
## 5.0 SAP WORKSHEET #5 – PROJECT ORGANIZATIONAL CHART

Lines of Authority ——— Lines of Communication .....



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## 6.0 SAP WORKSHEET #6 – COMMUNICATION PATHWAYS

| Communication Drivers | Responsible Affiliation | Name | Phone Number and/or E-mail | Procedure |
|---|---|---|---|---|
| FCN | BRADY PM | Fred Essig | 858.634.4552<br>fessig@rbrady.net | The field team leader will document any deviation from the SAP, including minor changes, major changes, or significant changes, by notifying the Project Team QAM and PM by phone and e-mail within 24 hours and will submit a FCN within 48 hours. All completed FCNs will be included as an appendix in the final report. The Project Team QAM will inform the NAVFAC SW QAO of any major or significant changes formalized in an FCN. |
| | AMJV PM | Qihai Chen | 858.771.3559<br>qchen@accordeng.com | |
| Field Audit | BRADY QAM | Jesse MacNeill | 858.634.4549<br>jmacneill@rbrady.net | The Project Team QAM may conduct a field audit during project fieldwork. Audit results are maintained in Project Team's project and QA files. Any issues requiring corrective action will be documented and assigned an appropriate response period. |
| Stop Work | BRADY QAM | Jesse MacNeill | 858.634.4549<br>jmacneill@rbrady.net | The Project Team's QAM, PM, HSO, NAVFAC SW RPM, or NAVFAC SW QAO may stop work in response to any serious quality or safety related issue, if warranted. In this case, the issue and proposed corrective action will be documented with planned timing for implementation. The Stop Work Notice will be submitted to the NAVFAC SW QAO and RPM by e-mail within 24 hours. |
| | BRADY PM | Fred Essig | 858.634.4552<br>fessig@rbrady.net | |
| | AMJV PM | Qihai Chen | 858.771.3559<br>qchen@accordeng.com | |
| | AMJV HSO | James Albright | 714.241.7200<br>JAlbright@accordeng.com | |
| | NAVFAC SW RPM | Brenda Reese | 619.532.4209<br>brenda.reese@navy.mil | |
| | NAVFAC SW POC | Pei-Fen Tamashiro | 562.626.7897<br>pei-fen.tamashiro@navy.mil | |
| | NAVFAC SW QAO | Narciso Ancog | 619.532.3046<br>narciso.ancog@navy.mil | |

**Table Continues**

| Communication Drivers | Responsible Affiliation | Name | Phone Number and/or E-mail | Procedure |
|---|---|---|---|---|
| Notification of Non-Usable Analytical Data | Program Chemist | Jesse MacNeill | 858.634.4549<br>jmacneill@rbrady.net | If significant problems are identified by the laboratory or the project team that impact the usability of the data (i.e. the data is rejected or the data quality objectives are not met), the Program Chemist will notify the NAVFACSW RPM and the NAVFACSW QAO within 24 hours or the next business day. |

Acronyms:

| | | | |
|---|---|---|---|
| AMJV | Accord MACTEC Joint Venture | | |
| BRADY | Richard Brady & Associates | QA | Quality Assurance |
| FCN | Field Change Notice | QAM | Quality Assurance Manager |
| HSO | Health and Safety Officer | QAO | Quality Assurance Officer |
| NAVFAC SW | Naval Facilities Engineering Command Southwest | RPM | Remedial Project Manager |
| PM | Project Manager | SAP | Sampling and Analysis Plan |

## 7.0 SAP WORKSHEET #7 – PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE

| Name | Title/Role | Organizational Affiliation | Responsibilities |
|---|---|---|---|
| Qihai Chen | Project Manager | AMJV | Responsible for implementing all activities specified in the Delivery Order. Supervises preparation of the WP and SAP by the Project Team. Responsible for ensuring AMJV's field team compliance with WP, SAP, SSHP and APP. Responsible for maintaining effective and timely communication between field team and AMJV management. |
| Jesse MacNeill | QA Manager | BRADY | Responsible for ensuring the Project Team's programmatic and project-specific compliance with QA policies generally, and this SAP specifically. Ensures SAP conforms to current NAVFAC SW and UFP-QAPP requirements. Ensures the Project Team maintains proper training, certification and experience to execute project-specified tasking.<br>Responsible for Project Team's environmental quality, including oversight to ensure compliance with Federal, State and local regulatory requirements and with Department of Navy policy; development of project plans; review of project-specific requirements as outlined in SAP; and support to Project Team. |
| Jim Pierce | Database Manager | BRADY | Responsible for developing, monitoring and maintaining the project database under guidance of Project Team PM and QAM. Ensures timely and accurate upload of project data to NEDD/NIRIS. Works with the QAM to resolve sample identification issues and geospatial data issues during fieldwork execution. |
| James Albright | H&S Manager/<br>On-Site Health & Safety Officer | AMJV | Responsible for implementing the Health and Safety Plan, determining appropriate site control measures, and identifying personal protection levels. Leads daily safety briefings for the Project Team, subcontractor personnel and site visitors. |
| Fred Essig | Project Manager | BRADY | Responsible for ensuring BRADY's field team compliance with WP, SAP, SSHP and APP. Responsible for maintaining effective and timely communication between field team and BRADY management. |
| Tim Shields | Environmental Program Manager | BRADY | Responsible for assigning appropriately trained and qualified staffing resources to project and for providing technical direction and field oversight to BRADY staff during SAP development and in execution of fieldwork. Responsible for ensuring effective and timely communication between Project Team and NAVFAC customer(s) and NAVWPNSTA Seal Beach facility representatives. |
| Narciso Ancog | QAO | NAVFAC SW | The QAO provides government oversight of the QA program, including review and approval of SAPs. The QAO has the authority to suspend affected projects or site activities if NAVFAC SW-approved quality requirements are not maintained. |

**Table Continues**

## SAP WORKSHEET # 7 - PERSONNEL RESPONSIBILITIES AND QUALIFICATIONS TABLE – CONTINUED

| Name | Title/Role | Organizational Affiliation | Responsibilities |
|---|---|---|---|
| Brenda Reese | Remedial Project Manager | NAVFAC SW | The RPM is the Navy manager directly responsible for project execution and coordination with base representatives, regulatory agencies and the NAVFAC SW management team. |
| Pei-Fen Tamashiro | Installation Restoration Program Coordinator | NAVFAC SW | Primary NAVWPNSTA Seal Beach point of contact for all project activities occurring on or near the facility. Ensures that project work is performed in accordance with NAVWPNSTA Seal Beach policies and procedures. The NAVWPNSTA Seal Beach POC has stop work authority. |
| Ye Myint | Project Manger | EMAX Laboratories, Inc. | Responsible for delivering analytical services that meet the requirements of this SAP. Reviews and understands all analytical requirements of this SAP. Works with the Project Team's QAM to confirm sample delivery schedules and ensure performance according to specifications. Reviews the laboratory data package before it is delivered to the Project Team QAM. |
| Erlinda Rauto | Operations Manager | LDC, Inc. | Conducts independent third-party validation of analytical data received from laboratory. Assures the data end user of known and documented data quality. |
| Andrew Hillstrand | Driller | Boart Longyear Environmental & Infrastructure Drilling Services | Responsible for ensuring that subcontractor activities are performed in accordance with state regulations and standards. |

Acronyms:

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| APP | Accident Prevention Plan |
| BRADY | Richard Brady & Associates |
| H&S | Health and Safety |
| LDS | Laboratory Data Consultants, Inc. |
| NAVFAC SW | Facilities Engineering Command Southwest |
| NAVWPNSTA | Naval Weapons Station |
| NEDD/NIRIS | Navy Electronic Data Deliverable/Naval Installation Restoration Information Solution |
| PM | Project Manager |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| RPM | Remedial Project Manager |
| SAP | Sampling and Analysis Plan |
| SSHP | Site Specific Health and Safety Plan |
| UFP-QAPP | Uniform Policy for Quality Assurance Project Plans |
| WP | Work Plan |

## 8.0 SAP WORKSHEET #8 – SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE

**No specialized training is required for this project.**

The Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) training requirements, as described in Title 29 Code of Federal Regulations (CFR) §1910.120, apply to those persons conducting field work. The regulation states that all personnel involved in characterization or remediation of an uncontrolled hazardous waste site shall be required to have 40 hours of certified training and three days of supervised field experience. In compliance with Title 29 CFR §1910.120, "general site workers," those individuals performing field activities such as collecting media samples, will have completed the appropriate OSHA HAZWOPER training course.

Personnel who are on site to perform occasional inspection and sampling activities and are unlikely to experience exposure over the permissible exposure limit and published exposure limits may be considered "workers on site only occasionally for a specific limited task." These workers must have 24 hours of training and one day of actual field experience. Employees who have minimal (low risk) exposure or low probability of exposure to hazardous substances are covered by other OSHA standards, such as the Hazard Communication standard, Title 29 CFR §1910.120.

All Project Team site workers will be 40-hour trained and will meet the minimum standard for supervised field experience. In compliance with regulatory procedures related to training, at least one supervisor having received the OSHA 8-hr Hazardous Waste Supervisor training will be on-site at all times. At least two Project Team personnel, properly trained and certified in adult first aid and CPR and trained in the blood borne pathogens, will be assigned and on-site at all times work is being performed.

All drilling and sampling activities will be supervised by a professional geologist licensed in California. Drilling will be conducted by a C-57 licensed driller.

Geophysical and surveying equipment will be operated in accordance with manufacturer's instructions by qualified personnel. Permanent monitoring well locations and elevations will be surveyed by a Professional Land Surveyor.

# 9.0 SAP WORKSHEET #9 – PROJECT SCOPING SESSION PARTICIPANTS SHEET

## 9.1 Internal Project Kickoff Meeting with NAVFAC SW, NAVWPNSTA Seal Beach and Contractor Team

| | |
|---|---|
| **Project Name: Site 75 PA/SI**<br>**Projected Date(s) of Sampling: 2011** | **Site Name: Site 75**<br>**Site Location: NAVWPNSTA Seal Beach, California**<br>**NAVFAC SW RPM: Brenda Reese** |

**Date of Session: October 12, 2010**
**Scoping Session Purpose: Internal Project Kickoff Meeting with NAVFAC SW and Contractor Team**

| Name | Title | Affiliation | Phone # | E-mail Address | Project Role |
|---|---|---|---|---|---|
| Brenda Reese | RPM | NAVFAC SW | 619.532.4209 | brenda.reese@navy.mil | RPM |
| Stephen Banister | Intern | NAVFAC SW | NA | stephen.banister@navy.mil | RPM Support |
| Scott Kehe | FEAD POC | NAVFAC SW | 949.726.2506 | scott.kehe@navy.mil | FEAD POC |
| Pei-Fen Tamashiro | IRP Coordinator | NAVWPNSTA Seal Beach | 562.626.7897 | pei-fen.tamashiro@navy.mil | POC |
| Jay Chesser | Vice President | AMJV | 619.402.4084 | jchesser@accordeng.com | Program Manager |
| Tim Shields | Program Manager | BRADY | 858.634.4514 | tshields@rbrady.net | Program Manager |
| Tara Lieberman | Environmental Scientist | BRADY | 858.634.4558 | tlieberman@rbrady.net | Project Support |

Acronyms:

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| BRADY | Richard Brady & Associates |
| FEAD | Facility Engineering and Accusations Division |
| IRP | Installation Restoration Program |
| NA | not available |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| POC | Point of Contact |
| RPM | Remedial Project Manager |

### 9.1.1 Comments/Decisions

Team discussed project roles and responsibilities and developed preliminary technical strategy for project and discussed baseline project schedule.

### 9.1.2 Action Items

Continue development of the technical strategy and proceed with development of the Preliminary Draft Work Plan and Sampling and Analysis Plan.

## 9.2 Partnering Meeting to Resolve Comments on Draft Work Plan/SAP

| **Project Name: Site 75 PA/SI**<br>**Projected Date(s) of Sampling: Begin July 2011** | | | **Site Name: Site 75**<br>**Site Location: NAVWPNSTA Seal Beach, California**<br>**NAVFAC SW RPM: Brenda Reese** | | |
|---|---|---|---|---|---|
| **Date of Session: June 1, 2011**<br>**Scoping Session Purpose: Discuss and resolve agency comments on Draft Work Plan** | | | | | |
| **Name** | **Title** | **Affiliation** | **Phone #** | **E-mail Address** | **Project Role** |
| Brenda Reese | RPM | NAVFAC SW | 619.532.4209 | brenda.reese@navy.mil | RPM |
| Pei-Fen Tamashiro | IRP Coordinator | NAVWPNSTA Seal Beach | 562.626.7897 | pei-fen.tamashiro@navy.mil | POC |
| Stephen Niou | Agency Rep. | DTSC | 714.484.5458 | sniou@dtsc.ca.go | POC |
| John Broderick | | RWQCB | 951.782.4494 | jbroderick@waterboards.ca.gov | POC |
| Qihai Chen | Project Manager | AMJV | 858.771.3559 | qchen@accordeng.com | Project Manager |
| Tim Shields | Program Manager | BRADY | 858.634.4514 | tshields@rbrady.net | Program Manager |
| Rain Yu Zeng | QQ Mgr. | AMJV | 858.771.3518 | YZeng@accordeng.com | POC |

Acronyms:

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| BRADY | Richard Brady & Associates |
| DTSC | Department of Toxic Substance Control |
| IRP | Installation Restoration Program |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| POC | Point of Contact |
| RPM | Remedial Project Manager |
| RWQCB | Regional Water Quality Control Board |

### 9.2.1 Comments/Decisions

- Remove the words “and up-gradient” from Worksheet 11 Step 5, Decision Rule 1.
- The first boring will be located approximately 50 feet east of former KAYO-SB. It will be drilled to approximately 310 feet bgs. A 3-inch-diameter well will be installed in the borehole at the depth where contaminant screening shows the highest concentrations.
- Well pairs will be installed at two other locations within the Navy fence line, approximately 400 feet to the northwest and southwest of former KAYO-SB, planned to target two depths with highest concentrations.
- Single wells will be installed at two locations outside the fence line, planned to target depth with highest concentrations.
- Depths and distribution of wells will be optimized and finalized based on real-time screening data.
- If budget permits, 4-inch-diameter wells will be installed instead of 3-inch-diameter.

### 9.2.2 Action Items

Revise Work Plan and SAP according to decisions from this meeting.

# 10.0 SAP WORKSHEET #10 – PROBLEM DEFINITION

This worksheet provides the first of seven steps of the data quality objective (DQO) process as detailed by the United States Environmental Protection Agency (U.S. EPA) (U.S. EPA, 2006). The DQO process is designed to define the project objectives and assure that the quality of data collected supports the objectives. The main objective of this project is to conduct a PA/SI to update and refine the conceptual site model (CSM); with primary focus on resolving the source(s) of VOCs in groundwater, and the associated potential responsible parties (PRPs). Data collected during this investigation will be employed to support these objectives.

Inherent in the development of DQOs is a systematic and logical approach intended to yield an efficient sampling design based on accepted levels of potential decision errors. The CSM is the basis for Step 1 of the DQO process. The following subsections provide a site description of Site 75 developed to formulate the CSM presented in the work plan (WP) and summarized in Section 10.2.

Project DQOs for Site 75 were developed in general accordance with the seven-step DQO process presented in EPA guidance documents (EPA, 1994 and 2000). These steps are identified below.

*Step 1. State the problem.* Clearly describe the problem(s) to be studied.

*Step 2. Identify decisions.* Identify the questions the study will attempt to resolve and what actions may result.

*Step 3. Identify decision inputs.* Identify data inputs (e.g., analytical results) and guidance inputs (e.g., regulatory screening levels) required to make the decisions identified in Step 2.

*Step 4. Define study boundaries.* Define the spatial and temporal boundaries of the problem(s).

*Step 5. Develop decision rules.* Identify the logical basis for choosing among decision statements.

*Step 6. Specify tolerance limits on decision errors.* Define the variability related to sample collection, identification of contaminated areas, and risk assessment.

*Step 7. Optimize the sampling design.* Define the sampling program for collection of data.

Step 1 of the DQO process for Site 75 is detailed in the following subsections. Steps 2 through 7 are described on SAP Worksheet 11. To provide context for Step 1, the problem statement, the following background information is provided.

## 10.1 Site Description and History

The NAVWPNSTA Seal Beach is located in the northwest corner of Orange County, California, in the City of Seal Beach, approximately 20 miles south of Los Angeles (Figure 1). Nearby communities include the Cites of Huntington Beach, Westminster, Los Alamitos, and Garden

Grove. Comprised of 5,256 acres, NAVWPNSTA Seal Beach is a weapons and munitions loading, storage, and maintenance facility which has been operated by the Navy and its contractors since its inception in 1944. NAVWPNSTA Seal Beach consists of 230 buildings and 128 ammunition magazines providing over 500,000 square feet of ammunition storage space.

Agricultural well KAYO-SB was located on NAVWPNSTA Seal Beach, approximately 1,300 feet south of Bolsa Avenue and approximately 800 feet west of Bolsa Chica Road (Figure 2). The agricultural well was used as an irrigation source for a portion of NAVWPNSTA Seal Beach that is currently leased out for crop production. The well was drilled in 1926 to 320 feet below ground surface (bgs) and was cased to 299 feet bgs, with perforations in three intervals: 203-208, 233-240, and 297-299 feet bgs. According to a 1994 video log report, the well was originally constructed with 16-inch-diameter steel casing from ground surface to 200 ft bgs, and 14-inch-diameter steel casing below 200 ft bgs. After the video log was complete, a 12-inch-diameter steel inner casing was installed in the well and the annular space between the inner and the outer casing was backfilled with pea gravel. The inner casing was perforated beginning at approximately 200 feet bgs (Tetra Tech, 2007).

The well was destroyed in 2006. The pump motor, pump, and approximately 240 feet of 6-inch-diameter steel discharge pipe were removed. The pipe segments contained an oily residue that was likely present due to past application of lubricating oil. The day after the pump and pipe were removed, the well was tested for the presence of oil on the groundwater surface. None was detected. A video log was performed, showing that the inner casing was screened from 208.6 ft bgs to refusal on silt and sediments at 286.7 feet bgs. After the video log was completed, three groundwater samples were collected from depths of approximately 208, 240, and 280 feet bgs using low-flow sampling and analyzed by EPA Method 8260B for VOCs and by EPA Method 8015M for total petroleum hydrocarbons quantified (TPH) quantified as diesel (-d), motor oil (-mo), and gasoline (-g). The detected VOCs were: 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethane (1,2-DCA), cis-1,2-dichloroethene (cis-1,2-DCE), tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride (VC). The results are summarized in the following table:

| Analyte | Units | 208 ft bgs | 240 ft bgs | 280 ft bgs |
|---|---|---|---|---|
| 1,1,1-TCA | µg/L | 1.7 | 0.50J | 0.24J |
| 1,1-DCA | µg/L | 75 | 21 | 11 |
| 1,1-DCE | µg/L | 170 | 46 | 23 |
| 1,2-DCA | µg/L | 0.37J | ND | ND |
| cis-1,2-DCE | µg/L | 0.57J | ND | ND |
| PCE | µg/L | 15 | 4.7 | 2.3 |
| TCE | µg/L | 140 | 43 | 22 |
| VC | µg/L | 0.43J | ND | ND |

***Notes:***
µg/L – micrograms per liter; J – estimated value; ND – not detected

It was determined that the thickness of the steel well casing precluded the use of a tearing device to destroy the well casing in advance of grouting. With Orange County Health Care Agency (OCHCA) concurrence, the decision was made to delete the perforation of the well casing from the destruction process, and to proceed with grouting the well. An estimated total of 9.5 cubic yards of grout was pumped into the well using the tremie method (Tetra Tech, 2007).

The source of the VOCs detected in the well is unknown.

## 10.2 Land Use

Agricultural well KAYO-SB was located on NAVWPNSTA Seal Beach, approximately 1,300 feet south of Bolsa Avenue and approximately 800 feet west of Bolsa Chica Road (Figure 2). The area to the east of Bolsa Chica Road and NAVWPNSTA Seal Beach is mixed residential and industrial use, including the Boeing Huntington Beach facility that has experienced a VOC release to groundwater. The investigation at the Boeing facility has reported several aquifers with different gradients, with most aquifers (upper sands and Alpha) flowing generally towards the west and the deepest (Beta) aquifer flowing generally towards the east.

## 10.3 Conceptual Site Model

The initial CSM for Site 75 was compiled from historical research, site visits, and from available hydrogeological and chemical data from previous investigations described in Worksheet #2. A more refined CSM will be developed based on the results of this investigation. The initial CSM is presented in the following sections.

### 10.3.1 Potential Sources and Contaminants

Site 75 is associated with a former agricultural well KAYO-SB located near the eastern boundary of NAVWPNSTA Seal Beach in an unimproved area of the base. Well KAYO-SB was used as an irrigation source for a portion of NAVWPNSTA Seal Beach leased out for crop production. Research conducted for this investigation did not reveal any prior site history associated with chemical storage, disposal, release, or generation at Site 75 in connection with the chemicals of potential concern (COPCs) detected in groundwater collected from KAYO-SB.

Numerous potential off-site sources are also under consideration. An environmental data records search obtained from Environmental FirstSearch Network for this project identified 233 sites within a 1-mile radius of the location of former agricultural well KAYO-SB (Work Plan Appendix C). Identified off-site sites include waste streams and/or releases of chlorinated petroleum hydrocarbons, several of which have the potential for transport to the site based upon current identified groundwater conditions.

The Environmental FirstSearch report was designed to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312) and the American Society for Testing and Materials Standard Practice for Environmental Site Assessments (E 1527-05). Several agency files for operations within this 1-mile radius which had target VOCs reported in soil or groundwater investigations were reviewed by the Project Team. Due to schedule constraints, all agency files were not available at the time of this Work Plan submittal.

Applicable file review results will be incorporated into an updated CSM and presented in the SI Summary Report.

### 10.3.2 Geology

The site is located in the Los Angeles sedimentary basin within the Bolsa-Sunset Gap, a 2 to 3 mile wide topographic low formed between the Bolsa Chica Mesa to the southeast and Landing Hill to the northwest. Current topography in the area is reflective of the late Pliocene and Pleistocene movement along the northwest-trending Newport-Inglewood structural zone.

The late Pliocene and Pleistocene sediment deposition in the vicinity of the site was derived from erosion of uplifting mountain ranges followed by sediment transport and ultimate deposition in the area as interbedded sands, silts, and clays in a marine embayment of moderate to shallow depths.

For the purposes of this investigation, two geologic units are discussed, the Recent Alluvium and the upper Pleistocene Lakewood Formation.

Historical Boeing site investigations are referenced in this section due to the extensive Boeing investigation footprint adjacent the site to the northeast, the areal extent of the Boeing data, the large number of wells and borings, and the depth compatibility with former well KAYO-SB. This soil and groundwater study is designed to investigate to approximately 310 feet bgs essentially matching the total depth of well KAYO-SB.

Geological investigation of the Boeing site immediately to the north of Site 75 (Halley & Aldrich, 2009c), revealed as many as four shallow, water-bearing intervals. These four water bearing intervals are separated by finer grained aquitard zones and all lie within the Recent Alluvium extending variably from the surface to approximately 130 feet bgs. The four water bearing zones, are referred to as the upper fine grained unit (UFGU) (silt/clay 0 – 45 feet bgs), the 45-foot sand (45 – 55 feet bgs), the 60-foot sand (60 – 80 feet bgs), and the intermittent 90-foot sand (90 – 95 feet bgs). The grain size distribution within these water bearing intervals ranges from the silt and clay of the UFGU to medium grained sands and gravels of the 60-foot sand. Separating the four water bearing units are aquitard one, aquitard two, and aquitard three composed primarily of interbedded clays and silts (Figure 3).

The upper Pleistocene Lakewood Formation lies beneath the Recent Alluvium reportedly extending beyond 500 feet below grade. Within the Lakewood Formation, the Alpha Aquifer, composed primarily of poorly graded, fine to medium sand and gravels extends from approximately 130 to 200 feet bgs. Aquitard 4, composed of interbedded silts and clays, separates the Alpha Aquifer from the underlying Beta Aquifer. The Beta Aquifer, composed of poorly graded medium to coarse sand and gravel and minor lenses of silt and clay, extends from approximately 230 feet to approximately 300 feet where the interbedded clay and silt of aquitard 5 begins.

### 10.3.3 Hydrogeology

The data from the Boeing site indicates there are four shallow water-bearing intervals identified beneath the nearby Boeing site referred to collectively as the shallow water-bearing zones. Individually, these zones are identified as the UFGU, 45-foot sand, 60-foot sand, and the 90-foot sand/silt.

***The Upper Fine Grained Unit***

Groundwater elevations measured in the UFGU show groundwater elevations ranging from 8.70 to 12.43 feet above MSL. Within the UFGU, the groundwater gradient direction is westerly at 0.002 to 0.004 foot vertical/foot horizontal (ft/ft) reportedly subject to localized influence from remedial activities.

***The 45-Foot Sand***

Groundwater elevations measured in the 45-foot sand show groundwater elevations ranging from 8.33 to 11.58 feet above MSL. The approximate groundwater gradient within the 45-foot sand is westerly to southwesterly at 0.002 ft/ft.

***The 60-Foot Sand***

Groundwater elevations measured in the 60-foot sand show groundwater elevations ranging from 6.44 to 11.05 feet above MSL. The approximate groundwater gradient within the 45-foot sand is southwesterly at 0.001ft/ft.

***The 90-Foot Sand***

Cross sections through the Boeing site terminating closest to Site 75 suggest the 90-foot sand, although observed to the north of the site, may not exist in the area of well KAYO-SB. According to historical data, the horizontal groundwater head gradient is 0.002 ft/ft and the flow direction is to the south-southwest in the 90-foot sand where present. Groundwater measurements from Boeing site wells screened in the 90-foot sand show groundwater elevations from 8 to 10 feet above MSL to -1.5 feet below MSL.

Historical groundwater elevation measurements do not show strong evidence of downward vertical migration from the 90-foot sand to the underlying Alpha Aquifer. In general however, the other shallow water bearing zones do show evidence of downward vertical migration.

Underlying the shallow, water-bearing units are the Alpha Aquifer and Beta Aquifer of the Lakewood Formation. Reportedly, the Alpha and Beta Aquifers are pumped periodically for irrigation from NAVWPNSTA Seal Beach wells. The aquifers are also subject to pumping by the City of Huntington Beach from production wells located to the north and northeast of the Site as part of the City's water supply (Haley & Aldrich, 2009c).

***Alpha Aquifer***

Groundwater gradient in the Alpha Aquifer is reportedly influenced by the pumping of the City of Huntington Beach production wells located north and northeast of the site. Groundwater gradient ranges from 0.0002 to 0.0006 ft/ft, with a predominantly flowing eastward direction but, the groundwater flow direction will vary from northeast to west in response to pumping from supply wells.

***Beta Aquifer***

As with the Alpha Aquifer, water levels and groundwater flow directions in the Beta Aquifer are influenced by the pumping of the City of Huntington Beach production wells located north and northeast of the Boeing site. Historical monitoring data show groundwater elevation changes ranging from -15.03 to -40.53 feet MSL. The beta gradient was reported at 0.002 ft/ft, with groundwater flowing to the northeast and east northeast (Haley & Aldrich, 2009c).

#### 10.3.4 Potential Migration Pathways

Potential transport pathways for the dissolved volatile organic compounds (VOCs) present at Site 75 include the multiple transmissive intervals made up of the more permeable water bearing intervals beneath the site (Figure 3).

The regional groundwater gradient direction is generally westerly, but data from nearby sites show there may be significant directional variation with depth possibly influenced by periodic pumping, saltwater intrusion mitigation, and potential localized effects due to remedial operations (Figure 4).

#### 10.3.5 Potential Receptors

NAVWPNSTA Seal Beach is a weapons and munitions loading, storage, and maintenance facility which has been operated by the Navy and its contractors since its inception in 1944. In addition to industrial facilities NAVWPNSTA Seal Beach has wetlands, RV parks, housing and office spaces. The Navy's proposed future use for the entire facility will remain essentially the same as it is now, with controlled access restricted to badged personnel. There are currently no plans for redevelopment into residential land use.

Human receptors are relatively unlikely to be affected by the contaminant plume at this site as follows:

- Surface water and direct contact by humans is unlikely also due to the downward migration tendencies of the contaminant suite at issue.
- The only known supply well (KAYO-SB) in the vicinity has been destroyed, closing the pathway to receptors linked to agricultural supply.

However, human consumption of groundwater could occur depending on where the contamination is and how it is migrating.

**Ecological receptors**

Ecological receptors are precluded from a completed pathway at Site 75 for the following reasons:

- Ecological receptors are unlikely to come in direct contact with contaminants in this plume because of the probable downward migration characteristics of the chlorinated solvents comprising the plume. Surface water is unlikely to be affected.
- The only known supply well in the vicinity has been abandoned, closing the pathway to ecological receptors that may come in contact and or consume irrigation water or agricultural produce.

## 10.4 Step 1 – State the Problem

Dissolved-phase VOCs (1,1,1-TCA, 1,1-DCA, 1,1-DCE, 1,2-DCA, cis-1,2-DCE, PCE, TCE and VC) were identified in samples taken in September 2006 from agricultural well KAYO-SB. The source of the VOCs is unknown.

The location of former agricultural Well KAYO-SB is near the property line in the southeastern portion of the facility; which is adjacent to an active industrial area in the City of Huntington Beach (Figure 4). An environmental data records report obtained for this project identified numerous potential off-site sources within a 1-mile radius of the former agricultural Well KAYO-SB (Work Plan Appendix C). Identified non-Navy sites include chemical releases of VOCs which have the potential to impact groundwater in the vicinity of the facility property line.

The objectives of this investigation are listed below along with related problem statements.

**Objective: Evaluate whether or not the PCE, TCE, DCE, TCA, DCA, and/or VC previously discovered in groundwater from a former agricultural well located on Navy property originate from a source within the Navy property line.**

**Problem Statement:**

- There is insufficient existing data to determine whether or not target VOCs detected in former agricultural Well KAYO-SB originate from a Navy or non-Navy source.

### 10.4.1 Members of the DQO Planning Team

The DQO planning team identified to address the problems at the site includes the NAVFAC RPM and QAO, NAVWPNSTA Seal Beach Point of Contact (POC), regulatory agency partners from DTSC and RWQCB, and technical support from the Project Team.

### 10.4.2 Available Resources

The Department of the Navy (DoN) has allocated the budget that is required for this assessment. The project is planned for an approximate 21-month duration. This timeframe includes preparation and review of this SAP, field investigation, data validation and interpretation, and preparation of the final PA/SI report.

# 11.0 SAP WORKSHEET #11 – PROJECT QUALITY OBJECTIVES/ SYSTEMATIC PLANNING PROCESS STATEMENTS

This worksheet provides Steps 2 through 7 of the DQO process as detailed by the U.S. EPA (U.S. EPA, 2006). The process is used to determine the type, quantity, and quality of the data necessary to support decision-making regarding current site conditions and future site management decisions.

Inherent in the development of DQOs is a systematic and logical approach intended to yield an efficient sampling design based on accepted levels of potential decision errors. The following subsections provide the primary study goal of the proposed assessment, the information inputs and analytical approach that will be used to achieve the study goal, as well as the performance criteria that will be used to assure that the data used to make project decisions is of sufficient quality.

## 11.1 Step 2 – Identify the Goals of the Study

**Primary Goal: Evaluate whether or not the PCE, TCE, DCE, TCA, DCA, and/or VC previously discovered in groundwater from a former agricultural well located on Navy property originate from a source within the Navy property line.**

The primary goal will be achieved by answering the following decision question:

1. Are target VOC concentrations increasing in an off-property direction from former Well KAYO-SB?

## 11.2 Step 3 – Identify Information Inputs

The purpose of this step is to identify sources of additional data to support project decisions. Inputs to project decisions include regulatory data, existing hydrogeologic data, and new data to be collected under this SAP.

**Existing data inputs include:**

- November 2010 Environmental FirstSearch report (Work Plan, Appendix C)
- Decisions made in stakeholder planning meetings (Worksheet #9)
- Historical air photos documenting site use since the 1930s
- Hydrogeologic data from the Final Well Decommissioning Report, Naval Weapons Station Seal Beach, California. (Tetra Tech, 2007)
- Information from the California RWQCB geographical environmental information management system (GeoTracker) database.

**New data inputs will consist of:**

- Lithologic data produced during continuous coring. Detailed geologic logs will identify transmissive water-bearing units that are potential pathways for dissolved VOC migration.

- Validated soil data to confirm residual soil contamination or non-aqueous phase liquid (NAPL), if present, that is logged by the project geologist.
- Screening data collected using field screening EPA Method 8265 to obtain a log of concentrations of VOC constituents. A detailed log of VOC concentrations will be produced by collecting samples of the continuous core approximately every 2 feet and analyzing them onsite with the direct sampling ion trap mass spectrometry (DSITMS). The VOC screening data and geologic logs will be used to optimize the design of up to nine permanent groundwater monitoring wells so that they target water-bearing units with the highest VOC concentrations.
- Validated groundwater data collected from up to nine permanent monitoring wells in the vicinity of former agricultural well KAYO-SB. Wells designs will be optimized dynamically based on geologic and VOC screening data. Groundwater samples will be collected during two monitoring events and analyzed for target VOCs using EPA Method 8260B. The purpose of this data is to assess the migration direction of target VOCs in groundwater.
- Groundwater elevation data collected from up to nine permanent monitoring wells to evaluate groundwater elevation and flow gradient in up to two separate water-bearing units with the highest VOC screening concentrations.

## 11.3 Step 4 – Define the Boundaries of the Study

The preliminary horizontal boundary for this investigation has been chosen based on hydrogeologic and chemical data provided by the Navy and during agency file reviews. Proposed well locations are displayed on Figure 5. The actual horizontal boundary may be adjusted based on hydraulic and VOC concentration gradients identified during the field investigation.

The planned vertical boundary for this investigation is 310 feet bgs; which is approximately 10 feet below were the Beta Aquifer was encountered in former Well KAYO-SB. This is the maximum total depth that monitoring wells are anticipated to be set. The actual vertical boundary will be adjusted dynamically based on geologic logs and VOC screening data generated during the field investigation.

The temporal boundary of the field investigation is defined by the completion of the second proposed groundwater sampling event, currently planned for November 2011.

## 11.4 Step 5 – Develop the Analytical Approach

EPA Method 8265 will be used to screen for target VOC constituents (including PCE, TCE, DCE, TCA, DCA, and VC). A detailed log of VOC screening concentrations will be produced by making a measurement of the continuous core approximately every 2 feet to a depth of 310 feet bgs adjacent to former Well KAYO-SB. If the geologist observes stains, odors, or a photoionization detector (PID) reading in the soil core that is interpreted as residual soil contamination or NAPL, a soil sample will be collected for fixed base laboratory analysis by EPA Method 8260B.

The geologic and VOC logs will be examined to identify the two transmissive units with the highest VOC screening concentrations. These two water bearing units will be proposed to be the targets of wells at other locations shown on Figure 5. Paired wells will be bored separately, although as close together as practical. The deeper well will be drilled first, and the continuous core will be logged by a Professional Geologist and field screened approximately every 2 feet for VOCs using EPA Method 8265. This data will be used to confirm that the target well depths intersect the targeted water bearing units. The shallower well will be drilled second, using the geologic and VOC logs from the deeper well to confirm the planned depth. Groundwater samples will be collected from permanent monitoring wells for two consecutive quarters and analyzed for target VOCs by EPA Method 8260B; in accordance with Worksheets #14 and #18 of this SAP. Because the resulting data set will likely be at or below the minimum number of observations (8 to 10 per population) recommended for statistical two-sample hypothesis testing, point-by-point comparisons and graphical presentation methods will be the primary method used to evaluate whether or not concentrations are increasing in a particular spatial direction. Statistical two-sample hypothesis testing using ProUCL computer software will be used as a secondary comparison method, subject to qualification due to the potential constraints of the data set.

Based on the analytical approach, the following decision rules are proposed:

1. **Are PCE, TCE, DCE, TCA, DCA, and/or VC concentrations increasing in an off-property direction?**

   **Yes:** Conclude that target VOCs in groundwater are migrating from an upgradient non-Navy source. Based on the updated CSM resulting from the sampling and the file reviews, evaluate the need for additional sampling to resolve data gaps.

   **No:** Conclude that the Navy is the likely source of target VOCs identified in groundwater in the vicinity of former agricultural well KAYO-SB. Plan appropriate future actions.

2. **Are PCE, TCE, DCE, TCA, DCA, and/or VC present at concentrations greater than 100 mg/kg (Westinghouse, 2001), thereby indicating potential residual soil contamination (NAPL)?**

   **Yes:** Conclude that the residual soil contamination (NAPL) is located near a source area, evaluate whether or not the source area is within Navy property.

   **No:** Conclude that residual soil contamination (NAPL) was not encountered during the investigation. Refer to decision rule #1 to evaluate source.

## 11.5 Step 6 – Specify Performance or Acceptance Criteria

There are two types of decision errors: sampling design errors and measurement errors. Sampling design errors are a function of the selection of sample locations or analytical methods used to

characterize the site to be studied. Measurement errors are a function of the procedures used to collect and analyze the samples.

In sampling designs that use a statistical approach to evaluate the data using decision rules, numerical limits on allowable error can be set and controlled by the sampling design (e.g., the number of samples). The use of classical statistics for this project would require a significant number of sampling locations to systematically examine the area potentially affected by the identified release. A random statistically defined sample grid would not meet the DQOs established for this project. This proposed investigation is focused on evaluating if target VOCs are migrating onto NAVWPNSTA Seal Beach from an offsite source, not on identifying the complete distribution of chemicals for which the source may or may not be originating from the facility. Although this project is planned using a judgmental approach, the sampling design proposed in this SAP will yield an adequate data set to address the DQOs established for this investigation.

Measurement errors that arise during the various steps of the sample-measurement process (e.g., sample collection, sample handling, sample preparation, sample analysis, data reduction, and data handling) are possible regardless of the sampling design. Neither measurement errors nor variability can be eliminated, but they can be controlled by selecting appropriate procedures and using properly trained personnel. Measurement error will be minimized by using a trained and experienced field team under the guidance of the Project Team's QAM. Each field sampler will be familiar with SAP DQOs and sampling requirements.

Measurement error is further managed by using Standard Operating Procedures (SOPs) and data quality management. Attachment 1 of this SAP presents SOPs that will be followed to minimize and control measurement error. The analytical methods and method reporting limits for groundwater samples are listed in Worksheet #15.

Decision uncertainty is managed by increasing the density of sampling points, especially in areas where there is high uncertainty about the correctness of a decision. This is cost-effectively accomplished by using field screening methods such as EPA Method 8265 to build a detailed CSM in near real-time. By collecting and analyzing data in near real-time, critical data gaps are identified and filled, an accurate and complete CSM is developed, and field mobilizations and work plan cycles are reduced.

The following table presents possible decision errors, identifies associated consequences, and addresses related uncertainties. The most severe error in judgmental sampling would be to conclude that action is not required when, in reality, an unacceptable risk to human-health and/or the environment exists. The judgmental sampling approach is designed to limit the probability of this error.

**Possible Decision Errors**

| Possible Error | Associated Consequences | Uncertainty |
|---|---|---|
| Concluding that target VOCs are present in groundwater when not present. | Incorrectly identifying groundwater as contaminated and improperly determining that target VOCs are originating from NAVWPNSTA Seal Beach, or migrating onto the facility from an offsite source. | Low: Conclusions will be based on permanent monitoring wells sampled in accordance with SOPs that follow NAVFAC requirements, samples will be analyzed by an approved fixed base laboratory, and laboratory data validated by a third party. See Decision Rules. |
| Concluding that target VOCs are not present in groundwater when in fact they are present. | Failing to identify groundwater as contaminated and consequently failing to correctly identify whether target VOCs originate from the facility or an offsite source. | Low: Conclusions will be based on permanent monitoring wells sampled in accordance with SOPs that follow NAVFAC requirements, samples analyzed by an approved fixed base laboratory, and laboratory data validated by a third party. See Decision Rules. |

Decision uncertainty will be managed by specific targeting of initial screening points, especially in areas where there is high uncertainty about the correctness of a decision. This is cost-effectively accomplished by targeting appropriate and discrete intervals and screening analytical methods, and building out a detailed CSM during the field deployment. By compiling and modeling data while still in the field, critical data gaps will be identified and filled, an accurate preliminary CSM developed based on geologic and VOC screening data, and all critical data required to optimize the design of permanent monitoring wells that will answer the data quality objectives will be collected within one Work Plan/field sampling/reporting cycle.

## 11.6 Step 7 – Develop the Detailed Plan for Obtaining Data

This investigation was designed using chemical and hydrogeologic data from previous investigations in the study area, information from a current EDR report, limited review of agency files, and discussions with Navy and regulatory agency representatives. This investigation involves the collection of groundwater samples for chemical analysis to determine whether target VOCs in groundwater in the vicinity of former agricultural Well KAYO-SB originate from a Navy or non-Navy source. The data collected during this investigation, along with existing data from previous investigations, will be used to make this determination.

During this investigation, sonic drilling technology; or equivalent, will be used to collect continuous core samples at predetermined boring locations (Figure 5). The borings will subsequently be used to install permanent groundwater monitoring wells. The proposed boring locations were selected based on the preliminary CSM (Figures 3 and 4). The first proposed boring (SB75-MW01; Figure 5) will be advanced to approximately 310 feet bgs, adjacent to former Well KAYO-SB. The lithology will be logged by a Professional Geologist and VOC concentration measurements will be collected approximately every 2 lineal feet using DSITMS by EPA Method 8265. Since soil impact is not expected, DSITMS will be used to screen pore water captured within the sediment column. Following logging, a 3-inch-diameter groundwater

monitoring well will be installed in boring SB75-MW01 at the depth where contaminant screening shows the highest concentrations.

The results of the detailed geologic and VOC log of boring SB75-MW01 will be used to identify the depth and water-bearing unit(s) through which VOCs are migrating, and will preliminarily guide the boring depths and subsequent monitoring well designs and casing diameter at other proposed locations (Figure 5). The depths of the additional wells will be adjusted based on the detailed geologic logs and targeted VOC screening performed during advancement of each proposed boring.

Permanent groundwater wells will be constructed with Schedule 80 polyvinyl chloride (PVC) casing with 0.010 slotted well screen, or equivalent. The first well will have 3-inch diameter casing, subsequent wells will be constructed with 4-inch diameter casing if it can be done with the project budget. After completion and development, representative groundwater samples will be collected from each permanent monitoring well using low-flow methods described in Worksheet #14 and Accord Engineering, Inc. (AEI) SOP F30-002 (Attachment 1). Groundwater samples will be collected for two consecutive quarterly monitoring events and analyzed for target VOCs by a fixed-base analytical laboratory. All groundwater samples for off-site analysis will be handled in accordance with Worksheet #27.

# 12.0 SAP WORKSHEET #12 – MEASUREMENT PERFORMANCE CRITERIA

## 12.1 Measurement Performance Criteria Table – Field QC Samples (Soil)

| QC Sample | Analytical Group | Frequency | DQIs | Measurement Performance Criteria | QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A) |
|---|---|---|---|---|---|
| Equipment Rinsate (Equipment Blank) (Rinsate Blank) | VOCs | One per day | Sensitivity/ Contamination (Accuracy/Bias) | Detections < QLs (Worksheet #15) | S |
| Source Water Blank (Field Blank) | VOCs | One per sampling event or source of water used for the final decontamination rinse | Sensitivity/ Contamination (Accuracy/Bias) | Detections < QLs (Worksheet #15) | S |
| Trip Blank | VOCs | One per shipping container containing samples for VOCs | Sensitivity/ Contamination (Accuracy/Bias) | Detections < QLs (Worksheet #15) | S |
| Temperature Blank | VOCs | One per shipping container | Representativeness | 4 ˚C (± 2 ˚C) | S |

Acronyms:

| | |
|---|---|
| ˚C | degrees Celsius |
| DQI | data quality indicator |
| QC | quality control |
| QL | quantitation limit |
| RPD | relative percent difference |
| VOC | volatile organic compound |

## 12.2 Measurement Performance Criteria Table – Field QC Samples (Water)

| QC Sample | Analytical Group | Frequency | DQIs | Measurement Performance Criteria | QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A) |
|---|---|---|---|---|---|
| Equipment Rinsate (Equipment Blank) (Rinsate Blank) | VOCs | One per day | Sensitivity/ Contamination (Accuracy/Bias) | Detections < QLs (Worksheet #15) | S |
| Field Duplicate | VOCs | One per every 10 samples | Precision | RPD (Table 1) | S |
| Source Water Blank (Field Blank) | VOCs | One per sampling event or source of water used for the final decontamination rinse | Sensitivity/ Contamination (Accuracy/Bias) | Detections < QLs (Worksheet #15) | S |
| Trip Blank | VOCs | One per shipping container containing samples for VOCs | Sensitivity/ Contamination (Accuracy/Bias) | Detections < QLs (Worksheet #15) | S |
| Temperature Blank | VOCs | One per shipping container | Representativeness | 4 ˚C (± 2 ˚C) | S |

Acronyms:

| | |
|---|---|
| ˚C | degrees Celsius |
| DQI | data quality indicator |
| QC | quality control |
| QL | quantitation limit |
| RPD | relative percent difference |
| VOC | volatile organic compound |

## 13.0 SAP WORKSHEET #13 – SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

| Secondary Data | Data Source (originating organization, report title and date) | Data Generator(s) (originating organization, data types, data generation / collection dates) | How Data Will Be Used | Limitations on Data Use |
|---|---|---|---|---|
| Agricultural well KAYO-SB analytical results | Tetra Tech EC, Inc., *Final Well Decommissioning Report, Naval Weapons Station Seal Beach, CA.* February 12, 2007 | Groundwater analytical data collected from agricultural well KAYO-SB by Tetra Tech EC, Inc. during well decommissioning activities in September 2006. | To compare with current concentrations for target VOCs within the study area. | No data validation documentation provided. |

Acronyms:
VOC volatile organic compound

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# 14.0 SAP WORKSHEET #14 – SUMMARY OF PROJECT TASKS

The scope of work for this project includes installing and sampling up to seven permanent groundwater monitoring wells, based on screening data. EPA Method 8265 will be used to screen for target VOC constituents (including PCE, TCE, DCE, TCA, DCA, and VC).

The strategy for installation of the wells includes sonic drilling next to former KAYO-SB to a depth of 310 feet. Based on the KAYO-SB driller's log, this depth should penetrate 10 feet into the first transmissive unit of the Beta Aquifer. The continuous core will be logged by a Professional Geologist and field screened approximately every 2 feet for VOCs using DSITMS (EPA Method 8265). Draft field results will be sent to the project team on a daily basis. A well will be installed in this boring to collect VOC concentration data from the Beta Aquifer. It is estimated that it will take 3 days to drill and install the well.

The geologic and VOC logs will be examined to identify the two transmissive units with the highest VOC screening concentrations. These two water bearing units will be proposed to be the targets of wells at other locations (Figure 5). Paired wells will be bored separately, although as close together as practical. The deeper well will be drilled first, and the continuous core will be logged by a Professional Geologist and field screened approximately every 2 feet for VOCs using EPA Method 8265. This data will be used to confirm that the target well depths intersect the targeted water bearing units. The shallower well will be drilled second, using the geologic and VOC logs from the deeper well to confirm the planned depth.

Soil and groundwater samples will be collected in accordance with the methods described in Worksheets #14 and #18 of this SAP.

This worksheet summarizes the tasks that will be performed as part of this groundwater assessment. SOPs for pertinent tasks are presented in Attachment 1.

## 14.1 Permitting and Notification

The DoN is conducting this project with Environmental Response, Navy appropriation, under CERCLA. CERCLA Section 121(e) [42 USC 9621] and 40 CFR 300.400(e) provides exemption from Federal, State, and local permit fees for CERCLA response actions. The Project Team will submit a courtesy drilling permit application to the Orange County Health Care Agency. Fieldwork will not proceed until Orange County acknowledgement of the permit application is received.

## 14.2 Utility Clearance

Prior to intrusive drilling activities, NAVWPNSTA Seal Beach Public Works Utilities Department will be contacted for issuance of a Digging Permit for utility clearance at each intrusive location on the Facility. Underground utility clearance will be completed within a 6-foot radius of each proposed location using the following protocol:

- Mark the proposed boring locations and the utility lines in the immediate vicinity using conventionally color-coded surveyor paint.
- Coordinate utility-locating activities with the utility locator service.
- Coordinate utility-locating activities with Underground Service Alert.
- Use geophysical equipment and pipe locating procedures to ensure underground obstruction clearance.

Whenever possible, a transmitter/receiver unit will be attached to the exposed pipe or utility to trace metallic pipes or utilities that are either indicated on base utility maps or where obvious via surface expression. The location of the utility will be marked on the ground using color-coded surveyor paint.

If a utility is identified within a 3-foot radius of the proposed sampling location, the sampling point will be moved and the clearance procedures will be repeated.

Prior to drilling activities, each boring location will be cleared with a non-intrusive method (i.e air-knife, hand-auger) to a depth of approximately 5 ft bgs (or to the maximum depth practicable) to ensure clearance from subsurface utilities.

## 14.3 Soil Boring

Continuous geologic cores will be collected at four proposed boring locations using sonic drilling technology (Figure 5). A sonic drilling rig will be used to advance a core barrel by vibration, rotation, and downward force to collect continuous soil cores. Once the core barrel is at the desired depth, an outer secondary casing will be advanced down to the same depth to keep the borehole from collapsing while the core barrel is removed. The use of multiple secondary casings with decreasing diameters may be used to telescope the borehole through separate confining units. Once the core barrel is removed, the soil core will be pushed out of the core barrel through the use of vibration and either air or water pressure, into disposable plastic sleeves. If the integrity of the soil core is of concern during drilling, acetate liners may be used to keep the core intact within the core barrel. To minimize friction and absorb heat, potable water may be added between the core barrel and secondary casing during advancement. If water is added, a source blank will be collected and the additional volume of water will be extracted during well development activities.

The data collected from the continuous cores is discussed in the following sections. The data will be used to refine the preliminary CSM and aid in designing the proposed permanent groundwater monitoring well network; which will be used to assess target VOCs in groundwater at the site.

### 14.3.1 Geologic Logging

All continuous cores will be logged by a California Professional Geologist (PG), using lithologic descriptions in general accordance with the Unified Soils Classification System (USCS). Descriptions of any visible evidence of soil contamination (i.e., staining) and odor will also be recorded on the location specific boring log and in the field notebook.

### 14.3.2 VOC Screening by EPA Method 8265

Soil subsamples will be collected from the continuous geologic cores and screened in the field using DSITMS by EPA Method 8265. This method will be used to provide semi-quantitative data for assessing target VOCs. The available data strongly suggests that the proposed borings are not at source areas where soil contamination is expected. The VOC screening by 8265 will be performed on total matrix samples (soil plus pore water) from the sonic drilling cores, and the results can be used to evaluate the presence of residual NAPL or soil contamination. Beginning at approximately 6 feet below grade, the continuous core will be logged by a PG and field screened approximately every 2 feet. Temperature of the soil core will be logged using a non-contact thermometer gun or equivalent. This screening technique has been used successfully at other sites to screen for VOCs in pore water (i.e. groundwater). It is anticipated that screening samples will be collected approximately every 2 lineal feet in proposed boring SB75-MW01. Based on the results, VOC screening will be performed approximately every 2 lineal feet at the three additional proposed boring locations. The field staff will use their judgment to adjust the sampling depths or collect additional screening samples based on field observations of potential VOC impacts (mechanical, visual and/or olfactory) or changes in lithology. Samples will be screened in accordance with BRADY SOP T-009 and T-010.

### 14.3.3 Soil Sampling

While performing the VOC screening on the continuous geologic cores, if the geologist observes stains, odors, or a PID reading in the soil core that is interpreted as residual soil contamination or NAPL, a confirmation soil sample will be collected for fixed-base laboratory analysis by EPA Method 8260B. The soil samples will be collected from the continuous cores in accordance with BRADY SOP T-003 and T-006.

## 14.4 Monitoring Well Installations

Sonic drilling technology; or equivalent, will be used to install up to nine permanent groundwater monitoring wells. It is anticipated that the groundwater monitoring wells will be completed using manufacturer cleaned and wrapped flush-threaded 3-inch diameter Schedule 80 PVC casing with approximately 10 feet of 0.010-inch slotted screen, and designed in general accordance with the California Department of Water Resources Bulletins 74-81 and 74-90, and Orange County Environmental Health Division requirements. The filter pack will consist of #2/16 sand, or equivalent. The annular space above the filter pack will be sealed with hydrated bentonite chips and grout, and finished with a concrete sealed wellhead. A secured traffic rated flush-mount well box set in a raised concrete well pad will be installed at ground surface at each well location for well head protection. Final well depths will be based on site lithology and groundwater depth within the water-bearing unit of interest, but are projected to be set at a maximum depth of 310 feet bgs.

Each well will be installed under the supervision of a Professional Geologist registered in the State of California. Preliminary well construction logs will be completed in the field and well installation and sampling activities will be recorded in the field logbook in accordance with AEI SOP F10-001 (Attachment 1).

All fluids and tools introduced into the subsurface will be free of petroleum-based materials, including fuels, oils, grease, and/or solvents. A surface seal will be used as needed to prevent precipitation run-off or other materials from entering the borehole. Non-disposable field equipment will be decontaminated between sampling locations in accordance with AEI SOP F10-003.

## 14.5 Well Development

Following placement of the filter pack, but prior to placement of the bentonite transition seal and concrete surface seal, each groundwater monitoring well will be partially developed to ensure the filter pack level has stabilized. A surge block attached to the drill rig cable will be slowly raised and lowered within the screened interval to promote hydraulic communication between the geologic formation and well.

Full development will proceed after the concrete surface seal has hardened (normally within 72 hours of installation). Each well will then be purged with a submersible pump until a turbidity of less than 5 nephlometric turbidity units (NTUs) is observed, or at least three borehole volumes are removed. If potable water has been added during drilling, then the volume of water added will be removed in addition to the development water. Purge water will be stored on-site in 55-gallon drums until groundwater sample analytical results are received.

Following well development activities, each well will be allowed to stabilize for at least 72 hours prior to sampling.

## 14.6 Groundwater Sampling

Following installation and development activities, the newly installed permanent groundwater monitoring wells will be equipped with dedicated low-flow bladder pumps (Geotech Environmental Equipment, Inc. Model #GEO 1.66SS18; or equivalent). The wells will be micro-purged and sampled for target VOC analysis by EPA Method 8260B using low-flow sampling technology, as described below. Two consecutive quarterly groundwater monitoring events are planned. If possible, the sampling will be coordinated with the Huntington Beach production wells to coincide with a pumping cycle and a non-pumping period.

### 14.6.1 Water Level Measurement

Prior to purging each permanent monitoring well, the depth to free product (if detected), depth to groundwater, and total well depth will be measured using an interface meter in 0.01-foot increments in accordance with AEI SOP F40-001. Measurements will be taken relative to a permanently marked survey point located at the top of the well casing. These measurements will be recorded on the Well Sampling form (Attachment 2). The interface meter will be decontaminated between wells in accordance with AEI SOP F10-003 (Attachment 1).

### 14.6.2 Well Purging Activities

All permanent wells will be purged in accordance with AEI SOP F30-002 for low-flow sampling (Attachment 1). Following the recording of water level measurements, groundwater monitoring wells will be micro-purged with the dedicated low-flow pumps controlled by a Geotech

Geocontroller 2, or equivalent. To assess stabilization, the groundwater depth, temperature, conductivity, dissolved oxygen (DO), oxidation-reduction potential (ORP) and pH levels will be monitored at 5 minute intervals. The temperature, conductivity, DO, ORP, and pH parameters will be measured using a multi-parameter meter with flow-through cell, or equivalent. Water level measurements for stabilization will be taken using a 0.01-foot resolution interface meter. All wells will be purged until groundwater parameters stabilize, the well pumps dry, or three well volumes have been removed. Stabilization parameters will be recorded on the Well Sampling form (Attachment 2) and in the field logbook. All down-hole purge equipment will be decontaminated between wells using AEI SOP F10-003 (Attachment 1).

In accordance with AEI SOP F30-002 (Attachment 1), stabilization is achieved after all indicator parameters have met the following criteria:

- pH – Three successive readings within ±0.1 units.
- Temperature – Three successive readings within ±1degrees Celsius (°C).
- Specific conductance – Three successive readings within ±3%.
- Redox Potential or ORP – Three successive readings within ±10 millivolts (mV).
- Dissolved Oxygen – Three successive readings within ±0.3 milligrams per liter (mg/L).

All down-hole sampling equipment will be decontaminated between wells in accordance with AEI SOP F10-003 (Attachment 1).

### 14.6.3 Groundwater Sample Collection

Following stabilization of monitoring parameters as described above, groundwater samples will be collected from the groundwater monitoring wells in accordance with AEI SOP F30-002 for low-flow sampling (Attachment 1). All wells will be sampled with the dedicated low-flow pump after the well has been adequately purged. Groundwater samples will be collected by directing the discharge from the sampling pump into the appropriate laboratory prepared and preserved sample containers. After sample collection, the containers will be labeled, prepared for shipment, placed in an insulated cooler with wet ice (double-bagged in re-sealable plastic bags), and transported under COC to the fixed-base laboratory.

If the samples are to be delivered to the laboratory in the custody of a third-party shipment or courier service, custody seals will be used on each ice chest to provide tampering detection. The signed and dated custody seals will be placed on the front right and back left of the shipping container, and will be covered with wide, clear tape.

## 14.7 Quality Control Requirements

Quality assurance (QA) is an integrated system of activities in the area of quality planning, assessment, and improvement to provide the project with a measurable assurance that the established standards of quality are met. QC checks, including both field and laboratory, are specific operational techniques and activities used to fulfill the QA requirements. Worksheets

#12 and #28 summarize the collection frequencies for the various field and laboratory QC samples, respectively.

### 14.7.1 Field Quality Control

The field QC samples will be assigned unique sample numbers and will be submitted blind to the analytical laboratory. If abnormalities are detected in field QC samples, the data associated with the QC samples will be flagged and appropriate actions will be taken to rectify issues.

### 14.7.2 Field Duplicate Samples

Field duplicate/replicate samples will be collected at a rate of 10% of the total number of field samples. For all water samples, duplicate samples will be collected by retaining consecutive samples from the sampling device.

### 14.7.3 Equipment Rinsate Blanks

Equipment rinsate blanks will be collected daily during sampling to ensure that non-dedicated sampling devices have been decontaminated effectively. Equipment rinsate blanks will consist of the DI water used in the final rinse step of the sampling equipment decontamination procedure. Rinsate samples will be collected at a frequency of one per day during sampling events. Rinsate samples may be collected more frequently if required to meet the project DQOs. If a rinsate sample has already been collected, and if either the decontamination procedure comes into question or if a subsequent well produces a sample which has a questionable odor or color, an additional rinsate sample may be warranted after the next equipment decontamination procedure.

### 14.7.4 Trip Blanks

Trip blanks are hydrochloric acid (HCl)-preserved organic-free water prepared by the fixed-base laboratory in 40-milliliter (mL) volatile organic analysis (VOA) vials that will be carried into the field, stored with the samples, and returned to the laboratory for VOC analysis. Trip blanks will be used to determine whether samples have been cross-contaminated with VOCs during sample collection and transportation. Since trip blanks pertain only to VOCs, the vial must be free of any headspace. Trip blanks will be provided in each cooler and analyzed for VOCs for each shipment of samples sent to the fixed-base laboratory.

### 14.7.5 Source Blanks

Source blanks are collected to ensure that water used during decontamination is not a source of contamination. Source blank samples will be collected at a frequency of one for each source of water used for equipment rinsate blanks (for the duration of the sampling). If the source for decontamination water changes, additional source blank samples will be collected. To prepare source blanks, the sample containers will be filled with source water at the same time that it is used for decontamination.

### 14.7.6 Temperature Blanks

Temperature blank samples will accompany each cooler that contains samples with a temperature preservative requirement. The temperature blank will be prepared either by the

analytical laboratory or the field sampling crew by filling VOA vials with de-ionized (DI) water. The temperature of the samples will be verified upon arrival at the analytical laboratory using the temperature blank.

### 14.7.7 Laboratory Quality Control

Laboratory QC is addressed through the analysis of laboratory QC samples, documented internal and external laboratory QC practices, and laboratory audits. The types of laboratory QC samples will be project/chemical specific, but may include laboratory control samples (LCSs), laboratory duplicates, MSs, surrogate standards, internal standards, method blanks, and instrument blanks. MSs, MSDs, and LCSs are analyzed for every batch of up to 20 samples and serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MSs, MSDs, and LCSs which are analyzed for organic compounds in order to evaluate the method's accuracy and to help determine matrix interferences. Definitions of each type of laboratory QC sample are listed in the following subsections. For laboratory measurements, if any of the QC checks are outside the acceptance criteria, corrective actions will be taken based on procedures in the Laboratory Quality Assurance Program (LQAP).

### 14.7.8 Laboratory Control Samples

LCSs include blank spikes and blank spike duplicates. Blank spike samples are designed to check the accuracy of the laboratory analytical procedures by measuring a known concentration of an analyte in the blank spike samples. Blank spike duplicate samples are designed to check laboratory accuracy and precision of the analytical procedures by measuring a known concentration of an analyte in the blank spike duplicate sample. Blank spike and blank spike duplicate samples are prepared by the laboratory using clean laboratory matrices spiked with the same spiking compounds used for MSs at levels approximately 10 times greater than the method detection limit (MDL). LCSs will be processed with each analytical batch consisting of 20 samples or less.

### 14.7.9 Laboratory Duplicates

Laboratory duplicates are two aliquots of a sample taken from the same sample container under laboratory conditions and analyzed independently. The analysis of laboratory duplicates allows the laboratory to measure the precision associated with laboratory procedures. Laboratory duplicate samples will be processed with each analytical batch consisting of 20 samples or less.

### 14.7.10 Matrix Spikes

MS and MSD samples are designed to check the precision and accuracy of the analytical methods through the analysis of a field sample with a known amount of analyte added. Additional sample volume for MS and MSD samples is collected in the field in the same manner as field duplicate samples. In the laboratory, two portions of the sample are spiked with a standard solution of target analytes. MS and MSD samples are analyzed for the same parameters as the field samples, and analytical results will be evaluated for precision and accuracy of the laboratory process and effects of the sample matrix. A minimum of one MS/MSD will be analyzed per 20 field samples.

#### 14.7.11 Surrogate Standards

Surrogates are chemical compounds with properties that mimic analytes of interest, but that are unlikely to be found in environmental samples. Surrogates will be added to all field and QC samples analyzed for volatiles, to assess the recovery of the laboratory process, and to detect QC problems. The concentration and type of the surrogates used will be based on the LQAP.

#### 14.7.12 Internal Standards

Like the surrogate standard, an internal standard is a chemical compound, unlikely to be found in environmental samples, that is added as a reference compound for sample quantification. Internal standard procedures are used for the analysis of volatile organics and extractable organics using gas chromatograph/mass spectrometer (GC/MS) and also can be used for other GC and high-performance liquid chromatography analytical methods. The concentration and type of the internal standards used will be based on the LQAP.

#### 14.7.13 Method Blanks

Method blanks are designed to detect contamination of field samples that may occur in the laboratory. Method blanks verify that method interference caused by contaminants in solvents, reagents, glassware, and other sample processing hardware are known and minimized. Method blanks are deionized water for aqueous samples. A minimum of one method blank will be analyzed each day that field samples are analyzed, at the rate of 1 per 20 field samples. A method blank must be analyzed daily. The concentration of the target compounds in the method blank sample must be less than five times the MDL. If the blank is not under the specified limit, the source contamination is to be identified and corrective actions taken.

### 14.8 Equipment Decontamination

Decontamination of non-disposable sampling equipment will be performed to prevent the introduction of extraneous material into samples and to prevent cross-contamination between samples. Equipment will be decontaminated in accordance with AEI SOP F10-003 (Attachment 1).

In summary, decontamination of small non-disposable sample equipment will be conducted in the following steps:

1. Scrub the equipment with a brush, using laboratory grade detergent, such as Liquinox, and potable water solution, rinse with potable water, and rinse again with DI water. The equipment will be scrubbed and rinsed in three separate five-gallon buckets.
2. Reassemble the equipment and place it in a clean area on plastic or aluminum foil. If aluminum foil is used, wrap the equipment with the dull side toward the equipment.
3. Equipment rinsates will be collected from decontaminated equipment daily to provide a QC check on the decontamination procedure above. At least one field blank (source water used in the decontamination procedure) will be collected in the beginning of the assessment and analyzed for all target compounds.

## 14.9 Investigation Derived Waste Disposal

Wastes that are anticipated to be generated during the fieldwork include potentially VOC-impacted soil and groundwater, decontamination water, and personal protective equipment (PPE). VOC impacted soil and water will be containerized on-site and stored temporarily in 55-gallon drums or other suitable containers for future disposal. The PVC well materials and PPE will be disposed in an NAVWPNSTA Seal Beach facility dumpster or equivalent. Drums will be labeled and securely stored with spill control in accordance with AEI SOP F10-006 (Attachment 1).

Disposal of soil and groundwater wastes will be determined based on the analytical results of the media in question. Contaminated wastes will be transported to an authorized disposal facility within 90 days of generation under appropriate manifest.

## 14.10 Data Management

All field observations and laboratory results will be linked to a unique sample location through the use of the sample identification (ID) system (Worksheets #14 and 27). In accordance with AEI SOP F10-001 (Attachment 1), field observations and measurement data will be recorded on the field forms and in a field logbook to provide a permanent record of field activities. All data that are hand-entered will be subjected to a review by a second person to minimize data entry errors. A check for completeness of field records (logbooks, field forms, databases, electronic spreadsheets) will ensure that all requirements for field activities have been fulfilled, complete records exist for each activity, and the procedures specified in this SAP have been implemented. Field documentation will ensure sample integrity and provide sufficient technical information to recreate each field event.

Hard copies of the data reports received from the laboratories will be filed chronologically and will be stored separately from the electronic files. Hard copies of data signed by a representative of the analytical laboratory will be compared to any electronic versions of the data to confirm that the conversion process has not modified the reported results. Any additional reporting formats will be completed and electronic and hard copies will be stored in different locations at the Project Team facilities.

Following the data review process, the Project Team will enter the sample results into an electronic database. This electronic database will be submitted to NAVFAC SW in the NEDD format in accordance with the most current version of the NAVFAC SW Environmental Work Instruction (EWI) #6. Data will be compiled with spatial and temporal qualifiers (location ID and sample date) so that it will be possible to rapidly plot or review changes in the concentration of target analytes at each sampling point over time.

## 14.11 Third Party Data Validation

Data generated for this project will be reviewed and verified by the Project Team's QAM and validated by an independent outside reviewer. Data verification involves the process of generating qualitative and quantitative sample information through observations, field procedures, analytical measurements and calculations. The data verification and reporting

process for the field data involves ensuring that blank samples and field duplicates defined in this SAP are within the acceptance criteria. The verification process for the laboratory data involves ensuring that the holding times, precision, accuracy, laboratory blanks, and detection limits are within the acceptance criteria outlined in this SAP.

The field and laboratory personnel will provide the Project Team QAM with all the data. The Project Team's QAM will be responsible for the overall review of the data verification results for compliance with the specified DQOs. Data verification tasks include confirmation that laboratory sample receipt forms match COC documentation and logbook entries. The sampling data will be validated by an independent third-party in accordance with NAVFAC SW EWI #1 (Chemical Data Validation). For this project, a 10% Level-IV and 90% Level-III data validation strategy will be implemented.

Field screening results for VOCs by EPA Method 8265 will be used immediately to optimize the design of monitoring wells; therefore the screening data will not undergo third party data validation. The data from the confirmation soil samples and the monitoring well samples will undergo the third party data validation described above.

## 14.12 Level-III Validation

Level-III begins the process of data validation and includes an assessment of all the results reported in the standard data package. Qualifiers are issued at Level III and above. For level III data validation, the data values for routine and QC samples are generally assumed to be correctly reported by the laboratory. Data quality will be assessed by comparing the QC parameters to the appropriate criteria (or limits) as specified in this SAP, by CLP requirements, or by method-specific requirements (e.g., CLP, SW-846). If calculations for quantitation are verified, it is done on a limited basis and may require raw data in addition to the standard data forms normally present in a data package.

## 14.13 Level-IV Validation

Level-IV data validation constitutes the most extensive and exhaustive review and includes requantification of reported QC and field sample values using the raw data files. Level-IV data validation follows the EPA protocols and CLP criteria set forth in the functional guidelines for evaluating organic analyses (U.S. EPA, 1999). These guidelines apply to analytical data packages that include the raw data (e.g., spectra and chromatograms) and backup documentation for calibration standards, analysis run logs, LCS, dilution factors, and other types of information. This additional information is utilized in the Level-IV data validation process for checking calculations of quantified analytical data. Calculations are checked for lab QC samples (e.g., MS/MSD and LCS data) and routine field samples (including field duplicates, field and equipment rinsate blanks, and VOC trip blanks). To ensure that detection limits and data values are accurate and appropriate, an evaluation is made of instrument performance, calibration methods, and the original data for calibration standards.

Analytical data may be qualified based on data validation reviews. Qualifiers will be consistent with the applicable EPA functional guidelines and will be used to provide data users with an estimate of the level of uncertainty associated with the "flagged" result.

Data validation results will be evaluated with respect to the attached qualifiers to determine data usability issues, if any. The following qualifiers may be assigned during the validation process:

- J – estimated concentration
- R – rejected value (unusable)
- U – not detected (e.g., not present based on blank contamination)
- UJ – sample detection limit is estimated.

For any instances where the validation qualifiers impact the overall data interpretation and project recommendations, the Data Quality Assessment will discuss the issue and the necessary corrective action.

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# 15.0 SAP WORKSHEET #15 – REFERENCE LIMITS AND EVALUATION TABLES

## 15.1 VOCs by EPA Method 8260B – Matrix: Soil

| Analyte | CAS Number | Project Screening Level (ug/kg) | Project Screening Level Reference[a] | Project Quantitation Limit Goal (ug/kg) | Laboratory-specific | |
|---|---|---|---|---|---|---|
| | | | | | QLs (ug/kg) | MDLs (ug/kg) |
| 1,1,1-Trichloroethane | 71-55-6 | 100,000 | Westinghouse | 5 | 5 | 1 |
| 1,1-Dichloroethane | 75-34-3 | 100,000 | Westinghouse | 5 | 5 | 1 |
| 1,1-Dichloroethene | 75-35-4 | 100,000 | Westinghouse | 5 | 5 | 1 |
| 1,2-Dichloroethane | 107-06-2 | 100,000 | Westinghouse | 5 | 5 | 1 |
| cis-1,2-Dichloroethene | 156-59-2 | 100,000 | Westinghouse | 5 | 5 | 1 |
| Tetrachloroethene (PCE) | 127-18-4 | 100,000 | Westinghouse | 5 | 5 | 1 |
| Trichloroethene (TCE) | 79-01-6 | 100,000 | Westinghouse | 5 | 5 | 1 |
| Vinyl Chloride | 75-01-4 | 100,000 | Westinghouse | 5 | 5 | 1 |

Notes and Acronyms:

| | | | |
|---|---|---|---|
| CAS | Chemical Abstracts Service | ug/kg | micrograms per kilogram |
| MDL | method detection limit | QL | Quantitation Limit |

[a] Evaluating DNAPL Source and Migration Zones: M-Area Settling Basin and the Western Sector of A/M Area, Savannah River Site (U). Prepared for the United States Department of Energy. Westinghouse Savannah River Company (Westinghouse). 2001.

Surrogate parameters for this analytical method and associated QC limits are available in Table 1.

## 15.2 VOCs by EPA Method 8260B – Matrix: Water

| Analyte | CAS Number | Project Screening Level (ug/L) | Project Screening Level Reference[a] | Project Quantitation Limit Goal (ug/L) | Laboratory-specific | |
|---|---|---|---|---|---|---|
| | | | | | QLs (ug/L) | MDLs (ug/L) |
| 1,1,1-Trichloroethane | 71-55-6 | 200 | MCL | 1 | 1 | 0.2 |
| 1,1-Dichloroethane | 75-34-3 | 5.0 | MCL | 1 | 1 | 0.2 |
| 1,1-Dichloroethene | 75-35-4 | 6.0 | MCL | 1 | 1 | 0.2 |
| 1,2-Dichloroethane | 107-06-2 | 0.5[b] | MCL | 1 | 1 | 0.2 |
| cis-1,2-Dichloroethene | 156-59-2 | 6.0 | MCL | 1 | 1 | 0.2 |
| Tetrachloroethene (PCE) | 127-18-4 | 5.0 | MCL | 1 | 1 | 0.2 |
| Trichloroethene (TCE) | 79-01-6 | 5.0 | MCL | 1 | 1 | 0.2 |
| Vinyl Chloride | 75-01-4 | 0.5[b] | MCL | 1 | 1 | 0.2 |

| | | | |
|---|---|---|---|
| CAS | Chemical Abstracts Service | ug/L | micrograms per liter |
| MCL | Maximum Contaminant Level | QL | Quantitation Limit |
| MDL | method detection limit | | |

[a] The State of California MCLs for drinking water (November, 2008) were selected as project screening levels for this investigation.

[b] The analytical method selected provides the lowest reporting limits available using routinely accepted methodology. Since the Project Screening Level is less than the laboratory-specific QL, this analyte will be reported to the MDL.

Surrogate parameters for this analytical method and associated QC limits are available in Table 1.

## 16.0 SAP WORKSHEET #16 – PROJECT SCHEDULE / TIMELINE TABLE

| Activities | Organization | Dates | | Deliverable | Deliverable Due Date |
|---|---|---|---|---|---|
| | | Anticipated Date of Initiation | Anticipated Date of Completion | | |
| Sample Collection | AMJV/BRADY | 7/5/11 | 7/31/11 | None | See Work Plan Schedule |
| Analysis of Samples by Analytical Laboratory | EMAX | After receipt of samples | 14 - 21 days after receipt of samples | Level 3 or 4 lab report (depending on sampling activity) | 21 Days |
| Data Validation | LDC | After receipt of electronic and hardcopy data from laboratory | 14 - 21 days after receipt of lab data | Data Validation Report | 21 Days |
| Data Review | BRADY | After receipt of electronic and hardcopy data from laboratory | 30 days after receipt of lab data | None | None |
| NIRIS Upload | BRADY | After receipt and review of electronic data from LDC | 30 days after completion of data validation | NIRIS Upload | 30 days after completed data validation |

Acronyms:

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| BRADY | Richard Brady and Associates |
| LDC | Laboratory Data Consultants, Inc. |
| NIRIS | Naval Installation Restoration Information Solution |

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## 17.0 SAP WORKSHEET #17 – SAMPLING DESIGN AND RATIONALE

This investigation was designed using chemical and hydrogeologic data from previous investigations in the study area, information from a current environmental data records search obtained from Environmental FirstSearch Network, limited review of agency files, and discussions with Navy representatives. This investigation involves the collection of groundwater samples for chemical analysis to evaluate whether or not target VOCs in groundwater in the vicinity of former agricultural well KAYO-SB, originate from within the Navy property line. The data collected during this investigation, along with existing data from previous investigations, will be used to make this determination.

During this investigation, sonic drilling technology; or equivalent, will be used to collect continuous core samples at predetermined boring locations (Figure 5). The borings will subsequently be used to install permanent groundwater monitoring wells. The proposed boring locations were selected based on the preliminary CSM (Figures 3 and 4), and were determined to be adequate to address the DQOs established for this investigation (Worksheet #11).

The first proposed boring (SB75-MW01; Figure 5) will be advanced to approximately 310 feet bgs, adjacent to former well KAYO-SB. Based on the KAYO-SB driller's log, this depth should penetrate 10 feet into the first transmissive unit of the Beta Aquifer. The lithology will be logged by a Professional Geologist and VOC screening concentration measurements will be collected approximately every 2 lineal feet using DSITMS by EPA Method 8265. Since soil impact is not expected, DSITMS will be used to screen pore water captured within the sediment column. If the geologist observes stains, odors, or a PID reading in the soil core that is interpreted as residual soil contamination or NAPL, a soil sample will be collected in accordance with BRADY SOP T-003 and T-006 (Attachment 1) for fixed base laboratory analysis by EPA Method 8260B. Following logging, a groundwater monitoring well will be installed in boring SB75-MW01 at the depth where contaminant screening shows the highest concentrations.

The geologic and VOC logs will be examined to identify the two water-bearing units with the highest VOC screening concentrations. These two water bearing units will be proposed to be the targets of wells at other locations (Figure 5). Paired wells will be bored separately, although as close together as practical. The deeper well will be drilled first, and the continuous core will be logged by a California Registered Professional Geologist and field screened approximately every 2 feet for VOCs using EPA Method 8265. This data will be used to confirm that the target well depths intersect the targeted water bearing units. The shallower well will be drilled second, using the geologic and VOC logs from the deeper well to confirm the planned depth. If only one VOC-bearing zone is identified by field screening, that zone will be targeted for monitoring well design. The DQO team will examine the lithology log to identify a depth/location for the second paired well. If the geologist observes stains, odors, or a PID reading in the soil core that is interpreted as residual soil contamination (NAPL), a soil sample will be collected in accordance with BRADY SOP T-003 and T-006 (Attachment 1) for fixed base laboratory analysis by EPA Method 8260B. Analytical results from the fixed base laboratory will be evaluated according to decision rule #2 (Worksheet #11).

The purpose of the proposed well network is to assess target VOC concentrations in groundwater in the vicinity of former agricultural well KAYO-SB, to determine if previously detected constituents originate from a Navy or non-Navy source.

Groundwater samples from up to nine permanent groundwater monitoring wells will be analyzed for target VOCs using EPA Method 8260B by a DoD ELAP-accredited, fixed-base laboratory. The laboratory data will be validated by an independent third-party. Groundwater samples will be collected using low-flow protocol in accordance with AEI SOP F30-002 (Attachment 1).

Following receipt of the validated analytical data, a PA/SI summary report will be prepared which will summarize the results of this proposed investigation. The SI summary report will also include a revised CSM; which will incorporate data generated during the groundwater investigation.

## 18.0 SAP WORKSHEET #18 – SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| ***Screening Sampling***[2] | | | | | |
| SB75MW01-SCRXXX | Pore Water | 6 – 310[3] | VOCs | 153 | BRADY T-009<br>BRADY T-010 |
| SB75MW02-SCRXXX | Pore Water | 6 – 310[3] | VOCs | 153 | BRADY T-009<br>BRADY T-010 |
| SB75MW03-SCRXXX | Pore Water | 6 – 310[3] | VOCs | 153 | BRADY T-009<br>BRADY T-010 |
| SB75MW04-SCRXXX | Pore Water | 6 – 310[3] | VOCs | 153 | BRADY T-009<br>BRADY T-010 |
| ***Confirmation Soil Sampling***[4] | | | | | |
| SB75MW01-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW01-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW01-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW01-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| SB75MW01-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW02-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW02-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW02-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW02-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW02-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW03-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW03-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW03-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW03-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| SB75MW03-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW04-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW04-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW04-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW04-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW04-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW05-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW05-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW05-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW05-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| SB75MW05-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW06-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW06-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW06-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW06-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW06-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW07-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW07-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW07-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| SB75MW07-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| SB75MW07-S-XXX | Soil | Field Determination[4] | VOCs | 1 | BRADY T-003<br>BRADY T-006 |
| ***Permanent Groundwater Monitoring Well Sampling (1st Event)*** | | | | | |
| SB75MW01-Q311-01 | Groundwater | 310[5] | VOCs | 1 | AEI F30-002 |
| SB75MW02-Q311-01 | Groundwater | 310[5] | VOCs | 1 | AEI F30-002 |
| SB75MW03-Q311-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW04-Q311-01 | Groundwater | 310[5] | VOCs | 1 | AEI F30-002 |
| SB75MW05-Q311-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW06-Q311-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW07-Q311-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW08-Q311-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW09-Q311-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| ***Permanent Groundwater Monitoring Well Sampling (2nd Event)*** | | | | | |
| SB75MW01-Q411-01 | Groundwater | 310[5] | VOCs | 1 | AEI F30-002 |
| SB75MW02-Q411-01 | Groundwater | 310[5] | VOCs | 1 | AEI F30-002 |
| SB75MW03-Q411-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW04-Q411-01 | Groundwater | 310[5] | VOCs | 1 | AEI F30-002 |
| SB75MW05-Q411-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |

| Sampling Location / ID Number | Matrix | Depth (ft bgs) | Analytical Group | Number of Samples | Sampling SOP Reference[1] |
|---|---|---|---|---|---|
| SB75MW06-Q411-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW07-Q411-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW08-Q411-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |
| SB75MW09-Q411-01 | Groundwater | 200[5] | VOCs | 1 | AEI F30-002 |

## SAP WORKSHEET # 18 – SAMPLING LOCATIONS AND METHODS/SOP REQUIREMENTS TABLE – CONTINUED

Notes and Acronyms:
[1] SOPs are available in Attachment 1.
[2] Screening sample identifications will include the sample depth as described in WS #27.
[3] Screening samples will be collected approximately every 2 feet to a maximum depth of 310 feet bgs. Prior to drilling activities, each boring location will be cleared with a non-intrusive method (i.e air-knife, hand-auger) to a depth of approximately 5 ft bgs.
[4] Confirmatory soil samples may be collected for fixed-base laboratory analysis if the geologist observes stains, odors, or PID readings in the soil core that are interpreted as residual soil contamination or NAPL. Soil sample identifications will include the sample depth as described in WS #27.
[5] This depth represents the anticipated maximum depth of the well. The groundwater monitoring well designs will be optimized in the field based on lithologic and screening data as described in WS #17. The sample depth for all groundwater samples will be based on the placement of the pump intake. The pump intake is anticipated to be placed at or near the mid-point of the well screen.

| | |
|---|---|
| bgs | below ground surface |
| SOP | Standard Operating Procedure |
| VOC | volatile organic compound |
| WS | worksheet |

# 19.0 SAP WORKSHEET #19 – ANALYTICAL SOP REQUIREMENTS TABLE

## 19.1 Matrix: Soil

| Matrix | Analytical Group | Analytical and Preparation Method / SOP Reference[1] | Containers (number, size, and type) | Sample Volume[2] (units) | Preservation Requirements (chemical, temperature, light protected) | Maximum Holding Time[3] (preparation /analysis) |
|---|---|---|---|---|---|---|
| Soil | VOCs | 8260B/5035/ EMAX-8260 | 3 x 5g EnCore Samplers | 15 grams | 4°C (±2°C) | 48 Hr. (7 Days[4])<br>14 days |

Notes and Acronyms:
[1] Analytical SOP Reference from Worksheet #23. A copy of this SOP will be provided in Attachment 3 of the final version of the SAP (CD-ROM). The field copy will have Attachment 3 as a hard copy.
[2] Laboratory sample volume requirements.
[3] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.
[4] Holding time for preparation of EnCore samplers can be 7 days if samples are frozen.

SOP standard operating procedures
VOCs volatile organic compounds

## 19.2 Matrix: Water

| Matrix | Analytical Group | Analytical and Preparation Method / SOP Reference[1] | Containers (number, size, and type) | Sample Volume[2] (units) | Preservation Requirements (chemical, temperature, light protected) | Maximum Holding Time[3] (preparation /analysis) |
|---|---|---|---|---|---|---|
| Water | VOCs | 8260B/5030B/ EMAX-8260 | 3 x 40 mL VOA vials | 120 mL | HCl, pH < 2 ≤ 4°C | 14 days |

Notes and Acronyms:
[1] Analytical SOP Reference from Worksheet #23. A copy of this SOP will be provided in Attachment 3 of the final version of the SAP (CD-ROM). The field copy will have Attachment 3 as a hard copy.
[2] Laboratory sample volume requirements.
[3] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

| | |
|---|---|
| HCL | hydrochloric acid |
| mL | milliliter |
| pH | potential of hydrogen |
| SOP | standard operating procedures |
| VOA | volatile organic analytes |
| VOCs | volatile organic compounds |

## 20.0 SAP WORKSHEET #20 – FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

| Matrix | Analytical Group | No. of Sampling Locations | No. of Field Duplicates | No. of MS/MSDs | No. of Field Blanks | No. of Equip. Blanks | No. of Trip Blanks | No. of PT Samples[1] | Total No. of Samples to Lab |
|---|---|---|---|---|---|---|---|---|---|
| Soil | VOCs | 35 | 0[2] | 2/2 | 1 | 3 | 1 | 0 | 44 |
| Water | VOCs | 7[3] | 1 | 1/1 | 1 | 3 | 1 | 0 | 15 |

Notes and Acronyms:
[1] PT samples will not be collected during this project.
[2] Soil duplicate samples will not be collected as part of the sampling efforts since assessment of spatial heterogeneity is not an objective of this project.
[3] The number of groundwater sampling locations and field quality control samples listed in the table represent ***one sampling event***. Up to two sampling events are planned, so ***this is the number of water samples that should be collected during each sampling event***.

MS/MSD matrix spike/matrix spike duplicate
PT proficiency testing
VOCs volatile organic compounds

## 21.0 SAP WORKSHEET #21 – PROJECT SAMPLING SOP REFERENCES TABLE

| Reference Number | Title, Revision Date and/or Number | Originating Organization of Sampling SOP | Equipment Type | Modified for Project Work? (Y/N) | Comments |
|---|---|---|---|---|---|
| AEI F10-002 | Instrument Calibration and Use, 4/16/10 | AEI | Multi-parameter meter, turbidity meter | N | |
| AEI F10-003 | Decontamination of Equipment, 4/16/10 | AEI | Non disposable drilling and sampling equipment | N | |
| AEI F20-003 | Monitoring Well Design, Installation, and Development, 4/16/10 | AEI | Drill Rig, Sonic or equivalent | N | |
| AEI F30-002 | Groundwater Sampling, 4/16/10 | AEI | Dedicated pump, in-line flow-through cell, multi-parameter meter | N | |
| AEI F40-001 | Water and Free Product Level Measurement in Wells, 4/16/10 | AEI | Interface meter | N | |
| BRADY T-003 | Soil Sampling Procedure for Volatile Organics Using the EnCore® Sampler, 9/30/09 | BRADY | EnCore® Sampler T-Handle, Disposable EnCore® Sampler | N | |
| BRADY T-006 | Environmental Soil Sampling, 9/30/09 | BRADY | Soil Sampling Equipment | N | |
| BRADY T-009 | Sampling and Analysis of VOCs in Soil using Direct Push Sampling and Direct Sampling Ion Trap Mass Spectrometry, 4/6/10 | BRADY | Mass Spectrometer | N | |
| BRADY T-010 | Sampling and Analysis of VOCs in Water using Direct Push Sampling and Direct Sampling Ion Trap Mass Spectrometry, 9/30/09 | BRADY | Mass Spectrometer | N | |

Notes and Acronyms:

[1] Sampling SOPs are available in Attachment 1.

AEI Accord Engineering, Inc.
AMJV Accord MACTEC Joint Venture
BRADY Richard Brady & Associates
SOP Standard Operating Procedure
VOC volatile organic compounds

## 22.0 SAP WORKSHEET #22 – FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

| Field Equipment[1] | Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference | Comments |
|---|---|---|---|---|---|---|---|
| Interface Meter | Maintenance | As needed.<br>Decontaminate after each use. | Operational. Depress the battery test button to test the battery and circuitry. | In house repair/ Return to manufacturer | AMJV Staff – Project Manager | AEI F40-001 | Replace batteries as needed.<br>Decontaminate after each well sampled. |
| Multi-parameter Meter | Maintenance | Rate of deposit build-up for anodes, cathodes, and surface of sensors.<br>Check electrolyte solution and membrane cap every 30 Days. | Reports criteria per calibration ranges. | Return to manufacturer | AMJV Staff – Project Manager | AEI F10-002<br>AEI F30-002 | Store probe in calibration cup filled with tap water and sealed to prevent evaporation when not in use.<br>Replace batteries as needed. |
| | Calibration | At the start of each sampling event and as needed based on DCC. | Per instrument specifications.<br>Calibration ranges vary per parameter<br>(D.O., pH, Specific Conductivity, and ORP). | Recalibrate until in acceptable range or return to manufacture for repair. | AMJV Staff – Project Manager | AEI F10-002<br>AEI F30-002 | Replace batteries as needed. |
| Low-Flow Purge Controller and Power Pack | Maintenance | Check various components (valves, regulators, gauges, and controller) daily per sampling event. | Pumping at required flow pressure and rate for sample recovery. | Return to manufacturer | AMJV Staff – Project Manager | AEI F30-002 | Replace batteries as needed. Air fittings must be in good condition and not leaking. |

**Table Continues**

## SAP WORKSHEET #22 – FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE – CONTINUED

| Field Equipment[1] | Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference | Comments |
|---|---|---|---|---|---|---|---|
| Low-Flow Bladder Pump | Maintenance | Check bladders and gaskets daily per sampling event and decontaminate after each use. | Pumping at required flow pressure and rate for sample recovery. | In house repair/ Return to manufacturer | AMJV Staff – Project Manager | AEI F30-002 | Various connecting parts and gaskets must fit and be in good working order. Inspect polyethylene tubing and bladders for leaks or wear. Decontaminate after each well sampled. |
| Portable Turbidity Meter | Maintenance | As Needed | Per instrument specifications | In house repair/ Return to manufacturer | AMJV Staff – Project Manager | AEI F10-002<br>AEI F30-002 | Replace batteries as needed. |
| | Calibration | At the start of each sampling event and as needed based on daily calibration check. | Per instrument specifications | Recalibrate until in acceptable range or return to manufacture for repair. | AMJV Staff – Project Manager | AEI F10-002<br>AEI F30-002 | Replace batteries as needed. |

Notes and Acronyms:
[1] Field equipment related to the collection of samples for chemical analysis. Other equipment such as geophysical and surveying equipment will be operated in accordance with manufacturer's instructions by qualified personnel. Monitoring well locations and elevations will be surveyed by a Professional Land Surveyor.

AEI Accord Engineering, Inc.
AMJV Accord MACTEC Joint Venture
DCC daily calibration check
DO dissolved oxygen
pH potential of hydrogen
ORP oxidation-reduction potential
SOP standard operating procedures

## 23.0 SAP WORKSHEET #23 – ANALYTICAL SOP REFERENCES TABLE

| Lab SOP Number[1] | Title, Revision Date, and / or Number | Definitive or Screening Data | Matrix/ Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? (Y/N) |
|---|---|---|---|---|---|---|
| EMAX-8260 | Volatile Organics by GCMS Rev. 6 | Definitive | Soil and Water / VOCs | GC/MS | EMAX Laboratories Inc. | N |

Notes and Acronyms:
[1] A copy of the analytical SOP will be provided in Attachment 3 of the final version of the SAP (CD-ROM). The field copy will have Attachment 3 as a hard copy.

GC/MS gas chromatograph/mass spectrometer
VOCs volatile organic compounds

## 24.0 SAP WORKSHEET #24 – ANALYTICAL INSTRUMENT CALIBRATION TABLE

| Instrument | Calibration Procedure | Frequency of Calibration | Acceptance Criteria | Corrective Action (CA) | Person Responsible for CA | SOP Reference |
|---|---|---|---|---|---|---|
| GC/MS | ICAL | Initially; as needed | SPCCs average RF ± 0.050 and %RSD for RFs for CCCs < 30% and one option below:<br>1) linear- mean RSD for all analytes =/<15%<br>2) linear – least squares regression<br>r =/> 0.995, when RSD >15%<br>3) non-linear – COD > 0.990 (6 points shall be used for second order, 7 points shall be used for third order) | Locate the source of the problem. If expected RFs are not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial calibration. | EMAX Labs Inc. Chemist | EMAX-8260 |
| GC/MS | ICV | After every ICAL | All analytes within ±25% of expected value<br>[* within ±35% of expected value] | Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem then repeat ICAL and ICV. | EMAX Labs Inc. Chemist | EMAX-8260 |
| GC/MS | DCC | Every 12 hrs. | SPCCs average RF > 0.050; and CCCs < 20% difference (when using RFs)or drift (when using least squares regression or non-linear calibration) | Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL. | EMAX Labs Inc. Chemist | EMAX-8260 |

Acronyms:

| | | | |
|---|---|---|---|
| CCC | criteria continuing concentration | ICV | initial calibration verification |
| COD | coefficient of determination | RF | response factor |
| CCV | continuing calibration verification | RPD | relative percent difference |
| DCC | daily calibration check | %RSD | percent relative standard deviation |
| GC/MS | gas chromatograph/mass spectrometer | RSD | relative standard deviation |
| ICAL | initial calibration | SPCC | system performance check compound |

## 25.0 SAP WORKSHEET #25 – ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

| Instrument/ Equipment | Maintenance Activity | Testing Activity | Inspection Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference |
|---|---|---|---|---|---|---|---|---|
| GC/MS | Parameter Setup | Physical check | Physical check | Initially; prior to DCC | Predetermined optimum parameter settings | Reset if incorrect | EMAX Labs Inc. Chemist | EMAX-8260 |
| GC/MS | Instrument Maintenance | Parameter Check | Based on instrument Maintenance Log: Clean Purge Port, Bake Trap, Check Column Head Pressure, Set Injector Port Temperature, Check Interface Setting | Daily, Prior to use. | Predetermined Settings | Perform corrective action to system. Document actions in Instrument Maintenance Log. | EMAX Labs Inc. Chemist | EMAX-8260 |

Acronyms
DCC daily calibration check
GCMS gas chromatography mass spectrometer

## 26.0 SAP WORKSHEET #26 – SAMPLE HANDLING SYSTEM

| |
|---|
| **SAMPLE COLLECTION, PACKAGING, AND SHIPMENT** |
| Sample Collection (Personnel/Organization): Field Sampling Personnel / AMJV |
| Sample Packaging (Personnel/Organization): Field Sampling Personnel / AMJV |
| Coordination of Shipment (Personnel/Organization): Quality Assurance Manager or PM / AMJV |
| Type of Shipment/Carrier: Commercial shipment courier or laboratory courier |
| **SAMPLE RECEIPT AND ANALYSIS** |
| Sample Receipt (Personnel/Organization): Sample Custodian, EMAX Laboratories Inc. |
| Sample Custody and Storage (Personnel/Organization): Sample Custodian, EMAX Laboratories Inc. |
| Sample Preparation (Personnel/Organization): Various chemists and technicians, EMAX Laboratories Inc. |
| Sample Determinative Analysis (Personnel/Organization): Various chemists and technicians, EMAX Laboratories Inc. |
| **SAMPLE ARCHIVING** |
| Field Sample Storage (No. of days from sample collection): 30 days, or as required on a project specific basis |
| Sample Extract/Digestate Storage (No. of days from extraction/digestion): 30 days, or as required on a project specific basis |
| Biological Sample Storage (No. of days from sample collection): NA |
| **SAMPLE DISPOSAL** |
| Personnel/Organization: Sample Custodian, EMAX Laboratories Inc. |
| Number of Days from Analysis: 30 days, or as required on a project specific basis |

Acronyms:

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| NA | Not Applicable |
| PM | project manager |

# 27.0 SAP WORKSHEET #27 – SAMPLE CUSTODY REQUIREMENTS

## 27.1 Sample Identification

To provide a method of tracking each sample through collection, analysis, data review, and data reduction, a sample identification system has been established. The sample identification systems for both screening and groundwater samples are described below.

### 27.1.1 Screening Sample Identification

Screening sample identification numbers will be assigned in the field according to the following identification system:

- A ten-character or less designation of the Station ID. If a Location ID has already been established in NIRIS (i.e. permanent monitoring well), then it will be used as the Station ID.
- A three character designation of the type of sample, i.e. “SCR” for screening sample.
- A three character designation of the depth that the sample is collected at the location. Leading zeros are used as needed to create three characters.

For example, sample identification number SB75MW01-SCR010 would refer to Station ID “SB75MW01” (where “SB75” refers to Naval Weapons Station Seal Beach IR Site 75 and “MW01” refers to that particular boring/monitoring well location), “SCR” refers to a screening sample, and “010” refers to the sample being collected at 10 feet bgs from that location.

### 27.1.2 Soil Sample Identification

Soil sample identification numbers will be assigned in the field according to the following identification system:

- A ten-character or less designation of the Station ID. If a Location ID has already been established in NIRIS (i.e. permanent monitoring well), then it will be used as the Station ID.
- A one character designation of the type of sample, i.e. “S” for soil sample.
- A three character designation of the depth that the sample is collected at the location. Leading zeros are used as needed to create three characters.

For example, sample identification number SB75MW01-S-010 would refer to Station ID “SB75MW01” (where “SB75” refers to Naval Weapons Station Seal Beach IR Site 75 and “MW01” refers to that particular boring/monitoring well location), “S” refers to a soil sample, and “010” refers to the sample being collected at 10 feet bgs from that location.

### 27.1.3 Groundwater Sample Identification

The sample identification system for groundwater samples is designed to be compatible with both the SWRCB GeoTracker database requirements, as well as the NEDD standard. Sample

number identification will be assigned in the field according to the following sample identification system:

- A ten-character or less designation of the Station ID. If a Location ID has already been established in NIRIS (i.e. permanent monitoring well), then it will be used as the Station ID.
- A four character designation of the quarter of the calendar year for which the groundwater sample is collected, i.e. "3Q11" for the third quarter of 2011.
- A two-character designation of the consecutive sample number collected at the monitoring well location. Leading zeros are used as needed to create two characters.

For samples collected at the permanent monitoring well locations, the format of the Station ID would also incorporate the monitoring well number. For example, Sample ID number SB75MW01-3Q11-01 refers to Station ID "SB75MW01" (where "SB75" refers to Naval Weapons Station Seal Beach Site 75, "MW01" refers to that particular monitoring well), "3Q11" refers to the third quarter of 2011, and "01" refers to the first water sample collected at that monitoring well.

Field QC samples subjected to chemical analysis, such as equipment rinsate blanks, field blanks, and trip blanks will also be named this way; sequentially numbered as collected in the field with the site characterization samples. Field QC samples will be submitted to the laboratory under blind identification. Field QC samples will *not* be identified as QC samples in the sample name or on the COC. Field QC samples will be labeled with a Sample ID comprised of the following sequential components, all separated by dashes:

- The Station ID of the preceding station sampled (i.e. the station sampled immediately prior to collecting the field QC sample).
- A four character designation of the quarter of the calendar year for which the QC sample is collected, i.e. "3Q11" for the third quarter of 2011.
- A two-character designation of the consecutive sample number collected, continuing from the preceding station. Leading zeros are used as needed to create two characters.

In the following hypothetical example, the first samples collected at the site are from the station with the Station ID SB75MW01, named in accordance with the protocol described above. In this hypothetical situation:

- One water sample is collected.
- An MS/MSD is collected with the first water sample.
- Following the sampling, an equipment blank and a field blank are collected.

The samples would be named as follows:

The water sample would be named SB75MW01-3Q11-01, referring to:

- Station ID "SB75MW01" (where "SB75" refers to Naval Weapons Station Seal Beach Site 75, and "MW01" refers to that particular permanent monitoring well.
- Collected during the third quarter of 2011 (3Q11)
- Consecutive sample "01"

The extra containers collected for the MS/MSD would also be labeled SB75MW01-3Q11-01, and the COC would identify this sample to the lab for use as an MS/MSD for lab QA/QC. The sample will be shown as a single line on the COC, with the total number of sample containers entered in the appropriate field.

The equipment blank would be named SB75MW01-3Q11-02, referring to:

- Station ID SB75MW01, representing the Field Point name of the preceding station where the sampling equipment was used.
- Collected during the third quarter of 2011 (3Q11)
- Consecutive sample "02" refers to the second water sample related to the station.

Similarly, the field blank would be named SB75MW01-3Q11-03.

Temperature blanks will be labeled as temperature blanks. Temperature blanks are not subject to chemical analysis.

Cross-reference information regarding the Station ID, the assigned sample identification number, and whether the sample is a field QC sample, will be documented in the bound field logbook.

## 27.2 Sample Custody

All samples will be recorded on COC forms using the sample ID described above. COCs will be completed using indelible ink and in a manner to ensure entries are legible. Any errors made by the individual completing the COC shall be crossed out with a single line, initialed, and dated. The COC serves as the legal documentation of the sample custody since it records the transfer of the samples from field personnel to the laboratory to ensure that no tampering occurs.

The COC form will be signed by the individual responsible for custody of the sample containers, and the original will accompany the samples to the laboratory. One copy of the COC form will be kept by the project manager (PM) and/or the quality assurance manager and included in the project files. Information to be recorded on the COC form should include:

- Sample matrix
- Sample collector's name
- Dates/times of sample collection
- Sample identification numbers
- Number and type of containers for each sample aliquot

- Type of preservation
- Laboratory QC sample designation
- Analysis method
- Special handling instructions
- Destination of samples
- Name, date, time, and signature of each individual releasing the shipping container.

## 27.3 Sample Packaging and Shipment

Sample packaging will be conducted to ensure that samples arrive at the laboratory undisturbed and in good condition. The following packaging procedures are also designed to meet EPA and Department of Transportation regulations:

- Immediately after sample collection, a sample label will be completed with indelible ink and affixed to each sample container. Each sample will be placed in a re-sealable plastic bag to keep the sample container and label dry.
- As samples are accumulated, they will be stored in a designated sample cooler and properly protected from breakage. Sufficient packing material will be used to prevent sample containers from making contact during shipment. Enough wet ice will be added (double-bagged in re-sealable plastic bags) to maintain sample temperature requirements ($\leq$ 4°C). Field samples and ice will be collectively bagged in plastic trash bags, taped shut, and placed in the shipping container, to avoid water leakage. If the shipping container used is equipped with a drain plug, the plug will be taped shut both inside and outside to further ensure that there is no water leakage.
- The COC form will be completed and signed by the Project Team's field personnel and courier (if other than the sampler) for the samples transported to the laboratory. The COC will be placed in a re-sealable plastic bag, and taped to the inside of the shipping container lid.
- The shipping container will be closed and taped shut with strapping tape (filament-type) completely around at both ends.
- If the samples are to be delivered to the laboratory using a commercial shipment courier service, custody seals will be used on each container to provide tampering detection. The signed and dated custody seals will be placed on the front right and back left of the shipping container, and will be covered with wide, clear tape.

International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. The package must be scheduled for priority overnight service to ensure that the temperature preservative requirement is not exceeded. Saturday deliveries will be coordinated with the laboratory.

## 27.4 Laboratory Receipt and Custody

The laboratory will designate a sample custodian. Upon receipt, this individual is responsible for inspecting the sample shipment, recording the temperature of the temperature blank and verifying the correctness of the COC records. The sample custodian will accept the samples by signing the COC form and noting the condition of the samples in the space provided on the COC form and on the Sample Receipt form. In case of breakage or discrepancies between the COC form, sample identification numbers, or requested analysis, the sample custodian will notify the Project Team QAM as soon as possible. All discrepancies associated with COC forms or sample breakage will be relayed to Project Team QAM within 24-hours so corrective action can be implemented appropriately. The COC is generally considered to be a legal document and thus will be filled out legibly and as error free as possible.

Samples received by the laboratory will be entered into a sample management system, which must include:

- Laboratory sample number
- Field sample designation
- Analytical batch numbers
- List of analyses requested for each sample container.

Immediately after receipt, the samples will be stored in an appropriate secure storage area. The laboratory will maintain custody of the samples as required by the contract or until further notification by the Project Team PM or QAM. The analytical laboratory will maintain written records showing the chronology of sample handling during the analysis process by various individuals at the laboratory.

## 27.5 Field Documents and Records

A project-specific field logbook will be used to provide daily records of significant events, observations, and measurements during the assessment in accordance with AEI SOP F10-001 (Attachment 1). The field logbook also will be used to document all sampling activities. The logbooks will be kept in the possession of the field team leader during the on-site work and all members of the field team will have access to the logbook. The logbook will be maintained as a permanent record. Any errors found in the logbook will be verified, crossed-through, and initialed by the person discovering the error.

The field logbook is intended to provide sufficient data and observations to reconstruct events that occurred during field activities. The field logbook should be permanently bound and pre-paginated; designated forms should be used whenever possible to ensure that field records are complete. The following items are examples of information that may be included in the field logbook:

- Weather conditions, health and safety briefing
- Name, date, and time of entries

- Names and responsibilities of field crew members
- Names and titles of any site visitors
- Descriptions of field procedures, and problems encountered
- Number and amount of samples taken at each location
- Details of sampling location, including sampling coordinates
- Sample identification numbers of all samples collected
- Date and time of collection
- Sample collector
- Sample collection method
- Decontamination procedures
- Field instrument calibration and maintenance
- Field measurements (e.g., organic vapor) and general observations.

Example forms are included as Attachment 2.

# 28.0 SAP WORKSHEET #28 – LABORATORY QC SAMPLES TABLE

## 28.1 VOCs - Soil

| | |
|---|---|
| Matrix | Soil |
| Analytical Group | VOCs |
| Analytical Method / SOP Reference | 8260B<br>EMAX-8260 |

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | DQI | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank | One per preparation batch | All analytes <1/2 QLs | Reprep and reanalyze blank and all samples processed with the non-conforming blank. | EMAX Labs Inc. Chemist | Accuracy/Bias - Contamination | Detections < QLs (Worksheet #15) |
| Surrogate | Every analytical sample | Refer to QC Limit (Table 1) | Reprep and reanalyze all samples processed with the non-conforming surrogate. | EMAX Labs Inc. Chemist | Accuracy/Bias | %R (Table 1) |
| LCS | One per sample preparation batch | Refer to QC Limit (Table 1) | Reprep and reanalyze LCS and all samples processed with the non-conforming LCS. | EMAX Labs Inc. Chemist | Accuracy/Bias | %R (Table 1) |
| MS/MSD | Project designated sample matrix QC. | Refer to QC Limit (Table 1) | If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample. | EMAX Labs Inc. Chemist | Interferences - Accuracy/Bias - Precision | %R / RPD (Table 1) |

**TABLE CONTINUES**

## SAP WORKSHEET # 28 – LABORATORY QC SAMPLE TABLE – CONTINUED

Acronyms:

| | |
|---|---|
| DQI | data quality indicator |
| LCS | laboratory control sample |
| MS/MSD | matrix spike/matrix spike duplicate |
| %R | percent recovery |
| QL | quantitation limit |
| QC | quality control |
| RPD | relative percent difference |
| VOC | volatile organic compound |

## 28.2 VOCs - Groundwater

| | |
|---|---|
| Matrix | Groundwater |
| Analytical Group | VOCs |
| Analytical Method / SOP Reference | 8260B<br>EMAX-8260 |

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | DQI | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank | One per preparation batch | All analytes <1/2 QLs | Reprep and reanalyze blank and all samples processed with the non-conforming blank. | EMAX Labs Inc. Chemist | Accuracy/Bias - Contamination | Detections < QLs (Worksheet #15) |
| Surrogate | Every analytical sample | Refer to QC Limit (Table 1) | Reprep and reanalyze all samples processed with the non-conforming surrogate. | EMAX Labs Inc. Chemist | Accuracy/Bias | %R (Table 1) |
| LCS | One per sample preparation batch | Refer to QC Limit (Table 1) | Reprep and reanalyze LCS and all samples processed with the non-conforming LCS. | EMAX Labs Inc. Chemist | Accuracy/Bias | %R (Table 1) |
| MS/MSD | Project designated sample matrix QC. | Refer to QC Limit (Table 1) | If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample. | EMAX Labs Inc. Chemist | Interferences - Accuracy/Bias - Precision | %R / RPD (Table 1) |

**TABLE CONTINUES**

## SAP WORKSHEET # 28 – LABORATORY QC SAMPLE TABLE – CONTINUED

Acronyms:

| | |
|---|---|
| DQI | data quality indicator |
| LCS | laboratory control sample |
| MS/MSD | matrix spike/matrix spike duplicate |
| %R | percent recovery |
| QL | quantitation limit |
| QC | quality control |
| RPD | relative percent difference |
| VOC | volatile organic compound |

## 29.0 SAP WORKSHEET #29 – PROJECT DOCUMENTS AND RECORDS TABLE

| Document | Where Maintained |
|---|---|
| Draft WP, SAP, APP and SSHP | AMJV project file and NAVFAC SW AR |
| Final WP, SAP, APP and SSHP | AMJV project file and NAVFAC SW AR |
| Field notes/logbook | AMJV project file |
| COC forms | AMJV project file |
| Audit checklists/reports | AMJV and laboratory project file |
| Corrective action forms/reports | AMJV and laboratory project file |
| Laboratory data package | AMJV, laboratory project file, and NAVFAC SW AR |
| Laboratory equipment calibration logs | Laboratory project file |
| Sample preparation logs | Laboratory project file |
| Run logs | Laboratory project file |
| Sample disposal records | Laboratory project file |
| Data validation package | AMJV, data validator project file, and NAVFAC SW AR |

Acronyms:

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| APP | Accident Prevention Plan |
| AR | Administrative Record |
| BRADY | Richard Brady & Associates |
| COC | Chain of Custody |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| SAP | Sampling and Analysis Plan |
| SSHP | Site Safety and Health Plan |
| WP | Work Plan |

## 30.0 SAP WORKSHEET #30 – ANALYTICAL SERVICES TABLE

For this project, analytical services will be provided by EMAX Laboratories, Inc. of Torrance, CA. Turnaround times for the laboratory data package will be based on the date in which the laboratory receives the samples. The final data package will be sent in electronic format to the AMJV office in 10 days. The backup laboratory for this project is BC Laboratories, Inc. of Bakersfield, CA. Both labs are currently certified by the California Department of Health Services Environmental Laboratory Accreditation Program (ELAP) for analysis of hazardous materials for the method specified in this SAP, and have received accreditation from a Department of Defense (DoD) ELAP accrediting body.

| Matrix | Analytical Group | Sample Locations/ ID Number | Analytical Method | Data Package Turnaround Time | Laboratory[1] / Organization (name and address, contact person and telephone number) | Backup Laboratory[1] /Organization (name and address, contact person and telephone number) |
|---|---|---|---|---|---|---|
| Soil | VOCs | Worksheet #18 contains all sample locations and/or ID numbers | 8260B[2] | 10 Day (Final) | EMAX Laboratories, Inc.<br>1835 W. 205th St.,<br>Torrance, CA 90501<br>310.618.8889<br>*Ye Myint* | BC Laboratories, Inc.<br>4100 Atlas Court<br>Bakersfield, CA 93308<br>661.852.4281<br>*Natalie Serda* |
| Water | VOCs | Worksheet #18 contains all sample locations and/or ID numbers | 8260B[2] | 10 Day (Final) | EMAX Laboratories, Inc.<br>1835 W. 205th St.,<br>Torrance, CA 90501<br>310.618.8889<br>*Ye Myint* | BC Laboratories, Inc.<br>4100 Atlas Court<br>Bakersfield, CA 93308<br>661.852.4281<br>*Natalie Serda* |

Notes and Acronyms:
[1] For this project, the laboratories must be certified by the State of California for EPA Method 8260B. In addition, the laboratories must have received accreditation from a DoD ELAP accrediting body for EPA Method 8260B.
[2] A copy of the analytical SOP will be provided in Attachment 3 of the final version of the SAP (CD-ROM). The field copy will have Attachment 3 as a hard copy.

VOC volatile organic compound

## 31.0 SAP WORKSHEET #31 – PLANNED PROJECT ASSESSMENTS TABLE

| Assessment Type | Frequency | Internal or External | Organization Performing Assessment | Person(s) Responsible for Performing Assessment | Person(s) Responsible for Responding to Assessment Findings | Person(s) Responsible for Identifying and Implementing CA | Person(s) Responsible for Monitoring Effectiveness of CA |
|---|---|---|---|---|---|---|---|
| Readiness Review[1] | Prior to initiating fieldwork | Internal | AMJV / BRADY | PM[2] | Project team | PM | PM |
| Field Sampling TSA[1] | At start of field sampling activities | Internal | BRADY | QAM | PM | QAM | QAM<br>PM |
| Field Documentation Review[1] | Daily | Internal | AMJV / BRADY | QAM<br>PM | PM | QAM | QAM<br>PM |

Notes and Acronyms:
[1] Attachment 2 contains the examples of the review and audit forms.
[2] The BRADY project manager will preside over the meeting. Additional participating project team members may include the BRADY quality assurance manager, the site health and safety officer and field sampling personnel.

AMJV Accord MACTEC Joint Venture
BRADY Richard Brady & Associates
CA Corrective Action
PM Project Manager
QA Quality Assurance
QAM Quality Assurance Manager
TSA technical systems audit

## 32.0 SAP WORKSHEET #32 – ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES

| Assessment Type | Nature of Deficiencies Documentation | Individual(s) Notified of Findings | Timeframe of Notification | Nature of Corrective Action Response Documentation | Individual(s) Receiving Corrective Action Response | Timeframe for Response |
|---|---|---|---|---|---|---|
| Readiness Review[1] | Action Item List | Jesse MacNeill, QAM, BRADY | 24 hours after review | Completed Action Item List | Jesse MacNeill, QAM, BRADY<br>Tim Shields,<br>Program Manager, BRADY<br>Qihai Chen, PM, AMJV | 5 days |
| Field Sampling TSA[1] | Audit report | Fred Essig, PM, BRADY | 24 hours after audit | Corrective Action Form and/or FCN | Jesse MacNeill, QAM, BRADY<br>Tim Shields,<br>Program Manager, BRADY<br>Qihai Chen, PM, AMJV<br>Brenda Reese,<br>RPM, NAVFAC SW<br>(if FCN issued only) | Within 24 hours |
| Field Documentation Review[1] | Field Data Review Checklist | Fred Essig, PM, BRADY | Upon completion of the review | Corrective Action Form | Jesse MacNeill, QAM, BRADY | 2 days |

Notes and Acronyms:
[1] Attachment 2 contains the examples of the review and audit forms.

| | |
|---|---|
| BRADY | Richard Brady & Associates |
| FCN | Field Change Notice |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| PM | project manager |
| QA | Quality Assurance |
| QAM | Quality Assurance Manager |
| RPM | remedial project manager |
| TSA | technical systems audit |

## 33.0 SAP WORKSHEET #33 – QA MANAGEMENT REPORTS TABLE

| Type of Report | Frequency | Projected Delivery Date(s) | Person(s) Responsible for Report Preparation | Report Recipient(s) |
|---|---|---|---|---|
| Readiness Review[1] | Prior to initiating fieldwork | 10 days prior to initiation of field activities | Fred Essig,<br>PM, BRADY | Tim Shields,<br>Program Manager, BRADY;<br>Jesse MacNeill, QAM, BRADY<br>Qihai Chen, PM, AMJV |
| Field Sampling TSA[1] | At start of field sampling activities | 24 hours after initiation of audit | Jesse MacNeill,<br>QAM, BRADY | Tim Shields,<br>Program Manager, BRADY;<br>Fred Essig, PM, BRADY<br>Qihai Chen, PM, AMJV |
| Field Documentation Review[1] | Daily | Upon completion of the review | Jesse MacNeill,<br>QAM, BRADY | Tim Shields,<br>Program Manager, BRADY;<br>Fred Essig, PM, BRADY<br>Qihai Chen, PM, AMJV |

Notes and Acronyms:
[1] Attachment 2 contains the examples of the review and audit forms.

BRADY Richard Brady & Associates
PM Project Manager
QA Quality Assurance
QAM Quality Assurance Manager
TSA technical systems audit

## 34.0 SAP WORKSHEET #34 – VERIFICATION (STEP I) PROCESS TABLE

| Verification Input | Description | Internal / External | Responsible for Verification |
|---|---|---|---|
| COC forms | COC forms will be reviewed internally upon their completion and verified against the packed sample containers they represent. The shipper's signature on the COC should be initialed by the reviewer, a copy of the COC retained in the project file, and the original and remaining copies taped inside the container for shipment. | Internal | Field Sampling Personnel (AMJV) |
| Field notes/logbook | Field notes and/or entries into the field logbook will be reviewed internally and placed in the project file upon project completion. | Internal | Field Sampling Personnel (AMJV/BRADY)<br>Quality Assurance Manager (BRADY) |
| Audit reports | Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. | Internal | PM (BRADY)<br>Quality Assurance Manager (BRADY) |
| Laboratory data | All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be verified externally according to the data validation procedures specified in Worksheet # 36 of this SAP. | Internal/ External | EMAX Laboratories, Inc.<br>LDC |
| Electronic data deliverables | All EDDs will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received EDDs will be verified externally against the hardcopy laboratory data packages. | Internal/ External | EMAX Laboratories, Inc.<br>LDC |

Acronyms:

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| BRADY | Richard Brady & Associates |
| COC | Chain-of-Custody |
| EDD | Electronic Data Deliverable |
| LDC | Laboratory Data Consultants, Inc. |
| PM | Project Manager |
| QAM | Quality Assurance Manager |
| SAP | Sampling and Analysis Plan |

## 35.0 SAP WORKSHEET #35 – VALIDATION (STEPS IIA AND IIB) PROCESS TABLE

| Step IIa / IIb[1] | Validation Input | Description | Responsible for Validation |
|---|---|---|---|
| IIa | Communication | Establish that required communication procedures were followed by field or laboratory personnel. | PM (AMJV/BRADY)<br>Quality Assurance Manager (BRADY) |
| IIa | Sampling Methods and Procedures | Establish that the required sampling methods were used and that any deviations were noted. Ensure that the sampling procedures and field measurements met performance criteria and that any deviations were documented. | PM (AMJV/BRADY)<br>Quality Assurance Manager (BRADY) |
| IIa | Holding Times | Ensure that samples were analyzed within holding times specified in method, procedure, or contract requirements. If holding times were not met, confirm that deviations were documented, that appropriate notifications were made as stated in BRADY's Statement of Work to the laboratory. | Quality Assurance Manager (BRADY)<br>Data Validator (LDC) |
| IIa | Analytes | Ensure that required lists of analytes were reported as specified in governing documents (i.e., method, procedure, or contract). | Quality Assurance Manager (BRADY)<br>Data Validator (LDC) |
| IIa | Analytical Methods and Procedures | Establish that the required analytical methods were used and that any deviations were noted. Ensure that the QC samples met performance criteria and that any deviations were documented. | Quality Assurance Manager (BRADY)<br>Data Validator (LDC) |
| IIa | Data Qualifiers | Determine that the laboratory data qualifiers were defined in the laboratory data package and applied as specified. | Quality Assurance Manager (BRADY)<br>Data Validator (LDC) |
| IIa | Field Transcription | Authenticate transcription accuracy of sampling data (i.e., from field logbook to report). | PM (BRADY)<br>Quality Assurance Manager (BRADY) |
| IIb | Sampling Plan | Determine whether the sampling plan was executed as specified (i.e., the number, location, and type of field samples were collected and analyzed as specified in the QAPP). | PM (AMJV/BRADY)<br>Quality Assurance Manager (BRADY) |
| IIb | Sampling Procedures | Evaluate whether sampling procedures were followed with respect to equipment and proper sampling support (e.g., techniques, equipment, decontamination, volume, temperature, preservative, etc.). | PM (AMJV/BRADY)<br>Quality Assurance Manager (BRADY) |
| IIb | Co-located Field Duplicates | Compare results of collocated field duplicates with criteria established in the QAPP (if applicable). | Quality Assurance Manager (BRADY)<br>Data Validator (LDC) |
| IIb | Project Quantitation Limits | Determine that quantitation limits were achieved, as outlined in the QAPP and that the laboratory successfully analyzed a standard at the QL. | Quality Assurance Manager (BRADY)<br>Data Validator (LDC) |
| IIb | Performance Criteria | Evaluate QC data against project-specific performance criteria in the QAPP (i.e., evaluate quality parameters beyond those outlined in the methods). | Quality Assurance Manager (BRADY)<br>Data Validator (LDC) |

## SAP WORKSHEET #35 – VALIDATION (STEPS IIA AND IIB) PROCESS TABLE – CONTINUED

Notes and Acronyms:

[1] IIa=compliance with methods, procedures, and contracts [see Table 20, page 117, UFP-QAPP manual, V.1, March 2005.]
IIb=comparison with measurement performance criteria in the SAP [see Table 21, page 118, UFP-QAPP manual, V.1, March 2005]

| | |
|---|---|
| AMJV | Accord MACTEC Joint Venture |
| BRADY | Richard Brady & Associates |
| LDC | Laboratory Data Consultants, Inc. |
| PM | Project Manager |
| QC | Quality Control |
| QL | Quantitation Limit |
| UFP-QAPP | Uniform Federal Policy for Quality Assurance Project Plans |

## 36.0 SAP WORKSHEET #36 – ANALYTICAL DATA VALIDATION (STEPS IIA AND IIB) SUMMARY TABLE

| Step IIa / IIb[1] | Matrix | Analytical Group | Validation Criteria[2] | Data Validator (title and organizational affiliation) |
|---|---|---|---|---|
| IIa | Soil & Groundwater | VOCs | In accordance with the DoD QSM v4.2, EPA Contract Lab Program National Functional Guidelines, SW-846 Methods, NAVFAC SW EWI #1, and EPA Level III and IV guidelines. | Project Manager, LDC |
| IIb | Soil & Groundwater | VOCs | In accordance with the DoD QSM v4.2, EPA Contract Lab Program National Functional Guidelines, SW-846 Methods, NAVFAC SW EWI #1, and EPA Level III and IV guidelines. | Project Manager, LDC |

Notes and Acronyms:

[1] IIa=compliance with methods, procedures, and contracts [see Table 20, page 117, UFP-QAPP manual, V.1, March 2005.]
IIb=comparison with measurement performance criteria in the SAP [see Table 21, page 118, UFP-QAPP manual, V.1, March 2005]

[2] Validation shall also be conducted in accordance with NFESC Special Publication SP-2056-ENV, *Navy Installation Restoration Chemical Data Quality Manual*, Appendix H, Naval Facilities Engineering Command, September 1999.

| | |
|---|---|
| DoD | Department of Defense |
| EPA | Environmental Protection Agency |
| EWI | environmental work instruction |
| LDC | Laboratory Data Consultants, Inc. |
| NAVFAC SW | Naval Facilities Engineering Command Southwest |
| PM | project manager |
| QSM | quality systems manual |
| UFP-QAPP | Uniform Federal Policy for Quality Assurance Project Plans |
| VOC | volatile organic compound |

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# 37.0 SAP WORKSHEET #37 – USABILITY ASSESSMENT

This section describes the QA/QC activities that occur after the data collection phase of the project has been completed. These activities ensure that data conform to the specified criteria and thus are useful for their intended purpose.

## 37.1 Usability Assessment Objectives

The data quality is a function of the sampling plan rationale and the procedures used to collect the samples, as well as the analytical methods and instrumentation used. As discussed in the following sections, data collected during this groundwater assessment will be evaluated for usability with respect to precision, accuracy, representativeness, completeness, comparability and sensitivity to determine whether the project DQOs have been met. All validated data collected for this groundwater assessment will be identified and included in a data usability assessment. The data usability assessment will be completed by BRADY personnel under the oversight of Tim Shields, BRADY Program Manager. The BRADY Project Manager, Fred Essig, will be responsible for the coordination and performance of the usability assessment.

## 37.2 Precision

Precision quantifies the repeatability of a given measurement. Given the limited number of field and QC samples for this project, precision will be measured by the analyses of both field and laboratory duplicate samples, including MS/MSD. The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken. The findings of the usability of the data relative to precision will be included in the report, including any limitations on the data set and/or individual analytical results. Precision is estimated by calculating the relative percent difference (RPD) of the duplicate samples, as shown in the following equation:

$$RPD = \frac{|A - B|}{(A + B)/2} \quad x \quad 100$$

Where:

A = First duplicate concentration
B = Second duplicate concentration

## 37.3 Accuracy

Accuracy refers to the percentage of a known amount of analyte recovered from a given matrix. It measures the bias in a measurement system. A measurement is accurate when the value reported does not differ (by a specified amount) from the true value, or from the known concentration of a MS or standard. The accuracy of the analytical determinations will be evaluated based on the analyses of LCS, MS/MSD, and surrogate spikes (where applicable). The findings of the usability of the data relative to accuracy will be included in the report, including

any limitations on the data set and/or individual analytical results. Percent recoveries are estimated using the following equation:

$$Percent\ \ Recovery = \frac{S - C}{T} \ x \ 100$$

Where:

S = Measured spike sample concentration
C = Sample concentration
T = True or actual concentration of the spike

## 37.4 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program. Sample representativeness will be assessed in terms of adherence to established sample collection procedures, required preservation, storage, and holding times. The findings of the usability of the data relative to representativeness will be included in the report, including any limitations on the data set and/or individual analytical results.

## 37.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount expected to be obtained under normal conditions. Completeness is determined based on the number of valid points (data not rejected) relative to the total number of validated data. In addition to validated results, broken, spilled samples, and any other problems that may compromise sample representativeness are included in the assessment of completeness.

$$\text{Completeness (\%)} = \frac{\text{Number of Valid Measurements}}{\text{Total Number of Measurements}} \times 100$$

A completeness standard of 90% has been established for this project. The findings of the usability of the data relative to completeness will be included in the report, including any limitations on the data set and/or individual analytical results.

## 37.6 Comparability

Comparability expresses the confidence with which one data set is compared with another. This evaluation criterion is critical for use in analyzing temporal trends in constituent variations within the sampling domain. Comparability will be achieved by using standard methods for sampling and analyses, presenting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. The findings of the usability of the data relative to comparability will be included in the report, including any limitations on the data set and/or individual analytical results.

## 37.7 Sensitivity

Sensitivity is the ability of the analytical test method and/or instrumentation to differentiate between detector responses to varying concentrations of the target constituent. Methodology to establish sensitivity for a given analytical method or instrument includes examination of standardized blanks, instrument detection limit studies, and calibration of the QL. The findings of the usability of the data relative to sensitivity will be included in the report, including any limitations on the data set and/or individual analytical results.

## 37.8 Usability Findings

The findings of the usability assessment will be presented in the assessment report and will include, in addition to the criteria described above, an analysis of any discrepancies in the COC, missed holding times for analysis, modifications to the scope of work, field changes, potential matrix interferences, and potential environmental impacts due to site conditions or meteorological effects.

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# SAP Tables

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# TABLE 1

## Precision and Accuracy Requirements for U.S. EPA Method 8260B

| Analyte | Precision (RPD) | Accuracy (% Recovery) | |
|---|---|---|---|
| | | MS | LCS |
| ***Volatile Organic Compounds by EPA Method 8260B*** | ***Soil*** | | |
| 1,1,1-trichloroethane (1,1,1-TCA) | 50 | 60-130 | 60-130 |
| 1,1-dichloroethane (1,1-DCA) | 50 | 70-140 | 70-130 |
| 1,1-dichloroethene (1,1-DCE) | 50 | 50-140 | 60-130 |
| 1,2-dichloroethane (1,2-DCA) | 50 | 60-160 | 60-140 |
| cis-1,2-Dichloroethene (cis-1,2-DCE) | 50 | 70-140 | 70-130 |
| Tetrachloroethylene (PCE) | 50 | 70-130 | 70-130 |
| Trichloroethene (TCE) | 50 | 60-140 | 70-130 |
| Vinyl Chloride (VC) | 50 | 60-150 | 60-150 |
| **Surrogates** | | | |
| 1,2-Dichloroethane -d 4 | -- | 60-160 | 70-140 |
| Toluene-d8 | -- | 70-140 | 70-130 |
| 4-Bromofluorobenzene | -- | 70-150 | 70-130 |
| ***Volatile Organic Compounds by EPA Method 8260B*** | ***Water*** | | |
| 1,1,1-trichloroethane (1,1,1-TCA) | 30 | 70-130 | 70-130 |
| 1,1-dichloroethane (1,1-DCA) | 30 | 70-130 | 70-130 |
| 1,1-dichloroethene (1,1-DCE) | 30 | 60-140 | 60-130 |
| 1,2-dichloroethane (1,2-DCA) | 30 | 70-140 | 70-130 |
| cis-1,2-Dichloroethene (cis-1,2-DCE) | 30 | 70-140 | 70-130 |
| Tetrachloroethylene (PCE) | 30 | 70-130 | 70-130 |
| Trichloroethene (TCE) | 30 | 60-140 | 70-130 |
| Vinyl Chloride (VC) | 30 | 60-160 | 60-150 |
| **Surrogates** | | | |
| 1,2-Dichloroethane -d 4 | -- | 70-140 | 70-140 |
| Toluene-d8 | -- | 70-140 | 70-130 |
| 4-Bromofluorobenzene | -- | 70-130 | 70-130 |

Notes:

| | |
|---|---|
| RPD | relative percent difference as calculated by the pair of analytical duplicates |
| % Recovery | percent recovery of spiked compounds |
| MS | matrix spike |
| LCS | laboratory control sample (blank spike) |

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# TABLE 2
## Additional References

| Author | Source |
|---|---|
| Haley & Aldridge, Inc., 2009 | Report on Groundwater Assessment Investigation Alpha and Beta Aquifers, Boeing Huntington Beach Facility, Huntington Beach, California. November 24. |
| Tetra Tech EC, Inc., 2007 | Final Well Decommissioning Report. February 12. |
| Westinghouse Savannah River Company (Westinghouse). 2001. | Evaluating DNAPL Source and Migration Zones: M-Area Settling Basin and the Western Sector of A/M Area, Savannah River Site (U). Prepared for the United States Department of Energy. 15 June. |

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# SAP Figures

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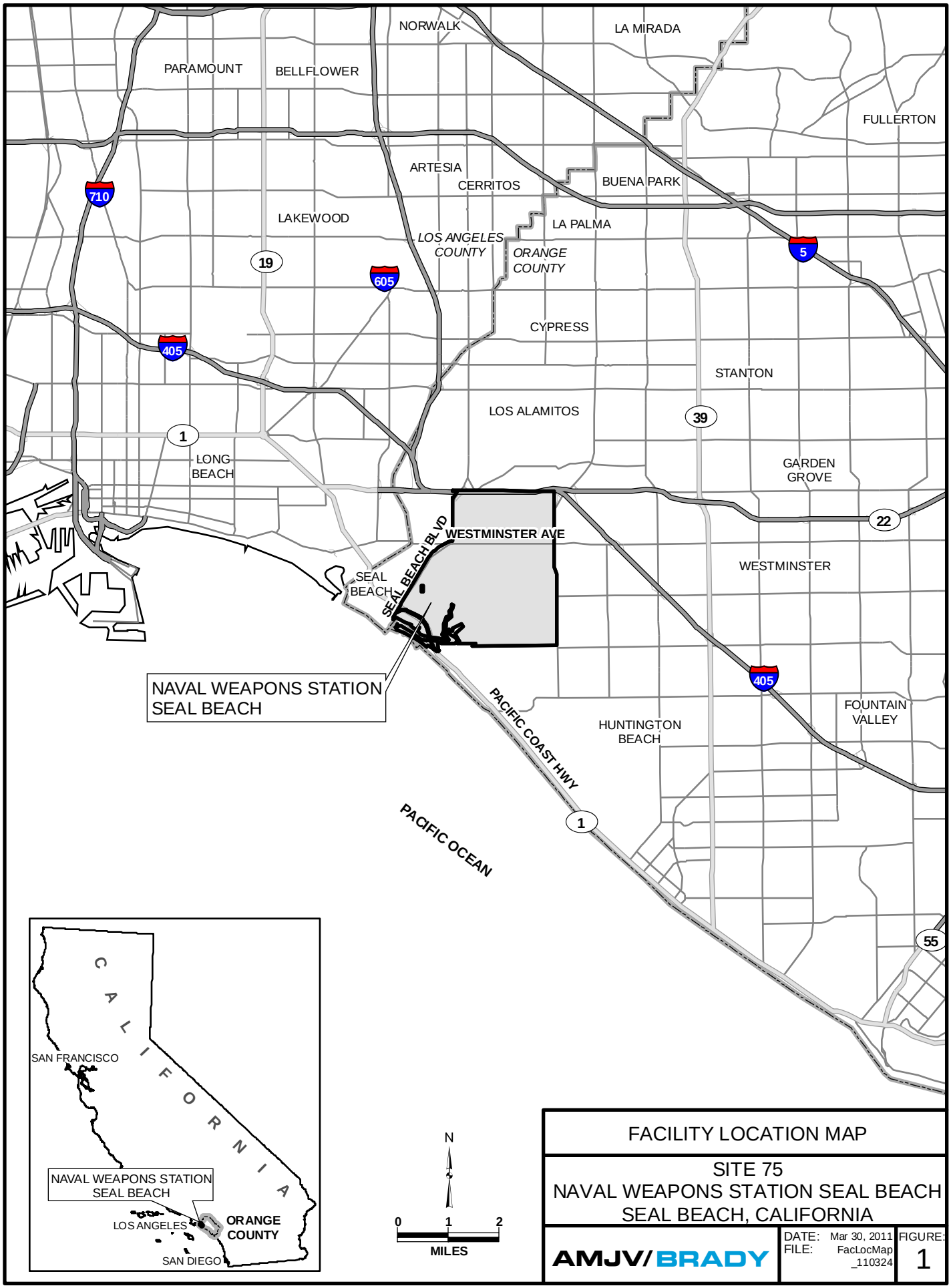


FACILITY LOCATION MAP

SITE 75
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

AMJV/BRADY

DATE: Mar 30, 2011
FILE: FacLocMap _110324

FIGURE: 1

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SITE LOCATION MAP

SITE 75
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

AMJV/BRADY

DATE: Mar 30, 2011
FILE: SiteLocMap _110324

FIGURE: 2

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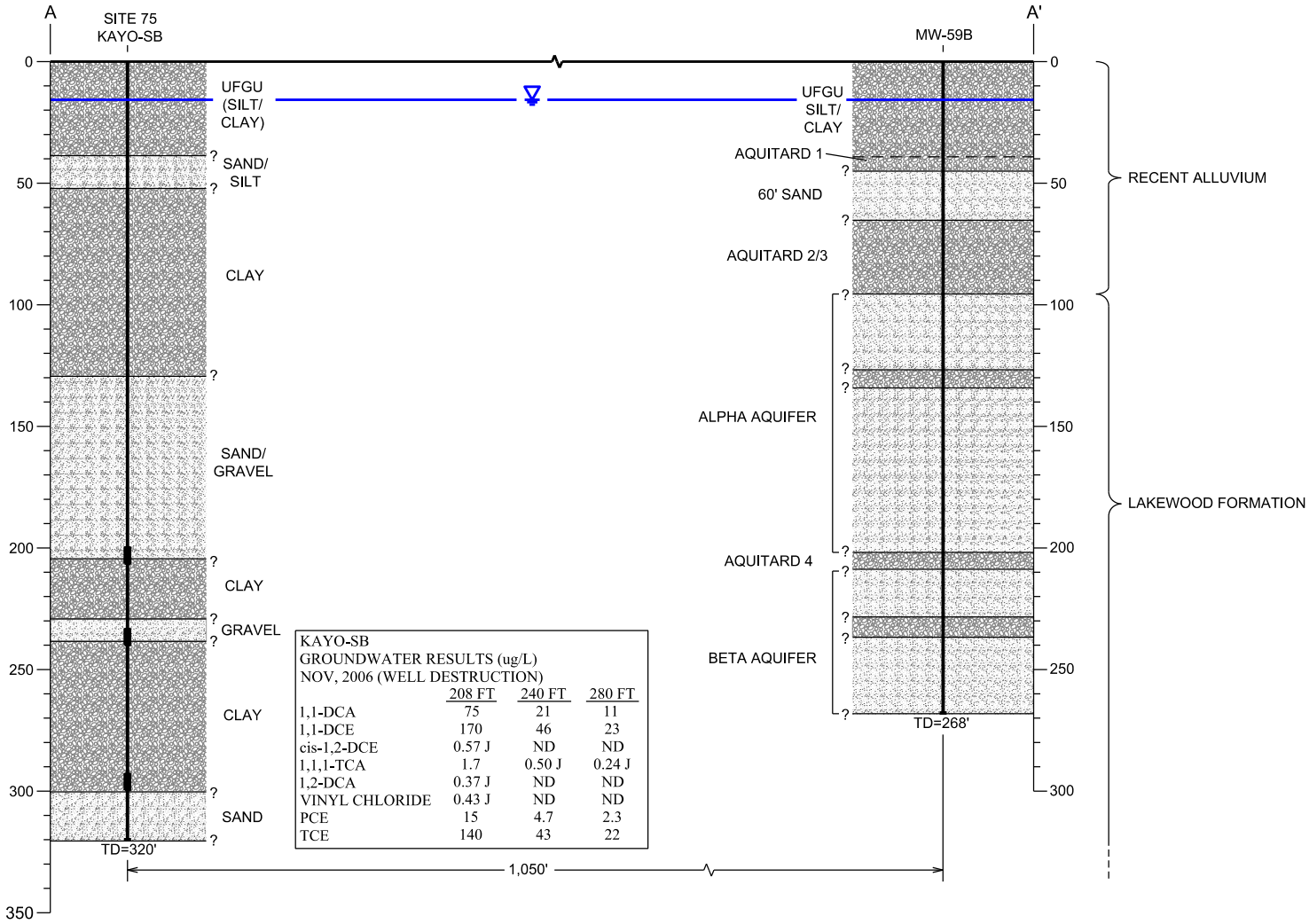
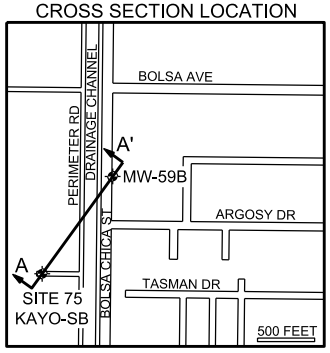
# GENERAL CSM CROSS SECTION
# LITHOLOGIC REPRESENTATION AT
# FORMER WELL KAYO-SB AND WELL MW-59B




KAYO-SB
GROUNDWATER RESULTS (ug/L)
NOV, 2006 (WELL DESTRUCTION)

| | 208 FT | 240 FT | 280 FT |
|---|---|---|---|
| 1,1-DCA | 75 | 21 | 11 |
| 1,1-DCE | 170 | 46 | 23 |
| cis-1,2-DCE | 0.57 J | ND | ND |
| 1,1,1-TCA | 1.7 | 0.50 J | 0.24 J |
| 1,2-DCA | 0.37 J | ND | ND |
| VINYL CHLORIDE | 0.43 J | ND | ND |
| PCE | 15 | 4.7 | 2.3 |
| TCE | 140 | 43 | 22 |

CROSS SECTION LOCATION




REFERENCE:
Haley & Aldrich, Inc., 2009c, Report on Groundwater Assessment Investigation Alpha and Beta Aquifers

NOTES:
1. THE WELL LOGS DO NOT SHOW THE PRESENCE OF THE 45' SAND AND THE 95' SAND IN THE AREAS SHOWN.

UFGU = UPPER FINED GRAIN UNIT
TD = TOTAL DEPTH
ug/L = MICROGRAMS PER LITER

APPROXIMATE GROUNDWATER ELEVATION

GENERAL CSM CROSS SECTION
SITE 75
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

AMJV/BRADY

Date: Mar 30, 2011
File: XSECTA.dgn

FIGURE 3

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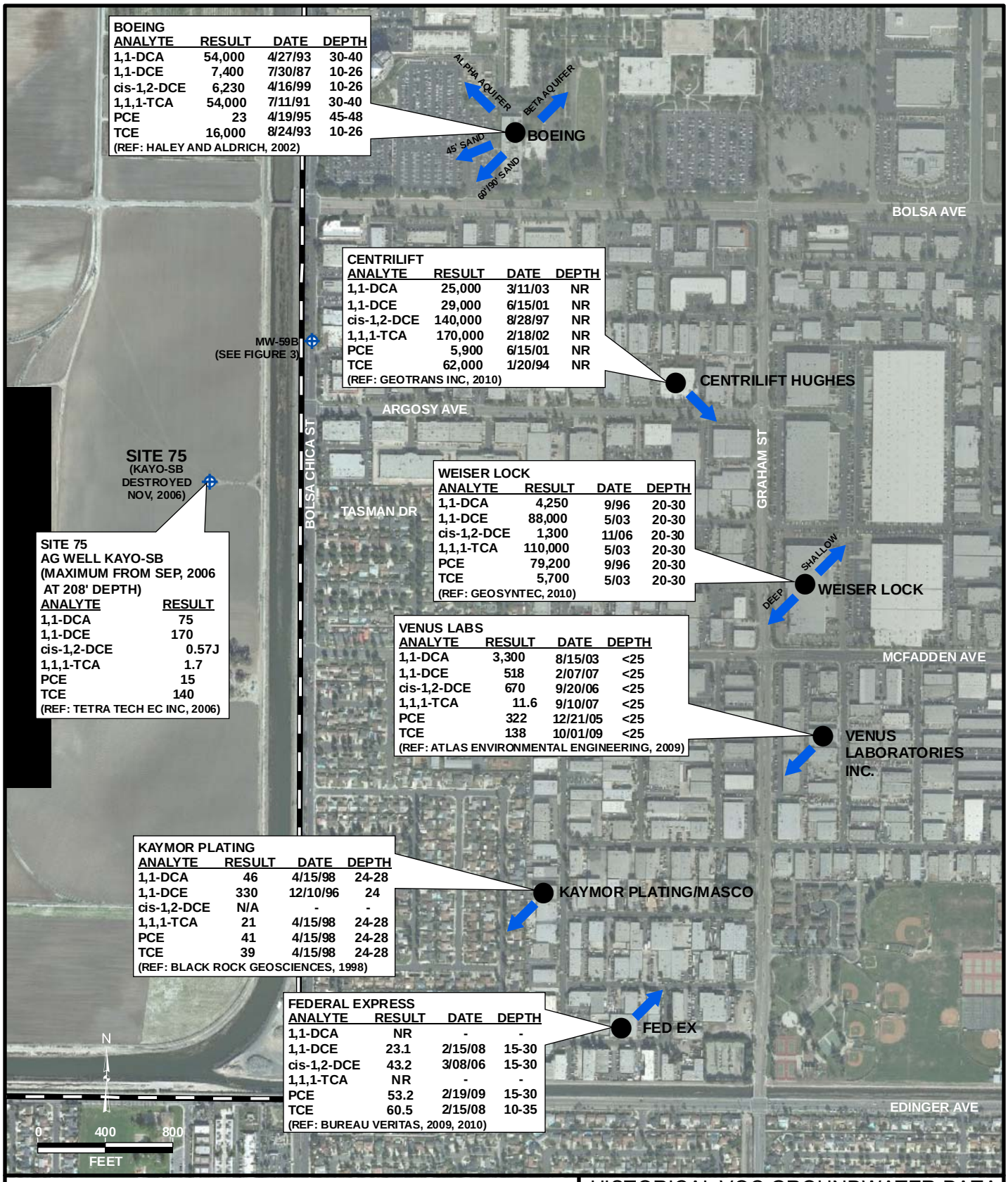


**BOEING**

| ANALYTE | RESULT | DATE | DEPTH |
|---|---|---|---|
| 1,1-DCA | 54,000 | 4/27/93 | 30-40 |
| 1,1-DCE | 7,400 | 7/30/87 | 10-26 |
| cis-1,2-DCE | 6,230 | 4/16/99 | 10-26 |
| 1,1,1-TCA | 54,000 | 7/11/91 | 30-40 |
| PCE | 23 | 4/19/95 | 45-48 |
| TCE | 16,000 | 8/24/93 | 10-26 |

(REF: HALEY AND ALDRICH, 2002)

**CENTRILIFT**

| ANALYTE | RESULT | DATE | DEPTH |
|---|---|---|---|
| 1,1-DCA | 25,000 | 3/11/03 | NR |
| 1,1-DCE | 29,000 | 6/15/01 | NR |
| cis-1,2-DCE | 140,000 | 8/28/97 | NR |
| 1,1,1-TCA | 170,000 | 2/18/02 | NR |
| PCE | 5,900 | 6/15/01 | NR |
| TCE | 62,000 | 1/20/94 | NR |

(REF: GEOTRANS INC, 2010)

**WEISER LOCK**

| ANALYTE | RESULT | DATE | DEPTH |
|---|---|---|---|
| 1,1-DCA | 4,250 | 9/96 | 20-30 |
| 1,1-DCE | 88,000 | 5/03 | 20-30 |
| cis-1,2-DCE | 1,300 | 11/06 | 20-30 |
| 1,1,1-TCA | 110,000 | 5/03 | 20-30 |
| PCE | 79,200 | 9/96 | 20-30 |
| TCE | 5,700 | 5/03 | 20-30 |

(REF: GEOSYNTEC, 2010)

**SITE 75**
**AG WELL KAYO-SB**
**(MAXIMUM FROM SEP, 2006 AT 208' DEPTH)**

| ANALYTE | RESULT |
|---|---|
| 1,1-DCA | 75 |
| 1,1-DCE | 170 |
| cis-1,2-DCE | 0.57J |
| 1,1,1-TCA | 1.7 |
| PCE | 15 |
| TCE | 140 |

(REF: TETRA TECH EC INC, 2006)

**VENUS LABS**

| ANALYTE | RESULT | DATE | DEPTH |
|---|---|---|---|
| 1,1-DCA | 3,300 | 8/15/03 | <25 |
| 1,1-DCE | 518 | 2/07/07 | <25 |
| cis-1,2-DCE | 670 | 9/20/06 | <25 |
| 1,1,1-TCA | 11.6 | 9/10/07 | <25 |
| PCE | 322 | 12/21/05 | <25 |
| TCE | 138 | 10/01/09 | <25 |

(REF: ATLAS ENVIRONMENTAL ENGINEERING, 2009)

**KAYMOR PLATING**

| ANALYTE | RESULT | DATE | DEPTH |
|---|---|---|---|
| 1,1-DCA | 46 | 4/15/98 | 24-28 |
| 1,1-DCE | 330 | 12/10/96 | 24 |
| cis-1,2-DCE | N/A | - | - |
| 1,1,1-TCA | 21 | 4/15/98 | 24-28 |
| PCE | 41 | 4/15/98 | 24-28 |
| TCE | 39 | 4/15/98 | 24-28 |

(REF: BLACK ROCK GEOSCIENCES, 1998)

**FEDERAL EXPRESS**

| ANALYTE | RESULT | DATE | DEPTH |
|---|---|---|---|
| 1,1-DCA | NR | - | - |
| 1,1-DCE | 23.1 | 2/15/08 | 15-30 |
| cis-1,2-DCE | 43.2 | 3/08/06 | 15-30 |
| 1,1,1-TCA | NR | - | - |
| PCE | 53.2 | 2/19/09 | 15-30 |
| TCE | 60.5 | 2/15/08 | 10-35 |

(REF: BUREAU VERITAS, 2009, 2010)

LEGEND
- SITE 75, FORMER AGRICULTURAL WELL KAYO-SB
- NON-NAVY SITE NEARBY SITE 75 NOTE: DOES NOT INDICATE LOCATION OF GROUNDWATER MONITORING WELLS
- GROUNDWATER GRADIENT DIRECTION (WATER BEARING UNIT NOTED)
- BASE BOUNDARY

NOTES
1. DEPTHS ARE APPROXIMATE, BASED ON AVAILABLE INFORMATION
2. DEPTH UNITS ARE FEET
3. RESULT UNITS ARE MICROGRAMS PER LITER (µg/L)

J = ESTIMATED
N/A = NOT AVAILABLE
NR = NOT REPORTED

# HISTORICAL VOC GROUNDWATER DATA AT NEARBY SITES

## SITE 75
## NAVAL WEAPONS STATION SEAL BEACH
## SEAL BEACH, CALIFORNIA

AMJV/BRADY

DATE: Mar 30, 2011
FILE: HistData _110329

FIGURE: 4

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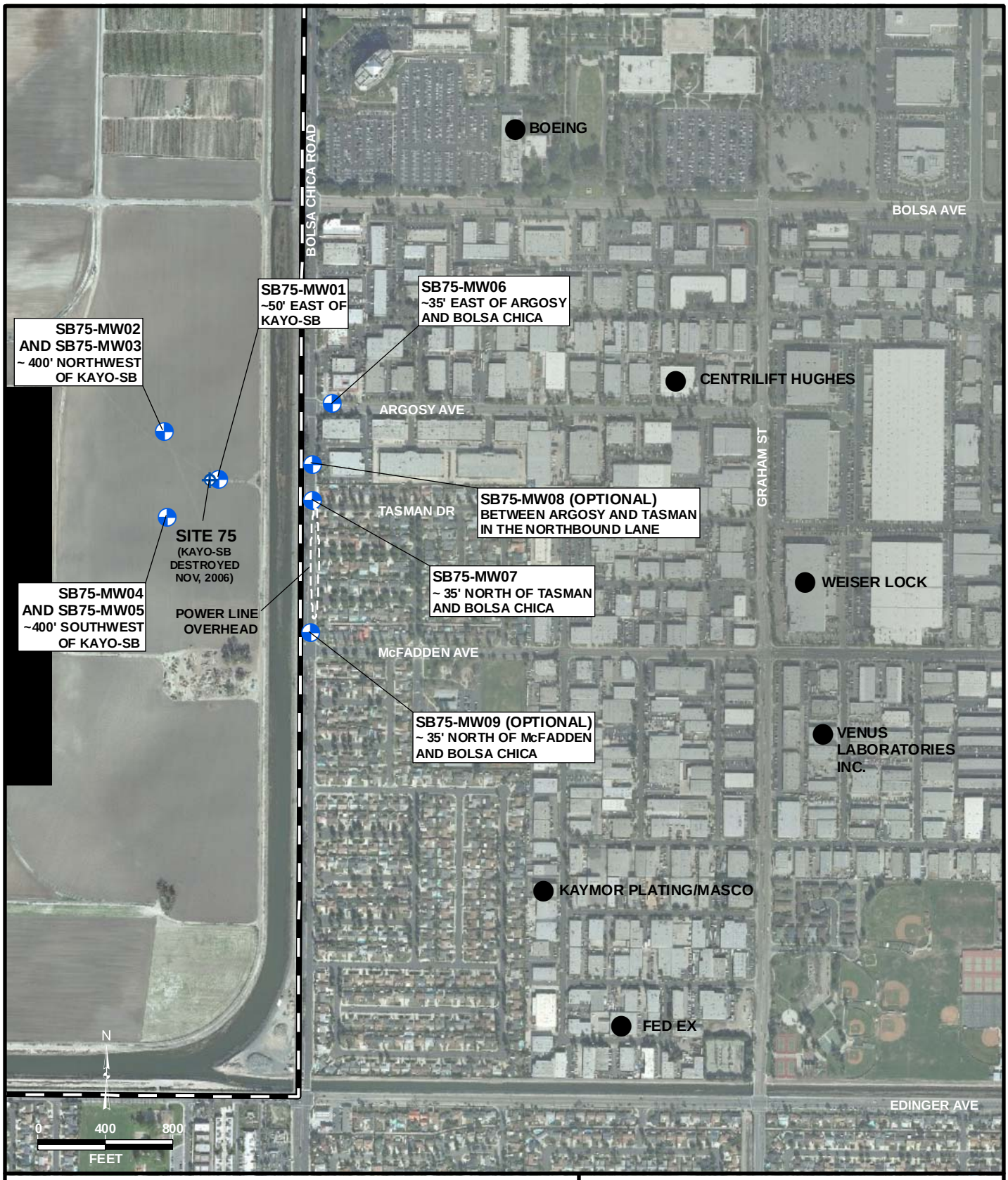


LEGEND

- PROPOSED BORING/WELL LOCATION
- SITE 75, FORMER AGRICULTURAL WELL KAYO-SB
- NON-NAVY SITE NEARBY SITE 75
  NOTE: DOES NOT INDICATE LOCATION
  OF GROUNDWATER MONITORING WELLS
- BASE BOUNDARY

PROPOSED BORING/WELL LOCATIONS

SITE 75
NAVAL WEAPONS STATION SEAL BEACH
SEAL BEACH, CALIFORNIA

AMJV/BRADY

DATE: June 14, 2011
FILE: PropLoc _110324

FIGURE: 5

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# SAP Attachment 1

Standard Operating Procedures

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# ATTACHMENT 1
# STANDARD OPERATING PROCEDURES

## TABLE OF CONTENTS


| SOP No. | SOP Reference No. | Title | Page |
|---|---|---|---|
| 1 | AEI F10-002 | Instrument Calibration and Use | 3 |
| 2 | AEI F10-003 | Decontamination of Equipment | 27 |
| 3 | AEI F20-003 | Monitoring Well Design, Installation, and Development | 33 |
| 4 | AEI F30-002 | Groundwater Sampling, | 56 |
| 5 | AEI F40-001 | Water and Free Product Level Measurement in Wells | 73 |
| 6 | BRADY T-003 | Soil Sampling Procedure for Volatile Organics Using the EnCore® Sampler | 83 |
| 7 | BRADY T-006 | Environmental Soil Sampling | 95 |
| 8 | BRADY T-009 | Sampling and Analysis of VOCs in Soil using Direct Push Sampling and Direct Sampling Ion Trap Mass Spectrometry | 109 |
| 9 | BRADY T-010 | Sampling and Analysis of VOCs in Water using Direct Push Sampling and Direct Sampling Ion Trap Mass Spectrometry | 117 |

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## 1.0 SIGNATURE AUTHORITY

| TITLE | NAME | SIGNATURE |
|---|---|---|
| Quality Control Manager | Yu Zeng | |
| Sr. Technical Manager | Rod Reeve | |
| Program Manager | Max Pan | |

## 2.0 PURPOSE

This Accord Engineering, Inc. (AEI) standard operating procedure (SOP) describes general procedures for calibration and use of instruments used to collect measurements in the field.

Such instruments produce direct field measurements used in reports to the client and field screening measurements used to make field decisions at the site.

Calibration of specific instruments commonly used is discussed in attachments to this SOP. For any instrument this procedure should be supplemented with the manufacturer's calibration and maintenance instructions.

## 3.0 SCOPE

This SOP addresses the need to provide instrument calibration data to meet the quality control demands of the analysis procedure for which the instrument is being used.

This SOP does not address calibration of instruments used for health and safety hazard detection, health physics, or industrial hygiene monitoring.

A data sheet for recording instrument calibration measurements and associated information is provided as Attachment A. If there are manufacturer prepared data sheets, field personnel should use them instead of the attached sheet.

## 4.0 REFERENCE MATERIALS

| DOC. NO. | TITLE |
|---|---|
| U.S. EPA 1989 | Superfund Ground Water Issue. EPA/540/4-89/00, March. |
| U.S. EPA 1987 | A Compendium of Superfund Field Operations Methods. EPA/540/P-87/2001, December. |
| U.S. EPA 1987 | Data Quality Objectives for Remedial Activities - Development Process, EPA/540/G-87/003, March. |
| U.S. EPA 1987 | RCRA Groundwater Monitoring Technical Enforcement Guidance Document, September. |

| DOC. NO. | TITLE |
|---|---|
| NA | American Public Health Association, American Water Works Association Water, Environment Federation. 1992. Standard Methods for the Examination of Water and Wastewater, 18th Edition. |
| NA | American Society for Testing Materials, Annual Book of ASTM Standards, Section 2, Standard Practice for Oxidation-Reduction Potential of Water ASTM D 1498-76 (1981), 1993. |

## 5.0 DEFINITIONS

**Calibration** - A procedure performed when using an instrument to determine whether the instrument is operating properly. An initial calibration can include adjustment of the instrument if it does not initially pass calibration. Calibration may involve comparing an instrument response to the response of an instrument known to be operating properly (instrument calibration by comparison to a standard instrument) or instrument measurement of a parameter whose value is known (instrument calibration by measurement of a standard).

**Direct Field Measurement** - A measurement of some parameter at the field site that is required to be reported by the scope of work. An example of a direct field measurement would be the measurement of water pH taken from a monitoring well during quarterly monitoring.

**Field Screening Measurement** - A measurement of a parameter at the field site that provides information that controls the course of a future action at the field site. For example, a field screening measurement of volatile organic compounds coming from excavated soil with a flame ionization detector (FID) or photo-ionization detector (PID) would be used to determine if the soil could be transported off-site or piled for remediation.

**Standard** - A material with known values for one or more of its properties. It can be used to check an instrument response. A standard usually represents a "secondary standard" that has itself been compared to a "primary standard." Standards can be manually prepared from materials of known qualities, but most standards are now purchased commercially and are traceable to primary standards. An example of a standard is a commercial pH buffer of known pH with guarantee of traceability to other primary chemical standards. Such a buffer solution can be used to calibrate pH meters. Note: A chemical standard usually has an expiration date, after which traceability is no longer guaranteed.

**Standard Instrument -** An instrument used in the calibration of other instruments. A standard instrument should only be used for standardization of other instruments and should not be used to measure parameters at field sites. A standard instrument usually represents a "secondary standard instrument," which has been compared to a '"primary standard instrument." An example of a standard instrument is a thermometer (secondary standard instrument) that can trace its own calibration back to a primary standard of the National Institute for Standards and Technology (NIST).

## 6.0 CALIBRATION FOR ANALYTICAL METHOD REQUIREMENTS

Calibration of a typical field instrument could include the following calibration steps:

1. Remove the instrument from its container, assemble it (if necessary), turn it on, and allow the instrument to warm up as necessary.
2. Clean and decontaminate the instrument (if necessary).
3. Calibrate the instrument for field use according to SOP or manufacturer's instructions. Calibration can be achieved by comparison to a standard instrument or by measurement of a standard. This first calibration is referred to as an "initial calibration." Adjustment of the instrument to obtain proper calibration is allowed during an initial calibration.
4. Following initial calibration, clean and decontaminate the instrument again (if necessary).
5. After using the instrument to make physical/chemical field measurements clean and decontaminate the instrument subsequent to each new measurement (if necessary).
6. Continue to check calibration at specific time intervals, when conditions change, or when a certain number of measurements have been taken as specified by the instrument manufacturer.
7. When measurements are completed, calibrate the instrument a final time. This final calibration is used to show that the instrument operated correctly from the time of the last continuing calibration until the time all field site measurements were completed.
8. Clean, decontaminate (if necessary), and return the instrument to its storage location.

### 6.1. Instrument Adjustment

Instruments may "drift" or slowly depart from a calibrated condition. Instruments that drift usually have control devices (adjustments) that can be tuned to recalibrate the instrument. The actual adjustments are described in the manufacturer manuals.

### 6.2. Initial Calibration

Initial calibration typically involves comparing instrument values to at least three different settings of a standard instrument or to at least three different standards. Instruments are usually designed to give linear response outputs. One comparison determines a point (nothing). Two comparisons determine only a simple line (slope). Three comparisons or more determine the shape of the curve (linearity). A three-comparison calibration is also called a "three-point" calibration.

Some instruments cannot be initially calibrated using a three-point method because of instrument limitations or lack of suitable standards. For these instruments, either a two-point calibration or a one-point calibration with a zero, ambient, or background point has to suffice. A two-point calibration should be arranged so that the two points of calibration bracket the expected measurements.

Initial calibration includes both the calibration process itself and any necessary "on-the-spot" instrument adjustments necessary for the calibration to pass. For initial calibration purposes, instrument adjustment is allowed to prevent calibration failure (Section 7.0).

6.3. Continuing and Final Calibrations

Continuing and final calibrations involve comparing instrument values to one or more different settings of a standard instrument or to one or more standards. The purpose of continuing and final calibrations is to check if instrument failure or drift has occurred since the initial calibration. Instrument adjustment is not allowed to prevent failure of a continuing or final calibration.

## 7.0 PASSED VERSUS FAILED CALIBRATION

Calibration compares an observed instrument response to an expected response. When agreement between an observed instrument response to an expected response is within the calibration criteria, the instrument is said to have "passed" calibration. When the observed and expected responses are farther apart than the calibration criteria, then the instrument is said to have "failed" calibration. Calibration failure is also called an "out-of-control" calibration. What constitutes the calibration criteria must be predetermined and known at the time of calibration. Calibration criteria can be found in the instrument manufacturer's manuals and in field sampling plans.

7.1. Declaration, Repair, and Recalibration After Failed Calibration

Failed initial calibrations that are not correctable with equipment adjustment, failed continuing calibrations, and failed final calibrations require declaration (Section 7.2), repair (Section 7.5), and recalibration.

7.2. Declaration of a Failed Calibration

All failed calibrations must be noted in the instrument user's logbook, instrument calibration logbook, or instrument maintenance logbook.

7.3. Instrument (and Standard) Inspection After Failed Calibration

After an instrument has failed calibration and the failure has been declared, it should be inspected to see if something is obviously wrong. Such an inspection could take a few seconds to a few minutes. At this point, it is proper to try any adjustment procedure, parts replacement, or repair to fix the instrument.

Inspection of the standard instrument or standard should not be overlooked.

7.4. Instrument is Defective

If the instrument failed calibration, cannot be adjusted, and inspection suggests it is not working, the instrument must be marked “defective" and be taken out of service.

It is improper to use an instrument that is labeled as defective.

7.5. Repair of a Defective Instrument

Sometimes defective instruments can be returned to a field service office for repairs. Replacements of batteries, probes, bulbs, fuses, chemicals, etc., can be handled in this way.

A defect requiring more than a simple part replacement should be handled by sending the defective instrument to the manufacturer or to an authorized repair shop.

A repaired instrument is not serviceable until it has passed an initial calibration.

7.6. Recording Instrument Repair and Recalibration

When an instrument is repaired after a failed calibration, the repair should be noted immediately following the declaration of calibration failure in the logbook.

Following a failed calibration and repair, the instrument should undergo an initial calibration before being used.

## 8.0 ATTACHMENTS

A Instrumentation Calibration Data Sheet

B Water Quality Instruments

C Field Screening Instruments

## 9.0 REVISION HISTORY

| REVISION | SECTION/FORM | REVISION DESCRIPTION | DATE |
|---|---|---|---|
| - | - | Initial Release | |

## ATTACHMENT A

## Instrumentation Calibration Data Sheet

# INSTRUMENT CALIBRATION DATA SHEET

| | | |
|---|---|---|
| Task/Site Description | | Serial No. |
| Instrument Type | Instrument Serial No. | Job No. |
| Originator: | Employer/Employee No. | Date |
| Measurement Purpose | | Sheet of |
| | | Work Location. |
| | | Reference Attached |
| | | |
| | | Functional Check Only |
| Calibration Method | | Procedure Reference |
| Calibration Standards Used | Grade (circle one) Commercial NIST Traceable | |
| | Calibration Standard Supplier or Certificate Reference | |

Calculations

As Found Response

As Left Response

Attachments

| Review | | Action |
|---|---|---|
| Calibration By: | Date | File |
| Site Manager/CTOL | Date | Repair |
| Property Manager | Date | |

# ATTACHMENT B

## Water Quality Instruments

## 1.0 INTRODUCTION

This attachment describes calibration procedures for the following water quality measurements:

| TYPE OF MEASUREMENT | SECTION NUMBER |
|---|---|
| Hydrogen Ion Concentration (pH) | 2 |
| Specific Electrical Conductance (EC) | 3 |
| Temperature (°C) | 4 |
| Redox Potential (Eh) | 5 |
| Dissolved Oxygen (DO) | 6 |
| Turbidity (NTU) | 7 |

Manufacturer instrument manuals should be referred to for proper calibration of all field analytical instruments.

Sometimes calibration depends upon the potential data uses. For example, calibration measurements of temperature, specific conductance, and hydrogen ion concentration (pH) associated with sampling for chemical analysis should be stable within 10 percent for at least three consecutive measurements.

## 2.0 HYDROGEN ION CONCENTRATION (PH) MEASUREMENT

This procedure applies only to field measurements of hydrogen ion concentration in aqueous media. Measurements in non-aqueous media (e.g., oil) will not be accurate and will damage the electrodes.

This measurement is determined electrometrically using a pH meter with either a glass electrode in combination with a reference electrode or a combination electrode.

Hydrogen ion concentration of a sample is given in pH units. The term "pH" is often used interchangeably with hydrogen ion concentration.

Temperature affects on the measurement of pH are controlled by using instruments having temperature compensation or by calibrating the electrode meter system at the temperature of the sample.

Samples with low specific conductance can cause fluctuations in pH readings.

The electrode shall be equilibrated by immersing the probe in the sample for a time before taking the measurement. Longer times should be allowed if the pH readings are either high or low.

Coatings of oily material or particulate matter can impair electrode response. Remove these coatings by spraying the electrode with distilled water then gently wiping the electrode with a tissue and rinsing again with distilled water.

Transport the pH meter and electrodes carefully. Both the meter and electrodes can be damaged by rough handling. Prior to field activity check the meter for mechanical and electrical failures, weak batteries, low electrode fluid levels, and cracked electrodes.

When not in use, electrode tips should be covered with a cap to prevent any liquids in the electrode from drying out.

2.1. Equipment

A portable pH meter with appropriate electrodes, secondary standard buffer solutions (pH 4, pH 7, and pH 10), and a polyethylene or Teflon beaker shall be used during the collection of pH measurements. A plastic squirt bottle of distilled water or de-ionized water is required for rinsing electrodes. A box of Kim-wipes or equivalent is useful for drying the electrodes.

2.2. Initial Calibration Procedure

Perform an initial calibration every day against standard buffer solutions before using an instrument to measure samples.

1. Rinse the electrode(s). Spraying water directly on the electrode(s) from a plastic spray bottle works best.
2. Using shaking and daubing with a Kim-wipe, remove any water droplets on the electrode(s).
3. Rinse the plastic beaker with 3 small volumes of buffer and pour in enough buffer solution to cover the tip of the electrode(s).
4. The electrode(s) are dipped in buffer solution in the plastic beaker. A reading should not be taken until the reading value stabilizes. This usually happens in 30 seconds or less. Swirling the beaker helps speed stabilization. At high or low pH, the wait may be as long as a minute.
5. If necessary, adjust the instrument to read the value of the buffer. Note and record pH value in the field notebook, along with buffer ID, date, instrument ID, and name of person taking reading,
6. Rinse and daub the electrode(s).
7. Repeat steps 1 through 5 for each buffer solution. Failure to be able to adjust the pH meter at any buffer level requires rereading and readjustment at all buffer levels. In addition, failure to be able to adjust the pH meter at all buffer levels indicates that a new electrode(s) may be required.

Calibration criteria can be found in the manufacturer's manual or in the Field Sampling Plan. As a worst case calibration, the readings should not be more than plus or minus 0.5 pH units from the readings expected for each buffer.

Having passed initial calibration, samples can now be analyzed using steps similar to those used in the initial calibration. The electrode(s) should be rinsed between samples. The beaker should be rinsed three times with sample solution. The electrode should be swirled while waiting for reading stabilization. Record the pH value in the field notebook along with sample ID, date, instrument ID and name of person taking reading.

2.3. Continuing Calibration

At specific intervals based on time or number of samples, the pH meter should be recalibrated with one or more of the buffers.

The procedure for continuing calibration is the same as for the initial calibration except that comparison to all buffers may not be required. If multiple continuing calibrations are required, buffer ranges should be alternated.

The instrument also should be recalibrated if there is a change of 5°C or greater between the sample temperature and the calibration temperature.

2.4. Final Calibration

After all samples have been measured, a single final calibration of a single buffer should be made. This final calibration is typically done using the pH 7 buffer.

Record the pH value in the field notebook along with sample ID, date, instrument .ID and name of person taking reading.

After the final calibration, the electrodes should be capped and the instrument should be replaced in its carrier.

2.5. Calibration For Only A Few Samples

In some situations, only a single sample or a small number of samples need to be measured. In such cases, only an initial calibration and a final calibration need be performed.

2.6. Reporting Limits

Readings shall be expressed in pH units. Results shall be reported to the nearest 0.1 pH unit. Duplicate field sample readings shall agree within 0.1 pH units or else they should be repeated.

## 3.0 CONDUCTIVITY OR SPECIFIC ELECTRICAL CONDUCTANCE (EC)

Electrical conductance, or conductivity, is the ability of a substance to conduct an electric current.

This procedure applies only to field measurements of conductivity in aqueous media. Measurements in nonaqueous media (e.g., oil) will not be accurate and may foul the electrodes.

This measurement is determined electrometrically using a conductivity meter with a pair of electrodes that are typically made of platinum.

Specific conductance, or conductivity (EC), is the ability of a substance to conduct an electric current. As such, it is the reciprocal of the resistance. The units of conductivity are reciprocal ohms, or mhos. Data are generally reported in micromhos per centimeter (µmhos/cm) at a temperature measured in degrees Celsius (°C).

Some values taken at other temperatures exist. At the time of field measurements, temperature must be determined and recorded. Field measurements can then be corrected for temperature effects.

The specific conductance of a groundwater sample is dependent upon the total dissolved solids (TDS) content of the sample. Typically, the ratio of TDS (measured in mg/L) to specific conductance (measured by ?mhos per cm) is between 0.6 and 0.8. Because the TDS concentration and specific conductance of a sample may be dependent upon hydrogen ion concentration, measurements of specific conductance should be accompanied by pH measurements.

Prior to field activity, check the conductivity meter for mechanical and electrical failures and/or weak batteries.

3.1. Equipment

A portable specific conductance meter shall be used. Known strength potassium chloride (KCl) solutions or other suitable solutions shall be used for standards. A polyethylene or Teflon beaker is practical for holding standards and samples for testing. A plastic squirt bottle of distilled water or de-ionized water is required for rinsing the electrodes. A box of Kimwipes is useful.

3.2. Initial Calibration Procedures

Perform an initial calibration every day against the potassium chloride using the following procedure.

1. Turn on and calibrate the instrument against known standards, usually potassium chloride (KCl). Refer to the standard documentation for temperature-to-conductance correspondence.
2. Rinse the electrode(s). The electrodes may be in a probe or contained in a cell. Squirting distilled or de-ionized water directly on the probe or into the cell from a plastic spray bottle works best.
3. Remove excess water before testing the standard solution. Rinse the probe in a beaker or cell with fresh standard three times. Refill the beaker or cell again. Swirl the probe or cell at a constant rate until the meter reading reaches equilibrium.
4. If necessary, perform any required adjustments to correlate reading value with expected value.
5. Record the EC value, in the field Logbook along with standard ID, date, instrument ID, and name of person making calibration.
6. Pour sample out of reading unit or withdraw probe from sample and prepare meter for next reading. Do not rinse probe or reading unit with distilled water in between readings.
7. Usually three separate readings of a single standard are made. The SAP should be consulted for number of standards and readings.

Having passed initial calibration, samples can now be analyzed using steps similar to those used in the initial calibration. The probe or cell should be rinsed three times between samples with the next sample solution. The probe or cell should be swirled while waiting for reading

stabilization. The EC should be recorded in field notebook along with sample ID, date, instrument ID, and name of person taking reading.

3.3. Continuing Calibration

At specific intervals based on time or number of samples, the conductivity meter should be recalibrated.

The procedure for continuing calibration is the same as for the initial calibration.

The instrument also should be recalibrated if there is a change of 5°C or greater between the sample temperature and the calibration temperature.

3.4. Final Calibration

After all samples have been measured, a final calibration should be made.

After the final calibration, turn meter off and rinse probe or cell with de-ionized water and replace the instrument in its carrier.

3.5. Calibration for only a few Samples

In some situations, only a single sample or a small number of samples need to be measured. In such cases, only an initial calibration and a final calibration need be performed.

3.6. Reporting Units

Readings shall be expressed in µmhos/cm corrected to 25°C, Results shall be reported to the nearest 10 units for readings under 1,000 µmhos/cm and the nearest 100 units for readings over 1,000 µmhos/cm. Duplicate field analyses shall agree within 10 percent or require recalibration.

## 4.0 TEMPERATURE

All field measurements of temperature in aqueous media should be carried out with a calibrated thermometer or thermistor.

Glass thermometers should be transported in a protective case to prevent breakage.

4.1. Equipment

A thermometer or thermistor is required for sample readings (temperature measurement probe). A temperature probe from a combination meter (i.e., pH, EC, temperature combination meter) may also be used. A beaker or other container is needed.

4.2. One-Time Calibration Procedure

Inspect the thermometer for cracks in the glass and spaces (breaks) in the mercury column.

At the field site, thoroughly rinse the temperature probe with distilled water. Prior to field activity remove excess water before immersion in sample.

Allow sample thermometers to equilibrate in a prepared sample, and check the readings against one another for calibration. Swirl the probe at a constant rate, and take the measurement when the mercury column or digital readout stabilizes.

The temperature should be recorded in field notebook, along with sample ID, date, instrument ID, and name of person taking reading. Note correction required, if any, in the field notebook.

This calibration activity need only be performed once per sampling event.

4.3. Reporting Limits

Results shall be expressed in either degrees Celsius (°C) or degrees Fahrenheit (°F) to the nearest 0.5 degree. Duplicate field analyses shall agree within 10 percent or be repeated.

## 5.0 OXIDATION REDUCTION POTENTIAL (ORP OR EH)

The ability of a natural environment to bring about an oxidation or reduction process is measured by a quantity called its redox potential, designated as Eh. Eh is a measure of the ability of an environment to supply electrons to an oxidizing agent or to take up electrons from a reducing agent. In any environmental system, the redox potential is a measure of the cumulative redox potentials of all the individual chemical oxidation-reduction reactions in the system.

The oxidation-reduction potential (Eh) of a solution is defined as the electro-motive force developed by an inert (noble metal) electrode immersed in the sample in reference to a standard hydrogen electrode, Because a standard hydrogen electrode is fragile and impractical for fieldwork, other reference electrodes are used. Correction to the standard hydrogen electrode potential values can be made.

It is not possible to calibrate Eh values over a range of redox potentials (as is done with pH electrodes). Instead, standard solutions that exhibit both chemical stability and known redox potentials for specific indicator electrodes are used to check electrode response at the temperature of the measurement.

In this procedure, the Eh of a solution is potentiometrically measured as a millivolt signal produced when a noble metal electrode, generally platinum, and a reference electrode (calomel, silver-silver chloride, or other constant potential) are placed in the sample. The electrodes are calibrated using standard redox solutions prior to use.

The Eh of an aqueous solution is sensitive to change in temperature, but a correction is rarely made due to its minimal effect.

The Eh of an aqueous solution is sensitive to hydrogen ion concentration (pH) changes when any chemical oxidation-reduction reaction in the system involves either hydrogen ions or hydroxyl ions.

A brightly polished noble metal electrode surface is required for accurate measurements. Any oil and grease coating of the noble metal electrode will cause erroneous readings.

Both exposure of standards and samples to the atmosphere should be minimized. Samples should be analyzed upon collection and should not be stored.

5.1. References

This procedure is based upon American Society of Testing Materials, Annual Book of ASTM Standards, Section 2, Standard Test Method for Oxidation-Reduction Potential of Water, ASTM D 1498-93, 1993.

A copy of ASTM D 1498-93 is appended to this attachment.

An alternate reference is American Public Health Association (APHA), American Water Works Association (A\JVVVA), Water Environment Federation (WEF), Standard Methods for the Examination of Water and Wastewater, Method 2580 B (Oxidation-Reduction Potential Measurement in Clean Water), Section 2-60, 18th , Edition, 1992.

5.2. Equipment

A high-impedance millivolt (mV) meter (readable to 1 mV) is required along with a reference electrode; and an oxidation-reduction electrode. Such meters are often built into multipurpose instruments to serve multiple tasks.

Chemicals (American Chemical Society [ACS] reagent grade) required include cleaning agents used to clean the noble metal electrode (aqua regia, chromic acid, nitric acid, and detergent); reagents for buffer solutions; reagents for standards solutions; and reagents for electrode testing (dilute sodium hydroxide and dilute nitric acid). A balance, pipettes, and volumetric flasks will be required to prepare solutions.

Polyethylene or Teflon beakers are needed to hold standards and samples. A plastic squirt bottle of distilled water is required for rinsing the electrodes. A box of Kim-wipes is useful.

5.3. Standards

Ferric/ferrous and quinhydrone standards should be prepared as directed in the ASTM reference. The ferric/ferrous standard is stable for weeks if kept cool and not Exposed to light or air. The quinhydrone standard must be made up daily and should be made in separate buffers (one with pH 4 buffer solution, one with pH 7 buffer solution).

5.4. Calibration Procedure

Prior to field activity, condition and maintain Eh electrodes as recommended by the manufacturer. At the field site, wipe off the oxidation/reduction electrode with a Kim-wipe and calibrate in accordance with manufacturer's instructions.

Be sure to indicate calibration measurements, the temperature, and type of electrode system used in the field notebook.

Upon completion of the initial calibration, samples can be analyzed.

Thoroughly wash the electrodes with DIW and remove excess water.

Rinse the beaker three times with sample. Insert electrodes into the sampler while agitating the beaker.

Read mV potential and record measurement in field notebook. Withdraw probe from sample and rinse with distilled water. Store electrodes as described in the operating instructions for the meter and electrodes.

Thoroughly wash the electrodes with deionized water and remove excess water before immersion in the next sample.

5.5. Continuing Calibration

The electrode standardization may be checked periodically at two different pH values by measuring the Eh of the two redox reference quinhydrone solutions and comparing the values to those in Table 3 of the ASTM Standard D 1498-93.

5.6. Final Calibration

After all samples have been measured, a final one-point calibration reading should be made using the pH 7 quinhydrone solution.

5.7. Reporting Limits

Results shall be expressed in mV and shall be reported to the nearest 1 mV. In the absence of substances that coat or poison the electrode, the precision is approximately ± 10 mV.

## 6.0 DISSOLVED OXYGEN

Dissolved oxygen (DO) levels in natural and wastewaters depend on the physical, chemical and biochemical activities in the water body. The analysis for DO is a key test in water pollution and waste treatment process control.

There are two generally accepted methods for the analysis of DO in water: the Winkler, or iodometric method, and the electrometric method using membrane electrodes. The iodometric method with its variety of modifications is the most precise and reliable method for DO analysis cannot be adapted easily for continuous monitoring and is not suited for field testing.

This procedure therefore describes the membrane electrode probe method of DO measurement. Being completely submersible, membrane electrodes are suited for analysis in-situ.

The membrane electrode probe is composed of two solid metal electrodes in contact with supporting electrolyte and separated from the test solution by the membrane.

Dissolved organic materials are not known to interfere in the output from DO probes. However, dissolved inorganic salts are a factor in the performance of DO probes. Reactive gases which pass through the membrane electrode probes may interfere in the output from DO probes. For example, chlorine will depolarize the cathode, cause a high probe output, and eventually desensitize the probe.

Hydrogen sulfide will also interfere with membrane electrode probes under certain conditions. DO membrane electrode probes are temperature sensitive, and temperature compensation is normally provided by the manufacturer.

Polyethylene and fluorocarbon membranes are permeable to oxygen gas and are relatively rugged. They can be readily replaced on the probe.

The following is a general field measurement procedure for DO and will not apply to every DO meter that could be used. Please refer to the manufacturer instructions on calibration and operation for each specific meter.

6.1. References

This procedure is based upon APHA, AWVVA, WEF, Standard Methods for the Examination of Water and Wastewater, Method 4500-0 G (Membrane Electrode Method), Section 4-103, 18th Edition, 1992.

6.2. Equipment

An oxygen-sensitive membrane electrode with appropriate meter and other reagents/apparatus as specified in Standard Methods or by manufacturer's instructions.

6.3. Standards

DO instruments are usually calibrated at the "zero oxygen" point, and some other points extending to near the end of the calibration range. A two-point calibration is a minimum requirement. The zero oxygen point requires a standard containing no DO. The other point requires a standard that has been previously determined by the iodometric method. One point can be a measurement in air.

Zero oxygen point standards are usually prepared by adding excess (until some solid remains that will not dissolve) sodium sulfite and a trace of cobalt chloride to water (preferably the sample water). The container is capped and shaken. The sulfite reacts quickly (within a few minutes) with the DO.

Other standards can be solutions that have been previously determined iodometrically. Commercial standards are available. A reasonably good standard can be obtained by allowing the probe to come to equilibrium (but not dry out) in air. The nearly constant atmospheric oxygen concentration is converted to DO units.

6.4. Initial Calibration

Prior to field activity, inspect membrane for air bubbles, oily film and/or holes. If the membrane is defective, it must be replaced, and the new membrane must be soaked in distilled water before calibration.

Follow manufacturer's calibration procedure. It is usually best to start with a zero standard and alternate with the end of range standard until at least two sets of readings agree. The stirring apparatus must be operating.

Calibration in fresh water can be done in sample water or de-ionized water, whichever is more convenient. Sample water should not be used if pollutants or interfering substances are present.

Calibration in salt water or water having a constant salt concentration in excess of 1000 mg/L requires use of the sample water.

Calibration in varying salt concentrations (e.g.) requires compensation based upon chloride ion content, salinity or conductivity (see Reference).

After the initial two-point calibration, samples can be measured. Samples can be measured in the source or collected in the grab sample collection container.

Follow manufacturer's instructions for sample measurement. When making measurements, be sure that the membrane electrode stirring apparatus is working and adjust the temperature compensator. Record DO measurement in the field notebook.

Keep the probe in distilled water when it is not in use to prevent the membrane from drying out.

If the sample temperature is 5°C greater than the calibration temperature, the meter should be recalibrated to the temperature of the sample.

6.5. Continuing Calibration

One or two-point recalibration should be done frequently (at least every 10 samples or every 2 hours).

Change of membrane requires a new initial calibration.

6.6. Final Calibration

When all samples have been measured, a final reading of the end of range standard should be measured. No instrument adjustment is required.

6.7. Reporting Units

Results shall be expressed in milligrams (mg) of DO per liter (DO/L) and shall be reported to the nearest 0.1 mg DO/L. Accuracy is typically ±0.1 mg DO/L and precision is typically ±0.05 mg DO/L.

## 7.0 TURBIDITY

The clarity of water is a major determinant of its condition. Turbidity in water is caused by suspended matter, such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton, and other microscopic organisms. Turbidity is an expression of the optical property that causes light to be scattered and absorbed, rather than transmitted in straight lines.

Turbidity in water is caused by the presence of suspended matter such as clay, silt, finely divided organic and inorganic matter, soluble colored organic compounds, plankton, and other microscopic organisms.

Measurements by turbidity instruments are given in terms of nephelometric turbidity units (NTU).

The measurement of turbidity can be affected by both the type of measuring instrument and by the nature of the suspension measured.

7.1. References

This procedure is based upon American Society of Testing Materials, Annual Book of ASTM Standards, Section 2, Standard Test Method for Turbidity of Water, ASTM D 1889-94, 1994.

A copy of ASTM D 1889-94 is appended to this attachment.

An alternate reference is APHA, A\NVVA, WEF, Standard Methods for the .Examination of Water and Wastewater, Method 2130 (Turbidity), Section 2-8, 18th Edition, 1992.

7.2. Equipment

ASTM D 1889-94 requires either a nephelometric or calibrated slit turbidity meter. Both instruments have ranges from 0.05 to 40 NTU. Higher sample turbidities can be measured following serial dilution of the sample to give readings in the applicable range.

Also required are sample tubes made of clear, colorless glass, which is kept extremely clean, and a grab sample collection container.

Rinsing and a zero standard require turbidity-free water. Turbidity-free water for measuring turbidity to as low as 0.02 NTU can be made by passing distilled water through a membrane filter having precision sized pores of 0.2 microns (Nucleopore Corporation, 7035 Commerce Circle, Pleasanton, CA or equivalent). Some commercial bottled demineralized or distilled waters can be used to prepare turbidity-free water.

Standards can be prepared or purchased from commercial organizations. All prepared standards (particularly low level standards) and some commercial standards have a short lifetime.

7.3. Commercial Standards

Most turbidity meters will come from the manufacturer with standards to compare and calibrate with. See manufacturers' instructions for proper procedure.

7.4. Continuing Calibration

Continuing calibration is not necessary unless a large number of samples (over 50) require measurement.

7.5. Final Calibration

When all samples have been measured, a final one-point calibration sample should be measured. No instrument adjustment is required.

7.6. Reporting Units

Results shall be reported in nephelometric turbidity units (NTU). Results shall be reported as follows:

| Turbidity Range (NTU) | Report to Nearest NTU |
|---|---|
| 0 – 1 | 0.05 |
| 1 – 10 | 0.1 |
| 10 – 40 | 1 |
| 40 – 100 | 5 |
| 100 – 400 | 10 |
| 400 – 1000 | 50 |
| > 1000 | 100 |

# ATTACHMENT C

## Field Screening Instruments

## 1.0 INTRODUCTION

Field screening is an on-site test procedure that yields immediate results. These results can be used as the basis of surveys or for making field decisions. An example of field screening is the use of a flame ionization detector instrument to determine hot spots in piles of dirt contaminated by petroleum. Field screening also might be used to sample drum headspace to determine if the drums can be safely disposed. Another use is to measure well headspace to determine the appropriate method for well purging/sampling based on the level of oxygen in the well.

Field-screening measurements are usually semi-quantitative. The measurements may be used only briefly if they serve as a basis for a decision and have no further value after the decision is made.

A number of portable instruments are available for field-screening purposes.

Many of these instruments have other primary purposes (e.g., the detection of hazards as a health and safety issue).

Field-screening measurements do not usually require the full quality assurance/quality control (QA/QC) rigor of measurements reported to the client. Calibration requirements for an instrument used in field screening can often be relaxed in comparison to using of the instrument for primary purposes such as hazard assessment.

Wherever possible, this attachment will point to calibration procedures listed in other AM8AJV documents. These documents will contain the calibration procedures for the primary purpose of the instrument. Discussion will be aimed at any allowable relaxation of the primary purpose calibration procedures

This attachment describes calibration procedures for the following instruments:

1. flame ionization detector (FID);
2. gas combustion meter (lower-explosive limit [LEL] meter);
3. photoionization detector (PID); and
4. Draeger tubes.

## 2.0 REFERENCES

None.

## 3.0 FLAME IONIZATION DETECTOR (FID)

A FID samples air through a probe and passes it through a flame that breaks up molecules into ions, which are electronically detected.

This instrument detects everything except gases such as oxygen, nitrogen, water vapor, carbon monoxide, and carbon dioxide. Because of its detection range and high sensitivity, it is used wherever little is known about chemical makeup of the air sample. It is also used where few chemicals are present and a high sensitivity is required.

FIDs are frequently used to detect petroleum vapors because it is particularly sensitive to these compounds.

3.1. Calibration

Calibration of the FID can be performed using methane and isobutylene standards and then related to other chemicals through sensitivity factors. For screening work, this is seldom necessary.

A good FID calibration for field work is to zero the instrument well away from the sample area and then check for function by placing almost any kind of ink marker in front of the probe.

## 4.0 OXYGEN LEVEL – GAS COMBUSTION METER ($O_2$ – LEL)

Oxygen level-gas combustion meters are commonly used for health and safety purposes such as evaluating confined spaces. While such meters can be manufactured individually, it is much more common to find them included in an instrument capable of performing multiple tests. The oxygen-level meter reads in percent and the gas combustion meter usually reads in percent lower explosive level (LEL), but conversions can be made for particular chemicals.

For screening purposes, the oxygen-level meter is sometimes useful in testing well headspace. The gas combustion meter is useful in detecting flammable materials. As such, it is an excellent detector of hydrocarbons. It does not react to chemicals that will not burn, such as halocarbons. A FID-gas combustion meter combination can be used to determine whether a spill is a fuel (detected by both) or a solvent (only detected by the FID).

The oxygen level meter is calibrated at the factory and is usually returned annually for calibration. In ambient air, the oxygen level should read between 20.5 to 21.5 percent. A function check of the oxygen meter can be made by holding one's breath for a few seconds and slowly exhaling into the probe. Air exhaled in this manner usually has an oxygen level of 18 to 19 percent.

The gas combustion meter is usually calibrated on a single gas standard and seldom needs recalibration. A function test can be performed by exposing the meter probe to rubber cement, nail polish remover, or certain hydrocarbon solvent ink sticks. It will not respond to solvents (halocarbons).

## 5.0 PHOTOIONIZATION DETECTOR

The PID is very sensitive to chemical compounds that contain double or triple bonds, or aromatic substituents (benzene rings). This limitation, along with the requirement for volatility, allows PID sensitivity only to materials of environmental concern, such as benzene, toluene, ethylbenzene, xylenes (BTEX); chlorobenzene; styrene; other substituted benzenes; perchloroethylene (PCE); trichloroethylene; dichloroethylene; and vinyl chloride. It can be used to detect petroleum (but not as effectively as a FID) because petroleum contains small amounts of BTEX.

Calibration of the PID for screening purposes, the daily 100-ppm isobutylene standard check is usually not necessary. The instrument should be zeroed in an area away from the sample area. A small gasoline sample in a vial can serve as a function test.

## 6.0 DRAEGER TUBES

Draeger tubes contain a material that changes color when exposed to a specific chemical (or specific group of chemicals). Sample air is drawn through the tubes, and color moves up the tube in proportion to the amount of chemical in the sample. Usually 100 milliliters of air is drawn through the tube.

Draeger is a commonly used trade name. A number of companies manufacture similar tubes. Draeger tubes can be used to detect (semi-quantitatively) a variety of chemicals. They are almost always designed to detect a specific chemical or group of chemicals.

Draeger tubes are calibrated at time of manufacture and require no recalibration. The hand air pump sometimes leaks and can be checked to determine if it is pumping 100 milliliters per stroke.

## 1.0 SIGNATURE AUTHORITY

| TITLE | NAME | SIGNATURE |
|---|---|---|
| Quality Control Manager | Yu Zeng | |
| Sr. Technical Manager | Rod Reeve | |
| Program Manager | Max Pan | |

## 2.0 PURPOSE

This Accord Engineering, Inc. (AEI) Standard Operating Procedure (SOP) is applicable to the decontamination of field equipment that comes in contact with chemically contaminated or potentially contaminated materials. It is based upon guidance given in the references in Section 4.0. This SOP does not address radioactive contaminated equipment.

## 3.0 SCOPE

3.1. This SOP aims to prevent:

- cross contamination among environmental samples;
- risk to personnel or the environment caused by the spread of contaminants; and
- cross contamination by inaccurate decontamination of field equipment...

3.2. This SOP is general in nature. Any more stringent decontamination procedures described in site-specific Sampling and Analysis Plans (SAPs) or in Site Health and Safety Plan (SHSPs) take precedence over this SOP. .

3.3. This SOP is designed to be implemented on-site at or near the field equipment point-of-use or at the border of a contamination exclusion area. Except in emergency circumstances, transport of contaminated field equipment off-site is forbidden. In a similar manner, storage of contaminated field equipment that has not been decontaminated either on-site or off-site is not allowed.

Contamination of field equipment does not have to be proven in order for decontamination to be required. A reasonable possibility or potential for field equipment to be contaminated is sufficient requirement for decontamination. This procedure includes the minimum standards required for decontamination activities by subcontractors (Section 7.4, decontamination of drill rigs).

3.4. This procedure does not apply to field equipment that is intended for one-time use and dispose. Such equipment shall be containerized after use and kept containerized until disposal.

3.5. This procedure does not apply to personnel decontamination (body, personal protective equipment [PPE], or clothing).

## 4.0 REFERENCE MATERIALS

| DOC. NO. | TITLE |
|---|---|
| NA | Glossary |
| SOP F10-002 | Instrument Calibration and Use |
| SOP F10-006 | Investigation-Derived Waste Management |
| SOP F20-003 | Monitoring Well Design, Installation, and Development |
| SOP F20-004 | Abandonment of Boreholes and Wells |
| SOP F30-001 | Soil Sampling |
| SOP F30-002 | Groundwater Sampling |
| SOP F40-001 | Water and Free product Level Measurement in Well |
| U.S. EPA 1993 | Preparation of a U.S. EPA Region IX Sample Plan for EPA-Lead Superfund Projects. San Francisco, California: Quality Assurance Management Section (QAMS), U.S. EPA Region IX. |

## 5.0 DEFINITIONS

***Decontamination*** *- The process of removing contamination from persons or objects.*

***SHSR*** *- Site Health and Safety Representative; Person responsible for health and safety of personnel at the site.*

## 6.0 PROCEDURE

6.1. Preventing the Need for Decontamination

Whenever possible, field equipment should be transported or stored in containers that prevent contamination or wrapped in aluminum foil (shiny side out).

Polyethylene (PE) sheet material (Visqueen) can be used as a barrier between sources of contamination and field equipment. Note: PE can be a source of phthalates if semi-volatile analysis of rinsate is anticipated.

To minimize the potential for cross contamination, sampling activities should be planned to proceed from least contaminated locations to most contaminated locations.

"Disposable equipment" intended for one-time usedoes not have to be decontaminated following use, but shall be put into a suitable container and disposed of as investigation-derived waste (IDW).

6.2. Equipment and Materials for Field Equipment Decontamination

Prior to initiating field operations, the necessary decontamination equipment shall be acquired. The SAP shall identify the chemicals of concern and describe decontamination protocols. Typical equipment requirements may include:

- buckets or tubs to hold wash and rinse solutions;
- long-handled soft bristle brushes for scrubbing;
- nonphosphate detergent such as Alconox or Liqui-Nox;
- potable water supply or pump spray apparatus;
- Deionized (DI) Water, distilled, or American Society for Testing Materials (ASTM) Type II Water;
- nonreactive wash bottles for nitric acid solutionsand rinse water;
- towels or wipes;
- Department of Transportation (DOT) approved drums to hold waste decontamination solutions and equipment;
- visqueen for laydown in decontamination areas; and
- gloves, aprons, safety glasses, and any other PPE required in the SHSP.

A formal decontamination station may be required between a contaminated area and a contamination exclusion zone. For greatest efficiency, placement and use of such a station shall be coordinated with the sampling or other field activities.

6.3. Generic Decontamination Procedure

The four steps to decontamination of equipment are as follows:

- Remove Gross Contamination;
- Remove Residual Contamination;
- Prevent Recontamination; and
- Disposal of Contaminants.

6.3.1. Remove Gross Contamination

Gross contamination removal may be accomplished by steam or high-pressure hot water cleaning and/or vigorous brushing with a nonphosphate detergent or by soaking and brushing. The method chosen shall consider the type of equipment being decontaminated (e.g., drilling tools or electronic equipment) and the contaminating medium.

6.3.2. Remove Residual Contamination

Residual contamination removal consists of a formal set of steps based on the contaminants (present and suspected). Since the subject contaminants are often visible,

these steps must be meticulously applied to the entire surface area of each piece of equipment suspected of coming in contact with contamination.

The following generic procedure is recommended by the United States Environmental Protection Agency (U.S. EPA), Region IX for EPA-Lead Superfund Projects (U.S. EPA 1992). This constitutes a model method that may be modified for specific applications.

Liqui-Nox (or other nonphosphate-containing detergents) should be used when phosphate may be detrimental to the analysis. Alconox (or other phosphate-containing detergent) can be used if a stronger detergent action is required and phosphate will not impact target analytes. Liqui-Nox and Alconox (manufactured by Alconox, Inc.) have been used historically, but any similar detergents can be used.

Residual contamination removal steps are as follows:

- low or nonphosphate detergent wash (e.g., Alconox or Liqui-Nox solutions made up as directed by the manufacturer);
- potable water rinse;
- DI or distilled water rinse.

6.3.3. Prevent Recontamination After Decontamination

After decontamination, the equipment shall be treated in a manner that will protect it from further contamination to the extent practical. These procedures will vary considerably with the nature of the equipment and the specifics of the project. Protection measures include wrapping with oil-free aluminum foil or plastic and storing in zip-lock bags.

6.3.4. Disposal of Contaminants

Gross contamination and all washing and rinsing solutions must be considered to be IDW and managed as directed in AEI SOP F10-006. After use, gloves and other contaminated PPE must also be managed as IDW in accordance with the site specific IDW Plan.

## 7.0 SPECIFIC DECONTAMINATION PROCEDURES

7.1. Decontamination of Field Instruments

Field instruments such as organic vapor monitors and gas analyzers are typically not constructed to allow immersion or aggressive scrubbing. Care should be taken to minimize the exposure to solid or liquid contaminants. In environments with high potential for contamination, instruments may be operated in plastic bags, allowing only detector assemblies to be exposed. Manufacturer's instructions should be consulted, as well as AEI SOP F10-002. Probes of pH, temperature, and specific conductance meters should be thoroughly washed with deionized or distilled water, then rinsed with deionized water.

7.2. Decontamination of Soil and Sediment Sampling Equipment

Soil and sediment sampling equipment includes sample barrels, sleeves (i.e., tubes, liners), retainers, hand augers, trowels, spoons, corers, grab samplers, dredges, and any other objects that might come into contact with a soil or sediment sample in the course of its collection and handling. This equipment shall be decontaminated before each use and before departing the field. Scrubbing with nonphosphate detergent should be sufficient to remove soil deposits. The procedure detailed in Section 6.3.2 of this SOP should be followed for the chemicals of concern. Rinsing shall be thorough, since contaminants may not be visible. Decontaminated equipment shall be protected from recontamination by dust, spray, and airborne contaminants by aluminum foil and/or plastic wrap.

7.3. Decontamination of Groundwater Sampling Equipment

Groundwater sampling equipment, as specified in the SAP, includes bailers, well sounding tapes, water-level tapes, interface detectors, pumps, hoses, and wires introduced into wells, and any other objects that might come into contact with groundwater that might be sampled. Gross contamination is typically not a problem from the well unless viscous non aqueous-phase liquids (NAPLs) have accumulated. It is important to recognize that just a few drops of a NAPL could contaminate a well.

Care shall be taken on the ground surface to avoid introducing gross contaminants to wells. Tapes, hoses, and wires should not be permitted to line on the ground or on contaminated surfaces. If such items become contaminated by ground contact, they must be decontaminated prior to use.

Equipment may be protected by hose reels, plastic sheeting, or plastic tubs.

Appropriate rinses or wipes shall be conducted prior to inserting devices into wells and as they are moved between wells. Manufacturer's instructions shall be consulted for decontamination of pumps and interface probes.

7.4. Decontamination of Subcontractor Drilling Equipment

Drilling equipment decontamination shall be performed by the subcontractor, in accordance with the applicable SAP or SHSP.

Decontamination is required for equipment involved in drilling and/or sampling soil borings and monitoring wells. It is required for equipment on drilling rigs involved in developing, purging, sampling, or aquifer tests. It is also required for any other equipment (e.g., backhoes, rigs that drive points, orpenetrometer cones that might come into contact with contaminated media).

Decontamination is required for all rig components that touch or enter the ground. Decontamination may also be required to parts of the drill rig vehicle that become splattered with boring materials. Drill rig vehicle decontamination should be conducted on decontamination pads or in designated decontamination areas (typically a depression lined with visqueen) located close enough to the work site that contamination is not spread during the movement of the vehicle. Gross decontamination is removed at the work site prior to moving the vehicle to the decontamination pad.

Vehicles and downhole drilling equipment shall be decontaminated prior to moving onto the site, between each drilling location, and prior to leaving the site.

Decontamination shall consist of steam or high-pressure hot water wash, nonphosphate detergent, and a potable water rinse. Where the potential for cross contamination/transference exists, the SHSR shall approve all daily vehicle movement off-site after confirmation that the vehicle has been satisfactorily decontaminated.

The vehicle operator shall take steps to prevent contamination of the vehicle interiors. All equipment necessary for work shall be removed from the cab interior prior to start of work.

## 8.0 QUALITY CONTROL

The final rinse solution of equipment decontamination can be collected and analyzed. Such samples are referred to as rinsate samples. The number, frequency, and method of collection of rinsate samples will be described in the SAP.

## 9.0 DECONTAMINATION SAFETY AND HEALTH ASPECTS

Material Safety Data Sheets are required for all chemical decontamination agents (except water) brought on-site. Use of acids, solvents, etc., other than specified in this procedure requires the approval of the AEI Health and Safety Manager.

Requirements for PPE decontamination are established in the SHSP and enforced by the SHSR.

AEI personnel shall not operate subcontractor decontamination equipment unless that equipment is provided specifically for their use and personnel have been trained in the use of that equipment.

## 10.0 DOCUMENTATION

Decontamination of field equipment, including drilling equipment, shall be documented in a field logbook. Typical decontamination of field equipment can be documented with a single entry. All deviations and reasons for deviations from normal decontamination procedures shall be noted and initialed in the field logbook.

## 11.0 REVISION HISTORY

| REVISION | SECTION/FORM | REVISION DESCRIPTION | DATE |
|---|---|---|---|
| - | - | Initial Release | |

## 1.0 SIGNATURE AUTHORITY

| TITLE | NAME | SIGNATURE |
|---|---|---|
| Quality Control Manager | Yu Zeng | |
| Sr. Technical Manager | Rod Reeve | |
| Program Manager | Max Pan | |

## 2.0 PURPOSE

This Accord Engineering, Inc. (AEI) standard operating procedure (SOP) is to provide a standardized method for the design, installation, and development of a vertical monitoring well intended to serve as access to a specific hydrogeologic unit for the measurement of water levels, free product and/or the collection of groundwater samples.

## 3.0 SCOPE

This SOP is intended for use by geologists/engineers for general guidance in the design, construction, and development of monitoring wells to be installed during site investigations. This SOP does not include borehole drilling and logging procedures, design of a monitoring well network, or well construction details that may be necessitated by site- specific conditions.

## 4.0 REFERENCE MATERIALS

| DOC. NO. | TITLE |
|---|---|
| NA | Glossary |
| SOP F10-003 | Decontamination of Equipment |
| Aller, et al. 1989. | Aller, L., T.W. Bennet, G. Hacket, R.J. Petty, J.H. Lehr, H. Sedoris, D.M. Nielsen, and J.E. Denne. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. Dublin, OH: National Water Well Association RC-EPA/600/4-89/034. |
| Cal- EPA 1994 | Cal- EPA, DTSC. Monitoring Well Design and Construction for Hydrogeologic Characterization: Guidance Manual for Ground Water Investigations. Interim Final. |
| Driscoll, F .G. 1989 | Groundwater and Wells. St. Paul, MN: Johnson Division. |
| Fetter, C. W. 1988 | Applied Hydrogeology. Second Edition. New York, NY. Macmillan Publishing Co. |
| CDWR 1991 | California Department of Water Resources (CDWR). Standards, Bulletin 74-90. June. |

| DOC. NO. | TITLE |
|---|---|
| CDWR 1981 | California Department of Water Resources (CDWR). Water Well Standards, Bulletin 74-81. |
| NA | American Society for Testing and Materials. 1990. Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers. October. |

## 5.0 DEFINITIONS

**Annular space:** Annulus - the space between well casing and the borehole wall.

**Aquitard** - A fine-grained geologic unit of relatively low permeability material that is stratigraphically adjacent to one or more aquifers or water-bearing zones.

**Bailer** - A pipe with a check valve at the bottom used to collect groundwater from a well.

**Bridge** - An obstruction within the annulus of a well that may hinder proper emplacement of the filter pack and annular sealing materials.

**Casing –** A series of pipes connected by joints that can be fitted together and used either temporarily or permanently to advance a borehole, counteract caving, isolate a zone to be monitored, provide a conduit to the well screen interval, or a combination thereof.

**Protective cap** - Is placed over the top of well casing to prevent damage and unauthorized entry.

**Surface casing** - Is used to stabilize a borehole near the surface during drilling.

**Conductor casing** - Generally refers to casing used to stabilize a section of the borehole and/or to isolate a contaminated zone from the zone to be monitored.

**Centralizer** - A device used to keep casing centered inside a borehole or another casing.

**Confined aquifer** - A subsurface water-bearing zone that is overlain and underlain by relatively impermeable, fine-grained geologic units that restrain the vertical movement of groundwater.

**Drill cuttings** - Soil or rock fragments that are expelled from a borehole during the drilling process.

**Hydrogeologic** - Of or pertaining to the study of water contained within the pore spaces and/or fractures of soil or rock.

**Non-aqueous phase liquid (NAPL)** - A liquid phase that has a density greater than or less than water. Chlorinated solvents (e.g., trichloroethylene, vinyl chloride) are examples of dense NAPLs (DNAPLs) that sink in water; gasoline and other fuel hydrocarbons are examples of light NAPLs (LNAPLs) that float on water.

**Potentiometric surface** - The level to which water rises in a unconfined aquifer.

**Riser casing** - Refers to the blank well casing that extends from the ground surface to the top of the target zone, where it is connected to the well screen.

**Sump** - Section of blank casing located beneath the screened interval in a well that is fitted with a bottom cap and serves to collect sediment or DNAPLs that enter the well screen; also called a sediment trap or well cellar.

**Surge block** - A well development tool that is operated like a plunger in a well casing to force water to flow into and out of the well screen.

**Tremie** - The process of using a pipe or rigid tube to emplace filter pack and annular seal materials at the appropriate intervals within the annulus of a well.

**Unconfined aquifer** - A water-bearing zone subject to atmospheric pressure where the water table is free to rise and fall.

**Water table** - The surface of an unconfined aquifer.

**Well cluster** - Two or more individual wells constructed at a given location where each is open to different water-bearing zones in the subsurface.

**Well nest** - A well in which several casings are installed in a single borehole; each is screened to monitor a different water-bearing zone in the subsurface.

**Well screen** - A filtering device that serves as the intake portion of a well installation. See Glossary of Terms and Definitions.

## 6.0 PROCEDURE

Monitoring well design, installation, and development are addressed by this SOP as described below.

### 6.1. Well Permitting

Well installation permits are usually required by one or more local, regional, and/or state regulatory agencies. Permits from the lead regulatory agency (LEA) may also be required for boreholes that are advanced below the water table using conventional drilling techniques, a direct-push sampling rig and for the destruction (abandonment) of existing wells.

The designated LEA overseeing well installation/destruction activities is typically the county department of health and environmental services, a state agency (e.g., the California Department of Water Resources, the California Regional Water Quality Control Board, or the California Environmental Protection Agency [Cal-EPA] Department of Toxic Substances Control [DTSC]). A site may also be subject to federal or regional EPA guidelines. City permits may be required if the site is located within the city limits or on land owned by a municipality. Permission must be obtained from property owners if a proposed well location is on and/or accessed by private property.

The geologist/engineer is responsible for identifying the proper well installation-permitting agency (or agencies) and for obtaining the required permits.

A completed well permit application typically includes a completed application form that is signed by a registered geologist, a site location map, a map of proposed well locations, a schematic diagram illustrating proposed well dimensions and construction materials, and a

check or money order for any required fees (Department of Defense [DOD] sites may be exempt from the fees but typically permits are still required).

The well location map submitted with a permit application may show the proposed well location(s) in terms of local landmarks in urbanized areas (e.g., 150 feet north of the intersection of Palm Drive and Imperial Road in center median) in terms of the Township and Range System (e.g., 2, 100 feet north of the south line of Section 26 and 1,460 feet west of the east line of Section 26), or northing and eastings in State Plane coordinates.

## 6.2. Well Design

The purpose of a monitoring well is to provide access to groundwater within a specific (target) water-bearing zone in order to evaluate its hydrogeologic properties and/or to collect representative groundwater samples for measurement of its physical characteristics (e.g., temperature, pH, electrical conductivity, turbidity, dissolved oxygen) and analysis of its chemical constituents.

Preparation of the well design entails specifying the dimensions of the borehole in which the well will be installed and the type and dimensions of well construction materials, and considering site-specific needs and conditions. The drilling method proposed to advance the borehole and the well construction materials emplaced should minimize, to the extent possible, disturbance to the adjoining geologic formation and/or alteration of the groundwater physical and chemical properties.

A primary objective of drilling and well installation procedures is to maintain the integrity of fine-grained geologic units (i.e., aquitards) that separate water- bearing units such that the mixing of groundwater of differing quality and/or the transfer of groundwater contamination from one water-bearing zone to another.

When subsurface conditions indicate that several aquifers are to be monitored at a given location, design of a well cluster or nest is appropriate. Installation of a well cluster is preferable to installing a well nest except under extraordinary circumstances where the water-bearing zones to be monitored are unusually deep and drilling costs are prohibitively expensive.

### 6.2.1. Borehole Specifications

Specifications for the dimensions of the borehole in which the proposed well is to be installed are prepared in accordance with the following criteria:

- the diameter allows a minimum of 2.5 inches and a maximum of 5 inches between the well casing and the borehole wall (annular space) to accommodate filter pack and annular seal materials (Cal- EPA 1994), and
- the total depth is within a few feet below the bottom of the proposed screened interval.

If a borehole is advanced more than a few feet below the proposed screened depth, the excess portion of the borehole is to be sealed with bentonite or a bentonite/cement grout prior to well construction. If a hollow-stem auger rig is being used to install the well, this seal shall be placed through the auger assembly to avoid sealing the target

zone; otherwise, this seal shall be emplaced using a tremie pipe. Placement of the seal is necessary to restrict potential vertical migration of groundwater from the target zone to greater depths.

As the borehole is advanced through the target zone, samples of formation material should be collected for subsequent particle-size analyses. These analyses are performed to establish filter pack and screen slot-size specifications for a proposed well.

If the mud rotary method is used to advance the borehole, it is necessary to clean the borehole by circulating potable water prior to well installation.

6.2.2. Specifications for Well Construction Materials

Design of a groundwater monitoring well entails specification of the type, quantity, and, if applicable, dimensions, of well construction materials, especially with regards the depth to and length of the interval to be monitored. Well construction materials generally include well casing and screen, a sump (optional), top and bottom caps for the casing assembly, a filter pack, annular sealing materials, and surface completion components.

6.2.2.1. Well Casing and Screen

The selection of well casing and screen materials requires consideration of the proposed use(s) of the well;

- √ as a piezometer, installed primarily for measurement of water levels;
- √ as a monitoring well, for both measurement of water levels and collection of groundwater samples;
- √ as an observation well, for aquifer testing purposes; or
- √ as a monitoring well for subsequent conversion to extraction well.

The following conditions influence each of the factors above;

- √ the geologic environment;
- √ the geochemistry of uncontaminated or contaminated formation materials and groundwater;
- √ the types and concentrations of suspected contaminants; the proposed well depth; and
- √ the anticipated design life of the well.

Well casing and screen type are specified according to the manner in which the joints of casing and screen are connected. Flush-jointed, threaded connections are recommended to avoid the use of adhesive chemicals or glue (polyvinyl chloride [PVC] casing), or welding (steel casing), or the use of screws or pins and to provide a watertight seal. The joints are commonly specified in

2.5-, 5-, 10-, or 20-foot lengths. Other lengths may be required depending on site- specific conditions and objectives.

**Well Casing**

Blank well riser casing extends vertically downward from the ground surface to the top of the target zone, where it is connected to the well screen. Acceptable casing and screen composition for monitoring well construction includes thermoplastic (e.g., PVC); fluoropolymer (e.g., Teflon); carbon, low-carbon, or stainless steel material (Cal-EPA 1994). Other casing materials, such as fiberglass, are available for use in specialized applications, especially where there are concerns about long-term compatibility with groundwater or contaminant chemistry.

PVC is widely used as material for monitoring well casing for most applications. Stainless steel is used in hydrogeologic environments characterized by harsh physical or chemical conditions, or where long-term use (20 years or more) is anticipated. Hybrid wells may be constructed using more than one type of material (e.g., PVG riser casing with a wire-wound, stainless steel screen).

PVC riser casing is commonly specified as either Schedule 40 or 80 for the construction of monitoring wells. The wall thickness of Schedule 40 PVC casing is less than that of Schedule 80, and is generally used for constructing shallow wells to depths of 150 to 200 feet below the ground surface. At greater depths, the integrity of a well cased with Schedule 40 PVC casing could be compromised due to increased pressures and from the grout 'heat of hydration." Schedule 80 PVC casing is generally used for deeper well installations because it has greater strength due to a greater wall thickness. However, the inside diameter of Schedule 80 casing is less than that of Schedule 40. This must be taken into consideration when specifying sizes of pumps or other equipment that will subsequently be lowered into the well for monitoring and/or sampling.

Nominal monitoring well casing diameters for groundwater monitoring wells are typically specified as 2, 4, or 6 inches. Borings are generally required to allow from 2.5 to 5 inches of annular space between the well casing and the borehole wall to accommodate at least 2 inches of filter pack material around the well screen and 2 inches of grout around the riser casing. Wells constructed with 2- inch-diameter casing are generally used as piezometers for measuring groundwater levels. Wells intended for routine sampling and/or aquifer testing are generally constructed with casing diameters of 4 to 6 inches to allow greater flexibility in the selection of submersible pumps, bailers, and other down-hole equipment and instrumentation.

Well casing materials also include bottom caps, sumps (optional), centralizers, and top caps. A bottom cap and a sump are attached to the base of the well

screen for settlement and collection of any fine-grained formation materials that might pass through the well screen and/or DNAPLs. Threaded bottom caps, typically 6 inches long, are to be attached to the bottom of the well screen or sump. Centralizers, generally used at the top and bottom of well screens and every 40 to 50 feet along the length of the well casing to keep it centered in the borehole, are typically made of stainless steel regardless of the type of casing material. (Note: Wells installed using a hollow-stem auger rig do not require centralizers). Top caps are available as slip-on or threaded PVC or steel.

**Well Screen**

Well screen, constructed of one of the above well casing materials, allows groundwater of low turbidity from the target zone to flow into the well. A well screen (typically PVC or stainless steel) is required for wells completed in unconsolidated formations, but may not be necessary for wells completed in rock formations, where a stable, open-hole condition, may be maintained.

In addition to the type of material used, well screen specifications also specify the depth to and length of the screened interval. For wells installed to monitor unconfined aquifers, design of the screen length should take into consideration the anticipated range of water levels due to seasonal or tidal variation, or variation in the thickness of LNAPL, if present. In most cases, the top of the well screen should not extend beyond the top of the groundwater table (into the vadose zone) unless designed specifically to monitor for floating product (LNAPL). The screen length for a well monitoring LNAPL is determined based on site-specific hydrogeologic conditions, with typically, 5 to 7 feet of screen installed above the groundwater/LNAPL interface.

The screen length for a well installed to monitor the potentiometric surface of a confined aquifer should be the minimum necessary to satisfy site-specific objectives and should not extend above the base of the upper confining layer. At locations where sinking product, or DNAPLs, such as chlorinated hydrocarbons have been released to groundwater, the well screen is installed at the base of the aquifer or water-bearing zone where vertical migration of DNAPLs may be impeded by the presence of a lower confining layer. The well screen length is typically 5 to 10 feet under these conditions.

The size of openings or slots is also specified for a design of a well screen. For PVC screen, the types to be used for monitoring well installation are those with machine-cut slots that are cut transverse to the axis of the casing, or those designated as continuous slot. Machine-cut PVC screen is commonly specified because of its low cost. Continuous-slot screen is also frequently used because it provides a significantly greater area open to the formation. However, continuous slot screen has less strength than machine-cut PVC.

Stainless steel, wire-wound well screen may be used with a PVC or stainless steel riser casing.

Well screen slots are generally available in standard sizes of 0.010 to 0.050 inches. The size of the well screen openings is generally specified to hold back 85 to 100 percent of the filter pack materials" Methods for determining the appropriate slot size for screens is discussed in Driscoll (1989).

6.2.2.2. Filter Pack

A filter pack composed of chemically inert, quartz sand (or pea gravel for gravel aquifers) is placed in the annular space around the well screen to restrict fine- grained materials from entering the well. The filter pack is emplaced from the bottom of the borehole to a level approximately 2 feet above the top of the well screen in wells less than 200 feet deep. If the well depth is greater than 200 feet, the filter pack may extend up to 5 feet above the top of the well screen (Cal- EPA 1994) to compensate for any compression of filter pack materials by a correspondingly greater volume of overlying transition and annular sealing material. At least 2 inches of filter pack material is emplaced between the well screen and the borehole wall (Cal-EPA 1994, Aller et al. 1989).

A filter pack ratio, based on the results of particle size analyses, is used to specify the size differential between formation and filter pack materials. This ratio is generally the 50- or 70-percent-retained size during the particle-size analysis (Cal-EPA 1994). Methods for determining the appropriate filter pack gradations are presented in Driscoll (1989) and Aller et al. (1989).

A layer of chemically inert, fine sand may be placed over the filter pack prior to installation of the transition seal as a further precaution against invasion of annular sealing materials into the filter pack.

6.2.2.3. Transition Seal

A transition (bentonite) seal, composed of a 2- to 5-foot-thick layer of pre-hydrated bentonite pellets or chips, or bentonite slurry, is emplaced on top of the filter pack. Proper pre-hydration of the pellets or chips entails the addition of approximately 2 to 5 gallons of deionized water per 50-pound bucket of bentonite pellets or chips. Bentonite slurry is mixed at the ground surface and, generally, is composed of approximately 15 pounds of dry bentonite powder to 7 gallons of water.

6.2.2.4. Grout Seal

A grout seal composed of a neat cement, cement/bentonite grout, or bentonite slurry, is emplaced over the bentonite seal, generally to within a few feet of the ground surface. A common neat cement mixture is composed of 5 to 6 gallons of potable water per 94-pound sack of cement. An appropriate

cement/bentonite grout mixture is composed of approximately 2 to 4 percent pre-hydrated bentonite and 7 to 9 gallons of potable water for each 94-pound sack of Type I Portland cement (Cal-EPA 1994). Bentonite slurry is mixed in the proportions stated in Section 6.2.2.3. The integrity of the confining layer can be maintained by placing the annular seal at least 5 feet below the top of the confining layer or, preferably, adjacent to the entire confining interval.

6.2.2.5. Surface Completion

A surface completion is placed over the top of the well riser casing to provide structural protection and restrict unauthorized access to the well.

An aboveground surface completion typically consists of a protective, steel casing (or standpipe) with a locking steel cap that is set over the riser casing stick-up (i.e., the portion above the ground surface). The protective casing is fixed into a cement pad at the ground surface that slopes away from the riser casing. An aboveground surface completion may be surrounded by guard posts as a further measure of protecting the wellhead. Due to improved wellhead protection, security, and visibility, aboveground surface completions are preferred for wells installed in off-road areas.

A below ground completion features a metal, traffic-rated vault cemented into place with a steel plate at the ground surface that allows the unimpeded flow of vehicular traffic and provides access to the well. The well surface completion may have a locking lid or the enclosed well casing may be secured with a locking well cap.

## 6.3. Well Installation Procedures

### 6.3.1. Pre-installation Activities

Well construction materials should be inspected in the field upon delivery to verify that those received complies with specifications for types and dimensions, and that sufficient quantities are present. Well screen and casing joints should be measured for length and checked for uniformity. Measurement of the length of well assembly components will serve as a check on the total installed depth of the well and on the proper placement of the well screen.

Materials should also be inspected to evaluate the need for decontamination prior to well construction. Well casing that is sealed in plastic before being shipped in cardboard boxes may not require decontamination prior to installation, but wrapped stainless steel casing and screen may have polishing grit on surfaces that require cleaning. Casing that has been exposed to the elements at any time before well installation should also be decontaminated prior to use.

Well construction materials should always be stored on, and covered by, plastic sheeting to protect them from the elements. It is recommended that these materials not be stored directly on the ground surface. Samples of well construction materials

may be archived for future reference. As a minimum, the manufacturer and material specifications listed on the shipping packages should be recorded.

6.3.2. Well Screen and Casing Assembly

The screen and casing assembly is performed in accordance with manufacturer instructions for tightening joints while taking precautions to prevent contamination of the well construction materials.

The bottom cap and sump (optional) are first attached to the bottom joint of the screen. Additional joints of screen are then added to form the screen assembly, which is typically no greater than 20 feet in length. After the screen assembly is completed, centralizers are placed near its top and base. The assembly is then attached to a winch, hoisted over the top of the borehole, and lowered into the borehole.

The screen assembly is held at the top of the borehole while a connection is made with the first joint of well riser casing. The well casing is assembled and lowered into the borehole one joint at a time. Centralizers are generally added to the casing string every 40 to 50 feet. After the screen and casing assembly has been lowered to the desired depth, the entire assembly is suspended by the winch until the filter pack, transition seal, and grout seal are emplaced.

6.3.3. Addition of Filter Pack

The filter pack is typically added to the annular space to a level that is at least 2 to 3 feet above the top of the well screen casing. Coarse sand or gravel filter pack materials are generally poured into the annulus and allowed to settle. When pouring filter pack materials into the annulus, it is important to minimize segregation of particles by size. If finer material (i.e., fine to medium-grained sand) comprises the filter pack, it can be mixed with fresh water and pumped through a tremie pipe for placement into the annulus. If fresh water is used in this manner, the source and volume of water should be recorded.

Measurement of the depth of the top of the filter pack is made by the drilling subcontractor as placement proceeds to check for bridging that might occur and to gauge the proper increments for withdrawing temporary conductor casing or auger flights. The actual amount of filter pack used should be compared to the calculated annular space volume based on the well design, keeping in mind that washouts, caving, and swelling clay zones can cause the actual volume to differ significantly.

The well is surged after emplacement of the filter pack. If settlement occurs during surging prior to emplacement, filter pack material should be added to the well annulus and surged until it meets design specifications.

Following final surging and measurement of the depth to the top of the filter pack, a 1-foot-thick layer of chemically inert, fine sand, as discussed in Section 6.2.2.2, may then be emplaced in the annulus using a tremie pipe.

6.3.4. Emplacement of the Transition Seal

For wells less than approximately 30 feet deep, the transition (bentonite) seal material (preferably as prehydrated pellets or chips [Section 6.2.2.3]) may be poured directly down the annulus and tamped into place to prevent bridging. Alternatively, for wells of any depth, bentonite slurry may be prepared (Section 6.2.2.3) and emplaced as the transition seal.

6.3.5. Emplacement of the Grout Seal

Using a tremie pipe, the remaining annular space above the transition seal is filled with either neat cement, bentonite, a cement/bentonite grout, or a bentonite slurry in one continuous operation to within 4 feet (or less) below the ground surface (CDWR 1991). The depth of the top of the grout seal depends on whether the well design specifies an aboveground or below ground surface completion (Section 6.3.6).

During placement of the grout seal, the end of the tremie pipe initially should be placed approximately 5 feet above the top of the transition seal and should remain submerged at least 20 feet while grouting. For wells installed to depths of greater than approximately 300 feet, a different mode of grout seal emplacement may be necessary to prevent potential failure of the grout and invasion of the well screen. Alternative methods of grout seal emplacement are discussed in Driscoll (1989).

6.3.6. Surface Completion

The surface completion is constructed above- or belowground in accordance with the well design. For an aboveground surface completion, the grout seal terminates at the ground surface. The protective casing is placed over the riser casing into the grout seal. After the grout seal has set up, a concrete pad is constructed around the protective casing that slopes away from the well. For a below ground completion, the traffic vault is placed from the top of the grout seal to at least the ground surface (CDWR 1991) to enclose the top of the riser casing (some localities may require the traffic vault to be slightly elevated above ground surface to prevent surface water ponding above the vault). The vault is then cemented into place.

The well identification number is usually scribed or written in indelible ink on the well cap or at the top of the well riser casing, and on the surface casing, if possible. The top of the riser casing should be even {i.e. not ragged). A saw- cut notch is cut into the north side of the top of the well riser casing to serve as a reference point for surveying and water-level gauging. The well vault or protective casing shall be secured with a lock to prevent unauthorized entry.

6.4. Well Development Procedures

Well development is a process aimed at repairing damage done to the water- bearing formation by drilling and to enhance the hydraulic properties of the formation near the borehole so that water flows more freely into the well. Development should stress both the filter pack and the formation sufficiently to enhance hydraulic exchange without damaging either. Well

development breaks down and reduces borehole wall accumulations of bentonite drilling fluids; it also draws in and removes the fine particles from the filter pack and formation that can obstruct the free passage of water, damage pumps, or result in the accumulation of silt in a well.

A variety of well development procedures are commonly used including bailing, pumping, surging, hydraulic jetting, and air lifting. Selection of anyone procedure, or a combination of procedures, depends on well design (especially casing and well volumes), formation properties, the drilling method used, well construction methods, and well discharge handling capability.

Development may also be performed in stages using several different techniques. Initially, a sand bailer may be used to remove accumulated sediment from the bottom of the well. This also draws formation water into the well, resulting in agitation and surging, which loosens fine particles. If the borehole was drilled with mud as the circulatory fluid, the mud may be removed using a bailer, or it may be displaced or thinned by circulating potable water, prior to well development. In most situations, water should not be added to the well during development in order to maintain the integrity of the well for water quality sampling (Fetter 1988).

After most of the sediment or bentonite drilling fluid is removed, the well can be further developed by a combination of surging and pumping techniques. Bailers and/or submersible pumps are commonly used in such a way to further loosen fine particles by surging and agitation. A bailer achieves this by oscillating well water, while a pump serves this purpose by overpumping and backflow surging. Surge blocks are specialized tools used for repeated surging and agitating and must be followed by bailing or pumping. For environmental or hazardous waste investigations, sediment and development water removed from the well must be contained for proper handling and subsequent disposal.

The progress of development in monitoring wells is typically evaluated qualitatively by observing water clarity. Quantitatively, it is monitored by measuring the volume of water removed and the sand content of the water (turbidity).

Wells are commonly judged to be properly developed when the water discharged from the well is clear and free of sediment. However, meeting this criterion may be impractical from a cost and schedule standpoint. It is therefore recommended that the water quality parameters temperature, pH, electrical conductivity, and dissolved oxygen be measured to aid in deciding when development duration has been sufficient. Development is frequently limited to 4 to 8 hours or the removal of 5 to 10 casing or well volumes.

### 6.5. Decontamination, Handling of Waste Materials, and Site Cleanup Procedures

Well installation and development procedures may generate large volumes of waste materials, particularly drill cuttings, development water, drilling mud (if mud rotary techniques are used), as well as used personal protective equipment (PPE). Site cleanliness and conformance with decontamination guidelines are necessary to reduce the risk of cross contamination and human exposure to potentially hazardous materials.

6.5.1. Decontamination of Equipment

Equipment and materials to be used in the installation of monitoring wells must be thoroughly cleaned as specified in SOP F10-003, Decontamination of Equipment, prior to starting work to remove contamination that may have been acquired in transit to the site, by exposure to the elements or exposure to on-site contaminants. Similarly, equipment used to install a well must be cleaned before starting work on a subsequent well installation to reduce transfer of contaminants from one borehole to another.

6.5.2. Handling of Waste Materials

Waste materials, including drill cuttings, development water, drilling mud (if applicable), and PPE that are generated during the installation of a well may be contaminated and must be properly contained and labeled for storage, handling, and disposal. Procedures to be followed for handling waste materials are presented in each site-specific plan for management of investigation-derived wastes (IDW).

6.5.3. Work Site Cleanup

The drilling location shall be kept as neat and clean as possible during field operations and, following the completion of work, shall be returned to its original condition. This includes mending or replacing fences, pavement, vegetation, structures, and utilities, and removing surplus materials. Stockpiled wastes shall also be removed unless other arrangements have been made.

6.6. Record-Keeping Procedures

Accurate recordkeeping by the geologist/engineer is critically important from both a technical and legal perspective. The geologist/engineer shall be responsible for preparing a daily field log, reviewing and approving the driller's daily drilling report, and recording well construction details on Well Construction Details/logs: Well development information and measurements shall be recorded on Well Development Form.

Each entry onto the field forms shall be legibly recorded in black indelible ink such that each form is reproducible. A line shall be made through any entry made in error. The incorrect entry should be initialed and dated. The original field forms shall be submitted as part of a project hardbound field notebook. Copies of the field forms shall be distributed to the project manager and to the geologist/ engineer that originally completed the field forms.

6.6.1. Driller Records

The driller shall keep a daily drilling report (a quantity verification sheet) that records, at a minimum, the subcontract number; project number; name of the site; the monitoring well identification number; the names and titles of subcontract drilling personnel performing the work; delivery order pay item numbers and the services and/or equipment and supplies provided under the pay item; and the quantities associated with the pay item number (e.g., duration of service or equipment use in hours or days, footage, mileage). If a service, piece of equipment, or a supply is not included in the

subcontract line item price, a Field Change Notice must be prepared by the geologist/engineer to initiate revision of the delivery order.

The geologist/engineer shall sign each drilling report on the day of generation to indicate concurrence with the pay item numbers arid quantities recorded by the driller. The drilling report is then used by the drilling subcontractor as the basis for invoicing the work.

6.6.2. Daily Field Log

The geologist/engineer shall keep a daily field log in the hardbound field notebook to document the nature and timing of activities performed, the names of personnel on-site, and any other pertinent information (e.g., a separate tally of the types and quantities of construction materials used for each well installed, the nature of any interactions with base personnel, weather conditions).

6.6.3. Well Construction Diagram

The geologist/engineer shall record well construction details on Well Construction Details/log. Critical information to be recorded for each well includes measurements of the lengths of the well screen and casing, the depths to the bottom of the hole and to the top of the filter pack land transition seals, and the types of materials used. These details must be accurate as they form the basis for subsequent well design, development, and monitoring activities. The well construction graphics shall be used to sketch the well completion, and shall also be used when the attachments are converted to an electronic format.

6.6.4. Well Development Record

The geologist/engineer shall record the nature and timing of development activities including: techniques used; duration; volumes of water discharged from the well; and turbidity measurements. The recommended measurements of pH, temperature, electrical conductivity, turbidity, and dissolved oxygen may also be recorded on the Well Development Form.

6.6.5. Deliverables to the Well Permitting Agency

The geologist/engineer is responsible for submitting well documentation specified in the well permit to the permitting agency within the time frame stated on the permit. Prior to submitting this documentation, it shall be provided to the registered geologist or engineer that signed the well permit application for his/her review.

6.7. Field Form Checking

The project manager will assign a geologist/engineer who is not involved in the site-specific fieldwork to check the completed field forms for technical adequacy and conformance to this SOP. Any subsequent editing of the completed field forms shall be done on copies. The editor shall sign the log copy and indicate the date of any edits made.

## 7.0 ATTACHMENTS

A Well Construction Details/Log: Aboveground Surface Completion

B Well Construction Details/Log: Belowground Surface Completion

C Well Construction Graphics

D Well Development Form

## 8.0 REVISION HISTORY

| REVISION | SECTION/FORM | REVISION DESCRIPTION | DATE |
|---|---|---|---|
| - | - | Initial Release | |

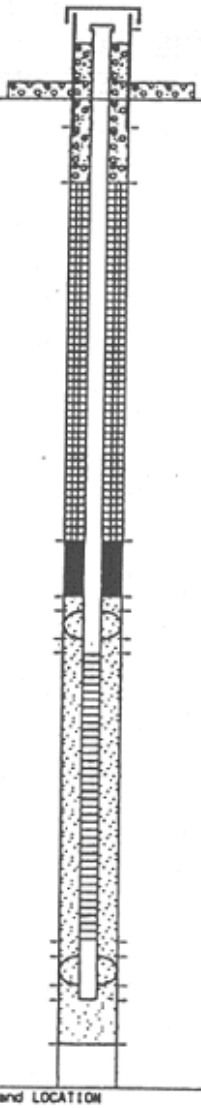
## ATTACHMENT A

## Well Construction Details/Log: Aboveground Surface Completion

## Well Construction Details/Log: Aboveground Surface Completion

| WELL CONSTRUCTION DETAILS | PROJECT and JOB NUMBER | | HOLE NO. | |
|---|---|---|---|---|
| | SITE and LOCATION | | SHEET NO. 1 OF 1 / HOLE SIZE | BEGUN |
| DRILLER / DRILLING METHOD | COORDINATES | LOGGED BY: | TD OF WELL | COMPLETED |
| ELEV.: TOP of RISER CASING / GROUND / | GROUND WATER DEPTH / ELEVATION ∇ / | CHECKED BY: | TD of HOLE | UPDATE |

(Template: AWELL)

| Well Construction Details | Depth in Feet | Well Graphics | Elevation in Feet | Graphics | Geologic Description and Classification |
|---|---|---|---|---|---|
| SURFACE COMPLETION<br>Dia. & Type:<br>Bottom Depth = ___.__ft.<br>CONDUCTOR CASING<br>Dia. & Type:<br>Bottom Depth = ___.__ft.<br>GROUT SEAL<br>Type:<br>RISER CASING<br>Dia. & Type:<br>CENTRALIZERS (above screen)<br>Depths = ___.__, ___.__ft.<br>BENTONITE SEAL<br>Top of Seal = ___.__ft.<br>Type:<br>FILTER PACK<br>Top of Filter Pack = ___.__ft.<br>Type:<br>SCREEN<br>Top of Screen = ___.__ft.<br>Dia. & Type:<br>Slot Size & Type:<br>Bottom of Screen = ___.__ft.<br>CENTRALIZER (below screen)<br>Depth = ___.__ft.<br>SUMP<br>Dia. & Type:<br>Bottom of Sump = ___.__ft. | |  | | | |

| See key for graphic symbols. | SITE and LOCATION | HOLE NO. |
|---|---|---|

## ATTACHMENT B

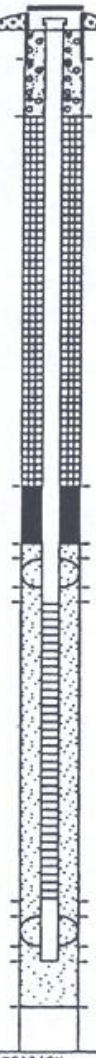
## Well Construction Details/Log: Belowground Surface Completion

## Well Construction Details/Log: Belowground Surface Completion

| WELL CONSTRUCTION DETAILS | PROJECT and JOB NUMBER | | HOLE NO. | |
|---|---|---|---|---|
| | | | SHEET NO. 1 OF 1 | |
| | SITE and LOCATION | | HOLE SIZE | BEGUN |
| DRILLER / DRILLING METHOD | COORDINATES | LOGGED BY: | TD OF WELL | COMPLETED |
| ELEV.: TOP of RISER CASING / GROUND / | GROUND WATER DEPTH / ELEVATION ∇ / | CHECKED BY: | TD of HOLE | UPDATE |

(Template: BWELL)

| Well Construction Details | Well Graphics: Depth in Feet | Well Graphics: Elevation in Feet | Graphics | Geologic Description and Classification |
|---|---|---|---|---|
| SURFACE COMPLETION<br>Dia. & Type:<br>Bottom Depth = ___.__ft. | | | | |
| CONDUCTOR CASING<br>Dia. & Type:<br>Bottom Depth = ___.__ft. | | | | |
| GROUT SEAL<br>Type: | | | | |
| RISER CASING<br>Dia. & Type: | | | | |
| CENTRALIZERS (above screen)<br>Depths = ___.__, ___.__ft. | | | | |
| BENTONITE SEAL<br>Top of Seal = ___.__ft.<br>Type: | | | | |
| FILTER PACK<br>Top of Filter Pack = ___.__ft.<br>Type: | | | | |
| SCREEN<br>Top of Screen = ___.__ft.<br>Dia. & Type:<br>Slot Size & Type:<br>Bottom of Screen = ___.__ft. | | | | |
| CENTRALIZER (below screen)<br>Depth = ___.__ft. | | | | |
| SUMP<br>Dia. & Type:<br>Bottom of Sump = ___.__ft. | | | | |

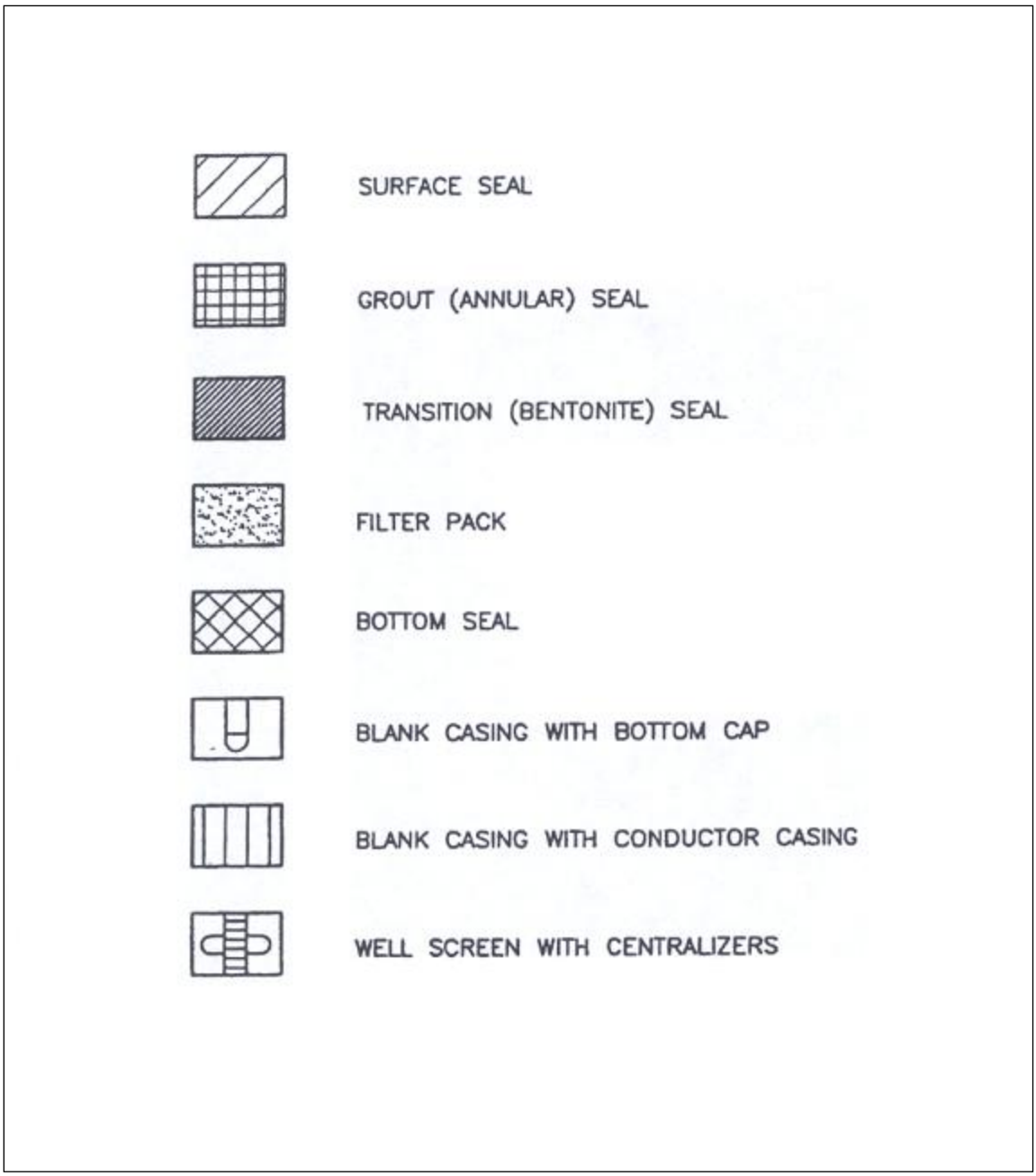


| See key for graphic symbols. | SITE and LOCATION | HOLE NO. |
|---|---|---|

## ATTACHMENT C

## Well Construction Graphics

## Well Construction Graphics



**ATTACHMENT D**

## Well Development Form

## Well Development Form

**WELL DEVELOPMENT**

PROJECT:

WELL NO.:

JOB NO.:

SITE:

PREPARED BY

Name:_____

Signature:_____

DEVELOPMENT CRITERIA:

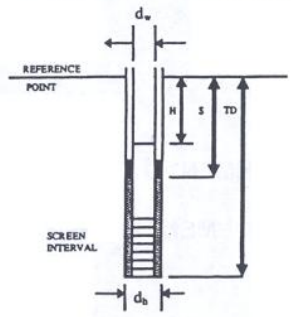
CHECKED BY

Name:_____

Signature:_____

REMARKS:

| | | | |
|---|---|---|---|
| BOREHOLE DIAMETER | $d_h$ | = | ____ feet |
| WELL CASING: | | | |
| INSIDE DIAMETER | $d_w$ID | = | ____ feet |
| OUTSIDE DIAMETER | $d_w$OD | = | ____ feet |
| REFERENCE POINT: | TOC | | |
| DEPTH TO: | | | |
| WATER LEVEL | H | = | ____ feet |
| BASE OF SEAL | S | = | ____ feet |
| TOP OF SCREEN | | = | ____ feet |
| BASE OF SCREEN | | = | ____ feet |
| BASE OF WELL | TD | = | ____ feet |
| ESTIMATED FILTER PACK POROSITY | P | = | ____ % |




**WELL VOLUME CALCULATION**

CASING VOLUME (Vc)

$$V_C = \pi \left(\frac{d_w ID}{2}\right)^2 (TD - H) = ___ ft^3$$

FILTER PACK PORE VOLUME ($V_F$)

$$V_F = \pi \left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - S \text{ or } H)(P) = ___ ft^3$$

(IF S < H, USE H. IF S > H, USE S)

TOTAL WELL VOLUME (VT)

$$VT = VC + VF = ___ ft^3$$

$$ft^3 \times \frac{7.48 \text{ gallons}}{ft} = ___ \text{ gallons}$$

| DEVELOPMENT LOG | | | | | CUMULATIVE TOTAL REMOVED | | WATER QUALITY PARAMETERS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time Begun | Time Finished | Method | Water Removed | Gallons per Liter | Well Volumes | Turbidity (Visual or NTU) | pH | Temperature (°F) | Electrical Conductivity (µmhos) | Dissolved Oxygen (% or mg/L) | COMMENTS |
| | | | | | | | | | | | | |
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## 1.0 SIGNATURE AUTHORITY

| TITLE | NAME | SIGNATURE |
|---|---|---|
| Quality Control Manager | Yu Zeng | |
| Sr. Technical Manager | Rod Reeve | |
| Program Manager | Max Pan | |

## 2.0 PURPOSE

The primary objective of a groundwater-sampling event is to obtain accurate water quality data representative of the groundwater being monitored at the time of the collection. The purpose of this Accord Engineering, Inc. (AEI) standard operating procedure (SOP) is to direct the proper collection of groundwater samples through adherence to a site-specific sampling analysis plan (SAP) and implementation of quality assurance/quality control (QA/QC) measures.

## 3.0 SCOPE

This procedure is intended for use by field samplers in association with hydrogeologic/hazardous waste field investigations. It applies to the collection and handling of groundwater samples from monitoring wells. It addresses the specific activities to be performed prior to going to the field and upon arrival at each sampling location. This procedure also explains the process of groundwater sample collection, preparation or collection of QA/QC samples, and sampling event documentation.

Sample containers and preservatives for water samples are described in SOP F10-004 (Sample Containers, Preservation, and Handling). The project specific SAP presents sample numbering protocols. Chain-of-custody protocols for sample shipment to analytical laboratories are provided in SOP F10-005 (Sample Custody Transfer and Shipment).

## 4.0 REFERENCE MATERIALS

| DOC. NO. | TITLE |
|---|---|
| NA | Glossary |
| SOP F10-001 | Logbook Protocols |
| SOP F10-002 | Instrument Calibration and Use |
| SOP F10-004 | Sample Containers, Preservation, and Handling |
| SOP F10-005 | Sample Custody, Transfer, and Shipment |

| DOC. NO. | TITLE |
|---|---|
| SOP F40-001 | Water and Free Product Level Measurement in Wells |
| NFESC 1996 | Navy Installation Restoration Laboratory Quality Assurance Guide, Naval Facilities Engineering Service Center (NFESC). 1996. Interim Guidance Document. February. |
| NFESC 1999 | Naval Facilities Engineering Command (NAVFAC), Navy Installation Restoration Chemical Data Quality Manual (IR CDQM), Naval Facilities Engineering Service Center (NFESC), September 1999. |
| NFESC 2006 | Naval Facilities Engineering Command (NAVFAC), Navy Environmental Work/ Institution, NFESC 19 April 2006. |

## 5.0 DEFINITIONS

**Aliquot** - A portion of a solution or sample.

**Analyte** - A chemical component of a sample to be determined or measured.

**Analytical (or Testing) method** - A specification for sample preparation and instrumentation procedures or steps that must be performed to estimate the quantity of analyte in a sample.

**Bladder pump** - A stainless steel housing, a flexible membrane (i.e., the bladder) enclosed by the housing, and a screen that filters out materials that might clog check valves located above and below the bladder. Water enters the bladder through the lower check valve, while compressed gas (air) is injected at regulated intervals into the cavity between the housing and bladder. The bladder expands and contracts with air intake and escape, forcing the water to move through the upper check valve and into the discharge line to the wellhead; the upper check valve prevents back-flow into the bladder.

**Dissolved Metals** - Metals that can pass through a 0.45-micron filter in an undigested medium.

**Duplicate** -Two samples collected from a single location that have been designated for identical handling and testing. The purpose of taking these samples is to determine if the sampling procedure or the water source produces samples of a similar quality.

**Equipment Rinsate Blank** - The final distilled water rinse from equipment decontamination procedures. This procedure is performed when equipment is being field-cleaned or before a particularly critical well is to be sampled when it is desirable to assure that no foreign materials have been introduced into the well.

**Field Pour Blank** - Distilled water that is poured into a sample bottle at a sampling station to evaluate potential contamination from ambient air conditions (e.g., a volatile organic blank at a refinery area where ambient organic chemicals could contaminate well water that is being collected at that point, or a metals pour blank in an area where there is a high concentration of fugitive dust).

**Matrix Spike** - An aliquot sample with known quantities of compounds that is mixed with a field sample and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. This procedure is performed by the laboratory.

**Matrix Spike Duplicate** - A second aliquot of the same compounds as the matrix spike that is spiked into a duplicate field sample in order to verify the precision and accuracy of the results of the matrix spike. This procedure is performed by the laboratory.

**Peristaltic pump** - A series of dividers or vanes fitted into a slotted rotor. When rotated, these vanes move radially to conform to the contour of the pump housing such that, due to the creation of a partial vacuum, water is pushed from the pump in a continuous flow ahead of the vanes. This pump is not recommended for samples being collected for organic analysis.

**Replicate** - A laboratory term used to designate iterative testing of the same sample to determine laboratory precision and accuracy.

**Spike** - A known amount of specific chemical constituent added by the laboratory to selected samples to test the appropriateness and recovery efficiencies of specific analytical methods within the actual sample matrices.

**Split** - A sample collected from a single location that has been divided into two portions designated for identical handling and testing. This is different from the duplicate, as the test here is to determine laboratory precision and accuracy. Note: splits are homogenous or made to be homogenous; duplicates are not.

**Static Water Level** - The water level of a well that occurs when no water is withdrawn or added to the well.

**Submersible pump** - A bowl assembly over an electric motor that is submersible. Water enters through an intake screen between the motor and the bowl assemblies, passes through the stages, and is discharged directly through the pump column to the wellhead.

**Trip Blank** - An aliquot of distilled water poured into a decontaminated sample bottle by the laboratory prior to a sampling event. It is exposed to the same trip environment as the field sample container and other similar sample containers and is analyzed to evaluate background or ambient conditions and/or handling procedures that may affect the results. Trip blanks also can be assembled at the sample staging area (i.e., they do not have to originate at the laboratory).

## 6.0 PROCEDURE

This SOP addresses the specific activities to be performed to accomplish a groundwater sampling event. The SOP includes a review of the SAP preparation of a delivery order for analytical laboratory services, procurement of equipment and supplies, field inspection of wells to be sampled, well water-level measurement, well purging and measurement of field parameters, groundwater sample collection, and field documentation requirements.

### 6.1. Preparation for Groundwater Sampling from Wells

#### 6.1.1. Review of Field Sampling Plan

In preparation for a groundwater-sampling event at a given site, the field sampler shall review the site SAP to obtain the following information:

- the identification number(s) of the well(s) to be sampled,

- the locations of the wells,
- well location access requirements (e.g., permission of owner, locked gates, road conditions),
- the field and analytical parameters to be tested,
- the type and number of sample containers needed,
- volume of sample required for analysis,
- the type and number of QA/QC samples to be collected (e.g., duplicates, splits, and blanks), and
- the type of equipment needed for the scheduled sampling activity.

A copy of the SAP shall be taken to the field that will include a well location map. Copies of well completion diagrams and specifications shall be obtained for field reference as well as any available, previously obtained, well water level data for the wells to be sampled.

Field information and data obtained during the sampling event shall be recorded in accordance with SOP F10-001, Logbook Protocols in a logbook that is dedicated to the project. A Well Sampling Record (WSR) form or forms (Attachment A) shall be prepared to record the required information for the well sampling event.

*6.1.2.* Procurement of Analytical Laboratory Services

A subcontract work authorization for laboratory analytical services shall be prepared and submitted to the laboratory that specifies the sample media, number of samples, pay item numbers, and analytical parameters to be tested. The analytical laboratory, in accordance with the sampling schedule and the sample volume requirements, will provide sample containers, preservatives, and trip blanks as requested by the project manager or laboratory coordinator.

6.1.3. Equipment and Supplies

Planning for a sampling event entails assessing, selecting, and assembling the types of equipment, instruments, and supplies necessary to perform the scope of work. Prior to going to the field, instrumentation shall be assembled, calibrated (if applicable), and tested (procedures for instrument calibration are addressed in SOP F10-002: Instrument Calibration and Use). Listed below are the basic types of equipment, instruments, and supplies used for groundwater sampling from wells:

- instrument for measuring organic vapor concentrations (photoionization detector (PID) or organic vapor analyzer (OVA)/flame ionization detector (FID»,
- water-level indicator (e.g., electrical conductivity meter) and intercept probe or clear bailer if two-phase system is possible,
- Teflon or stainless steel bailer for purging and/or sampling wells and sufficient wire or line to lower bailers into the wells,
- pump for purging and/or sampling wells,
- containers (e.g., drums and/or Baker tanks) for purged well water that have capacity marked so amount of bailed or pumped water can be determined,
- measuring tape,

- sample containers and preservatives supplied by the laboratory,
- pH/conductivity/temperature meter(s), and extra batteries,
- turbidity and/or dissolved oxygen meters (optional),
- filtration equipment and 0.45-micron filters (if tests for dissolved metals are required),
- coolers and cooling agents (e.g., ice, blue ice),
- filament or duct tape for sealing coolers for shipment,
- decontamination supplies, including a plastic tarp, buckets, brushes, etc.
- calculator,
- keys to well protective casings,
- logbook,
- field sampling and field instrument calibration WSR forms, and
- chain-of-custody forms, sample labels, and custody seals (SOP F10-005).

Selection of the type(s) of purging and sampling devices (e.g., bailers and/or pumps) to be used for the sampling event shall be made during field preparations (if not already specified in the SAP). Bailers may be used if the wells to be purged and sampled are less than 40 feet deep and 4 inches or less in diameter. Pumps are generally used for larger, deeper wells. Low-flow bladder pumps or piston pumps, both of which require an air compressor to operate, may be used for purging and sampling wells where depth of water is less than approximately 100 feet below ground surface. Bladder pumps are recommended for sampling where water quality has been impaired by volatile organic compound (VOC) contamination. Stainless steel, low-flow, submersible, centrifugal pumps are used for purging wells in which water levels are more than 25 feet below ground surface. Submersible centrifugal pumps will require an electrical hookup or a gasoline- or diesel-powered generator to operate. Both pumps require sufficient lengths of polypropylene or polyethylene discharge hose to convey purge water to temporary storage containers (such as 55-gallon drums, roll-off bins, water buffaloes, or Baker tanks). Peristaltic pumps can be used to purge wells that are less than 25 feet deep. They are not generally employed for organic sampling.

6.1.4. Well Inspection

Prior to sampling a given well, its condition shall be inspected and recorded in the logbook. Any signs of vandalism, unauthorized entry or settlement and/or ponding around the well surface completion shall be noted in the logbook, along with the well identification number and the date.

The well protective casing shall then be unlocked and the well cap removed to allow the well to vent for approximately 2 minutes. As the well is uncapped, the potential evolution of any organic vapors or combustible gases (e.g., methane) from the well shall be tested using an organic vapor detector (e.g., PID or OVA/FID). The concentration, if any, of gaseous well emissions shall be recorded in parts per million (ppm) in the field logbook. In the event that no emissions are detected at the wellhead, a "0 ppm" measurement shall be recorded.

6.1.5. Water-Level Measurement

A water-level indicator (e.g., electrical conductivity meter or similar device) shall be used to sound the total depth of the well. Any discrepancy between the well total depth compared to the well specifications shall be noted in the logbook. Such a discrepancy may indicate the presence of a possible obstruction or break in the casing or sedimentation at the bottom of the well.

The depth to water shall be measured from the well top-of-casing reference point in accordance with SOP F40-001, Water and Free Product Level Measurement in Wells. The water level shall be recorded in the logbook to the nearest 0.01 feet, along with the time of day when the measurement was obtained and the weather conditions. If free product is encountered during the water-level measurement, an intercept probe or clear bailer shall be used to measure the depth to the top of the free product and the depth to water (SOP F40-001).

The water-level measurement shall be compared to the most recent water-level measurement obtained for the well (if any). If the measurements differ by more than 0.5 feet, the depth to water shall be measured a second time for verification purposes (the water level probe shall be dry before another measurement is obtained). A notation shall be made in the logbook if a probable cause for the discrepancy is known (e.g., tidal fluctuation, rainfall event, start-up of a nearby pumping well etc.).

6.1.6. Preparation for Well Purging

Purging (i.e., removing several casing volumes of groundwater from a well, including the volume of water contained in the filter pack) shall be performed prior to sampling to assure that the water sampled is representative of water in the formation being monitored. It is important to purge a sufficient volume of water from the well to yield representative samples, but not to over purge such that water from any nearby surface water features (e.g., streams, ponds), or groundwater contaminant plumes, is drawn into the well. In order to assure that an appropriate amount of water is purged from the well prior to sampling, its borehole volume must be calculated.

Using the well total depth, length of sand pack, and depth-to-water measurements, along with the measured internal diameter of the well casing (measured in tenths of a foot) and the nominal diameter of the boring for the sand pack, the borehole volume M of the casing can be determined. The bore-hole volume can be calculated using the following formula:

- $V = [\pi r_1^2 (h_1 + h_2) + \pi (r_2^2 - r_1^2) \rho h_2] \times 7.481 \text{ gal/ft}^3$

  Where:

  $r_1$ = radius of the casing, in feet

  $r_2$ = radius of borehole, in feet

  $h_1$ = height of water in the well above filter pack, in feet

  $h_2$ = length of filter pack

$\rho$ = estimated porosity of the filter pack

$\pi$ = 3.142

The calculated (V) shall be recorded in the logbook.

6.1.7. Well Purging

Depending on the depth of the well and the volume of water to be removed, the well can be purged using either a bailer or a pump. If low-flow (minimal drawdown) purging is being conducted, the use of a bailer is not appropriate (see Section 6.3).

Purging is necessary to remove stagnant water in the casing that may have assumed different water quality characteristics due to interaction with the casing, or filter pack and/or changes in conditions (e.g., higher temperatures and/or dissolved oxygen levels).

6.1.7.1. Bailing Purge Water

Purging of groundwater from small-diameter, shallow wells (i.e., wells 2 to 4 inches in diameter) that are installed to a maximum depth of 40 feet below ground surface, and that contain a column of water less than 20 feet in height, can be performed by bailing. A polyethylene, stainless steel, or Teflon, single- or dual-check valve bailer shall be used for bailing groundwater-monitoring wells.

Prior to bailing a well, a clean length of monofilament nylon or polyethylene shall be attached to a decontaminated bailer that is of sufficient length to reach the bottom of the well. The other end of the cord shall be attached to a fixed feature (e.g., the well protective casing) to prevent the possible loss of the bailer down the well. Alternatively, the cord may be secured and wrapped around a reel to facilitate raising and lowering the bailer during the purging effort.

Bailing of a well shall be initiated by slowly lowering the bailer into the well water column and allowing it to fill. The groundwater evacuated from the well during the initial bailing run shall then be tested for the field water quality parameters (Section 6.1.7.3). Field parameter measurements shall be recorded in the logbook. The well discharge in the bailer shall then be poured into a container with capacity markings so that the amount of water removed can be calculated easily. This water shall then be transferred to a Department of Transportation approved 55-gallon drum. The well shall be bailed repeatedly until three to five well volumes have been discharged and the field parameter measurements have stabilized. The analytical test results received from the laboratory may also be utilized to evaluate disposal options. If the field parameters have not stabilized after five volumes, the well shall be sampled anyway.

The purge water collected in one or more 55-gallon drums shall be secured with ringed lids, and its contents shall be properly labeled. Alternatively, the purge water may be pumped into a Baker tank for temporary, on-site storage.

Purged groundwater in the temporary storage containers shall be tested and analyzed to evaluate disposal options in accordance with the site waste management plan. The analytical test results from the laboratory may also be utilized to evaluate disposal options. If there is prior knowledge of the potential for encountering contaminated water, it may be possible to segregate potentially uncontaminated wells from contaminated ones to minimize disposal costs.

6.1.7.2. Pumping Purge Water

- Groundwater purging at monitoring wells will be conducted using the low-flow purge/sampling method (USEPA/QAD023, October 1997). Disposable nitrile gloves will be worn during all purging and sampling activities. Nitrile gloves will be disposed of after purging activities, and a new pair will be worn before sampling each well to avoid possible cross-contamination.
- The location of the well screen interval will be determined from the well construction logs. The stainless steel bladder pump inlet will be lowered into the well to the midpoint of the screen interval. Record the depth of the pump inlet on the well sampling form.
- Connect the pump discharge tubing to the water quality meter flow-through cell. The discharge tubing from the top end of the flow-through cell should be directed to a 5-gallon bucket to collect the groundwater during purging activities.
- Connect the air inlet hose to the pump control box.
- Personnel should start pumping the well at 0.1 to 0.3 liters (100 to 300 milliliters) per minute Check the water level in the well, and measure the discharge rate of the pump by using a graduated cylinder and stopwatch every minute for the first 5 minutes. Measure and record the water level, discharge rate, and water quality indicator parameters in the well on the Well Sampling Form every 3 to 5 minutes during purging.
- During purging activities, check the discharge tubing for air bubbles. If bubble(s) exist, move the tubing where the bubble is to enable the bubble to pass through the tubing and into the flow-through cell.
- During the well purging, a minimum volume of water (volume of the water in the pump and the flow-through cell) must be purged before recording the water quality indicator parameters. During purging, monitor pH, temperature, specific conductance, oxidation/reduction potential (ORP), and dissolved oxygen (DO) approximately every 3 to 5 minutes with a calibrated water quality meter. The water quality meter will be calibrated to the manufacturer's specifications using current (un-expired) standards. A 2-point calibration procedure will be conducted

on each water quality meter, as appropriate. A flow-through cell will be used to monitor the water quality indicator parameters.

6.1.7.3. Measurement of Field Parameters during Well Purging

The groundwater should be purged until indicator parameters have stabilized. The well will be considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings, as follows:

√ Consecutive readings within ± 0.1 standard units for pH;

√ Consecutive readings within ± 1 degree Celsius (°C) for temperature;

√ Consecutive readings within ± 3 percent microhms per centimeter (μohms/cm) for specific conductance;

√ Consecutive readings within ± 10 millivolts for oxidation reduction potential (ORP); and

√ Consecutive readings within ± 0.3 for DO (milligrams per liter [mg/l]).

A well in which the static water level is slow to recover shall be allowed to recover to 80 percent of the static water level. If over 2 hours are required for the well to recover from the purging effort, the well shall be purged to dryness again. A sample shall be collected as soon as the well has recovered to 80 percent regardless of the volume of water purged.

6.2. Groundwater Sample Collection from Wells

During a scheduled sampling event, groundwater samples shall be collected first from wells that are least likely to be contaminated. The most heavily contaminated wells shall be sampled last. Sampling wells in this order will reduce the possibility of cross-contamination between wells.

Once the field-parameter have stabilized, discard gloves worn during purging activities, put on a new pair of nitrile gloves. Remove the discharge tubing from the bottom of the water-quality meter flow-through cell and collect the samples directly from the end of the discharge tubing.

The pump tubing has to be completely full of groundwater (no bubbles) to prevent the groundwater from being aerated as it flows through the tubing. Tubing should not touch vials or bottles during sampling.

Sample wells for analytes in the following sequence:

- Volatiles
- Semi-volatiles
- Pesticides/PCBs
- Other Organics (BTEX, TPH)
- Water Quality (wet chemistry ) parameters
- Inorganics
- Metals (filtered)

Fill each laboratory supplied container (VOA vials, 1 liter ambers, and polyethylene bottles). VOA vials should be filled until a positive meniscus is formed at the top. After the containers are full, cap immediately. VOA vial should be inverted then taped on the side lightly to check for the presence of air bubbles. If air bubbles are present, discard the sample, and resample using a new vial.

Collect the required volume of groundwater for field analytical methods (i.e. ferrous iron, hydrogen sulfide, and dissolved oxygen) as applicable.

Immediately after sample collection, bottles are filled and capped. Dry the outside of bottles with a clean paper towel. Affix completed label on all sample bottles. If label is wet, re-label bottle with new label. Place a piece of packaging tape over the filled-out label on the bottle to protect the label from moisture during shipping. Record the sample ID on the Well Sampling sheet and COC forms. Wrap glass bottles in bubble-wrap packaging material and place specific bottles per analysis into individual re-sealable bags. Seal the bags and place them into a cooler containing ice.

Carefully remove bladder pump from the well.

Close and lock the well.

If a Teflon, polyethylene or stainless steel, single- or dual-check valve bailer is used for sampling; it shall be slowly and repeatedly lowered into the well until sufficient sample has been obtained to meet the volume requirements for the analytes to be tested. The bailer shall be raised with a smooth action that avoids contact with the casing walls or other agitation. The sample may be poured into the container from the top of the bailer or through a discharge port attached to the bottom of the bailer. If the sample is collected with a bladder pump or a submersible pump, the discharge rate may be adjusted slightly and the sample may be collected directly into the sample container. When a pump is used, U.S. EPA recommends that volatile organic samples be collected at a rate of less than 0.1 liter per minute.

6.2.1. Sample Containers and Preservatives

Requirements for groundwater sample containers, preservation requirements, and holding times are addressed in SOP F10-004 (Sample Containers, Preservation, and Handling). Additional requirements for groundwater samples designated for analysis of VOCs and metals are presented below.

Groundwater samples designated to be tested for VOCs and/or total organic halogens (TOX) shall be collected in 40 milliliter (mL), volatile organic analysis (VOA) vials. The vials shall be filled until a convex meniscus forms at the top of each vial, then capped with a Teflon-lined cap with no headspace left. Each VOA vial shall then be inverted and tapped to check for air bubbles. If either bubbles or headspace is observed, the vial shall be discarded and the sample re-collected and again checked for zero headspace and air bubbles. If acceptable, the sample VOA vials shall then be stored immediately inside a cooler at a temperature of less than or equal to 6 degrees Celsius.

Samples to be submitted for dissolved metals analysis may require field filtration prior to transfer or shipment to the laboratory. In this case, sufficient sample shall be

collected in a decontaminated bucket or other suitable container from which the water may be pumped through a filter and into the appropriate (pre-preserved sample) container. A peristaltic pump shall be used for filtering along with disposable tubing and an in-line disposable cartridge with a 0.45-micron pore-diameter filter. Approximately 200 mL of discharge water shall be flushed through the filter prior to collecting the sample. The filter shall be replaced when flow of water through the filter is impaired.

6.2.2. Quality Control Samples

For each sampling event, additional samples are required for QA/QC purposes. In accordance with NFESC (1996), QA/QC samples shall be collected and handled at the same time and in the same manner as the other groundwater samples collected.

6.2.2.1. Field Blanks

Field blanks shall be prepared in the field. The field blank shall be prepared by pouring analyte-free water into a decontaminated sample jar at the station of interest. The field blank shall then be sealed and handled in accordance with SOP F10-004.

6.2.2.2. Trip Blanks

Trip blank samples generally shall be prepared by the analytical laboratory prior to the sampling event and shall be used whenever samples are designated for analysis of VOCs. They can however, be prepared as part of a sampling event in the field. Trip blanks shall be prepared with demonstrated analyte-free water and shall be kept with the samples collected during the sampling event. The trip blanks shall be sealed in 40-mL glass VOA vials with Teflon-lined septum caps, and shall be completely filled (i.e., leaving no headspace). The trip blanks shall be submitted to the laboratory with each cooler that contains samples for analysis of VOCs.

6.2.2.3. Equipment Rinsate Blanks

An equipment rinsate blank shall be prepared by the field sampler using demonstrated analyte-free water that has been poured into and over, and/or pumped through decontaminated sampling equipment (excluding disposable or dedicated equipment), including non-dedicated pumps and tubing, and filtration devices used during a groundwater-sampling event. A blank shall be obtained at least once daily. The rinsate blank shall be analyzed for all analytes specified in the site-specific SAP for the station at which it was collected. If the blank is a general check, then it shall be analyzed for all analytes of concern.

6.2.2.4. Duplicates

Duplicate samples shall be collected at a frequency of at least 10 percent, or a minimum of 1 per 10 samples collected. The duplicates shall be designated for

analysis by the same testing methods for the same analytes as the original samples. Duplicates shall be submitted to the analytical laboratory in the blind.

6.2.2.5. Matrix Spike/Matrix Spike Duplicate

A matrix spike (MS)/matrix spike duplicate (MSD) blank shall be collected by the field sampler during the sampling event and shall consist of a triple volume of groundwater sample that is collected in three separate containers from one well during a sampling event. After the MS/MSD samples have been submitted to the analytical laboratory, the laboratory shall spike the MS/MSD samples. MS/MSDs shall be collected at a frequency of at least 5 percent or one every two weeks or as specified in the site-specific SAP. Collection of MS and MSD samples is not required for equipment rinsate blanks.

6.2.3. Sample Documentation

The appropriate sample custody documentation shall be completed in accordance with SOP F10-005, Sample Custody, Transfer, and Shipment. All entries on the chain-of-custody form shall be entered using indelible ink. Any errors shall be lined out with a single line, and then initialed and dated. All chain-of-custody forms shall be signed and all applicable blocks shall have entries. Unused blocks or spaces shall be marked with a "N/A" (not applicable) or shall be lined out.

6.2.3.1. Well Sampling Record

The groundwater samples collected from each well shall be identified in the field logbook along with the QA/QC samples prepared or collected. The field sampler shall be responsible for completing the WSR and other logbook entries. The logbook shall be submitted to the Project Manager for review in accordance with SOP F10-001, Logbook Protocols.

6.3. Low-Flow (Minimal Drawdown) Ground Water Sampling

Under certain conditions, the common ground water purging and sampling methodology of well purging by use of bailers or high-speed pumps can cause adverse impacts on turbidity levels. This, in turn, can compromise analytical results. Selection of low-flow purging and sampling techniques (U. S. EPA 1997) can diminish these adverse effects.

The collection of representative groundwater samples is limited primarily due to:

- mixing of stagnant casing and fresh screen waters during sampling or groundwater level measuring device insertion
- increased turbidity due to disturbance and re-suspension of settled solids as the result of too high pumping rates or inappropriate use of pumps or bailers;
- introduction of atmospheric gases or degassing from groundwater during purging and sampling operations.

6.3.1. Sampling Recommendations

Low-flow pumps that pump at a rate of 0.1 to 0.5 liter per minute (L/min) shall be used for pumping and sampling for all analyses. Bailers are inappropriate for low-flow groundwater sampling.

Whether using portable or dedicated systems, this method shall be done using a pump intake set in the middle or slightly above the middle of the screened interval. If sampling is being done from an unconfined aquifer (screened across the water table), placement of the pump is recommended at the top of the water column or at the particular level of interest within the screened interval.

Use low-flow rates (less than 0.5 L/min) during both purging and sampling. This will minimize the well drawdown. Use tubing that is of maximum thickness and of minimum length. During water level measurements and installation of the sampling device to be used, minimize the disturbance of the water column above the screened interval. Stabilize the flow rates as quickly as possible and monitor the water quality indicators during purging. Unfiltered samples should be collected to estimate contaminant level and transport potential in the groundwater aquifer.

6.3.2. Equipment Calibration

All equipment shall be calibrated according to SOP F10-002 or as specified in the site-specific SAP.

6.3.3. Water-Level Measurement and Monitoring

Depth to water shall be measured as described in Section 6.1.5. If possible, obtain well depth from the well logs to avoid re-suspension of settled solids from the formation (which will necessitate longer purging times for stabilization of turbidity). Measure the well depth according to SOP F40-001, Water and Free Product Level Measurement in Wells.

6.3.4. Pump Type

A pump with a capability of low-flow rates (0.1 to 0.5 L/min) should be used for purging and sampling all analyte types. Avoid the use of bailers for low-flow (minimal drawdown) sampling. Various pump types include peristaltic pumps, bladder pumps, and electric submersible pumps. The pump should provide consistent results and minimal disturbance of the sample across low flow rates.

6.3.5. Pump Installation

If possible, use a dedicated system capable of pumping and sampling. Otherwise, install the pump slowly to the middle or slightly above the middle of the screened interval, thus minimizing mixing of stagnant casing water with formation water within the screened interval, and re-suspension of settled solids from the bottom of the well.

6.3.6. Filtration

Use 0.45-micron pore diameter filters to assess dissolved concentrations of major ions and trace metals. If significant particulate calcium carbonate is present, also filter samples when assessing alkalinity concentrations.

Be aware that filtration may inadvertently affect oxidation, aeration or other parameters during sample analysis, and cause uncertainty in results. Filtration guidelines should be established and followed, considering filter type, media, pore size, etc.

Use in-line filtration if possible. Pre-rinse filters according to manufacturer's recommendations. To avoid filter cake, pre-filtering with a larger pore size filter, or smaller sample volumes may be instrumental in avoiding reduction of the effective pore diameter of the membrane, excessive particle loads, and exclusion of particles smaller than the stated pore size.

6.3.7. Water-Level Monitoring and Water Quality Parameters

For low-flow (minimal drawdown) well purging, water level monitoring and water quality parameters should be monitored continuously (i.e., every 3 to 5 minutes when using a flow rate of 0.1 to 0.5 L/min). See section 6.1.7.2.

It is important to monitor drawdown in the well to ascertain the need for flow rate adjustment.

6.3.8. Sampling, Sample Containers, Preservation and Decontamination

Sample wells progressively from least to most contaminated, in the following sequence:

- Volatiles
- Semi-volatiles
- Pesticides/PCBs
- Other Organics (BTEX, TPH)
- Water Quality (wet chemistry) parameters
- Inorganics
- Metals (filtered)

Follow sampling, sample container, preservation and decontamination procedures as specified in Sections 6.2 above, in accordance with SOP F10-004, Sample Containers, Preservation, and Handling, and in accordance with the site-specific SAP.

6.3.9. Blanks

Follow the procedures as specified in Section 6.2.2, Quality Control Samples, above, and in accordance with the site-specific SAP.

## 7.0 ATTACHMENTS

A Well Sampling Record

## 8.0 REVISION HISTORY

| REVISION | SECTION/FORM | REVISION DESCRIPTION | DATE |
|---|---|---|---|
| - | - | Initial Release | |

## ATTACHMENT A

## Well Sampling Record

# WELL SAMPLING

PROJECT:
JOB NO.:

WELL NO.:
SITE:

PREPARED BY
Name: _____
Signature: _____

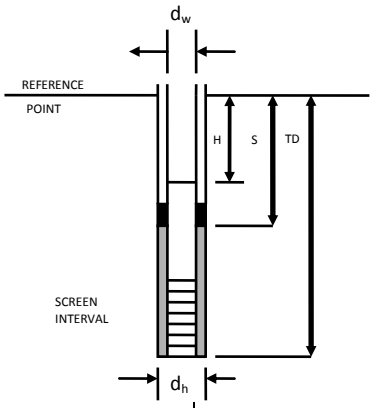
PURGING CRITERIA: **3 Borehole Volumes**

**GROUNDWATER QUALITY PARAMETER STABILIZATION CRITERIA:**
**PH ±0.1; CONDUCTIVITY ±3%; TURBIDITY or DISSOLVED OXYGEN ±10%**

CHECKED BY
Name: _____
Signature: _____

REMARKS (include depth of pump inlet, if applicable):
.

| | | | |
|---|---|---|---|
| BOREHOLE DIAMETER | $d_h$ | = | _____feet |
| WELL CASING: | | | |
| INSIDE DIAMETER | $d_w$ID | = | _____feet |
| OUTSIDE DIAMETER | $d_w$OD | = | _____feet |
| REFERENCE POINT: | TOC | | |
| DEPTH TO: | | | |
| WATER LEVEL | H | = | feet |
| BASE OF SEAL | S | = | feet |
| TOP OF SCREEN | | = | feet |
| BASE OF SCREEN | | = | feet |
| BASE OF WELL | TD | = | feet |
| ESTIMATED FILTER PACK POROSITY | P | = | % |




**WELL VOLUME CALCULATION**

CASING VOLUME ($V_C$)

$$V_C = \pi\left(\frac{d_w ID}{2}\right)^2 (TD - H) = ___ ft^3$$

FILTER PACK PORE VOLUME ($V_F$)

$$V_F = \pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - S \text{ or } H)(P) = ___ ft^3$$

(IF S < H, USE H. IF S > H, USE S)

TOTAL WELL VOLUME (VT)

$$VT = VC + VF = \quad ft^3$$

$$ft^3 \times \frac{7.48 \text{ gallons}}{ft} = \text{gallons}$$

| PURGE LOG | | | | | CUMULATIVE TOTAL REMOVED | | WATER QUALITY PARAMETERS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time Begun | Time Finished | GW Level | Water Removed | Gallons per Minute | Well Volumes | Turbidity (Visual or NTU) | pH | Temperature (°C) | Electrical Conductivity (mS/m) | Dissolved Oxygen (mg/L) | Salinity (%) | ORP |
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## 1.0 SIGNATURE AUTHORITY

| TITLE | NAME | SIGNATURE |
|---|---|---|
| Quality Control Manager | Yu Zeng | |
| Sr. Technical Manager | Rod Reeve | |
| Program Manager | Max Pan | |

## 2.0 PURPOSE

The purpose of this Accord Engineering, Inc. (AEI) standard operating procedure (SOP) is to identify the methods to be used for the measurement of water and free-product levels in wells and to provide standardized reporting formats for documentation of data.

## 3.0 SCOPE

This SOP is intended for use by personnel for the field acquisition and documentation of well water-level data, measured as the depth-to-water from a surveyed reference point elevation. Measurement and the reporting of the level of any free-product layer detected in a given well during monitoring activities is also addressed. Well water levels may be monitored continuously using electronic data loggers and pressure-sensitive transducers, or obtained manually, with a water-level indicator or steel surveyor tape, by a geologist/environmental engineer.

During a field investigation, well water-levels may be obtained in association with well development (SOP F20-003, Monitoring Well Installation and Development), purging and sampling (SOP F30-002, Groundwater Sampling), or aquifer testing activities. Successive measurements of well water levels over time in association with a long-term monitoring program may be used to assess seasonal and/or diurnal fluctuations, as well as the effects of any pumping wells on groundwater flow direction and gradient.

## 4.0 REFERENCE MATERIALS

| DOC. NO. | TITLE |
|---|---|
| NA | Glossary |
| SOP F10-001 | Logbook Protocols |
| SOP F10-003 | Decontamination of Equipment |
| SOP F20-003 | Monitoring Well Installation and Development |
| SOP F30-002 | Groundwater Sampling |

| DOC. NO. | TITLE |
|---|---|
| U.S. EPA 1986 | RCRA Groundwater Monitoring Technical Enforcement Document, OSWER-9950.1, September. |
| U.S. EPA 1987 | A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001: Washington, D.C. |
| NA | ASTM D 4750-87, 1988, Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well), January. |

## 5.0 DEFINITIONS

**Apparent thickness** - The calculated thickness of a free-product layer overlying groundwater is obtained by subtracting the depth measurement to water from the wells surveyed reference point elevation; the true free-product thickness (i.e., as measured in the formation) may differ from that calculated as a function of hydrogeologic conditions.

**Hydrograph** - A plot of well water-level elevation versus time.

**Immiscible fluid** - A fluid that is incapable of mixing or blending with water.

**Potentiometric surface** - The level to which water will rise in a cased well under atmospheric pressure conditions.

## 6.0 PROCEDURE

Water-level measurements in wells in which no immiscible components are detected shall be obtained manually using a two-conductor, battery-powered water-level indicator (e.g., electrical sounder or conductivity meter) or steel surveyor tape. Continuous water level measurements, made in association with aquifer testing activities or tidal influence studies, may be obtained using an electronic data logger (e.g., an In Situ Inc. Troll®, or equivalent device) and pressure transducers. Measurement of water and free product in wells shall be performed using an interface probe (e.g., Solinst interface probe or an equivalent device).

6.1. Preparation for Monitoring Well Water/Product Levels

In preparation for a well monitoring event, the geologist/environmental engineer shall review the site work plan to obtain the following information:

- the identification number(s) of the well or wells to be monitored,
- the locations of the wells as shown on a site map,
- records listing the most recent water-level measurement for the well(s) (if available),
- well access requirements (e.g., permission of owner, locked gates, road conditions),
- the types of equipment needed to perform the scheduled monitoring activity,
- calibration requirements for the equipment (if applicable), and

- health and safety considerations, as appropriate.

Preparation for the well monitoring event also includes the use of a hard-bound field logbook in accordance with SOP F10-001 (Logbook Protocols). One or more Water/Product Level Form(s) (Attachment A) for each monitoring well shall be utilized to document relevant data. Water-level measurements and supporting information (Section 6.3) shall be recorded on these forms in the field.

6.1.1. Review of Existing Data

The geologist/environmental engineer may elect to prepare a hydrograph with the water-level data available for each well (or update an existing hydrograph) prior to going to the field. A hydrograph provides a visual record of water-level fluctuations over time and is useful to identify any water-level measurements that appear anomalous due to changes in conditions (e.g., a water-level rise due to a rainfall event or events, a drop in water level due to initiation of pumping at a nearby well).

6.1.2. Equipment

Planning for a well water level monitoring event entails assessing, selecting, and testing the types of equipment and supplies necessary to perform the scope of work. Listed below are the basic types of equipment and supplies used for the measurement of water levels.

6.1.2.1. Manual Measurement

√ Water level indicator (two-wire electrical sounder or conductivity meter), equipped with a sufficient length of cable to reach the deepest anticipated water-level; the cable should be graduated into 0.01-foot intervals.

√ Interface probe, as needed per Section 6.3.2, equipped with a sufficient length of cable to reach the deepest anticipated water- level; the cable should be graduated into 0.01-foot intervals.

√ Teflon® bailer.

√ Extra batteries for the water level indicator.

√ Decontamination supplies (e.g., Alconox or other nonphosphate detergent, deionized or distilled water, brush, plastic bucket, clean spray bottles, paper towels, clean plastic sheeting) used for decontamination of the water-level indicator or interface probe and cable, as per SOP F10-003, Decontamination of Equipment.

√ Keys for locked protective casings.

√ Tools (e.g., wrenches), as needed, to enter wellheads.

6.1.2.2. Continuous Measurement

- √ Electronic data logger (with the appropriate number of channels, as a function of the number of wells to be monitored simultaneously).
- √ Water level indicator, (as described above).
- √ Pressure-sensitive transducers, including one barometric pressure transducer, that are compatible with both water quality and anticipated pressure-sensitivity range in a given well. Also, transducer cables graduated into 0.01-foot intervals-
- √ Decontamination supplies, (as described above).
- √ Keys for locked protective casings.
- √ Tools, as needed, to enter well heads.

6.2. Well Inspection

Prior to obtaining a water level in a given well, its condition shall be inspected. Any signs of vandalism, unauthorized entry, or settlement and/or ponding around the well surface completion shall be noted in the "Remarks" column of Attachment A.

6.3. Manual Water-Level Measurement

The procedures for manual water measurement in wells are presented below for wells in which no free product has been detected, and for wells in which free product is known to float on the water surface.

6.3.1. Water-Level Measurement

A water-level meter shall be used to measure the water level. The type of device used for water level measurement shall be noted in the "Remarks" column of Attachment A.

If a water-level indicator is used, the probe is to be lowered into the riser casing until water is encountered, as indicated by the instrument signal. The water level is then measured with respect to the "top-of-casing" reference point and entered on Attachment A. Two additional water level measurements shall be made per the manufacturer's instructions to verify the initial reading obtained.

6.3.2. Water Level/Free-Product Level Measurement

If free product is detected in a well as a floating layer over water, an interface probe shall be used to obtain the level of the free product and the underlying water level. An interface probe can detect a free product layer that is approximately 1/200-foot-thick or greater.

The cable of the instrument shall be slowly lowered into the well's riser casing until a signal occurs indicating the top of free product (the nature of the signal will vary according to manufacturer). The depth to the top of the product from the wells

surveyed reference point shall be recorded on Attachment A. The cable shall then continue to be lowered into the casing until the interface probe signal is observed or heard indicating that the water level has been reached. The depth-to-water indicated shall also be recorded on the form.

By subtracting the depth-to-water from the depth-to-product, the apparent thickness of the free product is calculated and recorded on Attachment A. The water-level elevation is calculated by subtracting the depth-to-water from the wells reference point elevation.

## 6.4. Continuous Water Level Measurement

Continuous water-level data may be required for certain field investigation activities such as aquifer testing and gauging tidal influence on well water levels. Electronic data loggers and transducers are typically used for continuous water-level measurement.

### 6.4.1. Equipment Installation

An electronic data logger may be installed in one well with one transducer cable or may be connected to additional transducer cables that simultaneously monitor up to 15 additional nearby wells (the maximum transducer cable length currently available from one manufacturer [In situ, Inc.] is 4,500 feet). Standard transducer cables are made of polyurethane and are available for rental or purchase; however, Teflon cables are also available for purchase. One of the transducers used should be a barometric pressure transducer; if a barometric pressure transducer is not available, a barograph may be used to gage changes in barometric pressure during the monitoring event that might impact water-level measurements.

The electronic data logger and transducer cables shall be installed by the geologist/environmental engineer in accordance with the manufacturer's instructions. The data logger may be placed near a well or mounted on a post (if mounted on a post, the data logger shall be housed in a protective cabinet). A transducer cable shall be lowered into each well to be monitored and secured with plastic tie strips to the riser casing or protective well casing. The cable shall be positioned such that it does not interfere with closing and locking of the wells protective casing; the cable shall be positioned such that it is not pinched. If transducer cables are extended over areas that are heavily trafficked or mowed, they should be buried in a 6-inch-deep trench or strung through small-diameter, polyvinyl chloride (PVC) casing for protection. If cables are buried, their respective locations shall be flagged with survey laths and colored surveyor tape.

### 6.4.2. Equipment Calibration

Pressure transducers are available which require no field calibration (e.g., In-Situ Inc. Troll 9500). If fluctuations in water levels are anticipated over a range of less than 23 feet, a transducer rated at 10 pounds per square inch (psi) is appropriate. If a greater range of water-level fluctuation is anticipated, the manufacturer's representative

should be consulted as to the transducer psi rating required. Periodic manual measurement of water levels shall be performed as a check on the water-level data recorded by a data logger.

6.5. Quality Assurance/Quality Control

To promote consistency of data, water-level measurements in a given well should be obtained with the same measuring device as used during previous monitoring events.

As a Quality Assurance/Quality Control (QA/QC) check on the accuracy of water- level indicator measurements, the water level in a well may be obtained using steel tape and Carpenter chalk. Measuring water levels with a steel tape graduated to 0.01-foot is considered the most accurate method for obtaining water levels. Measurement of the water level in which a free-product layer is present may be checked for accuracy, using steel tape and water-finding paste. As stated in Section 6.4.2, verification of data obtained with an electronic data logger shall be obtained by periodic (e.g., hourly, daily) manual water-level measurement.

## 7.0 RECORDS

The geologist/environmental engineer shall submit copies of water and/or water/product levels forms to the project manager immediately following the monitoring event for checking and revision purposes. The field logbook will be saved in the project file.

## 8.0 ATTACHMENTS

A Water-Level Measurements Form

B Water/Product-Level Measurements Form

## 9.0 REVISION HISTORY

| REVISION | SECTION/FORM | REVISION DESCRIPTION | DATE |
|---|---|---|---|
| - | - | Initial Release | |

**ATTACHMENT A**
**Water-Level Measurements Form**

# WATER-LEVEL MEASUREMENTS FORM

| Water-Level Measurements | Project and Job Number | Sheet No. |
|---|---|---|
| Facility | Site | Monitored By:<br>Checked By: |

| Well ID Number | Date/ Time | Instrument Serial Number | Calibrated By | Reference Point Elevation (feet) | Depth To Water (feet) | Water-Level Elevation (feet) | Remarks |
|---|---|---|---|---|---|---|---|
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**ATTACHMENT B**
**Water/Product-Level Measurements Form**

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## WATER/PRODUCT-LEVEL MEASUREMENTS FORM

| Water/Product Level Measurements | Project and Job Number: | Sheet No. |
|---|---|---|
| Facility | Site | Monitored By:<br>Checked By: |

| Well ID No. | Date/Time | Instrument Serial Number | Reference Point Elevation (feet) | Depth to Product (feet) | Apparent Product Thickness (feet) | Water Level Elevation (uncorrected) (feet) | Remarks |
|---|---|---|---|---|---|---|---|
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# STANDARD OPERATING PROCEDURE

## SOIL SAMPLING PROCEDURE FOR VOLATILE ORGANICS USING THE EnCore® SAMPLER

*SOP NUMBER: T-003*

*REVISION NUMBER: 03*

*REVISION DATE: September 30, 2009*

*REVIEW DATE: July 16, 2010*

*Prepared by: _____ September 30, 2009*
*Jason Williams* *Date*

*Approved by: _____ September 30, 2009*
*Jesse MacNeill - Quality Assurance Manager* *Date*

*Approved by: _____ September 30, 2009*
*Tim Shields - Program Manager* *Date*

3710 Ruffin Road
San Diego, CA 92123

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# RICHARD BRADY AND ASSOCIATES
# STANDARD OPERATING PROCEDURE

# SOIL SAMPLING PROCEDURE FOR VOLATILE ORGANICS USING THE En Core® SAMPLER

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) describes a procedure for collecting soil samples for volatile organic compounds (VOCs) using the En Core® Sampler. The outlined procedure is based on the EPA Method 5035 methodology presented in Update III of SW-846 promulgated in June 1997 and may be used in conjunction with analytical determinations of volatile organics including EPA Method 8015Modified (gasoline fraction only), 8021A, and 8260B.

EPA Method 5035 addresses four on-site handling options from which to select. This SOP focuses on the collection of soil samples for VOC analyses using a headspace-free, gas-tight sampler known as the En Core® Sampler. This SOP is not intended to replace thorough training and reading of reference materials

## 2.0 BACKGROUND

Collection and storage of soils for VOC analyses using previous EPA methodology (EPA Method 5030) has shown to be inadequate. The primary reasons are the loss of volatiles in the sampling and sub-sampling stages, and microbial degradation of aromatic volatiles. The methodology presented in EPA Method 5035 was designed to minimize VOC losses through volatilization and biodegradation. To address these problems and minimize the loss of VOCs during sample handling stages, EPA Method 5035 includes provisions such as field-preservation or the use of an En Core® Sampler designed to store and transfer soils (no field preservation required) with minimal loss of VOCs.

The En Core® Sampler can be used as applicable (cohesive granular soils) to collect and store samples without preservation for a maximum of 48 hours. A minimum of three En Core® Samplers per location is required to determine whether the concentration is high- or low-level, and to cover the potential for low-level and high-level contamination. Moisture content (so VOC results can be reported on a dry-weight basis) can be determined from unpreserved samples and may be collected from the conventional sample sleeve. The En Core® Sampler is a single use device.

## 3.0 APPLICABILITY

The procedures presented in this SOP are applicable to field investigation activities involving soil sample collection for VOC analyses. If needed, other methods of field preservation are covered under EPA method 5035. The other methods are not covered in this SOP.

Prior to determining the most appropriate VOC sample collection and preservation method, it is important to gather information regarding the type of soil to be sampled. If this information is not available, the project Sampling and Analysis Plan (SAP) should address all potential available methods of sample collection and preservation to minimize the loss of VOCs during sampling activities. In this case, field personnel should be prepared to perform any of the potential methods.

- Cohesive Granular Soils– The En Core® Sampler should be used on sites where cohesive soils are anticipated or known to occur. This sample collection and preservation method is preferable since it eliminates weighting and the addition of preservation in the field. In this case, samples must be stored at 4°C and prepared for analysis within 48 hours of sample collection.
- Non-cohesive Granular Soils– If gravel or a mixture of gravel and fines cannot be transferred using the En Core® Sampler, the soil may be quickly sampled using a stainless steel spatula or scoop and placed in a sealed VOC vial and analyzed as soon as possible. In this case, it is recommended to use a mobile laboratory to analyze samples as soon as they are collected. Caution should be taken in the interpretation of these results since loss of VOCs is likely due to the sampling method and the non-cohesive nature of the soil being sampled.
- Cemented Soil– If the soil requiring sampling is cemented in a manner that the En Core® Sampler can not be used, subsamples of the soil may be sampled by fragmenting a larger portion of the material using a clean spatula or chisel to generate a fragment that can be placed in a VOC vial. Care should be taken when transferring the aggregate to the sample container to prevent compromising the sealing surfaces and threads of the container. Caution should be taken in the interpretation of these results since loss of VOCs may occur during generation of the aggregate sample.

## 4.0 DEFINITIONS

**Accuracy** – The degree of agreement between an observed value and a true value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator.

**Action Levels** – The numerical value specified that causes the decision maker to choose one of the alternative actions (e.g., compliance or noncompliance). It may be a regulatory threshold standard, such as a Maximum Contamination Level, a risk-based concentration level, a technological limitation, or a reference-based standard. The action level is specified during the planning phase of a data collection activity.

**Analyte -** A chemical component of a sample to be determined or measured.

**Bias –** The systematic or persistent distortion of a measurement process which causes errors in one direction (i.e., the expected sample measurement is different than the sample's true value.

**Cohesive Soil** – Soil that possess some resistance to deformation because of the surface tension present in the water films. For example, wet clays can be molded into various shapes without breaking and will retain these shapes. Gravels or a mixture of gravel and fines that can not be easily obtained or transferred using coring tools are not cohesive and are called non-cohesive.

**Contaminant of Potential Concern -** Any physical, chemical, biological, or radiological substance or matter that has an adverse effect on air, water, or soil.

**Data Quality Objectives** – Qualitative and quantitative statements derived from the DQO process that clarify study objectives, define the appropriate type of data to collect, determine the most appropriate conditions from which to collect data, and specify the tolerable probabilities of making a decision error. These statements are used as the basis for establishing the type, quality, and quantity of data needed to support decisions.

**Matrix Spike (MS) -** An aliquot sample with known quantities of compounds (target analytes) that is mixed with a field sample and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery. The sample provides information on the target analyte stability and loss due to matrix interference and volatility after collection and during transport, storage, sample preparation and analysis.

**Matrix Spike Duplicate (MSD) -** A second aliquot of the same compounds as the matrix spike that is spiked into a duplicate field sample in order to verify the precision and accuracy of the results of the matrix spike.

**Sampling –** The process of obtaining samples and/or measurements of a subset of population units from the population. Proper sampling techniques must be employed to obtain samples that are representative of actual site conditions.

**Target Analyte** – The element, compound, or class of compounds detected and quantitated through the analytical measurement process.

**Test Method** – An adoption of a scientific technique for a specific measurement problem, as documented in a SOP.

**Volatile Organic Compounds** – Chemicals that have a low boiling point, evaporate easily, and contain hydrogen (H), carbon (C), and possibly other elements.

## 5.0 REFERENCES

Naval Facilities Engineering Service Center (NFESC), 1999, Navy Installation Restoration Chemical Data Quality Manual, September.

United States Environmental Protection Agency (EPA), 1997, Test Methods for Evaluation Solid Wastes, SW-846, Update III.

United States Environmental Protection Agency (EPA), 1999 Memorandum, Regional Interim Policy for Determination of Volatile Organic Compound (VOC) Concentrations in Soil and Solid Matrices.

United States Environmental Protection Agency (EPA), 1994, Guidance for The Data Quality Objectives Process, USEPA QA/G-4

## 6.0 APPARATUS AND MATERIALS

- Stainless steel spatula, scoop or knife.
- En Core® Sampler T-Handle and/or En Core® Sampler Extrusion Tool.
- Disposable En Core® Sampler and En Core® Sampler bag (labeled zipbag).
- Decontamination supplies, including a plastic tarp.
- Ice chest and wet ice (double bagged).
- Paper towel.
- Field Logbook.
- Soil Sample Collection Log forms.
- Chain-of-custody forms; sample labels, and custody seals.

## 7.0 PROCEDURE

This procedure addresses the specific activities to collect soil samples for VOC analyses (any volatile organic compound). The sampling protocol described below focuses on the use of a coring device (En Core® Sampler) that also serves as a shipping container.

### 7.1 Review of SAP or Work Plan

In preparation for a sampling effort involving the collection of soil samples for VOC analyses (TPH-gasoline and/or VOCs) at a given site, the Project Manager shall meet with the designated field personnel in charge of collecting the samples to review the site SAP and convey the following information:

- Access requirements (e.g., permission of owner, locked gates, road conditions).
- Identification number(s) of the areas to be sampled.
- Specific sample locations and sample identification strategy.
- Soil type being sampled, if known and any special considerations.
- Selected VOC sampling procedure (En Core® Sampler versus preservation).

- The potential use of a mobile lab (instant on-site analyses) and selection of confirmation samples using an En Core® Sampler to the fixed-based laboratory.
- Anticipated number of environmental samples and QC samples to meet project DQOs.
- Sample volume requirements (5 grams versus 25 grams) and/or En Core® Samplers needed by the contracted laboratory. The 25-gram sampler is typically used when Toxicity Characteristic Leaching Procedure (TCLP) and other leaching tests [i.e., synthetic precipitation leaching procedure (SPLP) and waste extraction test (WET)] are required.
- Required Field Logbook entries and any supporting documentation.
- Type of equipment needed for the scheduled sampling activity.

## 7.2 Sample Collection

The following procedure is designed to provide detailed information in the collection of soil samples using the En Core® Sampler. For a diagram of the sampling device, refer to the Manufacturer's Instructions (Attachment 1)

1. Label all sample pouches with the sample identification scheme indicated in the SAP.
2. Before taking the samples, hold coring device and push the plunger rod down until small o-ring rests against tabs. Depress the locking lever and place coring body plunger end first, into open end of T-handle, aligning the slots on the coring body with the locking pins in the T-handle. Twist coring body clockwise to lock pins in slots. Make sure sampler is locked in place.
3. Immediately before sampling, remove approximately half inch of soil from the exposed surface soil with a clean spatula, scoop, or knife. When inserting a clean coring tool into a fresh surface for sample collection, air should not be trapped behind the sample. This procedure will ensure that a fresh exposed surface is sampled.
4. Turn the T-Handle with the T up and coring down. Using the T-Handle, push sampler into soil until coring body is completely full. The coring body will be full when the small o-ring is centered in the T-Handle viewing hole. Remove sampler from soil sleeve and quickly wipe the coring body exterior to ensure a tight seal.
5. Cap the coring body while it is still on T-Handle. Push and twist cap over bottom until grooves on locking arms seat over ridge on coring body. Cap must be sealed to seal sampler.
6. Remove the capped sampler by depressing locking lever on the T-Handle while twisting and pulling sampler from T-Handle. Lock plunger by rotating extended plunger rod fully counterclockwise until wings rest firmly against tabs.
7. Insert the sampler into the sealable/labeled pouch and immediately place samples in a cooled (4°C) ice chest.

8. Collect field QC samples in accordance with the SAP requirements. A minimum of 3 En Core® Samplers are needed for each sample. A total of 9 En Core® Samplers are needed if collecting sample for MS/MSD.
9. Samples must be analyzed or frozen within 48 hours. Samples that are frozen shall be analyzed within 7 days to meet holding time requirements. Sampler should not be frozen below -20°C due to potential problems with tool seals and the loss of VOCs upon sample thawing.
10. Record laboratory and field identification numbers in the Soil Sample Collection form. Chain of custody forms will be completed with the laboratory identification number only so QC samples are submitted "blind" to the laboratory. .

## 8.0 DOCUMENTATION

Document all procedures and equipment used during soil sampling in the Field Logbook or appropriate soil sample collection form. Recorded field data shall include:

- Soil type and any relevant visual observations (i.e., stains).
- Inability to collect a representative sample.
- Sample collection date and times.
- Any observation that may impact data interpretation.

## 9.0 ATTACHMENTS

1. En Core® Sampler Manufacturer's Instructions

**RICHARD BRADY AND ASSOCIATES**

**STANDARD OPERATING PROCEDURE**

# SOIL SAMPLING PROCEDURE FOR VOLATILE ORGANICS USING THE EnCore® SAMPLER

## ATTACHMENT 1

## EnCore® SAMPLER MANUFACTURER'S INSTRUCTIONS

# Disposable En Core® Sampler

® **En Novative Technologies, Inc.**
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## Sampling Procedures

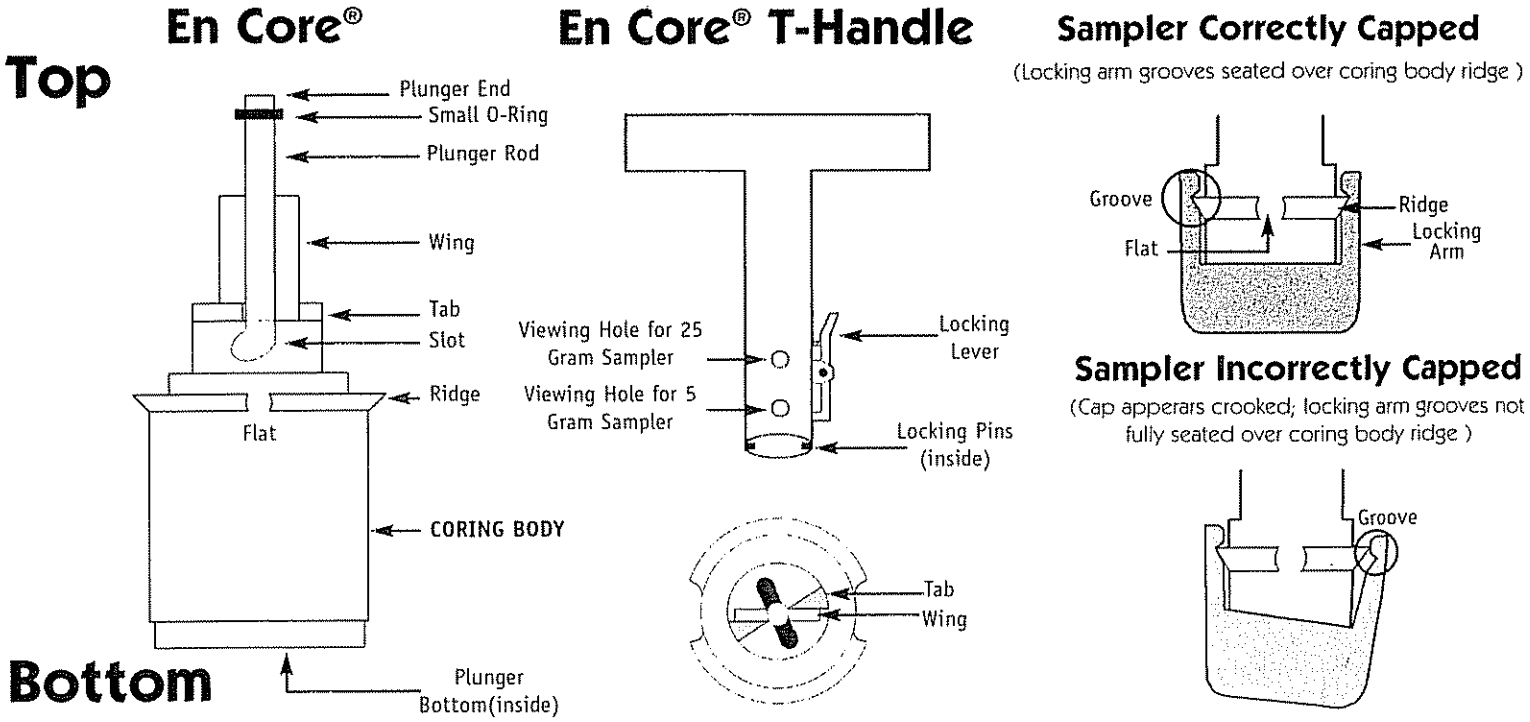
*NOTE:*

1. En Core® Sampler is a SINGLE USE device. It cannot be cleaned and/or reused.

2. En Core® Sampler is designed to store soil. Do not use En Core Sampler to store solvent or free product!

3. En Core® Sampler must be used with En Core® T-Handle and/or En Core® Extrusion Tool exclusively. (These items are sold separately.)

## Using The En Core® T-Handle




**BEFORE TAKING SAMPLE:**

1. Hold **coring body** and push **plunger rod** down until **small o-ring** rests against **tabs**. This will assure that plunger moves freely.

2. Depress **locking lever** on En Core T-Handle. Place coring body, **plunger end first,** into open end of T-Handle, *aligning the (2)* ***slots*** *on the coring body with the (2)* ***locking pins*** *in the T-Handle.* Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.

**TAKING SAMPLE:**

3. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push Sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle **viewing hole**. Remove Sampler from soil. Wipe excess soil from coring body exterior.

4. Cap coring body while it is still on T-handle. *Push* **cap** over **flat** area of **ridge** *and twist* to lock **cap** in place. **CAP MUST BE SEATED TO SEAL SAMPLER (see diagram)**.

**PREPARING SAMPLER FOR SHIPMENT:**

5. Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until **wings** rest firmly against tabs (see plunger diagram).

7. Attach completed tear-off label (from En Core Sampler bag) to cap on coring body.

8. Return full En Core Sampler to zipper bag. Seal bag and put on ice.

# Disposable En Core® Sampler

## EXTRUSION PROCEDURES

## USING THE En Core® EXTRUSION TOOL

***CAUTION! Always use the Extrusion Tool to extrude soil from the En Core Sampler. If the Extrusion Tool is not used, the Sampler may fragment, causing injury.***

1. Use a pliers to break locking arms on cap of En Core Sampler. Do not remove cap at this time. **(CAUTION: Broken edges will be sharp.)**

2. To attach En Core Sampler to En Core Extrusion Tool: Depress locking lever on Extrusion Tool and place Sampler, plunger end first, into open end of Extrusion Tool, aligning slots on coring body with pins in Extrusion Tool. Turn coring body clockwise until it locks into place. Release locking lever.

3. Rotate and gently push Extrusion Tool plunger knob clockwise until plunger slides over wings of coring body. (When properly positioned plunger will not rotate further.)

4. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. To release soil core, remove cap from Sampler and push down on plunger knob of En Core Extrusion Tool. Remove and properly dispose of En Core Sampler.

## Warranty and Disclaimers

IMPORTANT: FAILURE TO USE THE EN CORE SAMPLER IN COMPLIANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED HEREIN VOIDS ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

**PRINCIPLE OF USE.** The En Core Sampler Cartridge System is a volumetric sampling system designed to collect, store and deliver a soil sample. The En Core Sampler comes in two sizes for sample volumes of approximately 25 or 5 grams. There are four components: the cartridge with a movable plunger; a cap with two locking arms; a T-handle (purchased separately); and an extrusion handle (purchased separately). NOTE: The En Core Sampler is designed to store soil. It is not designed to store solvent or free product.

The soil is stored in a sealed headspace-free state. The seals are achieved by three special Viton® * o-rings, two located on the plunger and one on the cap of the Sampler. At no time and under no condition should these o-rings be removed or disturbed.

**QUALITY CONTROL.** The cartridge is sealed in an airtight package to prevent contamination prior to use. Due to the stringent quality control requirements associated with the use of this system, the disposable cartridge is designed to be used only once.

**WARRANTY.** En Novative Technologies, Inc. ("En Novative Technologies") warrants that the En Core Sampler shall perform consistent with the research conducted under En Novative Technologies' approval, within thirty (30) days from the date of delivery, provided that the Customer gives En Novative Technologies prompt notice of any defect or failure to perform and satisfactory proof thereof. THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING, AS SOLELY DETERMINED BY EN NOVATIVE TECHNOLOGIES: (a) Damage caused by accident, abuse, mishandling or dropping; (b)Samplers that have been opened, taken apart or mishandled; (c)Samplers not used in accordance with the directions; and (d)Damages exceeding the cost of the sampler. Seller warrants that all En Core Samplers shall be free from defects in title. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY INFORMATION PROVIDED BY SALES REPRESENTATIVES OR IN MARKETING LITERATURE. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. En Novative Technologies' warranty obligations and Customer's remedies, except as to title, are solely and exclusively as stated herein.

**LIMITATION OF LIABILITY.** IN NO EVENT SHALL EN NOVATIVE TECHNOLOGIES BE LIABLE FOR ANTICIPATED PROFITS, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, DOWN TIME, REMEDIATION ACTIVITIES, REMOBILIZATION OR RESAMPLING, COST OF CAPITAL, SERVICE INTERRUPTION OR FAILURE OF SUPPLY, LIABILITY OF CUSTOMER TO A THIRD PARTY, OR FOR LABOR, OVERHEAD, TRANSPORTATION, SUBSTITUTE SUPPLY SOURCES OR ANY OTHER EXPENSE. DAMAGE OR LOSS, INCLUDING PERSONAL INJURY OR PROPERTY DAMAGE. En Novative Technologies' liability on any claim of any kind shall be replacement of the En Core Sampler or refund of the purchase price. En Novative Technologies shall not be liable for penalties of any description whatsoever. In the event the En Core Sampler will be utilized by Customer on behalf of a third party, such third party shall not occupy the position of a third-party beneficiary of the obligation or warranty provided by En Novative Technologies, and no such third party shall have the right to enforce same. All claims must be brought within one (1) year of shipment, regardless of their nature.

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The En Core® Sampler is covered by One or More of the Following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271. Other U.S. and Foreign Patents Pending

* Viton® is a registered trademark of DuPont Dow Elastomers.

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# STANDARD OPERATING PROCEDURE

## ENVIRONMENTAL SOIL SAMPLING

*SOP NUMBER: T-006*

*REVISION NUMBER: 3*

*REVISION DATE: September 30, 2009*

*REVIEW DATE: July 16, 2010*

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# RICHARD BRADY AND ASSOCIATES STANDARD OPERATING PROCEDURE

# ENVIRONMENTAL SOIL SAMPLING

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) provides direction and establishes guidelines and procedures for field personnel collecting soil samples for environmental laboratory chemical analysis. This SOP is not intended to apply to every situation that may be encountered, nor is intended to replace thorough training and reading of reference materials.

## 2.0 BACKGROUND

Responsible parties and regulatory agencies make decisions about protecting human health and the environment from chemicals that may have been released during historic or current site activities. Chemical analysis of soil samples is often one source of information used in making environmental decisions. Soil sampling may be used in conjunction with various methods of subsurface investigations using various techniques.

## 3.0 APPLICABILITY

Soil sampling activities are applicable but not limited to activities associated with site construction, site demolition, underground storage tank removal, pipeline removal, site investigations, and remedial activities. This SOP is applicable to all soil sampling activities.

## 4.0 DEFINITIONS

**Analyte** - A chemical component of a sample to be determined or measured.

**Analytical (or Testing) Method** - A specification for sample preparation and instrumentation procedures or steps that must be performed to estimate the quantity of analyte in a sample.

**Auger** – A device for sampling subsurface soil.

**Chain-of-custody -** A protocol to insure the integrity of samples and resulting analytical results. Written forms indicating the date and time of transfer (e.g., from a sampler to the lab) are used. The procedure accounts for the whereabouts and handling of a sample and data from collection to final determination.

**Drive sampler** - A sample device that utilizes a hand held slide hammer to drive a six inch barrel to shallow subsurface depths. Typically used when collecting samples with a hand auger.

**Encore sampler** – One of several specific types of sampling devices for collecting samples for analysis for Volatile Organic compounds (VOCs) in accordance with EPA test method 5035/8260.

**Field Log book** – A project-specific record of information in a bound field notebook gathered by field personnel.

**Hand auger** – A small manual auger used fro shallow subsurface sample borings

**Hollow-stem auger** – A small-diameter (typically 6- to 12-inch) drilling technique commonly used for collecting soil samples and installing monitoring wells.

**Matrix** - The sample medium in which analytes of interest are tested. The media in which analytes are tested includes water, soil and solids.

**Piston-type sampler** - Sampling device used to collect soil samples at a discrete depth when a piston is released to allow soil to enter the sampler. The sampler is typically lined with 21" (three-6", and one-3") of brass or stainless steel tubing. It does not spilt or break apart, the soil sample, inside the tubing, is carefully extruded from the sampler. Piston-type samplers are typically used with direct-push technology.

**SAP** – Sampling and Analysis Plan

**SCAPS** – Site Characterization and Analysis Penetrometer System. A system to obtain real time, subsurface assessment data on soil and chemical characteristics using a direct-push soil probe. Soil samples can also be collected using a direct-push piston-type sampler.

**Split-barrel/spoon sampler** – One of several specific types of sampling devices for retrieving representative soil samples from discrete depths. Use of these samplers requires the lining the interior of the sampler with appropriate sampling tubes, usually brass or stainless steel.

**VOC -** (Volatile Organic Compound). Chemicals that have a low boiling point and evaporate easily containing hydrogen (H), carbon (C), and possibly other elements.

**Underground utilities** - Include, but are not limited to, utilities (sewer, telephone, fuel, electric, water, and other product lines), tunnels, shafts, vaults, foundations, and other underground fixtures or equipment that may be encountered during excavation operations.

## 5.0 REFERENCES

Navy Installation Restoration Laboratory Quality Assurance Guide, Naval Facilities Engineering Service Center (NFESC), Interim Guidance Document (Feb 1996).

Navy/Marine Corps Installation Restoration Manual, Naval Facilities Engineering Services Command (NFESC) (February 1997).

San Diego County, Department of Environmental Health (DEH), Site Assessment and Mitigation Program (DEH-SA/M), Site Assessment Manual (2004).

California Department of Toxic Substances Control, Hazardous Materials Laboratory, User's Manual, Revision 12, January 2001.

CCR Title 22, Division 4.5, Chapter 11, Article 3, Section 66261.20(c).

EPA, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Revision 5, April 1998.

County of San Diego, Department of Environmental Health, Land & Water Quality Division, Site Assessment and Mitigation Program (SD DEH). Site Assessment and Mitigation Manual. http://www.sdcounty.ca.gov/deh/lwq/sam/manual_guidelines.html (This manual is updated yearly.)

## 6.0 APPARATUS AND MATERIALS

Select and assemble the types of equipment, instruments, and supplies necessary to perform the scope of work in accordance with the project specifications. A suggested checklist of apparatus and materials is included as Attachment A.

## 7.0 SOIL SAMPLE PROCEDURES

This procedure addresses the specific activities to be performed to accomplish a soil sampling event, including review of the Sampling and Analysis Plan (SAP) and general sample collection procedures, preparation for a sampling event by identifying necessary equipment, supplies and field documentation requirements.

### 7.1 Responsibilities

Project Manager (PM): The PM is responsible for ensuring that Richard Brady & Associates field personnel have been trained in the use of this procedure and for verification that soil sampling activities are performed in compliance with the Work Plan and this SOP.

Physical Science Technician (PST): The PST is responsible for compliance with this SOP including collection of samples, containerization of samples, and documentation.

### 7.2 Review of Sampling and Analysis Plan

In preparation for a soil sampling event at a given site, Richard Brady & Associates staff will review the site Sampling and Analysis Plan (SAP) and identify the following information:

- Identification number(s) of samples to be collected,
- Locations of the sample points,
- Location access requirements (e.g., permission of owner, locked gates, road conditions),
- Field and analytical parameters to be tested,
- Type and number of sample containers needed,
- Sample preservation methods,
- Volume of samples required for analysis,

- Type and number of QA/QC samples to be collected (e.g., duplicates, splits, and blanks), and
- Type of equipment needed for the scheduled sampling activity.

A location map shall be provided for use in the field. Copies of sampling specifications shall also be provided for field reference (if necessary).

Field information and data obtained during the sampling event shall be recorded in a logbook that is dedicated to the project.

### 7.3 Equipment and Supplies

Richard Brady & Associates staff shall plan for the sampling event by assessing, selecting, and assembling the types of equipment, instruments, and supplies necessary to perform the scope of work. Prior to going to the field, instrumentation shall be assembled, calibrated (if applicable), and tested. See Attachment 1.

### 7.4 General Soil Sampling Procedures

- Determine sampling locations and depths. Determining these locations depends on the nature of the sampling. In most cases, sample locations and depths will be determined prior to field mobilization and outlined in the site-specific SAP.
- After sample locations have been determined, penetrate the existing surface with sampling device; the depth will depend on the circumstances.
- When sample depth is attained, push/hammer sample (depending on sample method), until reaching undisturbed soil.
- If the soil is potentially impacted with hydrocarbons, it is usually desirable to obtain field organic vapor readings. After removing and breaking apart the sampler, collect a representative soil sample and place in a suitable container, such as a Ziplock bag, and record the result from the organic vapor analyzer (OVA).
- Collect representative soil samples in accordance with the SAP, ensuring correct sample container, preservation, labeling, storage, packing, and conveyance.
- Record the sampling information on the site plan, soil sample log, and a chain of custody form. Collect sample location information in accordance with the SAP, which may call for GPS or other location reference.
- Place the soil samples in a cooler packed with ice packets for cold storage pending transport to the environmental laboratory.
- The Project Manager is responsible for monitoring and documenting observations made during excavation activities in a field log. At a minimum the following information should be recorded prior to excavation activities: date, arrival time, site location, weather, onsite staff, any contractors (names and phone numbers), and the type and quantity of

equipment. During sampling activities the following information should be logged: start and stop time and location of all activities, blow counts performed to advance the sampler through each 6-inchinterval, description of the lithology encountered in accordance with the Unified Soil Classification System, odors and/or staining observed, depths and times which samples were taken, OVA readings (if taken), depth to water (if applicable), and problems causing delays during any activities.

- All sampling equipment should be decontaminated in accordance with the Richard Brady & Associates SOP T-001 Equipment Decontamination between all samples collected.

### 7.5 Subsurface Sampling Using a Split-barrel/spoon Sampler

Split-barrel/spoon samplers can be various lengths and are typically used for deeper samples with the hollow-stem auger. The following procedures provide directions for each step for this method of sampling.

- Decontaminate the split-barrel sampler and all other equipment.
- Begin augering to specified sample depths following SOP T-004 Hollow Stem Auger Drilling.
- After augering to a depth above the specified sample interval, stop augering and hammer the split-barrel sampler to the desired sample depth.
- Remove the sampler, break the sampler apart by unscrewing the ends and retrieve the tubing containing the sample.
- Collect the samples from the tubing depending on the preferred analysis. If the analysis is for VOCs, the SOP T-003 for Soil Sampling Procedure for Volatile Organics using the En Core® Sampler should be followed.
    - The stainless steel or brass tubing can be used for some other analysis or kept as a back-up sample. If this is the case, the tube ends should be wrapped in Teflon sheets and capped. Sealing the caps with silicon tape is optional. Do not use adhesive tape to seal the caps.
- The sampler and all equipment used to collect the sample should then be decontaminated following the SOP T-001 Equipment Decontamination.
- Repeat these steps until the specified number of samples have been collected from each boring.

### 7.6 Subsurface Sampling Using a Hand Auger (with drive sampler)

Hand augering may be used to collect soil samples from shallow depths when larger drilling equipment is not warranted. The collection of soil samples using a hand auger is typically used in conjunction with a drive sampler. The following procedures provide the minimum direction

for each step of a soil sampling activity using hand auger equipment in conjunction with a drive sampler.

- Decontaminate the hand auger, drive sampler barrel and other equipment.
- Hold the auger vertical, apply pressure, and rotate in a clockwise direction through the soil.
- When the auger bucket is full of soil, remove it from the boring and transfer the contents to the plastic sheeting located around or next to the bore hole.
- Repeat previous two steps until achieving a depth above the desired sample depth.
- Using the drive sampler, hammer the sample barrel (loaded with specified tubing) until it has been driven to the desired depth.
- Remove the sample by gently tapping the hammer in an upwards motion as to not remove the soil sample from the sample barrel.
- Once the sample has been removed from the boring removed the tubing from the barrel by unscrewing the end and carefully extruding the sample.
- The hand auger, drive sampler, and all other equipment used to take the sample should then be decontaminated following the SOP T-100 Equipment Decontamination.
- Repeat these steps until the specified number of samples have been collected from the boring or until a depth is reached at which other means of collecting samples are necessary.

### 7.7 Subsurface Sampling Using SCAPS

Collecting soil samples using SCAPS utilizes a hydraulic press to push a piston-type sampler to the desired sample depth. This method is extremely precise in collecting samples from specific depths. The following procedure provides each step of a soil sampling activity using the SCAPS direct-push piston-type sampler.

- Decontaminate the piston-type sampler (must be taken apart) and all other equipment that comes in direct contact with the sample.
- The SCAPS unit is aligned above the specific sample location.
- The piston-type sampler is pushed to a depth above the desired sample depth.
- The piston is released using a wire cable, and the sampler is pushed to the desired sample depth. The typical sample interval is 18” (1.5’).
- Once the sample has been taken, the piston-type sampler is removed by retracting the hydraulic press.
- The sample is removed by carefully extruding the tubing from the sampler.

- The piston-type sampler and all other equipment used to take the sample should then be decontaminated following the SOP T-100 Equipment Decontamination.
- Repeat these steps until the specified number of samples have been collected from the push.

### 7.8 Subsurface Sampling during Trench Excavation Activities

Soil samples are collected from trench excavation sidewalls and bottom at a spatial intervals and depth specified in the project work plan or field sampling plan to accomplish specific project goals. The samples are collected by hand directly from excavation equipment. This is done specifically to eliminate hazards associated with having personnel enter potentially unstable excavations.

- Soil samples are immediately collected as soon as the excavation equipment is withdrawn from the hole. Soil is initially collected by placing approximately four cubic inches of soil from the excavator bucket into a decontaminated stainless steel bowl. The sample is then obtained by packing a laboratory-supplied sample container with soil, being careful to leave no headspace in the container. The soil in the bowl will not be mixed and as many soil horizons as possible will be sampled to obtain as representative a sample as possible. All soil sample containers are immediately sealed capped with the supplied lid, and are labeled with the project and sample number, collection depth, date, and time. This information is then entered on the chain of custody document. The sample is stored at the proper preservation temperature in an ice chest packed with double-bagged wet ice (4° C environment) until analysis. In the case of Encore samples, the sample is collected using the Encore sampling SOP T-003.
- Residual sample soil not placed in containers for laboratory analysis may be screened for combustible vapors using a combustible gas indicator (CGI) or equivalent instrument. For each vapor-screening event, soil is added to a 6-inch long by 2.5-inch diameter sample insert until it is approximately 1/3 full. The insert is capped, shaken, and penetrated with a probe inserted through a small opening in the cap. For hydrocarbon impacted soils, use an organic vapor analyzer (OVA) and place the probe inside the borehole and record the flame ionization detector (FID) reading taken after approximately 20 seconds and record the value in the boring logs.

### 7.9 Stockpile Soil Sampling

Generate a 2-dimensional grid to represent the stockpile, and select sample locations at random. Third dimension grid points (depths) are also randomly selected at each 2-dimensional grid location. Undisturbed samples are to be collected using a hand-auger / hammer driven system. A schematic of the contoured and gridded stockpiles with sample locations is shown in a figure in the final report.

### 7.10 Demobilization/Site Restoration

After the excavation has been backfilled:

- Repair surfaces to approximate pre-drilling conditions;
- Repair all surface structures as per the contract;
- Identify and isolate with barricades remaining hazards, if any;
- Containerize, label, and manage investigative derived waste,

## 8.0 DOCUMENTATION

Document all procedures, observations, and equipment used during excavation and sampling activities on the field log and forms related to the project.

## 9.0 ATTACHMENTS

1. Equipment Supply Checklist

**RICHARD BRADY AND ASSOCIATES**

**STANDARD OPERATING PROCEDURE**

**ENVIRONMENTAL SOIL SAMPLING**

**ATTACHMENT 1**

**EQUIPMENT SUPPLY CHECKLIST**

# EQUIPMENT AND SUPPLY CHECKLIST

- ☐ Work Plan or Sampling and Analysis Plan
- ☐ Health and Safety Plan
- ☐ Underground Service Alert (USA) number
- ☐ Personal safety gear:
  - ☐ traffic vest,
  - ☐ steel toe shoes,
  - ☐ work gloves
  - ☐ earplugs,
  - ☐ sunscreen,
  - ☐ hardhat,
  - ☐ drinking water
  - ☐ Gloves (e.g., powder-free nitrile)
- ☐ Warning signs, barricades, cones, and yellow caution tape
- ☐ Field log (notebook and forms)
- ☐ Log forms
- ☐ Pens
- ☐ Hand auger
- ☐ Shovel and other various hand tools
- ☐ Buckets
- ☐ Brushes
- ☐ Liquinox
- ☐ Deionized water
- ☐ Deionized water sprayer
- ☐ Gas and vapor monitoring equipment
- ☐ Utility mark out report
- ☐ Underground Locating Service (ULS)
- ☐ Drilling permit issued by local government agency
- ☐ Digging Permit issued by facility (e.g., Public Works Center)
- ☐ Safety fence and flashing lights for night-time vehicle or pedestrian traffic
- ☐ Soil logging equipment
- ☐ Chain of Custody forms
- ☐ Sample forms
- ☐ Sampling trowel, scoop, spoon, etc. (not too big, expect 4 oz jars)
- ☐ Soil sampling equipment
- ☐ Teflon sheets for sample sleeves
- ☐ Sample jars
- ☐ Tool box
- ☐ Hammer
- ☐ Vise
- ☐ Baggies, large and small
- ☐ Sample labels
- ☐ Sharpie pens
- ☐ Plastic sheets for sample prep

- ☐ Plastic sheeting (6 mil. Min.)
- ☐ Soil classification chart
- ☐ Color chart
- ☐ Hand lens
- ☐ Ice Coolers for samples
- ☐ Ice
- ☐ Visqueen
- ☐ Drum labels
- ☐ Clipboards
- ☐ Paint for marking out auger locations
- ☐ Water level indicator
- ☐ Survey equipment (e.g., GPS unit)
- ☐ Camera
- ☐ Trash bags
- ☐ Dustpan foxtail
- ☐ Two tables: one for sampling, one for drying samplers
- ☐ Large paper clamps/clips for windy days
- ☐ Ice Coolers for drinks (must be marked FOOD ONLY)
- ☐ Shade
- ☐ Chairs
- ☐ EnCore® sampling devise extractor (if applicable),
- ☐ Instrument for measuring organic vapor concentrations such as a photoionization detector (PID) and/or a flame ionization detector (FID),

**NOTE:** The SCAPS truck and support trucks should be equipped with all SCAPS specific equipment for collecting soil samples.

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# STANDARD OPERATING PROCEDURE

# SAMPLING AND ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN SOIL USING DIRECT PUSH SAMPLING AND DIRECT SAMPLING ION TRAP MASS SPECTROMETRY

*SOP NUMBER: T-009*

*REVISION NUMBER: 02*

*REVISION DATE: April 6, 2010*

*REVIEW DATE: July 19, 2010*

*Prepared by:* _____ *April 6, 2010*
*William Davis* *Date*

*Approved by:* _____ *April 6, 2010*
*Jesse MacNeill - Quality Assurance Manager* *Date*

*Approved by:* _____ *April 6, 2010*
*Tim Shields - Program Manager* *Date*

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# RICHARD BRADY AND ASSOCIATES
# STANDARD OPERATING PROCEDURE

# SOIL SAMPLING USING DSMITMS

## 1.0 INTRODUCTION

This Standard Operating Procedure describes the procedures and methods used to subsample soil collected by soil core sampling methods and analysis of these subsamples for volatile organic compounds (VOC) using direct sampling ion trap mass spectrometry (DSITMS). In summary, soil cores are immediately subsampled into 40 mL VOC vials containing either distilled water or methanol using procedures described in US EPA Method 5035 (1). The samples are then analyzed for VOC contaminants of concern by DSITMS using procedures described US EPA Method 8265 (2).

## 2.0 SOIL SUBSAMPLING PROCEDURES FOR LOW LEVEL VOC CONTAMINATION

The procedures described here are those detailed in US EPA Method 5035 Sections 6.1.1 and 6.2.1 for the sampling of soils containing low level VOC contamination. The procedures have been modified for use with the 40 mL vial sparge interface of the DSITMS used to perform the VOC determination by EPA Method 8265.

- It is very important to subsample soil from the soil core as soon as possible once the soil is retrieved from the subsurface to avoid volatile loss of contaminants of concern. Therefore, all equipment for sub-sampling should be prepared before the soil sample is collected from the subsurface.

- Prepare in advance as many vials as will be needed during any particular sampling event (one soil core or numerous discrete cores in continuous coring). Weigh empty labeled vial and record this as the vial weight. Prepare vials by adding approximately 20 mL distilled water to a 40 mL VOC vial. Replace cap, weigh and record the weight. This is the initial tare weight for this sample vial.

- Once a discrete soil core has been collected, using a plastic 10 mL syringe with the tip removed, sub-core approximately 5 mL of soil from the direct push soil core. Extrude the sub-sample into a 40 mL VOC vial containing 20 mL distilled water. Seal the vial and weight it immediately, record the weight. This weight it the tare plus soil weight.

Immediately open and fill the vial completely with distilled water. Reseal the vial insuring that

no air bubble is present in the sample vial. Weigh full vial and record weight, this is total weight. Note, if the soil is of a fined grained material that does not readily form a slurry, use a spatula to break the subsample up before filling the vial completely with distilled water.

- Place the vial in a container out of heat and sunlight. Please note that EPA Method 5035 indicates that the sample should be placed on ice for shipment to an off site laboratory. Since this procedure is intended for use when the DSITMS analysis by EPA Method 8265 is performed almost immediately, on site, the samples are not placed on ice.

## 3.0 SOIL SLURRY ANALYSIS BY DIRECT SAMPLING ION TRAP MASS SPECTROMETRY

The procedures described here are those detailed in US EPA Method 8265 Sections 11 and 12. This procedure describes the use of the 40 mL vial sparge interface for the analysis of soil slurries for VOC analytes.

- Calibrate the DSITMS for VOC contaminants of concern using the 40 mL vial sparge interface using distilled water. The DSITMS should be calibrated from 0 to 500 µg/L for each analyte of concern for the site to be investigated. The calibration curve should contain a minimum of 5 points but most often contains 7 points; 0, 4, 10, 20, 75, 250 and 500 µg/L. Single replicate analyses of each concentration are analyzed to establish the calibration curve. The above range is generally used but it may be modified based on the data quality objectives (DQOs) for a particular site. Follow procedures in US EPA Method 8265 Section 11.1.4 for the quantitative calibration of the DSITMS using the 40 mL vial sparge interface.

- Using the calibration curve established in 3.1, analyze a Performance Evaluation Standard (PES) as described in US EPA Method 8265 Section 11.3.3. PES are externally prepared standards used to evaluate the calibration and continuing system performance. If the PES analysis indicates system is not holding calibration (analysis does not meet QC acceptance criteria), take corrective action and recalibrate system as specified in the Quality Assurance Plan (QAP, Appendix A).

- Once the system has been calibrated and passed the PES, analyze a soil slurry sample by decanting a small amount of the aqueous sample from the 40 mL vial, discard the decanted water. Place the vial onto the 40 mL vial interface and purge the entire remaining sample slurry as described in US EPA Method 8265 Section 11.3.5.

- Continue to analyze samples as required to support site DQOs. Follow normal quality control procedures to analyze QC samples at frequencies described in the QAP.

- Calculate the concentration of the VOC analytes of concern detected in the sample using

the procedures detailed in US EPA Method 8265 Section 12.3. Please note that you must have recorded the vial weight, tare weight, tare plus soil weight and the total weight of the 40 mL vial in order to obtain the soil sample and total water weight for use in calculations described in US EPA Method 8265 Section 12.3.

- Normal quality control procedures for this method include initial calibration, continuing calibration check standards, PES, blanks and duplicate analyses. It should be noted that, since each analysis requires only about 3 minutes to complete, the level of QC sample analysis tends to be higher than most other analytical techniques used for VOC analysis.

## 4.0 SOIL SAMPLING PROCEDURES FOR HIGH LEVEL VOC CONTAMINANTS IN SOIL

The procedures described here are those detailed in US EPA Method 5035 Sections 6.1.3 and 6.2.2 for the sampling of soils containing high level VOC contamination.

- It is very important to subsample soil from the soil core as soon as possible once the soil is retrieved from the subsurface to avoid volatile loss of contaminants of concern. Therefore, all equipment for subsampling should be prepared before the soil sample is collected from the subsurface.

- Prepare in advance as many vials as will be needed during any particular sampling event (one soil core or numerous discrete cores in continuous coring). Prepare vials by adding approximately 10 mL methanol to a 40 mL VOC vial. Replace cap, weigh and record the weight. This is the initial tare weight for this sample vial.

- Once a discrete soil core has been collected, using a plastic 10 mL syringe with the tip removed, sub-core approximately 5 mL of soil from the direct push soil core. Extrude the sub-sample into a 40 mL VOC vial containing 10 mL methanol. Seal the vial and weight it immediately, record the weight. This weight it the tare plus soil weight.

- Place the vial in a container out of heat and sunlight. Please note that EPA Method 5035 indicates that the sample should be placed on ice for shipment to an off site laboratory. Since this procedure is intended for use when the DSITMS analysis by EPA Method 8265 is performed almost immediately, on site, the samples are not placed on ice unless the analysis will not be performed within 30 minutes of subsampling.

## 5.0 ANALYSIS OF METHANOL EXTRACTS BY DIRECT SAMPLING ION TRAP MASS SPECTROMETRY

The procedures described here are those detailed in US EPA Method 8265 Sections 11 and 12. This procedure describes the use of the 40 mL vial sparge interface for the analysis of soil

slurries for VOC analytes.

- Calibrate the DSITMS for VOC contaminants of concern using the 40 mL vial sparge interface using distilled water. The DSITMS should be calibrated from 0 to 500 µg/L for each analyte of concern for the site to be investigated. The calibration curve should contain a minimum of 5 points but most often contains 7 points; 0, 4, 10, 20 75, 250 and 500 µg/L. Single replicate analyses of each concentration are analyzed to establish the calibration curve. The above range is generally used but it may be modified based on the data quality objectives (DQOs) for a particular site. Follow procedures in US EPA Method 8265 Section 11.1.4 for the quantitative calibration of the DSITMS using the 40 mL vial sparge interface.

- Using the calibration curve established in 5.1, analyze a Performance Evaluation Standard (PES) as described in US EPA Method 8265 Section 11.3.3. PES are externally prepared standards used to evaluate the calibration and continuing system performance. If the PES analysis indicates system is not holding calibration (analysis does not meet QC acceptance criteria), take corrective action and recalibrate system as specified in the Quality Assurance Plan (QAP, Appendix A).

- Once the system has been calibrated and passed the PES, analyze a soil methanol extract sample by injecting 25 to 500 µL of the extract into a vial containing 40 mL of distilled water. Decant a few mLs of water from the vial discard the decanted water. Place the vial onto the 40 mL vial interface and purge the entire sample as described in US EPA Method 8265 Section 11.3.5. Adjust the volume of methanol extract up or down, if original dilution does not fall within the linear range of calibration.

- Continue to analyze samples as required to support site DQOs. Follow normal quality control procedures to analyze QC samples at frequencies described in the QAP.

- Calculate the concentration of the VOC analytes of concern detected in the sample using the procedures detailed in US EPA Method 8265 Section 12.3. Please note that you must have recorded the tare weight, the total weight of the 40 mL vial and the volume of methanol extract diluted in the 40 mL of distilled water in order to obtain the soil sample weight and extract dilution for use in calculations described in US EPA Method 8265 Section 12.4.6 and 12.4.7.

- Normal quality control procedures for this method include initial calibration, continuing calibration check standards, PES, blanks and duplicate analyses. It should be noted that, since each analysis requires only about 3 minutes to complete, the level of QC sample analysis tends to be higher than most other analytical techniques used for VOC analysis.

## 6.0 REFERENCES

US Environmental Protection Agency, Test Methods for Evaluation of Solid and Hazardous Wastes, SW 846 Method 5035, Washington, DC 1998.

US Environmental Protection Agency, Test Methods for Evaluation of Solid and Hazardous Wastes, SW 846, Method 8265, Washington, DC 2002.

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# STANDARD OPERATING PROCEDURE

## SAMPLING AND ANALYSIS OF VOLATILE ORGANIC COMPOUNDS IN WATER USING DIRECT PUSH SAMPLING AND DIRECT SAMPLING ION TRAP MASS SPECTROMETRY

*SOP NUMBER: T-010*

*REVISION NUMBER: 03*

*REVISION DATE: September 30, 2009*

*REVIEW DATE: July 19, 2010*

*Prepared by:* _____ *September 30, 2009*
*William Davis* *Date*

*Approved by:* _____ *September 30, 2009*
*Jesse MacNeill - Quality Assurance Manager* *Date*

*Approved by:* _____ *September 30, 2009*
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# RICHARD BRADY AND ASSOCIATES
# STANDARD OPERATING PROCEDURE

# WATER SAMPLING USING DSMITMS

## 1.0 INTRODUCTION

This Standard Operating Procedure describes the procedures and methods used to sample water collected by sampling devices and analysis of these samples for volatile organic compounds (VOC) using direct sampling ion trap mass spectrometry (DSITMS). In summary, water collected using a sampling device is immediately subsampled into 40 mL VOC vials using procedures described in US EPA SW846 Chapter 4, Section 4.1.2. The samples are then analyzed for VOC contaminants of concern by DSITMS using procedures described US EPA Method 8265.

## 2.0 GROUNDWATER SAMPLING PROCEDURES

The procedures described here are those detailed in US EPA SW846 Chapter 4, Section 4.1.2 (1) for the sampling of water containing VOC contamination. The procedures have been modified for use with the 40 mL vial sparge interface of the DSITMS used to perform the VOC determination by EPA Method 8265.

- It is very important to sample groundwater from the sampling device as soon as possible once the sample is retrieved from the subsurface to avoid volatile loss of contaminants of concern. Therefore, all equipment for subsampling should be prepared before the sample is collected from the subsurface.

- Using a 40 mL VOC vial with a Teflon lined septum, gently fill the vial with the groundwater sample from the sampling device. Care should be taken to not create bubbling of the sample as this causes loss of the volatile contaminants of interest. Over fill the 40 mL VOC vial producing a positive meniscus. Carefully place the vial cap on the vial. Check to insure there are no bubbles in the sample. Empty and refill the vial if a bubble is found. A minimum of two replicate vials should be collected for each sampling location (plan view and depth).

- Place the vial in a container out of heat and sunlight. Please note that EPA SW846 Chapter 4, Section 4.1.2 indicates that the sample should be placed on ice for shipment to an off site laboratory. Since this procedure is intended for use when the DSITMS analysis by EPA Method 8265 is performed almost immediately on site, the samples are not placed on ice unless the analysis is to be performed later than 30 minutes after sample collection.

## 3.0 GROUNDWATER ANALYSIS BY DIRECT SAMPLING ION TRAP MASS SPECTROMETRY

The procedures described here are those detailed in US EPA Method 8265 Sections 11 and 12 (2). This procedure describes the use of the 40 mL vial sparge interface for the analysis of groundwater for VOC analytes.

- Calibrate the DSITMS for VOC contaminants of concern using the 40 mL vial sparge interface using distilled water. The DSITMS should be calibrated from 0 to 500 µg/L for each analyte of concern for the site to be investigated. The calibration curve should contain a minimum of 5 points but most often contains 7 points; 0, 4, 10, 20 75, 250 and 500 µg/L. Single replicate analyses of each concentration are analyzed to establish the calibration curve. The above range is generally used but it may be modified based on the data quality objectives (DQOs) for a particular site. Follow procedures in US EPA Method 8265 Section 11.1.4 for the quantitative calibration of the DSITMS using the 40 mL vial sparge interface.

- Using the calibration curve established in 3.1, analyze a Performance Evaluation Standard (PES) as described in US EPA Method 8265 Section 11.3.3. PES are externally prepared standards used to evaluate the calibration and continuing system performance. If the PES analysis indicates system is not holding calibration (analysis does not meet QC acceptance criteria), take corrective action and recalibrate system as specified in the Quality Assurance Plan (QAP, Appendix A).

- Once the system has been calibrated and passed the PES, analyze a groundwater sample by decanting a small amount of the aqueous sample from the 40 mL vial, discarding the decanted water. Place the vial onto the 40 mL vial interface and purge the entire remaining sample as described in US EPA Method 8265 Section 11.3.5 (2).

- Calculate the concentration of the VOC analytes of concern detected in the sample using the procedures detailed in US EPA Method 8265 Section 12.1.

- Continue to analyze groundwater samples as required to support site DQOs. Follow normal quality control procedures to analyze QC samples at frequencies described in the QAP.

- For sampling exceeding the linear calibration range, sample dilution should be performed using groundwater from the replicate vial for that sampling location. Depending on the estimated concentration from the first analysis, prepare a dilution from the replicate vial (generally from 0.25 to 0.001) using gas tight syringes and distilled water.

- Normal quality control procedures for this method include initial calibration, continuing calibration check standards, PES, blanks, matrix spikes and duplicate analyses. It should

be noted that, since each analysis requires only about 3 minutes to complete, the level of QC sample analysis tends to be higher than most other analytical techniques used for VOC analysis.

## 4.0 REFERENCES

US Environmental Protection Agency, Test Methods for Evaluation of Solid and Hazardous Wastes, SW 846, Chapter 4, Washington, DC 1998.

US Environmental Protection Agency, Test Methods for Evaluation of Solid and Hazardous Wastes, SW 846, Method 8265, Washington, DC 2002.

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# SAP Attachment 2

Form Examples

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# BOREHOLE LOG

| | | | |
|---|---|---|---|
| Project Name: | Project No: | Borehole Number: | |
| Borehole Location: | Northing: | Easting: | Sheet: 1 of 1 |
| Drilling Agency: | | Driller: | |
| Drilling Equipment: | | Date Started: | Total Depth (feet): |
| Drilling Method: | Number of Samplers: | Date Finished: | Depth to Bedrock (feet): |
| Drilling Fluid: | Borehole Diameter (in): | Sample Type: Split / Shelby / Driven / Grab | Sample Length: / Drop Length: / Driving Weight: |
| Completion Information: | | Elevation at top of casing (feet MSL) : | |
| | | Logged By: | Checked By: |

| Depth (feet) | Samples: Sample ID | Samples: Type | Samples: Blow Count | Samples: PID | Samples: Time | Est. % Gravel | Est. % Sand | Est. % Fines | Log: Graphic | Log: USCS or Rock Type | Lithologic Description | Monitoring Well Construction Diagram |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

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# WATER-LEVEL MEASUREMENTS FORM

| Water-Level Measurements | Project and Job Number | Sheet No. |
|---|---|---|
| Facility | Site | Monitored By:<br>Checked By: |

| Well ID Number | Date/ Time | Instrument Serial Number | Calibrated By | Reference Point Elevation (feet) | Depth To Water (feet) | Water-Level Elevation (feet) | Remarks |
|---|---|---|---|---|---|---|---|
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# WELL SAMPLING

PROJECT:
JOB NO.:

WELL NO.:
SITE:

PREPARED BY
Name: _____
Signature: _____

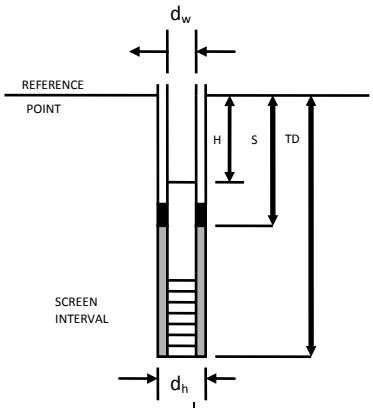
PURGING CRITERIA: **3 Borehole Volumes**

**GROUNDWATER QUALITY PARAMETER STABILIZATION CRITERIA:**
**PH ±0.1; CONDUCTIVITY ±3%; TURBIDITY or DISSOLVED OXYGEN ±10%**

CHECKED BY
Name: _____
Signature: _____

REMARKS (include depth of pump inlet, if applicable):
.

| | | | |
|---|---|---|---|
| BOREHOLE DIAMETER | $d_h$ | = | _____feet |
| WELL CASING: | | | |
| INSIDE DIAMETER | $d_w$ID | = | _____feet |
| OUTSIDE DIAMETER | $d_w$OD | = | _____feet |
| REFERENCE POINT: | TOC | | |
| DEPTH TO: | | | |
| WATER LEVEL | H | = | feet |
| BASE OF SEAL | S | = | feet |
| TOP OF SCREEN | | = | feet |
| BASE OF SCREEN | | = | feet |
| BASE OF WELL | TD | = | feet |
| ESTIMATED FILTER PACK POROSITY | P | = | % |




**WELL VOLUME CALCULATION**

CASING VOLUME ($V_C$)

$$V_C = \pi\left(\frac{d_w ID}{2}\right)^2 (TD - H) = ___ ft^3$$

FILTER PACK PORE VOLUME ($V_F$)

$$V_F = \pi\left[\left(\frac{d_h}{2}\right)^2 - \left(\frac{d_w OD}{2}\right)^2\right](TD - S \text{ or } H)(P) = ___ ft^3$$

(IF S < H, USE H. IF S > H, USE S)

TOTAL WELL VOLUME (VT)

$$VT = VC + VF = \quad ft^3$$

$$ft^3 \times \frac{7.48 \text{ gallons}}{ft} = \text{gallons}$$

| PURGE LOG | | | | | CUMULATIVE TOTAL REMOVED | | WATER QUALITY PARAMETERS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Time Begun | Time Finished | GW Level | Water Removed | Gallons per Minute | Well Volumes | Turbidity (Visual or NTU) | pH | Temperature (°C) | Electrical Conductivity (mS/m) | Dissolved Oxygen (mg/L) | Salinity (%) | ORP |
| | | | | | | | | | | | | | |
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Field Sampling Technical Systems Audit

Project Name: _____
Date of Audit: _____
Auditor: _____
Audit No: _____

General:

A. Has the site exclusion zone been defined and secured?
SAT ____ UNSAT ____ N/A ____

B. Is site access log available and in use?
SAT ____ UNSAT ____ N/A ____

C. Is the Work Plan, including the SAP, available onsite and are personnel complying?
SAT ____ UNSAT ____ N/A ____

D. Has the Project Personnel Sign-Off Sheet (SAP Worksheet #4) been signed by the key personnel prior to the start of work on-site?
SAT ____ UNSAT ____ N/A ____

E. Are the appropriate and current SOPs available onsite?
SAT ____ UNSAT ____ N/A ____

F. Have the site emergency phone numbers and the medical facilities address and route map been posted?
SAT ____ UNSAT ____ N/A ____

LOGBOOKS

1) Are logbooks permanently bound and pre-paginated?
SAT ____ UNSAT ____ N/A ____

2) Are corrections to logbook entries made with a single line out of the incorrect entry, and has the correction been initialed by the person making the correction?
SAT ____ UNSAT ____ N/A ____

3) Is each sample or field measurement properly documented to facilitate timely, correct and complete analysis of data?
SAT ____ UNSAT ____ N/A ____

HEALTH & SAFETY

4) Has a daily Health & Safety meeting covering site-specific health hazards and required PPE been conducted?
SAT ____ UNSAT ____ N/A ____

5) Have all visible Health & Safety concerns been addressed (ex. slips, trips, or falls)?
SAT ____ UNSAT ____ N/A ____

6) Have the utility & geophysical clearances been completed prior to the start of intrusive work?
SAT ____ UNSAT ____ N/A ____

7) Is an organic vapor meter, a PID/FID, being used to monitor organic vapors during direct push operations?

SAT ____ UNSAT ____ N/A ____

8) Are the field instruments being used calibrated, and is the calibration recorded? (Record instrument serial numbers.)

SAT ____ UNSAT ____ N/A ____

SCAPS

9) Was the SCAPS pre-push calibration of the laser performed and documented?

SAT ____ UNSAT ____ N/A ____

10) Was the SCAPS cone& sleeve strain gauge calibration performed and documented?

SAT ____ UNSAT ____ N/A ____

11) Are the site location names being used consistently with respect to the SCAPS WinOCPT data files and the sample identification numbers?

SAT ____ UNSAT ____ N/A ____

SAMPLING & ANALYSIS

12) Does the onsite mobile laboratory have current state certification? Current SOPs for methods they are performing? Qualification and certifications for the mobile lab operator?

SAT ____ UNSAT ____ N/A ____

13) Verify that the physical parameters for each groundwater sample collected are recorded and are in range. (include conductivity, pH, and temperature)

SAT ____ UNSAT ____ N/A ____

14) Verify that the soil or groundwater sample is transferred directly into the appropriate sample container, labeled, and placed into an ice chest.

SAT ____ UNSAT ____ N/A ____

15) Do the sample labels affixed to each sample container have the following information: project name and number, sample ID, analysis to be performed, type of preservative, sample collector's initials, collection date and time, and special instructions?

SAT ____ UNSAT ____ N/A ____

16) Are sampling equipment, materials, tools, and field measurement devices being decontaminated before each use, and in accordance with SOP T-001?

SAT ____ UNSAT ____ N/A ____

17) Are equipment rinsate blanks collected by pouring deionized water over or through the sampling equipment after decontamination and prior to taking the next sample?

SAT ____ UNSAT ____ N/A ____

18) Is one equipment rinsate sample (equipment blank) collected for each day that non-disposable sample equipment is used?

SAT ____ UNSAT ____ N/A ____

19) Is equipment rinsate documentation complete with detail of the equipment used and the source water description (ex. Arrowhead Distilled, Lot No., etc.)?

SAT ____ UNSAT ____ N/A ____

20) Is one MS/MSD sample collected for every 20 environmental samples collected?

SAT ____ UNSAT ____ N/A ____

21) Are source blanks being collected from the same source of water used for equipment decontamination?

SAT ____ UNSAT ____ N/A ____

22) Is one groundwater field duplicate sample collected for every 10 groundwater samples collected?

SAT ____ UNSAT ____ N/A ____

23) Does each shipping container being sent to the fixed-base laboratory contain a temperature blank?

SAT ____ UNSAT ____ N/A ____

24) Does each shipping container being sent to the fixed-base laboratory contain the appropriate number of trip blank samples?

SAT ____ UNSAT ____ N/A ____

25) Are soil and groundwater samples being sent to a fixed-base laboratory for the methods indicated in QAPP Worksheets 19, 20, and 28?

SAT ____ UNSAT ____ N/A ____

26) Are sample containers being placed in a cooler with wet or dry ice to maintain sample temperatures at 4°C?

SAT ____ UNSAT ____ N/A ____

27) Are glass sample containers being wrapped in foam or bubble wrap before being placed in a Ziploc style bag?

SAT ____ UNSAT ____ N/A ____

28) Are shipping containers being secured with two custody seals (front right & back left)?

SAT ____ UNSAT ____ N/A ____

29) Have all the appropriate sampling forms and sample decontamination been completed?

SAT ____ UNSAT ____ N/A ____

30) Is all applicable information recorded on the chain-of-custody (COC), including sample ID, ”relinquished/received by” signatures, and time and date of relinquishment?

SAT ____ UNSAT ____ N/A ____

31) Are samples requiring different QC levels or turnaround times recorded correctly on the COCs?

SAT ____ UNSAT ____ N/A ____

32) If samples are to be delivered to the fixed-base laboratory by an overnight carrier, has the airbill number been recorded on the COC?

SAT ____ UNSAT ____ N/A ____

33) If samples are to be delivered to the fixed-base laboratory by an overnight carrier, has the COC been placed inside a plastic Ziploc style bag and taped to the inside of the sample container lid?

SAT ____ UNSAT ____ N/A ____

INVESTIGATION DERIVED WASTE

34) Is IDW being handled and stored appropriately? (i.e. soil being placed in covered portable roll-off bins lined with plastic sheeting or DOT approved drums (ex. 17H 55-gallon drum) and liquids in a separate 17H 55-gallon drum?)

SAT ____ UNSAT ____ N/A ____

35) Is each IDW container clearly marked with a label to indicate the waste source, date of generation, point of contact, etc.?

SAT ____ UNSAT ____ N/A ____

36) Is any IDW being stored over 90 days? If storage area is at Camp Pendleton, is any IDW being stored over 60 days?

SAT ____ UNSAT ____ N/A ____

COMMENTS:

# SAP Attachment 3

Analytical Standard Operating Procedures

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STANDARD OPERATING PROCEDURES

# VOLATILE ORGANICS BY GC/MS

| | | | | | |
|---|---|---|---|---|---|
| SOP No.: | EMAX-8260 | Revision No. | 6 | Effective Date: | 25-Oct-10 |
| Prepared By: | W. Tu Nisamaneepong | | | Date: | 10-29-10 |
| Approved By: | Kenette Pimentel<br>QA Manager | | | Date: | 10-25-10 |
| Approved By: | Caspar Pang<br>Laboratory Director | | | Date: | 10-25-10 |

**Control Number: 8260-06-**

## 1.0 SCOPE AND APPLICATION

1.1. This analytical method is used to determine the concentration of volatile organic compounds whose boiling points are below 200°C and are water insoluble or slightly water-soluble found in solid or liquid samples. The list of compounds is summarized in Tables 7 and 8. Additional analytes may be added after verification. This SOP is an adaptation of Method 8260B.

## 2.0 SUMMARY OF METHOD

2.1. A measured sample is extracted using a purge and trap concentrator system. The extract is introduced to a temperature-programmed GC. The analytes are eluted through the GC column separating each analyte relative to its volatility. These analytes are captured and ionized by the mass spectrometer. The ionized fragments are measured by mass to charge ratio. Analyte qualitative identification is based on the characteristic electron impact mass spectra. Analyte quantitative identification is based on the response of the major ion relative to an internal standard using a multi-point calibration curve.

2.2. **Interferences**

2.2.1. Contamination may occur by diffusion of volatile organics (particularly chlorofluorocarbons and methylene chloride) through sample container septum during shipment and storage. Trip blanks and storage blanks can serve as means of monitoring.

2.2.2. Glassware and other sample processing materials in which the samples come into contact with are possible sources of contamination. All glassware and other materials used must be purchased pre-cleaned or decontaminated prior to use.

2.2.3. Solvents and reagents are possible sources of contamination. All solvents and reagents must be GC grade and must pass the QC checks prior to use.

2.2.4. Contamination by carry-over can occur whenever high concentration samples are analyzed in sequence with a low concentration sample. To reduce potential carry-over, the concentrator must be thoroughly baked-out between samples and the sample syringe and purging device must be thoroughly rinsed with an appropriate solvent between samples.

2.2.5. Another possible source of contamination is the analytical instrument itself. This can be monitored by analyzing an instrument blank prior to any analysis.

## 3.0 DETECTION LIMITS

3.1. **Detection Limit (DL), Limit of Detection (LOD) & Limit of Quantitation (LOQ)**

3.1.1. Refer to EMAX-QA04 for generation, validation and verification for DL, LOD and LOQ.

3.1.2. Refer to Tables 7 and 8 for established DL, LOD and LOQ levels.

## 4.0 DYNAMIC RANGE

4.1. The highest quantifiable concentration requiring no dilution is equal to the highest calibration point (see Sec. 9.4). All samples analyzed above this concentration are considered "over-range" and shall require dilution to properly quantitate.

4.2. The concentration in the diluted sample should be at or above the project reporting limit. All diluted samples analyzed below this concentration are considered "under-range". A lower dilution factor is required to properly quantitate.

4.3. **Typical Dynamic Range**

4.3.1. Water: 5 µg/L to 200 µg/L (5 ml purge)
1 µg/L to 40 µg/L (25 ml purge)

4.3.2. Soil: 5 µg/kg to 200 µg/kg

## 5.0 SAMPLE HOLDING TIME AND PRESERVATION

5.1. **Aqueous Samples**

5.1.1. Samples received in the laboratory should be contained in 40 ml vials with teflon lined septa with zero headspace.

***Note: The size of any bubble caused by degassing upon cooling the sample should not exceed 6 mm.***[1]

5.1.2. All samples must be stored at $\leq 6^{o}$C).

5.1.3. Samples preserved in HCL shall be analyzed within 14 days from the date of sampling. Samples with no chemical preservative must be analyzed within 7 days from the date of sampling.

5.2. **Soil Samples**

5.2.1. Samples receive in a glass jars or brass tubes shall be stored at $\leq 6^{o}$C. Samples must be analyzed within 14 days from sampling date.

5.2.2. Samples received in encore tubes are frozen, preserved with sodium bisulfate or extracted with methanol prior to analysis.

- Frozen encore tubes must be analyzed within 14 days from sampling date.
- Samples preserved with sodium bisulfate within 48 hours from sampling date must be analyzed within 14 days from sampling date.
- Methanol extracts shall be analyzed within 14 days from sampling date.
- Preserved samples and extracts shall be stored at $\leq 6^{o}$C.

[1] Referenced from SW846 Method 5030B, Section 6.1.

## 6.0 ASSOCIATED SOPs

6.1. EMAX-5030 - Purge and Trap For Aqueous Samples

6.2. EMAX-5035 - Closed-System Purge and Trap For Solid Samples

6.3. EMAX-DM01- Data Flow and Review

6.4. EMAX-QA04 - Method Detection Limit

6.5. EMAX-QA05 - Training

6.6. EMAX-QA08 - Corrective Action

6.7. EMAX-QC01 - Quality Control for Chemicals

6.8. EMAX-QC02 - Analytical Standard Preparation

6.9. EMAX-QC07 - Glassware Cleaning

6.10. EMAX-SM03 - Waste Disposal

6.11. EMAX-SM04 - Analytical and QC Sample Labeling

## 7.0 SAFETY

7.1. Read all MSDS of chemicals listed in this SOP.

7.2. All reagents, standards, and samples shall be treated as potential hazards. Observe standard laboratory safety procedures. Protective gear, i.e., lab coat, safety glasses, and gloves, shall be worn at all times when performing this procedure. All sample and standard handling shall be performed in the fume hood.

7.3. All waste generated during analytical process shall be placed in the waste containers. Waste shall be endorsed to the waste disposal section for proper disposal.

7.4. If for any reason, solvent and/or other reagents get in contact with the skin or any other part of the body, rinse the affected body part thoroughly with tap water. If irritations persist, inform your supervisor immediately so that proper action can be taken.

## 8.0 INSTRUMENTS, CHEMICALS AND REAGENTS

8.1. **Instruments and Supplies**

| | |
|---|---|
| Gas Chromatography | HP 5890 Series II or equivalent |
| Detector | HP 5970 MSD or equivalent |
| Column | RTX 502.2 (0.32 mm x 60 m), 1.8um thickness or equivalent after verification that the four gases (chloromethane, bromomethene, chloroethane, and vinyl chloride) can be resolved > 90% from each other in the total ion chromatogram |
| Data Acquisition Software | ChemStation or equivalent |
| Purge & Trap Device | 2000/OI 4460A/Dyna Tech/EST or equivalent |

| | |
|---|---|
| Multiple purging module | DynaTech/Archon or equivalent |
| Gases | Ultra-high purity helium/Air |
| Syringes | 5-ml, 25-ml Luerlok gas-tight |
| Microsyringes | 1, 10, 20, 25, 50, 100, and 1000 µL<br>(Hamilton 702N or equivalent) for dilution purposes |
| Volumetric Flasks | 2,5,10, 50, and 100 ml with ground glass stopper |
| Heated Jacket | Tekmar or O.I. Automatic sample heating jacket or equivalent |

8.2. **Chemicals and Reagents**

| | |
|---|---|
| Extraction Solvent | Purge & Trap Grade Methanol or equivalent |
| Reagent Water | Organic-free water |
| Reagent Soil | Organic-free Ottawa Sand or equivalent |
| Preservative | Sodium Bisulfate |

## 9.0 STANDARDS

9.1. Standard preparation for VOA is summarized in Tables 1 to 4. Refer to EMAX-QC02 for proper analytical standard preparation. Other concentration levels may be prepared provided it complies with the method and project requirements.

9.2. **Stock Standard**

9.2.1. Purchase Stock Standards as certified solutions.

9.2.2. Purchase one set of calibration standard (Refer to Tables 1) for calibration and a secondary source Stock Standard for calibration verification (Refer to Table 2).

9.2.3. Purchase Surrogate Mix at 2500 mg/L and Internal Standard at 2000 mg/L (Refer to Table 3).

9.2.4. Purchase BFB as Tuning Standard at 5000 mg/L (refer to Table 4).

9.2.5. After opening, transfer in inert vials with minimal headspace and store at -10$^{o}$C to -20$^{o}$C.

9.3. **Intermediate Standards**

9.3.1. Using the stock standard solutions, prepare intermediate standards in methanol according to Tables 1 to 4 and store with minimal headspace in an inert vial.

9.4. **Initial Calibration Standards (ICAL)**

9.4.1. ICAL for 5-ml Purge.

9.4.1.1. Using intermediate standards, prepare a minimum of 6 calibration standards as suggested below.

| Calibration Pt. | VOA (µg/L)* | Surrogate (µg/L) | Internal Std (µg/L) |
|---|---|---|---|
| 1 | 5 | 5 | 50 |
| 2 | 10 | 10 | 50 |
| 3 | 20 | 20 | 50 |
| 4 | 50 | 50 | 50 |
| 5 | 100 | 100 | 50 |
| 6 | 200 | 200 | 50 |

* Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.

9.4.2. ICAL for 25-ml Purge

9.4.2.1. Using intermediate standards, prepare a minimum of 6 calibration standards as suggested below:

| Calibration Pt. | VOA (µg/L)* | Surrogate (µg/L) | Internal Std (µg/L) |
|---|---|---|---|
| 1 | 0.5 | 0.5 | 10 |
| 2 | 1 | 1 | 10 |
| 3 | 2 | 2 | 10 |
| 4 | 10 | 10 | 10 |
| 5 | 20 | 20 | 10 |
| 6 | 40 | 40 | 10 |

* Ketones, Acrolein, Acrylonitrile and tert-Butanol are 5X the indicated concentration and m/p-Xylene is 2x the indicated concentration.

9.5. **Initial Calibration Verification Standard (ICV)**

9.5.1. Using the Intermediate Standard prepared from the secondary source, spike into 5-ml or 25-ml purge. Refer to Table 5 for concentration levels of each analyte.

9.6. **Daily Calibration Check Standard (DCC)**

9.6.1. Using the Intermediate Standard prepared from the same source as the ICAL Standard, spike into 5-ml or 25-ml purge. Spike also Surrogate Standard. Refer to Table 5 for concentration levels of each analyte.

9.7. **LCS and Matrix Spike Standard**

9.7.1. For spike standards, use the ICV standard unless otherwise specified by the project. Refer to Table 5.

## 10.0 PROCEDURES

10.1. **Sample Preparation**

10.1.1. Refer to EMAX-5030 and EMAX-5035.

10.2. **Instrument Parameters**

10.2.1. From the main gas supply (gas Tanks) regulate gas pressure at 80 psi.

10.1.1. Fine-tune the instrument guided by the parameter conditions suggested below. Adjust the parameter conditions accordingly to obtain optimum condition. Print the instrument parameter and post it on the instrument for daily routine maintenance check.

10.2.2. Typical GC Parameters

| | |
|---|---|
| Carrier gas flow (column) helium | 1 - 5 ml/min |
| Initial Temp | 40°C; hold for 1 min. |
| Rate | 6°C/min. |
| Final Temp | 200°C; hold for 1 min. |
| Inject Port | 160°C |
| Interface | 250°C |

10.2.3. Mass Spectrometer Parameter

| | |
|---|---|
| Scan Start | 0.5 min. |
| Splitless value time | 0 min. |
| Mass Range | 35 to 300 |
| Multiplier | 1200 to 2700 |

10.2.4. Typical Purge and Trap Condition

10.2.4.1. Purge samples at 40°C for 11 minutes, desorbed at 250°C for 2 minutes and then bake the trap at 260°C for 11 minutes.

10.3. **Calibration**

10.3.1. Set GC/MS operating condition as described in Section 10.2.

10.3.2. **Perform Tune Check**

10.3.2.1. Introduce a BFB[2] to yield 5 – 50ng on column by either direct injection or purge and trap in 5-ml or 25-ml organic-free water.

10.3.2.2. Evaluate the tune check by the highest scan on the peak or the average of at least 3 scans (before, at, and after the apex) with a background subtraction using a single scan no more than 20 scans prior to the elution of BFB.

10.3.2.3. Check Table 6 for acceptance criteria or follow the manufacturer's recommendation for tuning. A valid tune check expires after 12 hours.

10.3.2.4. If non-compliant refer to Section 12 for corrective action.

10.3.3. **Initial Calibration (ICAL)**

[2] Alternatively, BFB in DCC can be used to evaluate tuning.

10.3.3.1. Perform ICAL when one of the conditions occurs.

- Instrument is new
- Instrument undergoes a major repair
- DCC failed to meet the acceptance criteria

10.3.3.2. Analyze minimum of 6-point initial calibration curve (Refer to Section 9.4) after a valid tune check.

10.3.3.3. Check for completeness of target compound list. If there is/are missing compound(s), perform the following:

- Check the established retention time window
- Check the relative intensity of major ions
- Adjust accordingly if necessary.

10.3.3.4. Establish a summary of Relative Response Factors for each analyte at each concentration. Calculate the Average Relative Response Factor ($RRF_m$), the Standard Deviation (SD), and the Relative Standard Deviation (RSD) according to Eq. 10.6.1.2, Eq. 10.6.1.5 and Eq. 10.6.1.6, respectively.

10.3.3.5. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.3.6. Evaluate the ICAL for appropriate quantitation method.

- Use $RRF_m$ if the RSD of individual analyte $\leq$15%.
- Apply Inverse Weighting Factor (1/y or $1/y^2$; where y is the instrument response) if it is determined to be the best fit for the specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$15% and correlation coefficient of ≥0.99.
- Apply linear least squares regression if past experience or priori knowledge of instrument response is known to be the best fit for specific analytes. This approach may be applied to any analyte including analyte that has RSD of $\leq$15% and correlation coefficient of ≥0.99.
- It may be appropriate to force the regression through zero for specific analytes.[3] When exercising this option (as included in the data acquisition software) make sure that the origin (0,0) is not included as a calibration point but rather the intercept is set to zero. This option shall only be applied if the curve favors better accuracy of quantitation.

10.3.3.7. Submit summary of ICAL, raw data and manual integration (if any) for secondary review.

10.3.4. **Initial Calibration Verification (ICV)**

10.3.4.1. Analyze ICV to verify the concentration of the ICAL standards (refer to Section 9.5).

[3] SW846 Method 8000B, Section 7.5.3

10.3.4.2. Check for completeness of analytes as described in Section 10.4.2.

10.3.4.3. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.4.4. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.4.5. Refer to Appendix 1 for ICV acceptance criteria and/or corrective action.

10.3.4.6. When non-compliant refer to Section 12 for corrective action.

10.3.5. **Daily Continuing Calibration (DCC)**

10.3.5.1. Analyze DCC to check the validity of the ICAL (refer to 9.6).

10.3.5.2. Check for completeness of analytes as described in Section 10.4.2.

10.3.5.3. Evaluate System Performance Check Compounds (SPCC) and Calibration Check Compounds (CCC) as specified in Appendix 1.

10.3.5.4. Compare the retention times of the internal standards to the ICAL mid-point. Excursion of ± 30 seconds indicates instrument malfunction. When non-compliant check the column head pressure, gas supply or leaks. Corrective action is required prior to further analysis.

10.3.5.5. Compare the area of the Internal Standards (IS) acquired against the midpoint of the initial calibration point. The extracted ion current profile (EICP) must be within a factor of two (-50% to +100%).

10.3.5.6. Establish RRF of each analyte, calculate %D (Eq. 10.6.2.1) against the ICAL.

10.3.5.7. Refer to Appendix 1 for DCC acceptance criteria and/or corrective action.

10.3.5.8. When non-compliant refer to Section 12 for corrective action.

10.4. **Analysis**

10.4.1. **Analytical Sequence**

10.4.1.1. Analyze BFB and evaluate tuning

10.4.1.2. Analyze DCC and check ICAL validity

10.4.1.3. Analyze Lab Control Sample

10.4.1.4. Analyze Lab Control Sample Duplicate (if required)

10.4.1.5. Analyze Method Blank

10.4.1.6. Analyze samples to a maximum number of 12-hours from the time of BFB injection.

10.4.1.7. Analyze a pair of matrix spikes (MS/MSD) for every 20 samples of the same matrix.

10.4.1.8. Record analytical sequence in the analytical run log.

10.4.2. **Sample Result Evaluation**

10.4.2.1. Check the QC criteria as soon as the data is available.

- Check surrogate recoveries against project specific requirement (PSR). In the absence of PSR, default to Appendix 1 QC limits.
- Check concentration of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required. Note observations on the analytical run log. When results arise to questionable result, e.g. inconsistency from the first analysis, consult the Supervisor for further action.

10.4.3. **Qualitative Identification**

- The intensities of the characteristic ions maximize in the same scan or within one scan of each other.
- The relative retention time (RRT) of the sample component is within 0.06 RRT units of the RRT of the standard component.
- The relative intensity of the characteristic ions agrees within 30% of the relative intensity of these ions in the reference spectrum.
- Check the chromatogram for possible misidentified analytes. Investigate visible peaks in the chromatogram that were not identified in the data output. Manually integrate the peak if necessary.

10.4.3.1. For samples containing components not associated with the calibration standards, perform a library search for purposes of tentative identification4 (TIC). Execute *FTICB exe (HP RTE-1000 program) or LSC (Chem Station program) to initiate the library search using NIST/EPA/MSDC mass spectral library. Visually inspect each extracted mass ion chromatograph to determine the identification of the unknown before final reporting following the guidelines below.

- Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) should be present in the sample spectrum.
- The relative intensities of the major ions should agree within + 20%. Example: for an ion with an abundance of 50% of the standard spectra, the corresponding sample ion abundance must be between 30 and 70%.
- Molecular ions present in reference spectrum should be present in sample spectrum.
- Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of co-eluting analytes.
- Ions present in the reference spectrum but not present in the sample spectrum should be reviewed for possible subtraction from the sample spectrum because of background contamination or co-eluting analytes. Data system library reduction programs can sometimes create these discrepancies.

**10.4.3.2. Reporting TICs**

- If the library search produces a match at or above 85%, report the analyte.

[4] Library search is performed only when indicated in the PSR.

- If the library search produces more than one analyte at or above 85%, report the first analyte (highest).
- If the library search produces no matches at or above 85%, the compound should be reported as unknown.

10.4.4. **Quantitation**

- Apply the appropriate quantitation method (Section 10.3.3.6). Calculate the concentration of any positively identified target analyte using the appropriate equation in Section 10.6.3. Apply the dilution factor for diluted samples to calculate for the final concentration of the sample.

10.4.5. **Manual Integration**

10.4.5.1. Refer to EMAX-DM01, Section 4.4.3.

10.4.6. **Dealing with Carryover**

10.4.6.1. Check the sample analyzed after a sample having target analyte concentrations exceeding the calibration range.

10.4.6.2. If there is no target analyte detected as found in the sample that exceeded the calibration range, proceed with data reduction.

10.4.6.3. If there is any target analyte detected as found in the sample that exceeded the calibration range, re-analyze the sample to rule out carry over. If carry over is confirmed, proceed with data reduction and report the data from re-analysis.

10.4.6.4. For decontaminating the sample purger consider the following suggestion:

- Rinse the purging apparatus and the contaminated port with organic-free reagent water containing 10% methanol. Dry purge the system overnight and analyze reagent blank prior to sample analysis. Repeat the process until no evidence of contamination is observed.

10.5. **Data Reduction**

10.5.1. Make a copy of the analytical run log and highlight the data to be reported.

10.5.2. Check that all positively identified analytes are within the calibration range.

10.5.3. Collate the reportable raw data separating the QC results from the sample results.

10.5.4. Keep all other data generated with the analytical folder marked with “For record only”.

10.5.5. Proceed to report generation.

10.6. **Calculations**

10.6.1. Initial Calibration

10.6.1.1. Calculate for the Relative Response Factor (RRF)

$$RRF = \frac{A_X C_{IS}}{A_{IS} C_X} \qquad \textit{Eq. 10.6.1.1}$$

where:

*RRF* – Relative Response Factor

$A_X$ – Area of characteristic ion for the compound being measured

$A_{IS}$ – Area of characteristic ion for the specific internal standard

$C_X$ – Concentration of the compound being measured

$C_{IS}$ – Concentration of the specific internal standard

10.6.1.2. Calculate for the Average Relative Response Factor ($RRF_m$).

$$RRF_m = \frac{\sum RRF}{n} \qquad \textit{Eq. 10.6.1.2}$$

where:

$RRF_m$ – Average response factor

$\sum RRF$ – Summation of response factors

*n* – Number of measurements

10.6.1.3. Calculate for Least Square Linear Regression

$$y = ax + b \qquad \textit{Eq. 10.6.1.3}$$

where:

*y* – Response ratio ($A_X/A_{IS}$)

*x* – Amount ratio ($C_X/C_{IS}$)

*a* – x1 = slope of the line

$$a = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sum (x-\bar{x})^2}$$

where: $\bar{x}$ = average of amount ratios

$\bar{y}$ = average of response ratios

*b* – x0 = intercept of the line

$$b = \bar{y} - a * \bar{x}$$

10.6.1.4. Calculate for Inverse Weighting Factor

$$y = ax + b \qquad \textit{Eq. 10.6.1.4}$$

where:

*y* – Response ratio ($A_X/A_{IS}$)

*x* – Amount ratio ($C_X/C_{IS}$)

*a* – x1 = slope of the line

$$a = \frac{\sum (x - x_a)(y - y_a)}{\sum (x - x_a)^2}$$

where: $x_a = \sum \left[ x(1/x) / \sum (1/x) \right]$

$y_a = \sum \left[ y(1/x) / \sum (1/x) \right]$

or $x_a = \sum \left[ x(1/x^2) / \sum (1/x^2) \right]$

$y_a = \sum \left[ y(1/x^2) / \sum (1/x^2) \right]$

*b* – x0 = intercept of the line

$$b = y_a - a * x_a$$

10.6.1.5. Calculate the Standard Deviation

$$SD = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}} \qquad \textit{Eq. 10.6.1.5}$$

where:

*SD* – Standard deviation

$x_i$ – Result at $i^{th}$ measurement

$\bar{x}$ – Mean of the n measurements

*n* – Number of measurements

10.6.1.6. Calculate the % relative standard deviation (%RSD).

$$\%RSD = \frac{SD}{RRF_m} * 100\% \qquad \textit{Eq. 10.6.1.6}$$

where:

*SD* – Standard deviation

$RRF_m$ – Average response factor

10.6.2. Calibration Check/Continuing Calibration

10.6.2.1. Calculate Percent Difference (%D)

$$\%D = \frac{[RRF_c - RRF_m]}{RRF_m} * 100\% \qquad \textit{Eq. 10.6.2.1}$$

where:

$RRF_c$ – Response factor from continuing calibration standard

$RRF_m$ – Average response factor

10.6.2.2. % Drift

$$\%Drift = \frac{[found\ Conc. - true\ Conc]}{true\ Conc.} * 100\% \qquad Eq.\ 10.6.2.2$$

10.6.3. Calculation of Sample Concentration (Water and Soil/Sediment Samples). When a compound is identified, the quantitation of that compound shall be based on the integrated abundance from the EICP of the primary characteristic ion.

10.6.3.1. Water Samples

$$Concentration\ (ug/L) = \frac{(Ax)(Is)}{(Ais)(RRF_m)}\ x\ DF \qquad Eq.\ 10.6.3.1$$

where:

$A_x$ – Area of characteristic ion for the compound to be measured

$I_s$ – Concentration of internal standard added in µg/L

$A_{is}$ – Area of characteristic ion for the internal standard

$RRF_m$ – Average response factor

$DF$ – Dilution factor = $\frac{purge\ volume\ in\ ml\ \ (5\ ml\ or\ 25\ ml)}{sample\ \ amount\ \ in\ ml}$

10.6.3.2. Soil/Sediment Samples (Dry weight basis)

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad Eq.\ 10.6.3.2$$

where:

$A_x$ – Area of characteristic ion for the compound to be measured

$I_s$ – Concentration of internal standard added in µg/L

$A_{is}$ – Area of characteristic ion for the internal standard

$RRF_m$ – Average response factor

$DF$ – Dilution factor = $\frac{5\ g}{(sample\ \ amount\ \ in\ g)}$

$DW$ – % solid = $\frac{100 - \%moisture}{100}$

10.6.3.3. Extracted Soil/Sediment Samples (Dry weight basis)

$$Concentration\ (ug/kg) = \frac{(Ax)(Is)}{(Ais)(RRF_m)(DW)}\ x\ DF \qquad Eq.\ 10.6.3.3$$

where:

$A_x$ – Area of characteristic ion for the compound to be measured

$I_s$ – Concentration of internal standard added in µg/L

$A_{is}$ – Area of characteristic ion for the internal standard

$RRF_m$ – Average response factor

$DF$ – Dilution factor = $\frac{(purged\ \ volume\ \ in\ \mu L)(5\,g)}{(extract\ \ aliquot\ \ in\ \mu L)(sample\ \ amount\ \ in\ g)}$

$DW$ – % solid = $\frac{100 - \%moisture}{100}$

10.6.4. Alternatively, the regression line (area ratio of Ax/Ais versus concentration using first degree) fitted to the initial calibration may be used for determination of the sample concentration when RSD of the analyte is greater than 15% (Section 10.3.3.6).

10.6.5. Concentration of TIC is estimated by the same method as target compounds with the following assumptions:

10.6.5.1. The area Ax and Ais are derived from total ion chromatogram. Ais refers to the closest internal standard (IS) free of interference.

10.6.5.2. RRF of the TIC is 1.

10.6.6. Method Proficiency

10.6.6.1. Percent Recovery

$$\%\ \mathrm{Recovery} = \frac{C_f - C}{C_s} * 100\% \qquad \textit{Eq. 10.6.6.1}$$

where:

$C_f$ – Concentration found

$C$ – Concentration of sample

$C_s$ – Concentration of spike

10.6.6.2. Relative Percent Difference (%RPD)

$$\%\ RPD = \frac{|C_1 - C_2|}{\left(\frac{C_1 + C_2}{2}\right)} \times 100 \qquad \textit{Eq. 10.6.6.2}$$

where:

$RPD$ – Relative Percent Difference

$C1$ – Measured concentration of the first sample aliquot

$C2$ – Measured concentration of the second sample aliquot

10.7. **Report Generation**

10.7.1. Generate the method.txt file using WBDX[5].exe.

10.7.2. Generate Lab Chronicle using Labchron.exe

10.7.3. Generate the sample results using F1VX[5].exe

10.7.4. Generate the QC summary using QCVX[5].exe

10.7.5. Generate Case Narrative using CN1.exe

10.8. **Data Review**

10.8.1. Arrange the analysis package in sequence as detailed below using section separators. Attach all raw data to every form generated, to include manual integration and re-analyses.

- Sample Results
- LCS Summary
- MS/MSD Summary
- ICAL Summary
- ICV Summary
- DCC Summary

10.8.2. Perform a 100% data review in accordance to EMAX-DM01and the PSR.

- Check internal standard area. They should be within -50 to +100% of DCC to be acceptable.
- Check surrogate recoveries against project specific criteria (PSR). In the absence of PSR, default to in-house QC limits.
- Check concentration of target analytes if calibration range is exceeded.
- If any of the above checkpoints indicate a problem, re-analysis is required.

10.8.3. Review case narrative that it accurately describes what transpired in the analytical process

10.8.4. Submit the analysis package for secondary review.

10.9. **Preventive Maintenance**

10.9.1. Perform instrument routine preventive maintenance and record on instrument-specific maintenance logs. Routine maintenance ensures that all equipment is operating under optimum conditions, thus reducing the possibility of instrument malfunction that may affect data quality.

10.9.2. The table below list suggested routine maintenance schedule.

| Task | Every Day | Every Week | Every Month | Every 3 Months | Every 6 Months | As Needed |
|---|---|---|---|---|---|---|
| Quick Tune | ✓ | | | | | |

[5] X - version number

| Task | Every Day | Every Week | Every Month | Every 3 Months | Every 6 Months | As Needed |
|---|---|---|---|---|---|---|
| Tune Check | ✓ | | | | | |
| Check the tightness of the column nuts. | ✓ | | | | | |
| Check gas cylinders pressure | ✓ | | | | | |
| Check the foreline pump oil level | | ✓ | | | | |
| Check the calibration vial | | | ✓ | | | |
| Check and if necessary, change injection port liners, septa and O-rings. | | | | ✓ | | |
| Clean the split/splitless inlet vent line trap. | | | | | ✓ | |
| Replace the foreline pump oil | | | | | ✓ | |
| Replace the diffusion pump fluid | | | | | ✓ | |
| Replace the traps and filters | | | | | ✓ | |
| Clean the ion source | | | | | | ✓ |
| Change the carrier gas trap(s) and purifier | | | | | | ✓ |
| Replace column | | | | | | ✓ |
| AutoTune the MSD | | | | | | ✓ |
| Replace the worn out parts | | | | | | ✓ |

## 11.0 QUALITY CONTROL

### 11.1. Sample Preparation Batch QC

11.1.1. Analyze Method Blank (MB) to demonstrate that preparation of samples was free from contamination.

11.1.2. Analyze Lab Control Sample (LCS/LCD) to assess preparative batch accuracy and precision.

11.1.3. Analyze Matrix Spike (MS/MSD) to assess matrix interference.

11.1.4. All lab wares used in the sample preparation shall be properly treated as specified in EMAX-QC07.

11.1.5. All solvents and reagents shall undergo quality control check in the stationary laboratory prior to its use.

### 11.2. Analytical Batch QC

11.2.1. Perform tune check to verify that the mass spectrometer meets standard mass spectra abundance criteria prior to calibration and check for any contamination.

11.2.2. Perform initial calibration (ICAL) to establish a calibration curve for the quantification of the analytes of interest.

11.2.3. Establish retention time window position for each analyte every after ICAL for proper qualitative identification.

11.2.4. Perform initial continuing calibration verification (ICV) every after ICAL to verify accuracy of ICAL.

11.2.5. Perform continuing calibration verification (CCV) every 12 hours to verify that instrument response is reliable, and has not changed significantly from the current ICAL curve.

11.2.6. Evaluate relative retention time for each anlaytes in every sample to be within ±0.06 RRT units.

11.2.7. Verify internal standards(IS) for quantitative accuracy and that its Retention time is within ± 30 seconds from retention time of the midpoint standard in the ICAL and EICP area is within -50% to +100% of ICAL midpoint standard.

11.2.8. Evaluate surrogate recovery to monitor instrument response on every sample.

11.3. **Method QC**

11.3.1. Establish detection limit (DL) to determine the smallest analyte concentration that can be demonstrated to be different from zero.

11.3.2. Establish limit of detection (LOD) to determine the smallest concentration of an analyte that can be qualitatively identified in a sample with 99% confidence level.

11.3.3. Establish limit of quantitation (LOQ) to determine the lowest concentration that produces a quantitative result within specified limits of precision and bias.

11.3.4. Demonstrate capability by understanding and applying procedures set forth by this SOP and culminating it with demonstration of capability as described in EMAX-QA05.

11.4. Refer to Appendix 1 for all related Quality Control parameters, frequency, acceptance criteria and corrective action

## 12.0 CORRECTIVE ACTION

12.1. **Sample Preparation QC**

12.1.1. If MB is non-compliant, consider the following suggestions to correct the problem:

- If contaminant is trace level, bake the trap at 260 $^{o}$C for about 30 minutes.
- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem persist, inform the supervisor for further advice.

12.1.2. LCS is non-compliant, consider the following suggestions to help you correct the problem:

- If majority of the analyte response are low and no evidence of leak is apparent, it is indicative of a bad purge or standard degradation. Prepare a fresh standard and re-analyze LCS and the associated samples.

- If result is bias high, rule out contamination. Refer to 12.2.1
- If problem persist, inform the supervisor for further advice.

12.1.3. If MS is non-compliant consider the following suggestion to correct the problem:

- Verify that the spike amount added is accurate by checking the record and the micropipette calibration
- If LCS is within acceptance criteria then and the right amount of spike is added into the sample then it is indicative of matrix interference. Discuss the probable matrix interference in the case narrative

12.2. **Analytical Batch QC**

12.2.1. **Tune Check.** If tune check is non-compliant consider the following suggestion to correct the problem:

- Check the abundance of mass 95 and 174. If it is significantly less than previous tune checks, it is indicative of insufficient amount of BFB injected. Probable causes are: improper spiking, leaks, standard degradation or low vacuum system. Repeat tune check ensuring that BFB was properly spiked or rule out leaks, prepare a fresh BFB standard and repeat the tune check.
- If problem persist, retune the instrument and repeat tune check.

12.2.2. **Initial Calibration.**

12.2.2.1. If the %RSD is out of acceptance criteria, consider the following suggestions to correct the problem.

- If one of the standards returns a bias low or bias high on all of the analytes then that point is considered an out-liner. Prepare a standard at that ICAL point and re-analyze.
- If the highest ICAL point appears to be saturated, drop the highest point.
- If the lowest point returns a bias low or bias high response or the peaks are not distinct and sharp, drop the lowest point.

*Note : The lowest calibration point identifies the reporting limit (RL). Therefore, check that the RL is in conformance to the current projects where the ICAL will be used.*

12.2.3. **Daily Continuing Calibration Check (DCC)** If DCC is non-compliant consider the following suggestions to correct the problem

- If majority of the analyte response are low and no evidence of leak is apparent, it is indicative of a bad purge or leak. Re-analyze DCC.
- If problem persist, rule out standard degradation. Prepare a fresh standard and repeat DCC.
- Otherwise execute instrument maintenance and perform ICAL.

12.2.4. **Instrument Blank.** If instrument blank is non-compliant, consider the following suggestions to correct the problem

- If contaminant is trace level, bake the trap at 260 $^{o}$C for about 30 minutes.

- If contamination is high, flush the sample line with methanol and replace the trap.
- If problem persist, inform the supervisor for further action.

12.3. Generate a Non-Conformance Report (NCR) when an anomaly other than specified in Appendix 1 is observed. Refer to EMAX-QA08 for NCR details.

12.4. Discuss water samples that are labeled preserved having a pH value > 2 in the case narrative.

## 13.0 POLLUTION PREVENTION

13.1. Endorse all unused samples to the Waste Disposal Unit (WDU) for proper disposal. No samples shall be dumped on the laboratory sink.

13.2. Separate and properly identify all unused expired analytical standards prior to endorsing them to WDU for proper disposal.

## 14.0 WASTE MANAGEMENT

14.1. Dispose all unused samples, expired analytical standards and other waste generated during the analytical process in accordance to EMAX-SM-03.

## 15.0 SUPPLEMENTARY NOTES

15.1. **Definition of Terms**

15.1.1. Batch – A group of samples that are prepared and/or analyzed at the same time using the same lot of reagents.

15.1.1.1 ***Preparation batch*** is composed of one to 20 samples of the same matrix, a method blank, a lab control sample and matrix spike/matrix spike duplicate.

15.1.1.2 ***Analytical batch*** is composed of prepared samples (extracts, digestates, or concentrates), which are analyzed together as a group using an instrument in conformance to the analytical requirement. An analytical batch can include samples originating from various matrices, preparation batches, and can exceed 20 samples.

15.1.2. Calibration – A determinant measured from a standard to obtain the correct value of an instrument output.

15.1.3. Carry-over – Are contaminants retained in the instrument/apparatus from a highly contaminated sample that is passed into the succeeding sample(s).

15.1.4. CCC – Calibration check compounds that evaluate the integrity of the system. Variability of these compounds may indicate system leak or reactive sites in the column.

15.1.5. Instrument Method – A file generated to contain the instrument calibration and instrument parameter settings for a particular analysis.

15.1.6. Instrument Blank – A target-analyte-free solvent subjected to the entire analytical process to establish zero baseline or background value.

15.1.7. Lab Control Sample (LCS) – A target-analyte-free sample spiked with a verified known amount of target analyte(s) or a reference material with a certified known value subjected to the

entire sample preparation and/or analytical process. LCS is analyzed to monitor the accuracy of the analytical system.

15.1.8. Matrix – is a component or form of a sample.

15.1.9. Matrix Spike (MS) –A sample spiked with a verified known amount of target analyte(s) subjected to the entire sample preparation and/or analytical process. MS is analyzed to monitor matrix effect on a method's recovery efficiency.

15.1.10. Matrix Spike Duplicate (MSD) – A replicate of MS analyzed to monitor precision or recovery.

15.1.11. Method Blank – A target-analyte-free sample subjected to the entire sample preparation and/or analytical to monitor contamination.

15.1.12. MSDS – Material safety data sheet is where the physical data, toxicology and safety precaution of a certain substance is listed.

15.1.13. Response Factor – The ratio of the peak area of the target compound in the sample or sample extracts to the peak area of the internal standard in the sample or sample extract.

15.1.14. Sample – A specimen received in the laboratory bearing a sample label traceable to the accompanying COC. Samples collected in different containers having the same field sample ID are considered the same and therefore labeled with the same lab sample ID unless otherwise specified by the project.

15.1.15. Sample Duplicate – A replicate of a sub-sample taken from one sample, prepared and analyzed within the same preparation batch.

15.1.16. SPCC – System performance check compounds are compounds that are used to check compound stability and to check for degradation cause by contaminated lines or active sites in the system.

15.2. **Application of EMAX QC Procedures**

15.2.1. The procedures and QC criteria summarized in this SOP shall be applied to all projects when performing volatile analysis by GC/MS. The standard analyte list and RL are presented in Tables 7 & 8. In instances where there is a project or program QAPP, the requirements given in the project shall take precedence over this SOP.

15.3. **Department of Defense (DoD) Projects**

15.3.1. Samples from DoD sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoD Quality Systems Manual (QSM), latest update, shall be applied

15.4. **Department of Energy Basic Ordering Agreement (DOE-BOA) Projects**

15.4.1. Samples from DoE sponsored projects shall follow the Quality Assurance Project Plan (QAPP), Statement of Work (SOW) and/or client's quality control directive. In the absence of QAPP, the DoE Quality Systems for Analytical Services (QSAS), latest update, shall be applied.

## 16.0 REFERENCES

16.1. U.S. EPA Method 8260B; SW846, as updated.

16.2. EMAX Quality Systems Manual, as updated.

## 17.0 APPENDICES

17.1. **Figures**

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| 17.1.2. | Figure 2 | Typical Chromatogram |
| 16.1.1. | Figure 3 | Typical ICAL Summary |
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| 16.1.5. | Figure 7 | Typical LCS Report Summary |
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17.2. **Tables**

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| 17.2.6. | Table 6 | BFB Key Ion Abundance Criteria |
| 17.2.7. | Table 7 | Established DL, LOD and LOQ |
| 17.2.8. | Table 8 | Characteristic Ions for Purgeable Organic Compounds |
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17.3. **Appendices**

| | | |
|---|---|---|
| 17.3.1. | Appendix 1 | Summary of Quality Control Procedures |
| 17.3.2. | Appendix 2 | Demonstration of Capability |

17.4. **Forms**

| | | |
|---|---|---|
| 17.4.1. | 8260FA | Analytical Run Log |
| 17.4.2. | 8260FM | Instrument Maintenance Log |

**Figure 1:** **PEAK EVALUATION TECHNIQUES**

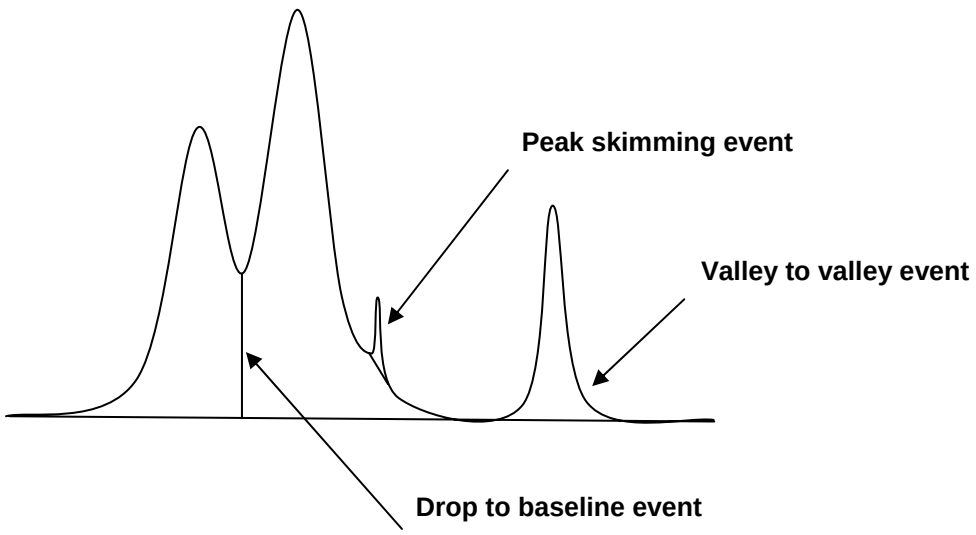
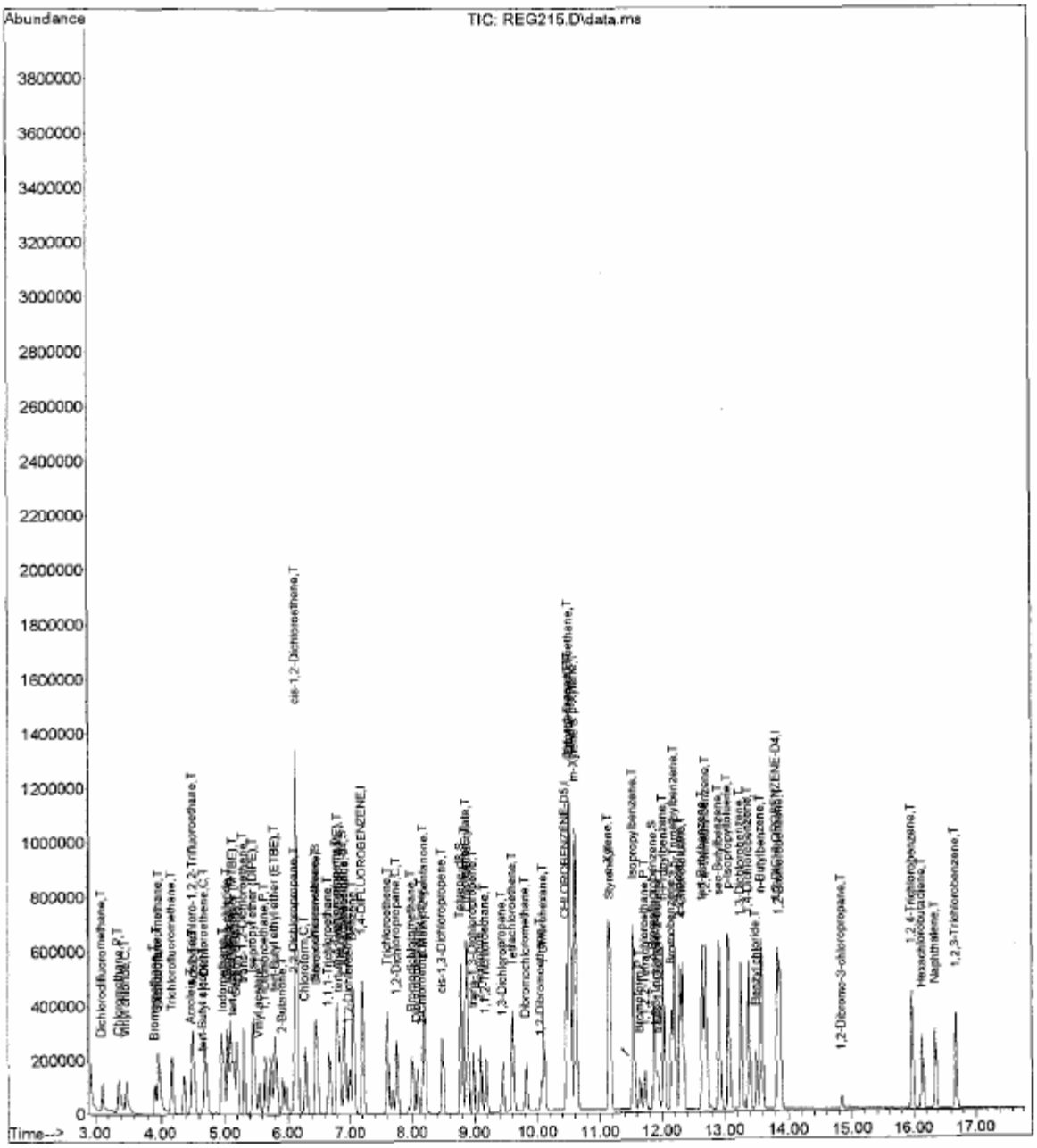


**Figure 2:** **TYPICAL CHROMATOGRAM**

Quantitation Report (Not Reviewed)

```
Data File : D:\Data\09E08\REG215.D                    Vial: 14
Acq On    :  8 May 2009  16:45                     Operator: CGM
Sample    : IVOE2E081                              Inst    : E2
Misc      : 10ppb 8260/50ppb KET-A-TBA/60ppb AC    Multiplr: 1.00
Integrator: RTE
Quant Time: May 13 13:20:08 2009
Quant Results File: VOE2E08.RES

Quant Method : C:\msdchem\1\METHODS\VOE2E08.M
Quant Title  : METHOD  8260  10mL
QLast Update : Wed May 13 13:16:50 2009
Response via : Initial Calibration
DataAcq Meth:VOE2E08.M
```




VOE2E08.M Wed May 13 13:20:09 2009 Page: 3

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**Figure 3:** **TYPICAL ICAL SUMMARY**

INITIAL_CALIBRATION - RELATIVE_RESPONSE_FACTOR

Instrument ID :E2
Beginning DateTime :05/08/09 12:03
Spike Units :PPB
IC File :REG208

Column Spec :RTX-502.2 ID :0.32MM
Ending DateTime :05/08/09 15:33
HPChem Method :VOE2E08

| M | IDX | Parameters | .3<br>12:03<br>REG203 | .5<br>12:26<br>REG204 | 1<br>12:49<br>REG205 | 2<br>13:13<br>REG206 | 5<br>13:36<br>REG207 | 10<br>14:00<br>REG208 | 30<br>14:23<br>REG209 | 50<br>14:47<br>REG210 | 100<br>15:10<br>REG211 | 200<br>15:33<br>REG212 | Av_RRF | %_RSD | Av_Rt_M |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1,4-DIFLUOROBENZENE | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 7.2174 |
| | 2 | Dichlorodifluoromethane | 0.243 | 0.210 | 0.233 | 0.223 | 0.275 | 0.267 | 0.267 | 0.261 | 0.238 | 0.238 | 0.245 | 8.72 | 3.1069 |
| | 3 | Chloromethane | ------ | 0.891 | 0.649 | 0.552 | 0.523 | 0.509 | 0.468 | 0.458 | 0.400 | 0.403 | 0.539 | 28.34 | 3.3674 |
| | 4 | Vinyl chloride | 0.439 | 0.385 | 0.353 | 0.361 | 0.380 | 0.378 | 0.357 | 0.348 | 0.276 | ------ | 0.364 | 11.78 | 3.4775 |
| | 5 | Bromomethane | 0.192 | 0.242 | 0.195 | 0.194 | 0.217 | 0.219 | 0.236 | 0.251 | 0.233 | 0.239 | 0.222 | 9.78 | 3.9081 |
| | 6 | Chloroethane | 0.174 | 0.202 | 0.203 | 0.202 | 0.216 | 0.219 | 0.215 | 0.217 | 0.192 | 0.193 | 0.203 | 7.00 | 3.9543 |
| | 7 | Dichlorofluoromethane | 0.466 | 0.453 | 0.495 | 0.517 | 0.581 | 0.548 | 0.517 | 0.535 | 0.482 | 0.489 | 0.508 | 7.70 | 3.9653 |
| | 8 | Trichlorofluoromethane | 0.521 | 0.502 | 0.426 | 0.455 | 0.484 | 0.470 | 0.468 | 0.477 | 0.431 | 0.416 | 0.465 | 7.25 | 4.1832 |
| 5 | 9 | Acrolein | 0.028 | 0.026 | 0.029 | 0.030 | 0.032 | 0.028 | 0.029 | 0.030 | 0.028 | 0.031 | 0.029 | 6.59 | 4.4837 |
| | 10 | 1,1,2-Trichloro-1,2,2-Trifluoroethane | 0.178 | 0.227 | 0.217 | 0.196 | 0.239 | 0.238 | 0.227 | 0.236 | 0.220 | 0.217 | 0.220 | 8.89 | 4.5134 |
| 5 | 11 | Acetone | 0.079 | 0.071 | 0.069 | 0.062 | 0.069 | 0.052 | 0.055 | 0.057 | 0.051 | 0.058 | 0.062 | 14.78 | 4.5156 |
| | 12 | 1,1-Dichloroethene | 0.346 | 0.374 | 0.392 | 0.371 | 0.420 | 0.403 | 0.386 | 0.401 | 0.371 | 0.361 | 0.383 | 5.81 | 4.6917 |
| 5 | 13 | tert-Butyl alcohol | ------ | ------ | 0.016 | 0.015 | 0.020 | 0.014 | 0.014 | 0.016 | 0.014 | 0.018 | 0.016 | 12.76 | 4.6697 |
| | 14 | Iodomethane | 0.285 | 0.360 | 0.368 | 0.407 | 0.455 | 0.465 | 0.438 | 0.456 | 0.410 | 0.406 | 0.405 | 13.66 | 4.9888 |
| | 15 | Methylene chloride | 0.505 | 0.478 | 0.462 | 0.479 | 0.499 | 0.471 | 0.449 | 0.459 | 0.412 | 0.416 | 0.463 | 6.69 | 5.0549 |
| 6 | 16 | Acrylonitrile | 0.090 | 0.096 | 0.100 | 0.091 | 0.102 | 0.084 | 0.086 | 0.089 | 0.082 | 0.090 | 0.091 | 7.35 | 5.0989 |
| | 17 | Carbon disulfide | 0.880 | 0.806 | 0.718 | 0.692 | 0.738 | 0.708 | 0.670 | 0.700 | 0.647 | 0.647 | 0.721 | 10.12 | 5.1979 |
| | 18 | tert-Butyl methyl ether (MTBE) | 0.485 | 0.532 | 0.533 | 0.509 | 0.591 | 0.501 | 0.507 | 0.527 | 0.483 | 0.517 | 0.519 | 5.97 | 5.1429 |
| | 19 | trans-1,2-Dichloroethene | 0.451 | 0.406 | 0.413 | 0.412 | 0.448 | 0.414 | 0.402 | 0.424 | 0.388 | 0.380 | 0.414 | 5.54 | 5.3091 |
| | 20 | Isopropyl ether (DIPE) | 1.136 | 0.993 | 1.019 | 1.051 | 1.159 | 1.055 | 1.018 | 1.058 | 0.964 | 0.969 | 1.042 | 6.22 | 5.4620 |
| | 21 | Vinyl acetate | 0.444 | 0.455 | 0.453 | 0.444 | 0.522 | 0.448 | 0.443 | 0.465 | 0.425 | 0.462 | 0.456 | 5.68 | 5.5501 |
| | 22 | 1,1-Dichloroethane | 0.487 | 0.518 | 0.513 | 0.518 | 0.560 | 0.519 | 0.502 | 0.518 | 0.476 | 0.464 | 0.507 | 5.33 | 5.6392 |
| | 23 | tert-Butyl ethyl ether (ETBE) | 0.790 | 0.793 | 0.768 | 0.806 | 0.910 | 0.786 | 0.788 | 0.826 | 0.764 | 0.801 | 0.803 | 5.18 | 5.8021 |
| 5 | 24 | 2-Butanone | 0.108 | 0.095 | 0.109 | 0.097 | 0.113 | 0.089 | 0.093 | 0.097 | 0.090 | 0.104 | 0.099 | 8.40 | 5.9132 |
| | 25 | 2,2-Dichloropropane | 0.326 | 0.360 | 0.361 | 0.359 | 0.388 | 0.384 | 0.367 | 0.385 | 0.352 | 0.358 | 0.364 | 5.10 | 6.1223 |
| | 26 | cis-1,2-Dichloroethene | 0.514 | 0.509 | 0.496 | 0.483 | 0.511 | 0.479 | 0.455 | 0.481 | 0.437 | 0.421 | 0.479 | 6.67 | 6.1543 |
| | 27 | Chloroform | 0.476 | 0.447 | 0.455 | 0.465 | 0.497 | 0.464 | 0.440 | 0.462 | 0.424 | 0.417 | 0.455 | 5.27 | 6.2863 |
| 5 | 28 | tert-Amyl alcohol (TAA) | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 29 | Bromochloromethane | 0.332 | 0.308 | 0.297 | 0.308 | 0.330 | 0.299 | 0.287 | 0.299 | 0.270 | 0.270 | 0.300 | 7.07 | 6.4525 |
| | 30 | Dibromofluoromethane | ------ | 0.315 | 0.328 | 0.355 | 0.373 | 0.349 | 0.346 | 0.362 | 0.328 | 0.328 | 0.343 | 5.56 | 6.4770 |
| | 31 | 1,1,1-Trichloroethane | 0.393 | 0.390 | 0.396 | 0.405 | 0.445 | 0.429 | 0.411 | 0.432 | 0.399 | 0.396 | 0.410 | 4.68 | 6.6693 |
| | 32 | tert-Amyl methyl ether (TAME) | 0.724 | 0.640 | 0.657 | 0.604 | 0.661 | 0.584 | 0.592 | 0.625 | 0.581 | 0.625 | 0.629 | 6.95 | 6.8245 |
| | 33 | 1,2-Dichloroethane-d4 | ------ | 0.303 | 0.297 | 0.301 | 0.345 | 0.297 | 0.301 | 0.309 | 0.281 | 0.293 | 0.303 | 5.79 | 6.9148 |
| | 34 | CHLOROBENZENE-D5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 10.4694 |
| | 35 | 1,1-Dichloropropene | 0.147 | 0.163 | 0.176 | 0.151 | 0.161 | 0.172 | 0.152 | 0.167 | 0.143 | 0.124 | 0.156 | 9.93 | 6.7981 |
| | 36 | Carbon tetrachloride | 0.432 | 0.492 | 0.483 | 0.472 | 0.455 | 0.497 | 0.437 | 0.477 | 0.412 | 0.354 | 0.451 | 9.75 | 6.9257 |
| | 37 | 1,2-Dichloroethane | 0.431 | 0.440 | 0.406 | 0.413 | 0.402 | 0.395 | 0.363 | 0.387 | 0.329 | 0.301 | 0.387 | 11.39 | 6.9973 |
| | 38 | Benzene | 1.445 | 1.318 | 1.187 | 1.132 | 1.145 | 1.153 | 1.030 | 1.119 | 0.960 | ------ | 1.166 | 12.37 | 7.0627 |
| | 39 | Trichloroethene | 0.439 | 0.419 | 0.380 | 0.361 | 0.360 | 0.369 | 0.329 | 0.365 | 0.317 | 0.277 | 0.362 | 12.98 | 7.6081 |
| | 40 | 1,2-Dichloropropane | 0.380 | 0.359 | 0.340 | 0.329 | 0.331 | 0.333 | 0.303 | 0.332 | 0.289 | 0.266 | 0.326 | 10.15 | 7.7610 |
| 20 | 41 | 1,4-Dioxane | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | ------ | 0.000 | 0.00 | 0.0000 |
| | 42 | Bromodichloromethane | 0.440 | 0.446 | 0.417 | 0.407 | 0.425 | 0.424 | 0.383 | 0.417 | 0.362 | 0.332 | 0.405 | 8.84 | 8.0031 |
| | 43 | Dibromomethane | 0.194 | 0.175 | 0.185 | 0.175 | 0.178 | 0.170 | 0.156 | 0.170 | 0.145 | 0.137 | 0.169 | 10.40 | 8.0791 |
| | 44 | 2-Chloroethyl vinyl ether | 0.118 | 0.126 | 0.127 | 0.120 | 0.138 | 0.135 | 0.133 | 0.145 | 0.129 | 0.134 | 0.130 | 6.37 | 8.1693 |
| 5 | 45 | 4-Methyl-2-pentanone | 0.270 | 0.271 | 0.294 | 0.254 | 0.275 | 0.242 | 0.245 | 0.264 | 0.231 | 0.236 | 0.258 | 7.70 | 8.2023 |
| | 46 | cis-1,3-Dichloropropene | 0.452 | 0.423 | 0.425 | 0.419 | 0.429 | 0.435 | 0.407 | 0.442 | 0.394 | 0.379 | 0.420 | 5.28 | 8.4885 |
| | 47 | Toluene-d8 | ------ | 1.163 | 1.121 | 1.138 | 1.125 | 1.191 | 1.133 | 1.239 | 1.103 | 1.024 | 1.137 | 5.21 | 8.7942 |
| | 48 | Toluene | 1.261 | 1.121 | 1.134 | 1.070 | 1.099 | 1.122 | 1.038 | 1.143 | 1.021 | 0.950 | 1.096 | 7.65 | 8.8736 |
| | 49 | Ethyl methacrylate | 0.169 | 0.172 | 0.197 | 0.185 | 0.217 | 0.200 | 0.198 | 0.217 | 0.193 | 0.205 | 0.195 | 8.42 | 8.8813 |
| | 50 | trans-1,3-Dichloropropene | 0.345 | 0.320 | 0.315 | 0.331 | 0.337 | 0.340 | 0.323 | 0.354 | 0.317 | 0.320 | 0.330 | 4.02 | 8.9837 |

**Figure 3 (cont.):** **TYPICAL ICAL SUMMARY**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 51 | 2-Hexanone | 0.131 | 0.140 | 0.155 | 0.131 | 0.146 | 0.128 | 0.130 | 0.142 | 0.124 | 0.132 | 0.136 | 7.13 | 9.0938 |
| | 52 | 1,1,2-Trichloroethane | 0.187 | 0.178 | 0.220 | 0.215 | 0.221 | 0.205 | 0.194 | 0.210 | 0.189 | 0.192 | 0.201 | 7.54 | 9.1818 |
| | 53 | 1,3-Dichloropropane | 0.338 | 0.316 | 0.333 | 0.307 | 0.336 | 0.316 | 0.295 | 0.322 | 0.288 | 0.292 | 0.314 | 5.88 | 9.4470 |
| | 54 | Tetrachloroethene | 0.284 | 0.279 | 0.282 | 0.258 | 0.269 | 0.291 | 0.262 | 0.289 | 0.266 | 0.250 | 0.273 | 5.07 | 9.6110 |
| | 55 | Dibromochloromethane | 0.299 | 0.307 | 0.309 | 0.306 | 0.319 | 0.313 | 0.299 | 0.330 | 0.299 | 0.303 | 0.308 | 3.20 | 9.8212 |
| | 56 | 1,2-Dibromoethane | 0.245 | 0.245 | 0.226 | 0.211 | 0.234 | 0.221 | 0.210 | 0.228 | 0.206 | 0.210 | 0.223 | 6.48 | 10.0611 |
| | 57 | 1-Chlorohexane | 0.296 | 0.312 | 0.351 | 0.314 | 0.345 | 0.380 | 0.349 | 0.392 | 0.358 | 0.345 | 0.344 | 8.70 | 10.1084 |
| | 58 | Chlorobenzene | 0.896 | 0.869 | 0.798 | 0.779 | 0.775 | 0.822 | 0.756 | 0.841 | 0.767 | 0.723 | 0.803 | 6.71 | 10.5233 |
| | 59 | 1,1,1,2-Tetrachloroethane | 0.362 | 0.335 | 0.335 | 0.328 | 0.344 | 0.343 | 0.320 | 0.354 | 0.317 | 0.292 | 0.333 | 6.02 | 10.5354 |
| | 60 | Ethylbenzene | 1.321 | 1.245 | 1.312 | 1.204 | 1.213 | 1.302 | 1.187 | 1.331 | 1.216 | 1.141 | 1.247 | 5.25 | 10.5354 |
| 2 | 61 | m-Xylene & p-Xylene | 1.007 | 0.942 | 0.937 | 0.898 | 0.926 | 0.967 | 0.900 | 1.017 | 0.934 | 0.873 | 0.940 | 4.91 | 10.6191 |
| | 62 | o-Xylene | 1.168 | 1.073 | 1.077 | 0.995 | 1.012 | 1.074 | 0.988 | 1.101 | 0.997 | 0.913 | 1.040 | 6.97 | 11.1484 |
| | 63 | Styrene | 0.720 | 0.670 | 0.702 | 0.688 | 0.714 | 0.762 | 0.716 | 0.821 | 0.740 | 0.701 | 0.723 | 5.92 | 11.1737 |
| | 64 | 1,2-DICHLOROBENZENE-D4 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 13.8370 |
| | 65 | Isopropylbenzene | 2.356 | 2.408 | 2.391 | 2.389 | 2.578 | 2.600 | 2.456 | 2.776 | 2.749 | 2.521 | 2.522 | 5.99 | 11.5468 |
| | 66 | Bromoform | 0.292 | 0.316 | 0.342 | 0.335 | 0.407 | 0.350 | 0.357 | 0.400 | 0.404 | 0.421 | 0.362 | 11.98 | 11.6459 |
| | 67 | 1,1,2,2-Tetrachloroethane | 0.432 | 0.525 | 0.524 | 0.494 | 0.567 | 0.477 | 0.470 | 0.517 | 0.497 | 0.513 | 0.502 | 7.36 | 11.7306 |
| | 68 | 4-Bromofluorobenzene | ------ | 0.810 | 0.728 | 0.779 | 0.839 | 0.826 | 0.813 | 0.910 | 0.907 | 0.890 | 0.834 | 7.30 | 11.8744 |
| | 69 | 1,2,3-Trichloropropane | ------ | 0.085 | 0.150 | 0.139 | 0.169 | 0.144 | 0.142 | 0.153 | 0.150 | 0.154 | 0.143 | 16.39 | 11.9123 |
| | 70 | trans-1,4-Dichloro-2-butene | ------ | 0.107 | 0.133 | 0.121 | 0.157 | 0.129 | 0.136 | 0.146 | 0.142 | 0.154 | 0.136 | 11.64 | 11.9453 |
| | 71 | n-Propylbenzene | 2.881 | 2.798 | 2.797 | 2.827 | 3.036 | 3.090 | 2.899 | 3.279 | 3.203 | 3.014 | 2.983 | 5.72 | 12.0310 |
| | 72 | Bromobenzene | 0.772 | 0.713 | 0.671 | 0.660 | 0.710 | 0.715 | 0.680 | 0.765 | 0.761 | 0.750 | 0.720 | 5.67 | 12.1642 |
| | 73 | 1,3,5-Trimethylbenzene | 1.903 | 1.911 | 2.069 | 2.004 | 2.217 | 2.226 | 2.146 | 2.391 | 2.209 | 2.111 | 2.118 | 7.21 | 12.2082 |
| | 74 | 2-Chlorotoluene | 1.982 | 1.892 | 1.923 | 1.801 | 1.919 | 1.952 | 1.793 | 2.011 | 1.927 | 1.793 | 1.899 | 4.16 | 12.2963 |
| | 75 | 4-Chlorotoluene | 1.544 | 1.467 | 1.536 | 1.495 | 1.628 | 1.610 | 1.535 | 1.753 | 1.729 | 1.715 | 1.601 | 6.39 | 12.3403 |
| | 76 | tert-Butylbenzene | 1.950 | 2.047 | 2.140 | 2.118 | 2.328 | 2.354 | 2.293 | 2.525 | 2.285 | 2.162 | 2.220 | 7.59 | 12.6594 |
| | 77 | 1,2,4-Trimethylbenzene | 2.032 | 1.882 | 1.956 | 2.006 | 2.207 | 2.203 | 2.115 | 2.328 | 2.164 | 2.088 | 2.098 | 6.36 | 12.7123 |
| | 78 | sec-Butylbenzene | 2.509 | 2.613 | 2.684 | 2.628 | 2.930 | 2.993 | 2.878 | 3.160 | 2.862 | 2.708 | 2.797 | 7.20 | 12.9236 |
| | 79 | p-Isopropyltoluene | 2.163 | 2.221 | 2.237 | 2.315 | 2.540 | 2.584 | 2.518 | 2.713 | 2.528 | 2.399 | 2.422 | 7.52 | 13.0765 |
| | 80 | 1,3-Dichlorobenzene | 1.440 | 1.410 | 1.430 | 1.334 | 1.466 | 1.455 | 1.361 | 1.502 | 1.442 | 1.425 | 1.427 | 3.44 | 13.2647 |
| | 81 | 1,4-Dichlorobenzene | 1.607 | 1.367 | 1.413 | 1.323 | 1.431 | 1.431 | 1.355 | 1.495 | 1.429 | 1.419 | 1.427 | 5.58 | 13.3858 |
| | 82 | Benzyl chloride | 0.908 | 0.889 | 0.918 | 0.870 | 1.003 | 0.931 | 0.941 | 1.013 | 0.959 | 1.067 | 0.950 | 6.47 | 13.5068 |
| | 83 | n-Butylbenzene | 1.847 | 1.937 | 2.070 | 1.948 | 2.194 | 2.208 | 2.138 | 2.286 | 2.201 | 2.042 | 2.087 | 6.83 | 13.5839 |
| | 84 | 1,2-Dichlorobenzene | 1.491 | 1.286 | 1.342 | 1.282 | 1.413 | 1.358 | 1.294 | 1.375 | 1.314 | 1.305 | 1.346 | 4.94 | 13.8711 |
| | 85 | 1,2-Dibromo-3-chloropropane | 0.121 | 0.077 | 0.103 | 0.099 | 0.127 | 0.103 | 0.105 | 0.110 | 0.107 | 0.116 | 0.107 | 12.84 | 14.8407 |
| | 86 | 1,2,4-Trichlorobenzene | 0.878 | 0.790 | 0.816 | 0.821 | 0.902 | 0.895 | 0.875 | 0.950 | 0.900 | 0.839 | 0.867 | 5.65 | 15.9830 |
| | 87 | Hexachlorobutadiene | 0.218 | 0.311 | 0.340 | 0.331 | 0.352 | 0.379 | 0.346 | 0.385 | 0.366 | 0.321 | 0.335 | 14.16 | 16.1392 |
| | 88 | Naphthalene | 1.482 | 1.446 | 1.661 | 1.550 | 1.785 | 1.544 | 1.590 | 1.730 | 1.636 | 1.620 | 1.604 | 6.56 | 16.3572 |
| | 89 | 1,2,3-Trichlorobenzene | 0.704 | 0.664 | 0.766 | 0.715 | 0.809 | 0.742 | 0.746 | 0.801 | 0.756 | 0.704 | 0.741 | 6.11 | 16.6884 |

Spike Amount = Nominal Amount * M
Ave_%RSD : 7.8 Max_%RSD : 28.3

Use Least Square Linear Regression with weighting factor of inverse concentration for comps with %_RSD > 15
Resp_Ratio = xo + x1 * Amt_Ratio

| IDX | Parameter | x0 | x1 | CCF |
|---|---|---|---|---|
| 3 | Chloromethane | 0.02923 | 0.41361 | 0.9980 |
| 69 | 1,2,3-Trichloropropane | -0.00215 | 0.15213 | 0.9996 |

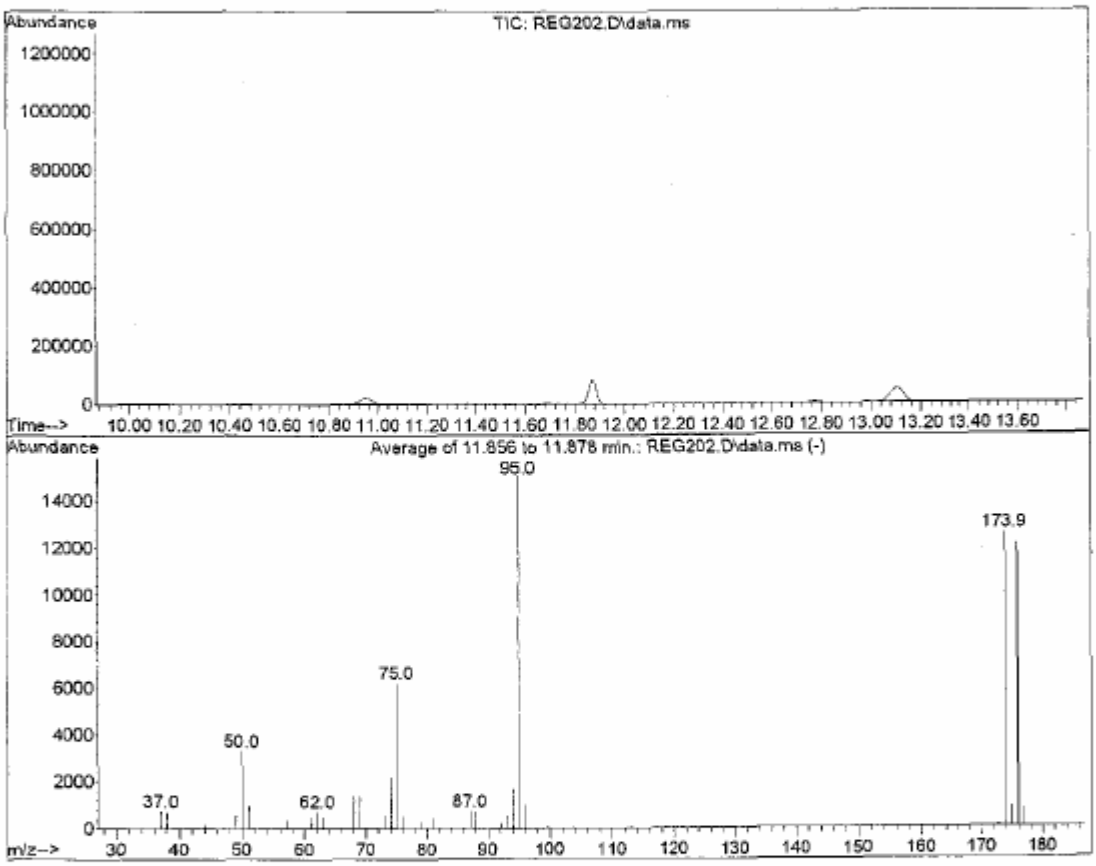
**Figure 4:** **TYPICAL INSTRUMENT PERFORMANCE CHECK (TUNING)**

BFB

```
Data Path : D:\Data\09E08\
Data File : REG202.D
Acq On    :  8 May 2009  11:08
Operator  : CGM
Sample    : BFBE2E10
Misc      : T/CHK
ALS Vial  : 1   Sample Multiplier: 1

Integration File: rteint.p

Method    : C:\msdchem\1\METHODS\VOE2E08.M
Title     : METHOD  8260  10mL
Last Update  : Wed May 13 13:05:40 2009
```




AutoFind: Scans 815, 816, 817; Background Corrected with Scan 810

| Target Mass | Rel. to Mass | Lower Limit% | Upper Limit% | Rel. Abn% | Raw Abn | Result Pass/Fail |
|---|---|---|---|---|---|---|
| 50 | 95 | 15 | 40 | 21.8 | 3288 | PASS |
| 75 | 95 | 30 | 60 | 40.9 | 6175 | PASS |
| 95 | 95 | 100 | 100 | 100.0 | 15091 | PASS |
| 96 | 95 | 5 | 9 | 6.5 | 976 | PASS |
| 173 | 174 | 0.00 | 2 | 0.9 | 111 | PASS |
| 174 | 95 | 50 | 100 | 83.1 | 12540 | PASS |
| 175 | 174 | 5 | 9 | 6.8 | 849 | PASS |
| 176 | 174 | 95 | 101 | 96.3 | 12070 | PASS |
| 177 | 176 | 5 | 9 | 6.3 | 765 | PASS |

VOE2E08.M Wed May 13 13:06:56 2009 Page: 1

**Figure 5: TYPICAL INTERNAL STANDARD AREA AND RETENTION TIME SUMMARY**

8A
VOLATILE INTERNAL STANDARD AREA AND RT SUMMARY

Lab Name: EMAX Inc
Lab Code: EMXT
Lab File ID: REG208
Instrument ID: TOE2
GC Column: RTX502.2 ID: 0.32mm (mm)

Project: XYZ, INC.
SDG No.: 09E108
Date Analyzed: 05/08/09
Time Analyzed: 14:00
Heated Purge: (Y/N) N

| | | IS1(DBF) | | IS2(CBZ) | | IS3(DCB) | |
|---|---|---|---|---|---|---|---|
| | | AREA # | RT # | AREA # | RT # | AREA # | RT # |
| | 12 HOUR STD | 437085 | 7.21 | 360505 | 10.47 | 188592 | 13.84 |
| | UPPER LIMIT | 874170 | 7.71 | 721010 | 10.97 | 377184 | 14.34 |
| | LOWER LIMIT | 218543 | 6.71 | 180253 | 9.97 | 94296 | 13.34 |
| | SAMPLE ID | | | | | | |
| 1 | VSTD010 | 507459 | 7.22 | 411195 | 10.47 | 226757 | 13.84 |
| 2 | MBLK1W | 516413 | 7.22 | 401562 | 10.47 | 236124 | 13.84 |
| 3 | LCS1W | 525586 | 7.22 | 424430 | 10.47 | 233099 | 13.84 |
| 4 | LCD1W | 520018 | 7.21 | 425171 | 10.47 | 230850 | 13.84 |
| 5 | TRIP01-05052009 | 507617 | 7.22 | 396523 | 10.47 | 232631 | 13.84 |
| 6 | TRIP02-05062009 | 472644 | 7.22 | 364071 | 10.47 | 210029 | 13.84 |
| 7 | 45MW13-05062009 | 499453 | 7.22 | 394036 | 10.47 | 231414 | 13.84 |
| 8 | 45MW13-05062009MS | 504742 | 7.21 | 417810 | 10.47 | 234683 | 13.84 |
| 9 | 45MW13-05062009MSD | 519198 | 7.22 | 424344 | 10.47 | 241377 | 13.84 |
| 10 | 45MW08-05052009 | 524027 | 7.22 | 400210 | 10.47 | 231882 | 13.84 |
| 11 | 45MW10-05052009 | 512150 | 7.22 | 407314 | 10.47 | 221461 | 13.84 |
| 12 | 45MW10D-05052009 | 543481 | 7.22 | 434322 | 10.47 | 229178 | 13.84 |
| 13 | 45MW11-05052009 | 612985 | 7.22 | 459226 | 10.48 | 234255 | 13.84 |
| 14 | 45MW12-05052009 | 509816 | 7.22 | 418635 | 10.48 | 240019 | 13.84 |

IS1 (DFB) = 1,4-Difluorobenzene
IS2 (CBZ) = Chlorobenzene-d5
IS3 (DCB) = 1,2-Dichlorobenzene-d4

AREA UPPER LIMIT = + 100% of internal standard area
AREA LOWER LIMIT = - 50% of internal standard area
AREA UPPER LIMIT = + 50% of surrogate area
AREA LOWER LIMIT = - 50% of surrogate area

# Column used to flag internal standard area values with an asterisk
* Values outside of QC limits.
page 1 of 1

FORM VIII VOA-8260 1/2000

**Figure 6:** **TYPICAL SAMPLE RESULT SUMMARY REPORT**

SW 5030B/8260B
VOLATILE ORGANICS BY GC/MS

| | | | |
|---|---|---|---|
| Client | : XYZ, INC. | Date Collected: | 05/06/09 |
| Project | : CLEAN WATER PROJECT | Date Received: | 05/08/09 |
| Batch No. | : 09E108 | Date Extracted: | 05/08/09 22:51 |
| Sample ID: | 45MW13-05062009 | Date Analyzed: | 05/08/09 22:51 |
| Lab Samp ID: | E108-07 | Dilution Factor: | 1 |
| Lab File ID: | REG230 | Matrix : | WATER |
| Ext Btch ID: | VOE2E11 | % Moisture : | NA |
| Calib. Ref.: | REG208 | Instrument ID : | T-OE2 |

| RESULTS PARAMETERS | RL (ug/L) | MDL (ug/L) | (ug/L) |
|---|---|---|---|
| 1,1,1,2-TETRACHLOROETHANE | ND | 1.0 | 0.20 |
| 1,1,1-TCA | 3.0 | 1.0 | 0.20 |
| 1,1,2,2-TETRACHLOROETHANE | ND | 1.0 | 0.20 |
| 1,1,2-TCA | ND | 1.0 | 0.20 |
| 1,1-DCA | 0.88F | 1.0 | 0.20 |
| 1,1-DCE | 1.5 | 1.0 | 0.20 |
| 1,1-DICHLOROPROPENE | ND | 1.0 | 0.20 |
| 1,2,3-TRICHLOROBENZENE | ND | 1.0 | 0.20 |
| 1,2,3-TRICHLOROPROPANE | ND | 1.0 | 0.50 |
| 1,2,4-TRICHLOROBENZENE | ND | 1.0 | 0.20 |
| 1,2,4-TRIMETHYLBENZENE | 5.5 | 1.0 | 0.20 |
| 1,2-DIBROMO-3-CHLOROPROPANE | ND | 2.0 | 0.50 |
| 1,2-DCB | ND | 1.0 | 0.20 |
| 1,2-DCA | ND | 1.0 | 0.20 |
| 1,2-DICHLOROPROPANE | ND | 1.0 | 0.20 |
| 1,2-DIBROMOETHANE (EDB) | ND | 1.0 | 0.20 |
| 1,3,5-TRIMETHYLBENZENE | 1.3 | 1.0 | 0.20 |
| 1,3-DCB | ND | 1.0 | 0.20 |
| 1,3-DICHLOROPROPANE | ND | 1.0 | 0.20 |
| 1,4-DCB | ND | 1.0 | 0.20 |
| 1-CHLOROHEXANE | ND | 1.0 | 0.20 |
| 2,2-DICHLOROPROPANE | ND | 1.0 | 0.20 |
| 2-CHLOROTOLUENE | ND | 1.0 | 0.20 |
| 4-CHLOROTOLUENE | ND | 1.0 | 0.20 |
| BENZENE | 0.56F | 1.0 | 0.20 |
| BROMOBENZENE | ND | 1.0 | 0.20 |
| BROMOCHLOROMETHANE | ND | 1.0 | 0.20 |
| BROMODICHLOROMETHANE | ND | 1.0 | 0.20 |
| BROMOFORM | ND | 1.0 | 0.30 |
| BROMOMETHANE | ND | 3.0 | 0.20 |
| CARBON TETRACHLORIDE | ND | 1.0 | 0.20 |
| CHLOROBENZENE | ND | 1.0 | 0.20 |
| CHLOROETHANE | ND | 1.0 | 0.20 |
| CHLOROFORM | 0.83F | 1.0 | 0.20 |
| CHLOROMETHANE | ND | 1.0 | 0.20 |
| CIS-1,2-DCE | 62 | 1.0 | 0.20 |
| CIS-1,3-DICHLOROPROPENE | ND | 1.0 | 0.20 |
| DIBROMOCHLOROMETHANE | ND | 1.0 | 0.20 |
| DIBROMOMETHANE | ND | 1.0 | 0.20 |
| DICHLORODIFLUOROMETHANE | ND | 1.0 | 0.30 |
| ETHYLBENZENE | 5.3 | 1.0 | 0.20 |
| HEXACHLOROBUTADIENE | ND | 1.0 | 0.20 |
| ISOPROPYL BENZENE | 0.65F | 1.0 | 0.20 |
| M/P-XYLENE | 30 | 2.0 | 0.50 |
| METHYLENE CHLORIDE | ND | 1.0 | 0.50 |
| N-BUTYLBENZENE | 0.34F | 1.0 | 0.20 |
| N-PROPYLBENZENE | 0.62F | 1.0 | 0.20 |
| NAPHTHALENE | 2.6 | 1.0 | 0.50 |
| O-XYLENE | 9.8 | 1.0 | 0.20 |
| P-ISOPROPYLTOLUENE | 0.37F | 1.0 | 0.20 |
| SEC-BUTYLBENZENE | 0.26F | 1.0 | 0.20 |
| STYRENE | ND | 1.0 | 0.20 |
| TERT-BUTYLBENZENE | ND | 1.0 | 0.20 |
| TETRACHLOROETHENE | 0.22F | 1.0 | 0.20 |
| TOLUENE | 26 | 1.0 | 0.20 |
| TRANS-1,2-DCE | 0.40F | 1.0 | 0.20 |
| TRANS-1,3-DICHLOROPROPENE | ND | 1.0 | 0.20 |
| TCE | 740J | 1.0 | 0.20 |
| TRICHLOROFLUOROMETHANE | ND | 1.0 | 0.20 |
| VINYL CHLORIDE | ND | 1.0 | 0.20 |

| SURROGATE PARAMETERS | % RECOVERY | QC LIMIT |
|---|---|---|
| 1,2-DICHLOROETHANE-D4 | 101 | 70-140 |
| TOLUENE-D8 | 107 | 70-140 |
| 4-BROMOFLUOROBENZENE | 94 | 70-130 |

**Figure 7:** **TYPICAL LCS SUMMARY REPORT**

EMAX QUALITY CONTROL DATA
LCS/LCD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 09E108
METHOD: SW5030B/8260B

| | | | | | |
|---|---|---|---|---|---|
| MATRIX: | WATER | | | % MOISTURE: | NA |
| DILUTION FACTOR: | 1 | 1 | 1 | | |
| SAMPLE ID: | MBLK1W | | | | |
| LAB SAMP ID: | VOE2E11Q | VOE2E11L | VOE2E11C | | |
| LAB FILE ID: | REG226 | REG222 | REG223 | | |
| DATE EXTRACTED: | 05/08/0921:17 | 05/08/0919:44 | 05/08/0920:09 | DATE COLLECTED: | NA |
| DATE ANALYZED: | 05/08/0921:17 | 05/08/0919:44 | 05/08/0920:09 | DATE RECEIVED: | 05/08/09 |
| PREP. BATCH: | VOE2E11 | VOE2E11 | VOE2E11 | | |
| CALIB. REF: | REG208 | REG208 | REG208 | | |

ACCESSION:

| PARAMETER | BLNK RSLT (ug/L) | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | RPD ( % ) | QC LIMIT ( % ) | MAX RPD ( % ) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | ND | 10.0 | 10.8 | 108 | 10.0 | 10.2 | 102 | 6 | 81-129 | 20 |
| 1,1,1-TCA | ND | 10.0 | 10.2 | 102 | 10.0 | 9.64 | 96 | 6 | 67-132 | 20 |
| 1,1,2,2-Tetrachloroethane | ND | 10.0 | 9.47 | 95 | 10.0 | 9.23 | 92 | 3 | 63-128 | 20 |
| 1,1,2-TCA | ND | 10.0 | 10.7 | 107 | 10.0 | 10.3 | 103 | 4 | 75-125 | 20 |
| 1,1-DCA | ND | 10.0 | 10.3 | 103 | 10.0 | 9.94 | 99 | 4 | 69-133 | 20 |
| 1,1-DCE | ND | 10.0 | 10.5 | 105 | 10.0 | 9.92 | 99 | 5 | 68-130 | 20 |
| 1,1-Dichloropropene | ND | 10.0 | 11.4 | 114 | 10.0 | 10.9 | 109 | 4 | 73-132 | 20 |
| 1,2,3-Trichlorobenzene | ND | 10.0 | 10.2 | 102 | 10.0 | 9.96 | 100 | 3 | 67-137 | 20 |
| 1,2,3-Trichloropropane | ND | 10.0 | 8.95 | 89 | 10.0 | 9.15 | 92 | 2 | 73-124 | 20 |
| 1,2,4-Trichlorobenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 10.0 | 100 | 3 | 66-134 | 20 |
| 1,2,4-Trimethylbenzene | ND | 10.0 | 10.2 | 102 | 10.0 | 9.89 | 99 | 3 | 74-132 | 20 |
| 1,2-Dibromo-3-chloropropane | ND | 10.0 | 10.4 | 104 | 10.0 | 10.1 | 101 | 3 | 50-132 | 20 |
| 1,2-DCB | ND | 10.0 | 10.1 | 101 | 10.0 | 9.81 | 98 | 2 | 71-122 | 20 |
| 1,2-DCA | ND | 10.0 | 10.4 | 104 | 10.0 | 9.96 | 100 | 5 | 69-132 | 20 |
| 1,2-Dichloropropane | ND | 10.0 | 10.7 | 107 | 10.0 | 10.2 | 102 | 5 | 75-125 | 20 |
| 1,2-Dibromoethane (EDB) | ND | 10.0 | 10.4 | 104 | 10.0 | 9.72 | 97 | 7 | 80-121 | 20 |
| 1,3,5-Trimethylbenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 9.99 | 100 | 3 | 74-131 | 20 |
| 1,3-DCB | ND | 10.0 | 10.0 | 100 | 10.0 | 9.59 | 96 | 4 | 75-124 | 20 |
| 1,3-Dichloropropane | ND | 10.0 | 10.4 | 104 | 10.0 | 9.87 | 99 | 5 | 73-126 | 20 |
| 1,4-DCB | ND | 10.0 | 9.83 | 98 | 10.0 | 9.57 | 96 | 3 | 74-123 | 20 |
| 1-Chlorohexane | ND | 10.0 | 10.8 | 108 | 10.0 | 10.2 | 102 | 6 | 70-125 | 20 |
| 2,2-Dichloropropane | ND | 10.0 | 9.81 | 98 | 10.0 | 9.62 | 96 | 2 | 69-137 | 20 |
| 2-Chlorotoluene | ND | 10.0 | 9.48 | 95 | 10.0 | 9.30 | 93 | 2 | 73-126 | 20 |
| 4-Chlorotoluene | ND | 10.0 | 9.63 | 96 | 10.0 | 9.37 | 94 | 3 | 74-128 | 20 |
| Benzene | ND | 10.0 | 10.3 | 103 | 10.0 | 9.71 | 97 | 6 | 81-122 | 20 |
| Bromobenzene | ND | 10.0 | 9.70 | 97 | 10.0 | 9.53 | 95 | 2 | 76-124 | 20 |
| Bromochloromethane | ND | 10.0 | 9.55 | 95 | 10.0 | 9.13 | 91 | 4 | 65-129 | 20 |
| Bromodichloromethane | ND | 10.0 | 10.3 | 103 | 10.0 | 10.1 | 101 | 1 | 76-121 | 20 |
| Bromoform | ND | 10.0 | 9.90 | 99 | 10.0 | 9.89 | 99 | 0 | 69-128 | 20 |
| Bromomethane | ND | 10.0 | 9.66 | 97 | 10.0 | 9.42 | 94 | 3 | 30-141 | 20 |
| Carbon Tetrachloride | ND | 10.0 | 11.0 | 110 | 10.0 | 10.2 | 102 | 8 | 66-138 | 20 |
| Chlorobenzene | ND | 10.0 | 10.6 | 106 | 10.0 | 10.1 | 101 | 5 | 81-122 | 20 |
| Chloroethane | ND | 10.0 | 9.91 | 99 | 10.0 | 10.0 | 100 | 1 | 58-133 | 20 |
| Chloroform | ND | 10.0 | 10.1 | 101 | 10.0 | 9.60 | 96 | 5 | 69-128 | 20 |
| Chloromethane | ND | 10.0 | 9.14 | 91 | 10.0 | 9.31 | 93 | 2 | 56-131 | 20 |
| cis-1,2-DCE | ND | 10.0 | 9.81 | 98 | 10.0 | 9.50 | 95 | 3 | 72-126 | 20 |
| cis-1,3-Dichloropropene | ND | 10.0 | 10.7 | 107 | 10.0 | 10.3 | 103 | 4 | 69-131 | 20 |
| Dibromochloromethane | ND | 10.0 | 10.6 | 106 | 10.0 | 10.3 | 103 | 3 | 66-133 | 20 |
| Dibromomethane | ND | 10.0 | 10.7 | 107 | 10.0 | 10.2 | 102 | 5 | 76-125 | 20 |
| Dichlorodifluoromethane | ND | 10.0 | 9.80 | 98 | 10.0 | 9.73 | 97 | 1 | 30-153 | 20 |
| Ethylbenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 9.89 | 99 | 4 | 73-127 | 20 |
| Hexachlorobutadiene | ND | 10.0 | 10.5 | 105 | 10.0 | 9.96 | 100 | 5 | 67-131 | 20 |
| Isopropyl Benzene | ND | 10.0 | 10.2 | 102 | 10.0 | 9.80 | 98 | 4 | 75-127 | 20 |
| m/p-Xylene | ND | 20.0 | 20.8 | 104 | 20.0 | 19.9 | 100 | 4 | 76-128 | 20 |
| Methylene Chloride | ND | 10.0 | 9.70 | 97 | 10.0 | 9.50 | 95 | 2 | 63-137 | 20 |
| n-Butylbenzene | ND | 10.0 | 9.98 | 100 | 10.0 | 9.80 | 98 | 2 | 69-137 | 20 |
| n-Propylbenzene | ND | 10.0 | 9.77 | 98 | 10.0 | 9.47 | 95 | 3 | 72-129 | 20 |
| Naphthalene | ND | 10.0 | 10.1 | 101 | 10.0 | 9.52 | 95 | 5 | 54-138 | 20 |
| o-Xylene | ND | 10.0 | 10.5 | 105 | 10.0 | 10.0 | 100 | 5 | 80-121 | 20 |
| p-Isopropyltoluene | ND | 10.0 | 10.5 | 105 | 10.0 | 10.0 | 100 | 4 | 73-130 | 20 |
| Sec-Butylbenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 9.89 | 99 | 4 | 72-127 | 20 |
| Styrene | ND | 10.0 | 10.7 | 107 | 10.0 | 10.1 | 101 | 5 | 65-134 | 20 |
| Tert-Butylbenzene | ND | 10.0 | 10.7 | 107 | 10.0 | 10.1 | 101 | 6 | 70-129 | 20 |
| Tetrachloroethene | ND | 10.0 | 11.3 | 113 | 10.0 | 10.4 | 104 | 8 | 66-128 | 20 |
| Toluene | ND | 10.0 | 10.6 | 106 | 10.0 | 10.2 | 102 | 4 | 77-122 | 20 |
| Trans-1,2-DCE | ND | 10.0 | 10.1 | 101 | 10.0 | 9.67 | 97 | 4 | 63-137 | 20 |
| Trans-1,3-Dichloropropene | ND | 10.0 | 10.6 | 106 | 10.0 | 10.4 | 104 | 2 | 59-135 | 20 |
| TCE | ND | 10.0 | 10.8 | 108 | 10.0 | 10.3 | 103 | 5 | 70-127 | 20 |
| Trichlorofluoromethane | ND | 10.0 | 9.36 | 94 | 10.0 | 9.47 | 95 | 1 | 57-129 | 20 |
| Vinyl Chloride | ND | 10.0 | 9.04 | 90 | 10.0 | 8.98 | 90 | 1 | 50-134 | 20 |

| SURROGATE PARAMETER | SPIKE AMT (ug/L) | BS RSLT (ug/L) | BS % REC | SPIKE AMT (ug/L) | BSD RSLT (ug/L) | BSD % REC | QC LIMIT ( % ) |
|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane-d4 | 10.0 | 9.30 | 93 | 10.0 | 9.34 | 93 | 70-140 |
| Toluene-d8 | 10.0 | 10.4 | 104 | 10.0 | 10.2 | 102 | 70-130 |

**Figure 8:** **TYPICAL MS/MSD REPORT SUMMARY**

EMAX QUALITY CONTROL DATA
MS/MSD ANALYSIS

CLIENT: XYZ, INC.
PROJECT: CLEAN WATER PROJECT
BATCH NO.: 09E108
METHOD: SW5030B/8260B

MATRIX: WATER % MOISTURE: NA

| | | | | | |
|---|---|---|---|---|---|
| DILUTION FACTOR: | 1 | 1 | 1 | | |
| SAMPLE ID: | 45MW13-05062009 | | | | |
| LAB SAMP ID: | E108-07 | E108-07M | E108-07S | | |
| LAB FILE ID: | REG230 | REG231 | REG232 | | |
| DATE EXTRACTED: | 05/08/0922:51 | 05/08/0923:16 | 05/08/0923:39 | DATE COLLECTED: | 05/06/09 |
| DATE ANALYZED: | 05/08/0922:51 | 05/08/0923:16 | 05/08/0923:39 | DATE RECEIVED: | 05/08/09 |
| PREP. BATCH: | VOE2E11 | VOE2E11 | VOE2E11 | | |
| CALIB. REF: | REG208 | REG208 | REG208 | | |

ACCESSION:

| PARAMETER | SMPL RSLT (ug/L) | SPIKE AMT (ug/L) | MS RSLT (ug/L) | MS % REC | SPIKE AMT (ug/L) | MSD RSLT (ug/L) | MSD % REC | RPD ( % ) | QC LIMIT ( % ) | MAX RPD ( % ) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | ND | 10.0 | 10.4 | 104 | 10.0 | 10.3 | 103 | 1 | 81-129 | 20 |
| 1,1,1-TCA | 2.95 | 10.0 | 13.0 | 100 | 10.0 | 12.4 | 95 | 5 | 67-132 | 20 |
| 1,1,2,2-Tetrachloroethane | ND | 10.0 | 9.16 | 92 | 10.0 | 9.70 | 97 | 6 | 63-128 | 20 |
| 1,1,2-TCA | ND | 10.0 | 10.7 | 107 | 10.0 | 10.5 | 105 | 3 | 75-125 | 20 |
| 1,1-DCA | 0.882F | 10.0 | 10.9 | 100 | 10.0 | 10.6 | 97 | 3 | 69-133 | 20 |
| 1,1-DCE | 1.46 | 10.0 | 11.1 | 96 | 10.0 | 10.6 | 91 | 4 | 68-130 | 20 |
| 1,1-Dichloropropene | ND | 10.0 | 10.9 | 109 | 10.0 | 10.7 | 107 | 2 | 73-132 | 20 |
| 1,2,3-Trichlorobenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 10.4 | 104 | 2 | 67-137 | 20 |
| 1,2,3-Trichloropropane | ND | 10.0 | 8.65 | 87 | 10.0 | 8.71 | 87 | 1 | 73-124 | 20 |
| 1,2,4-Trichlorobenzene | ND | 10.0 | 10.3 | 103 | 10.0 | 10.2 | 102 | 1 | 66-134 | 20 |
| 1,2,4-Trimethylbenzene | 5.47 | 10.0 | 15.9 | 104 | 10.0 | 15.4 | 99 | 3 | 74-132 | 20 |
| 1,2-Dibromo-3-chloropropane | ND | 10.0 | 10.1 | 101 | 10.0 | 10.9 | 109 | 8 | 50-132 | 20 |
| 1,2-DCB | ND | 10.0 | 9.62 | 96 | 10.0 | 9.43 | 94 | 2 | 71-122 | 20 |
| 1,2-DCA | ND | 10.0 | 9.93 | 99 | 10.0 | 9.76 | 98 | 2 | 69-132 | 20 |
| 1,2-Dichloropropane | ND | 10.0 | 10.5 | 105 | 10.0 | 10.3 | 103 | 1 | 75-125 | 20 |
| 1,2-Dibromoethane (EDB) | ND | 10.0 | 9.94 | 99 | 10.0 | 10.1 | 101 | 2 | 80-121 | 20 |
| 1,3,5-Trimethylbenzene | 1.28 | 10.0 | 11.4 | 101 | 10.0 | 11.0 | 97 | 4 | 74-131 | 20 |
| 1,3-DCB | ND | 10.0 | 9.56 | 96 | 10.0 | 9.50 | 95 | 1 | 75-124 | 20 |
| 1,3-Dichloropropane | ND | 10.0 | 9.95 | 99 | 10.0 | 10.1 | 101 | 2 | 73-126 | 20 |
| 1,4-DCB | ND | 10.0 | 9.57 | 96 | 10.0 | 9.50 | 95 | 1 | 74-123 | 20 |
| 1-Chlorohexane | ND | 10.0 | 11.0 | 110 | 10.0 | 10.8 | 108 | 2 | 70-125 | 20 |
| 2,2-Dichloropropane | ND | 10.0 | 9.33 | 93 | 10.0 | 8.82 | 88 | 6 | 69-137 | 20 |
| 2-Chlorotoluene | ND | 10.0 | 9.11 | 91 | 10.0 | 8.91 | 89 | 2 | 73-126 | 20 |
| 4-Chlorotoluene | ND | 10.0 | 9.22 | 92 | 10.0 | 8.98 | 90 | 3 | 74-128 | 20 |
| Benzene | 0.564F | 10.0 | 10.2 | 96 | 10.0 | 9.83 | 93 | 4 | 81-122 | 20 |
| Bromobenzene | ND | 10.0 | 9.20 | 92 | 10.0 | 9.20 | 92 | 0 | 76-124 | 20 |
| Bromochloromethane | ND | 10.0 | 9.27 | 93 | 10.0 | 8.82 | 88 | 5 | 65-129 | 20 |
| Bromodichloromethane | ND | 10.0 | 10.3 | 103 | 10.0 | 10.2 | 102 | 1 | 76-121 | 20 |
| Bromoform | ND | 10.0 | 9.42 | 94 | 10.0 | 9.61 | 96 | 2 | 69-128 | 20 |
| Bromomethane | ND | 10.0 | 10.2 | 102 | 10.0 | 9.80 | 98 | 4 | 30-141 | 20 |
| Carbon Tetrachloride | ND | 10.0 | 10.5 | 105 | 10.0 | 10.2 | 102 | 3 | 66-138 | 20 |
| Chlorobenzene | ND | 10.0 | 10.2 | 102 | 10.0 | 10.1 | 101 | 1 | 81-122 | 20 |
| Chloroethane | ND | 10.0 | 10.3 | 103 | 10.0 | 9.90 | 99 | 4 | 58-133 | 20 |
| Chloroform | 0.826F | 10.0 | 10.5 | 97 | 10.0 | 10.1 | 93 | 4 | 69-128 | 20 |
| Chloromethane | ND | 10.0 | 9.91 | 99 | 10.0 | 9.44 | 94 | 5 | 56-131 | 20 |
| cis-1,2-DCE | 61.5 | 10.0 | 56.6 | -49* | 10.0 | 54.4 | -71* | 4 | 72-126 | 20 |
| cis-1,3-Dichloropropene | ND | 10.0 | 10.1 | 101 | 10.0 | 10.1 | 101 | 0 | 69-131 | 20 |
| Dibromochloromethane | ND | 10.0 | 10.3 | 103 | 10.0 | 10.4 | 104 | 1 | 66-133 | 20 |
| Dibromomethane | ND | 10.0 | 9.70 | 97 | 10.0 | 9.77 | 98 | 1 | 76-125 | 20 |
| Dichlorodifluoromethane | ND | 10.0 | 10.3 | 103 | 10.0 | 9.12 | 91 | 12 | 30-153 | 20 |
| Ethylbenzene | 5.32 | 10.0 | 15.5 | 102 | 10.0 | 15.3 | 99 | 1 | 73-127 | 20 |
| Hexachlorobutadiene | ND | 10.0 | 10.2 | 102 | 10.0 | 10.1 | 101 | 1 | 67-131 | 20 |
| Isopropyl Benzene | 0.650F | 10.0 | 10.2 | 96 | 10.0 | 9.98 | 93 | 3 | 75-127 | 20 |
| m/p-Xylene | 30.2 | 20.0 | 50.3 | 100 | 20.0 | 49.6 | 97 | 1 | 76-128 | 20 |
| Methylene Chloride | ND | 10.0 | 9.60 | 96 | 10.0 | 9.27 | 93 | 4 | 63-137 | 20 |
| n-Butylbenzene | 0.343F | 10.0 | 10.2 | 98 | 10.0 | 9.93 | 96 | 2 | 69-137 | 20 |
| n-Propylbenzene | 0.617F | 10.0 | 10.1 | 95 | 10.0 | 9.65 | 90 | 4 | 72-129 | 20 |
| Naphthalene | 2.57 | 10.0 | 13.3 | 108 | 10.0 | 13.7 | 111 | 2 | 54-138 | 20 |
| o-Xylene | 9.84 | 10.0 | 20.1 | 102 | 10.0 | 19.8 | 99 | 1 | 80-121 | 20 |
| p-Isopropyltoluene | 0.369F | 10.0 | 10.8 | 104 | 10.0 | 10.4 | 101 | 3 | 73-130 | 20 |
| Sec-Butylbenzene | 0.258F | 10.0 | 10.3 | 101 | 10.0 | 10.1 | 99 | 2 | 72-127 | 20 |
| Styrene | ND | 10.0 | 10.9 | 109 | 10.0 | 10.8 | 108 | 1 | 65-134 | 20 |
| Tert-Butylbenzene | ND | 10.0 | 11.0 | 110 | 10.0 | 10.6 | 106 | 4 | 70-129 | 20 |
| Tetrachloroethene | 0.223F | 10.0 | 10.8 | 106 | 10.0 | 10.8 | 106 | 0 | 66-128 | 20 |
| Toluene | 25.7 | 10.0 | 35.5 | 99 | 10.0 | 34.9 | 93 | 2 | 77-122 | 20 |
| Trans-1,2-DCE | 0.398F | 10.0 | 10.3 | 99 | 10.0 | 9.66 | 93 | 6 | 63-137 | 20 |
| Trans-1,3-Dichloropropene | ND | 10.0 | 10.3 | 103 | 10.0 | 10.2 | 102 | 0 | 59-135 | 20 |
| TCE | 737J | 10.0 | 717J | -203* | 10.0 | 702J | -349* | 2 | 70-127 | 20 |
| Trichlorofluoromethane | ND | 10.0 | 9.48 | 95 | 10.0 | 9.32 | 93 | 2 | 57-129 | 20 |
| Vinyl Chloride | ND | 10.0 | 9.31 | 93 | 10.0 | 8.75 | 88 | 6 | 50-134 | 20 |

| SURROGATE PARAMETER | SPIKE AMT (ug/L) | MS RSLT (ug/L) | MS % REC | SPIKE AMT (ug/L) | MSD RSLT (ug/L) | MSD % REC | QC LIMIT ( % ) |
|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane-d4 | 10.0 | 9.74 | 97 | 10.0 | 9.45 | 94 | 70-140 |
| Toluene-d8 | 10.0 | 10.2 | 102 | 10.0 | 10.3 | 103 | 70-140 |
| 4-Bromofluorobenzene | 10.0 | 9.45 | 94 | 10.0 | 9.38 | 94 | 70-130 |

**Figure 9:** **TYPICAL CASE NARRATIVE**

CASE NARRATIVE

Client : XYZ, INC.

Project : CLEAN WATER PROJECT

SDG : 09E108

SW 5030B/8260B
VOLATILE ORGANICS BY GC/MS

A total of ten (10) water samples were received on 05/08/09 for Volatile Organics by GC/MS analysis, Method SW 5030B/8260B in accordance with AFCEE QAPP, Version 4.0

Holding Time
Samples were analyzed within the prescribed holding time.

Instrument Performance and Calibration
Instrument tune check was performed prior to calibration. Instrument mass ratios were within specification. Multi-calibration points were generated to establish initial calibration (ICAL). ICAL was verified using secondary source. Continuing calibration was carried on at a frequency required by the project. All project calibration requirements were satisfied. Refer to calibration summary forms for ICAL, ICV and CCV for details.

Method Blank
Method blanks were analyzed at the frequency required by the project. For this SDG, two (2) method blanks were analyzed with the samples. All results were compliant to project requirement. Refer to QC result summary form for details.

Lab Control Sample
Two (2) sets of LCS/LCD were analyzed with the samples in this SDG.
Percent recoveries for VOE2E11L/C were all within QC limits.
Percent recoveries for VOE2E13L/C were all within QC limits.

Matrix QC Sample
A set of MS/MSD was analyzed with the samples in this SDG.
Percent recoveries were within project QC limits except for results qualified with [*] in E108-07 M/S summary form, most likely due to matrix interference. Check QC summaries form for details.

Surrogate
Surrogates were added on QC and field samples. Surrogate recoveries were within projects QC limits.

Sample Analysis
Samples were analyzed according to prescribed analytical procedures. All project requirements were met otherwise anomalies were discussed within the associated QC parameter.
One analyte in samples E108-01,-02,-03,-05T,-07 and three analytes in samples 09E108-04,-05 were manually integrated to correct improper integration. Chromatograms of before and after manual integrations were retained with the initialed and corrected chromatograms.

**Table 1: INITIAL CALIBRATION INTERMEDIATE STANDARD PREPARATION**

| ICAL/DCC Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µL) | Final Vol. (mL) | |
| I | 1-Chlorohexane | AccuStandard | 2000 | 50 | 2 | 50 |
| | 2-Chloroethylvinylether | CPI | 2000 | 50 | 2 | 50 |
| | Oxygenate Gasoline Additive | AccuStandard | 2000-10000 | 50 | 2 | 50 - 250 |
| | Custom VOA Mix | CPI | 2000, 20000, 40000 | 50 | 2 | 50, 500, 1000 |
| II | VOC Gas Mix | Ultra Scientific | 2000 | 250 | 2 | 250 |
| | Vinyl Acetate | CPI | 2500 | 200 | 2 | 250 |
| III | Carbon Disulfide | CPI | 5000 | 100 | 2 | 250 |
| IV | VOA Calibration Mix 1 | Restek | 5000 | 100 | 2 | 250 |
| | Acrolein / Acrylonitrile | AccuStandard | 5000 | 100 | 2 | 250 |

**Table 2: INITIAL CALIBRATION VERIFICATION INTERMEDIATE STANDARD PREPARATION**

| ICV / LCS / MS Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µL) | Final Vol. (mL) | |
| I | 1-Chlorohexane | Ultra Scientific | 1000 | 100 | 2 | 50 |
| | 2-Chloroethylvinylether | AccuStandard | 2000 | 50 | 2 | 50 |
| | Chlorophenol | Restek | 5000 | 20 | 2 | 50 |
| | California Oxygenate Mix | Restek | 2000 - 10000 | 50 | 2 | 50 - 250 |
| | Custom 8260 Mega Mix | Restek | 2000, 20000, 40000 | 50 | 2 | 50, 500, 1000 |
| II | Volatile Organic Cpds Mix 6 | Supelco | 2000 | 250 | 2 | 250 |
| | Vinyl Acetate | Restek | 2000 | 250 | 2 | 250 |
| III | TCL Volatile Mix 1 | Supelco | 2000 | 250 | 2 | 250 |
| | Acrolein / Acrylonitrile | Ultra Scientific | 2000 | 250 | 2 | 250 |

**Table 3: SURROGATE / INTERNAL STANDARD PREPARATION**

| Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µL) | Final Vol. (mL) | |
| Surrogate | 8260 Surrogate Mix | Restek | 2500 | 200 | 2 | 250 |
| Internal Standard | Custom 8260 Internal Standard Mix, 3-30 | CPI | 2500 | 200 | 2 | 250 |

**Table 4: TUNING SOLUTION TANDARD PREPARATION**

| BFB Intermediate Standard | Stock Standard | | | Preparation (Solvent: Methanol) | | Final Conc. (mg/L) |
|---|---|---|---|---|---|---|
| | Standard Name | Source | Conc. (mg/L) | Aliquot (µL) | Final Vol. (mL) | |
| Tuning Compound | BFB | Restek | 5000 | 20 | 2 | 50 |

**Table 5: TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS**

| ANALYTES | ICAL ANALYTE CONCENTRATIONS (µg/L) 25-ml Purge | | | | | | | | | ICV/DCC | LCS/MS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| 1,1,1,2-Tetrachloroethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,1,1-Trichloroethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,1,2,2-Tetrachloroethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,1,2-Trichloroethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,1-Dichloroethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,1-Dichloroethene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,1-Dichloropropene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2,3-Trichlorobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2,3-Trichloropropane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2,4-Trichlorobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2,4-Trimethylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2-Dibromo-3-chloropropane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2-Dibromoethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2-Dichlorobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2-Dichloroethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2-Dichloropropane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,3,5-Trimethylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,3-Dichlorobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,3-Dichloropropane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,4-Dichlorobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1-Chlorohexane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 2,2-Dichloropropane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 2-Butanone (MEK) | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 |
| 2-Chloroethyl vinyl ether | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 2-Chlorotoluene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 2-Hexanone | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 |
| 4-Chlorotoluene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 4-Methyl-2-pentanone (MIBK) | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 |
| Acetone | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 |
| Acrolein | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 |
| Acrylonitrile | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 |
| Benzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Bromobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Bromochloromethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Bromodichloromethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Bromoform | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Bromomethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Carbon disulfide | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Carbon tetrachloride | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Chlorobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Chloroethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Chloroform | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Chloromethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| cis-1,2-Dichloroethene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| cis-1,3-Dichloropropene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Dibromochloromethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Dibromomethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Dichlorodifluoromethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Diisopropyl ether (DIPE) | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Ethyl Methacrylate | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Ethylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Ethyl-tert-butyl ether (ETBE) | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Freon 113 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Hexachlorobutadiene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Iodomethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Isopropylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |

**Table 5 (cont.) TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS**

| ANALYTES | ICAL ANALYTE CONCENTRATIONS (µg/L) 25-ml Purge | | | | | | | | | ICV/DCC | LCS/MS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | |
| m/p-Xylene | 0.6 | 1 | 2 | 4 | 10 | 20 | 40 | 60 | 80 | 20 | 20 |
| Methylene chloride | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Methyl-t-butyl ether (MTBE) | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Naphthalene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| n-Butylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| n-Propylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| o-Xylene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| p-Isopropyltoluene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| sec-Butylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Styrene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| tert-Amylmethyl ether (TAME) | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| tert-Butanol | 1.5 | 2.5 | 5 | 10 | 25 | 50 | 100 | 150 | 200 | 50 | 50 |
| tert-Butylbenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Tetrachloroethene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Toluene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| trans-1,2-Dichloroethene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| trans-1,3-Dichloropropene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| trans-1,4-Dichloro-2-butene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Trichloroethene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Trichlorofluoromethane | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Vinyl acetate | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Vinyl chloride | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| 1,2-Dichloroethane-d4 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Bromofluorobenzene | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Chlorobenzene-d5 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |
| Toluene-d8 | 0.3 | 0.5 | 1 | 2 | 5 | 10 | 20 | 30 | 40 | 10 | 10 |

**Table 5 (cont.) TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS**

| Analytes | ICAL ANALYTE CONCENTRATIONS (µg/L) 5-ml Purge | | | | | | | | ICV/DCC | LCS/MS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | | |
| 1,1,1,2-Tetrachloroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,1,1-Trichloroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,1,2,2-Tetrachloroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,1,2-Trichloroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,1-Dichloroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,1-Dichloroethene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,1-Dichloropropene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2,3-Trichlorobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2,3-Trichloropropane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2,4-Trichlorobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2,4-Trimethylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2-Dibromo-3-chloropropane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2-Dibromoethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2-Dichlorobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2-Dichloroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2-Dichloropropane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,3,5-Trimethylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,3-Dichlorobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,3-Dichloropropane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,4-Dichlorobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1-Chlorohexane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 2,2-Dichloropropane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 2-Butanone (MEK) | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 |
| 2-Chloroethyl vinyl ether | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 2-Chlorotoluene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 2-Hexanone | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 |
| 4-Chlorotoluene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 4-Methyl-2-pentanone (MIBK) | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 |
| Acetone | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 |
| Acrolein | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 |
| Acrylonitrile | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 |
| Benzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Bromobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Bromochloromethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Bromodichloromethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Bromoform | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Bromomethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Carbon disulfide | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Carbon tetrachloride | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Chlorobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Chloroethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Chloroform | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Chloromethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| cis-1,2-Dichloroethene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| cis-1,3-Dichloropropene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Dibromochloromethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Dibromomethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Dichlorodifluoromethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Diisopropyl ether (DIPE) | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Ethyl Methacrylate | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Ethylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Ethyl-tert-butyl ether (ETBE) | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Hexachlorobutadiene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Iodomethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Isopropylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |

**Table 5 (cont.)** **TYPICAL INITIAL CALIBRATION AND QC STANDARDS CONCENTRATION LEVELS**

| | ICAL ANALYTE CONCENTRATIONS (µg/L) 5-ml Purge | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Analytes | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | ICV/DCC | LCS/MS |
| m/p-Xylene | 4 | 10 | 20 | 40 | 100 | 160 | 200 | 400 | 100 | 100 |
| Methylene chloride | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Methyl-t-butyl ether (MTBE) | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Naphthalene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| n-Butylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| n-Propylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| o-Xylene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| p-Isopropyltoluene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| sec-Butylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Styrene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| tert-Amylmethyl ether (TAME) | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| tert-Butanol | 10 | 25 | 50 | 100 | 250 | 400 | 500 | 1000 | 250 | 250 |
| tert-Butylbenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Tetrachloroethene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Toluene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| trans-1,2-Dichloroethene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| trans-1,3-Dichloropropene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| trans-1,4-Dichloro-2-butene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Trichloroethene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Trichlorofluoromethane | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Vinyl acetate | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Vinyl chloride | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| 1,2-Dichloroethane-d4 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Bromofluorobenzene | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |
| Toluene-d8 | 2 | 5 | 10 | 20 | 50 | 80 | 100 | 200 | 50 | 50 |

**Table 6: BFB KEY ION ABUNDANCE CRITERIA**

| M/z | Required Intensity (relative abundance) |
|---|---|
| 50 | 15 to 40% of m/z 95 |
| 75 | 30 to 60% of m/z 95 |
| 95 | Base peak, 100% relative abundance |
| 96 | 5 to 9% of m/z 95 |
| 173 | Less than 2% of m/z 174 |
| 174 | Greater than 50% of m/z 95 |
| 175 | 5 to 9% of m/z 174 |
| 176 | Greater than 95% but less than 101% of m/z 174 |
| 177 | 5 to 9% of m/z 176 |

**Table 7: ESTABLISHED DL, LOD AND LOQ**

| PARAMETER | Water (5mL Purge) | | | Water (25mL Purge) | | | Soil | | |
|---|---|---|---|---|---|---|---|---|---|
| | DL | LOD | LOQ | DL | LOD | LOQ | DL | LOD | LOQ |
| Acetone | 2.5 | 5 | 10 | 2.6 | 5 | 10 | 3 | 5 | 10 |
| Acrolein | 2.5 | 5 | 10 | 2.5 | 5 | 10 | 2.5 | 5 | 10 |
| Acrylonitrile | 2.5 | 5 | 10 | 2.5 | 5 | 10 | 2.5 | 5 | 10 |
| Benzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Bromobenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Bromochloromethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Bromodichloromethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Bromoform | 0.5 | 1 | 5 | 0.2 | 0.3 | 0.5 | 1 | 2 | 5 |
| Bromomethane | 1.1 | 2 | 5 | 0.2 | 0.3 | 0.5 | 1.8 | 2 | 5 |
| tert-Butyl alcohol | 7 | 10 | 25 | 2.5 | 5 | 10 | 9 | 10 | 20 |
| 2-Butanone (MEK) | 2.5 | 5 | 10 | 2 | 4 | 10 | 2.5 | 5 | 10 |
| n-Butylbenzene | 0.7 | 1 | 5 | 0.2 | 0.2 | 0.5 | 0.7 | 1 | 5 |
| sec-Butylbenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.7 | 1 | 5 |
| tert-Butylbenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.6 | 1 | 5 |
| Carbon disulfide | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Carbon tetrachloride | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Chlorobenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 2-Chloroethyl vinyl ether | 1 | 2 | 5 | 0.5 | 1 | 2 | 1 | 2 | 5 |
| Chloroethane | 1 | 2 | 5 | 0.3 | 0.3 | 0.5 | 1 | 2 | 5 |
| Chloroform | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1-Chlorohexane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.6 | 1 | 5 |
| Chloromethane | 1 | 2 | 5 | 0.2 | 0.3 | 0.5 | 1 | 2 | 5 |
| 2-Chlorotoluene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.8 | 1 | 5 |
| 4-Chlorotoluene | 0.6 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.7 | 1 | 5 |
| Isopropyl ether (DIPE) | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Dibromochloromethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,2-Dibromo-3-chloropropane | 1 | 2 | 5 | 0.25 | 0.5 | 1 | 1 | 2 | 5 |
| 1,2-Dibromoethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Dibromomethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,1-Dichloroethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,2-Dichloroethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,2-Dichlorobenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,3-Dichlorobenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| trans-1,4-Dichloro-2-Butene | 1 | 2 | 5 | 0.5 | 1 | 2 | 1 | 2 | 5 |
| 1,4-Dichlorobenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Dichlorodifluoromethane | 1.3 | 2 | 5 | 0.2 | 0.3 | 0.5 | 1.2 | 2 | 5 |
| 1,1-Dichloroethene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| cis-1,2-Dichloroethene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| trans-1,2-Dichloroethene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Dichlorofluoromethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,1-Dichloropropene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,2-Dichloropropane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,3-Dichloropropane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 2,2-Dichloropropane | 1 | 2 | 5 | 0.2 | 0.2 | 0.5 | 1 | 2 | 5 |
| cis-1,3-Dichloropropene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| trans-1,3-Dichloropropene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| tert-Butyl ethyl ether (ETBE) | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Ethyl Methacrylate | 1 | 2 | 5 | 0.25 | 0.5 | 1 | 1 | 2 | 5 |
| Ethylbenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 2-Hexanone (MBK) | 2.5 | 5 | 10 | 2 | 4 | 5 | 2.9 | 5 | 10 |

**Table 7 (cont):** **ESTABLISHED DL, LOD AND LOQ**

| PARAMETER | Water (5mL Purge) | | | Water (25mL Purge) | | | Soil | | |
|---|---|---|---|---|---|---|---|---|---|
| | DL | LOD | LOQ | DL | LOD | LOQ | DL | LOD | LOQ |
| Hexachlorobutadiene | 0.5 | 1 | 5 | 0.2 | 0.3 | 0.5 | 1 | 2 | 5 |
| Iodomethane | 0.5 | 1 | 5 | 0.15 | 0.3 | 0.5 | 1 | 2 | 5 |
| Isopropylbenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.6 | 1 | 5 |
| p-Isopropyltoluene | 0.6 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.6 | 1 | 5 |
| Methylene Chloride | 0.5 | 1 | 5 | 0.3 | 0.5 | 1 | 1 | 2 | 5 |
| 4-Methyl-2-pentanone (MIBK) | 2.5 | 5 | 10 | 2 | 4 | 5 | 2.8 | 5 | 10 |
| tert-Butyl methyl ether | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Naphthalene | 1 | 2 | 5 | 0.25 | 0.5 | 1 | 1 | 2 | 5 |
| n-Propylbenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.65 | 1 | 5 |
| Styrene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| tert-Amyl methyl ether (TAME) | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,1,1,2-Tetrachloroethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,1,2,2-Tetrachloroethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Tetrachloroethene | 0.5 | 1 | 5 | 0.15 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Toluene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,1,1-Trichloroethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,1,2-Trichloroethane | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,2,3-Trichlorobenzene | 0.5 | 1 | 5 | 0.15 | 0.3 | 0.5 | 1 | 2 | 5 |
| 1,2,4-Trichlorobenzene | 0.5 | 1 | 5 | 0.15 | 0.3 | 0.5 | 1 | 2 | 5 |
| Trichloroethene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| Trichlorofluoromethane | 0.9 | 1 | 5 | 0.2 | 0.3 | 0.5 | 1.1 | 2 | 5 |
| 1,2,3-Trichloropropane | 1 | 2 | 5 | 0.25 | 0.5 | 1 | 1 | 2 | 5 |
| 1,1,2-Trichloro1,2,2-trifluoroethane | 1 | 2 | 5 | 0.2 | 0.3 | 0.5 | 1 | 2 | 5 |
| 1,2,4-Trimethylbenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.6 | 1 | 5 |
| 1,3,5-Trimethylbenzene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.6 | 1 | 5 |
| Vinyl Acetate | 1 | 2 | 5 | 0.25 | 0.5 | 1 | 1 | 2 | 5 |
| Vinyl Chloride | 0.6 | 1 | 5 | 0.1 | 0.2 | 0.5 | 1 | 2 | 5 |
| m-Xylene & p-xylene | 1 | 2 | 10 | 0.2 | 0.4 | 1 | 1 | 2 | 10 |
| o-Xylene | 0.5 | 1 | 5 | 0.1 | 0.2 | 0.5 | 0.5 | 1 | 5 |
| 1,2-Dichloroethane-d4 | 1 | 2 | 5 | 0.5 | 1 | 2 | 1 | 2 | 5 |
| Toluene-d8 | 1 | 2 | 5 | 0.5 | 1 | 2 | 1 | 2 | 5 |
| 4-Bromofluorobenzene | 1 | 2 | 5 | 0.5 | 1 | 2 | 1 | 2 | 5 |
| Dibromofluoromethane | 1 | 2 | 5 | 0.5 | 1 | 2 | 0.5 | 1 | 5 |

**Table 8: CHARACTERISTIC IONS**

| ANALYTE | PRIMARY CHARACTERISTIC ION(S) | SECONDARY CHARACTERISTIC ION(S) |
|---|---|---|
| Acetone | 43 | 58 |
| Acetonitrile | 41 | 40,39 |
| Acrolein | 56 | 55 |
| Acrylonitrile | 53 | 52, 51 |
| Benzene | 78 | 77, 52 |
| Benzyl Chloride | 91 | 126, 65, 125 |
| Bromobenzene | 156 | 51, 158 |
| Bromochloromethane | 49 | 128, 130 |
| Bromoform | 173 | 171, 175 |
| Bromomethane | 94 | 96 |
| n-Butylbenzene | 91 | 92, 134 |
| sec-Butylbenzene | 105 | 134 |
| tert-Butylbenzene | 119 | 91, 134 |
| Carbon Disulfide | 76 | 78 |
| Carbon Tetrachloride[6] | 119 | 117 |
| Chlorobenzene | 112 | 51, 77, 114 |
| Chloroethane | 64 | 49, 66 |
| 2-Chloroethyl vinyl ether | 63 | 65, 106 |
| Chloroform | 83 | 85, 47 |
| Chloromethane | 50 | 52 |
| 2-Chlorotoluene | 91 | 126 |
| 4-Chlorotoluene | 91 | 126 |
| 1,2-Dibromo-3-chloropropane | 157 | 155, 175 |
| Dibromochloromethane | 129 | 127. 131 |
| 1,2-Dibromoethane | 107 | 109 |
| Dibromomethane | 93 | 95, 174 |
| 1,2-Dichlorobenzene | 146 | 111, 148 |
| 1,3-Dichlorobenzene | 146 | 111, 148 |
| 1,4-Dichlorobenzene | 146 | 111, 148 |
| cis-1,4-Dichloro-2-butene | 75 | 53, 77, 124, 89 |
| trans-1,4-Dichloro-2-butene | 53 | 88 |
| Dichlorodifluoromethane | 85 | 87, 50 |
| 1,1-Dichloroethane | 63 | 65, 83 |
| 1,2-Dichloroethane | 62 | 98, 64 |
| 1,1-Dichloroethene | 61 | 63, 96 |
| cis-1,2-Dichloroethene | 96 | 61, 98 |
| trans-1,2-Dichloroethene | 61 | 96, 98 |
| 1,2-Dichloropropane | 63 | 41, 76 |
| 1,3-Dichloropropane | 76 | 63, 78 |
| 2,2-Dichloropropane | 77 | 97, 79, 41 |

[6] Quantitation ion was changed due to co-elution (Carbon tetrachloride – 117 to 119)

**Table 8 (cont): CHARACTERISTIC IONS**

| ANALYTE | PRIMARY CHARACTERISTIC ION(S) | SECONDARY CHARACTERISTIC ION(S) |
|---|---|---|
| 1,1-Dichloropropene[7] | 77 | 110, 75 |
| cis-1,3-Dichloropropene | 75 | 77, 39, 110 |
| trans-1,3-Dichloropropene | 75 | 77, 39, 110 |
| Ethylbenzene | 91 | 106 |
| Hexachlorobutadiene | 225 | 223, 227 |
| Hexachloroethane | 201 | 166, 199, 203 |
| 2-Hexanone | 43 | 58, 100 |
| Iodomethane | 142 | 127, 141 |
| Isopropyltoluene | 105 | 120, 79, 103 |
| Methyl-t-butyl ether | 73 | 57 |
| Methylene chloride | 49 | 84, 86 |
| Methyl ethyl ketone | 43 | 72 |
| 4-Methyl-2-pentanone | 43 | 58, 85, 100 |
| Naphthalene | 128 | 127 |
| n-Propylbenzene | 91 | 65, 120 |
| Styrene | 104 | 78, 103 |
| 1,2,3-Trichlorobenzene | 180 | 182, 145 |
| 1,2,4-Trichlorobenzene | 180 | 182, 145 |
| 1,1,1,2-Tetrachloroethane | 131 | 133, 119, 117 |
| 1,1,2,2-Tetrachloroethane | 83 | 131, 85 |
| Tetrachloroethene | 164 | 129, 131, 166 |
| Toluene | 92 | 91 |
| 1,1,1 -Trichloroethane | 97 | 99, 61 |
| 1,1,2 -Trichloroethane | 97 | 83, 85, 99 |
| Trichloroethene | 130 | 97, 132, 95 |
| Trichlorofluoromethane | 101 | 103 |
| 1,2,3-Trichloropropane | 75 | 61, 77 |
| 1,2,4-Trimethylbenzene | 105 | 120 |
| 1,3,5-Trimethylbenzene | 105 | 120, 119 |
| Vinyl acetate | 43 | 86 |
| Vinyl chloride | 62 | 64 |
| o-Xylene | 91 | 106 |
| m-Xylene | 91 | 106 |
| p-Xylene | 91 | 106 |
| **INTERNAL STANDARDS / SURROGATES** | | |
| 1,4-Difluorobenzene | 114 | 88 |
| Chlorobenzene-d5 | 117 | 82, 119 |
| 1,2-Dichlorobenzene-d4 | 152 | 150 |
| 4-Bromofluorobenzene | 95 | 174, 176 |
| 1,2-Dichloroethane-d4 | 65 | 102 |
| Toluene-d8 | 98 | 100 |

[7] Quantitation ion was changed due to co-elution (1,1-Dichloropropene – 75 to 77)

**Table 9: INTERNAL STANDARDS WITH CORRESPONDING TARGET COMPOUNDS AND SURROGATES ASSIGNED FOR QUANTITATION**

| **1,4-DIFLUOROBENZENE** | **CHLOROBENZENE-$D_5$** | **1,2-DICHLOROBENZENE-$D_4$** |
|---|---|---|
| Dichlorodifluoromethane | 1,1-Dichloropropene | Bromoform |
| Chloromethane | Carbon Tetrachloride | Isopropyl Benzene |
| Vinyl Chloride | Benzene | Bromofluorobenzene |
| Bromomethane | 1,2-Dichloroethane | Bromobenzene |
| Chloroethane | Trichloroethene | 1,1,2,2-Tetrachloroethane |
| Trichlorofluorometh | 1,2-Dichloropropane | 1,2,3-Trichloropropane |
| 1,1-Dichloroethene | Bromodichloromethane | 1,4-Dichloro-2-butene |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | Dibromomethane | n-Propylbenzene |
| Acetone | 2-Chloroethyl Vinyl Ether | 2-Chlorotoluene |
| Iodomethane | cis-1,3-Dichloropropene | 4-Chlorotoluene |
| Carbon Disulfide | 4-Methyl-2-Pentanone | 1,3,5-Trimethylbenzene |
| Methylene Chloride | Toluene-$d_8$ | tert-Butylbenzene |
| Acrylonitrile | Toluene | 124-Trimethylbenzen |
| trans-1,2-Dichloroe | trans-1,3-Dichloropropene | Sec-Butylbenzene |
| Acrolein | Ethyl Methacrylate | 1,3-Dichlorobenzene |
| MTBE | 1,1,2-trichloroethane | 1,4-Dichlorobenzene |
| 1,1-Dichloroethane | Tetrachloroethene | p-Isopropyltoluene |
| Vinyl Acetate | 1,3-Dichloropropane | 1,2-Dichlorobenzene |
| 2,2-Dichloropropane | 2-Hexanone | n-Butylbenzene |
| cis-1,2-Dichloroeth | Dibromochloromethane | 1,2-Dibromo-3-Chlorpropane |
| 2-Butanone | 1,2-Dibromoethane | 1,2,4-Trichlorobenzene |
| Bromochloromethane | Chlorobenzene | Hexachlorobutadiene |
| Chloroform | 1-Chlorohexane | Naphthalene |
| 1,1,1-Trichloroetha | 1,1,1,2-Tetrachloroethane | 1,2,3-Trichlorobenzene |
| 1,2-Dichloroethane-$d_4$ | Ethylbenzene | |
| | m/p-Xylenes | |
| | o-Xylene | |
| | Styrene | |

**Appendix 1:** **SUMMARY OF QUALITY CONTROL PROCEDURES**

| QC PROCEDURE | FREQUENCY | ACCEPTANCE CRITERIA | CORRECTIVE ACTION | 1st Rvw | 2nd Rvw |
|---|---|---|---|---|---|
| Check of mass spectral ion intensities using BFB | Prior to initial calibration and calibration verification | Refer to criteria listed in Table 6 | Retune instrument and verify | | |
| Minimum of 6-point initial calibration(ICAL) | Initially; as needed | SPCCs :<br>RF ≥ 0.1 for Bromoform, Chloromethane and 1,1-Dichloroethane<br>RF ≥ 0.3 for Chlorobenzene and 1,1,2,2-Tetrachloroethane<br><br>CCCs: Chloroform, 1,1-DCE, 1,2-DCP, Ethylbenzene, Toluene and Vinyl Chloride.<br>RFs for CCCs: RSD≤30% and one option below:<br><br>1). For analytes with RSD ≤ 15%, use RRFm<br>2). For analytes with RSD>15% and r ≥0..995, use either Inverse Weighting Factor or Linear Least Squares<br>3). For analytes with RSD>15% and COD ≥0.99, use non-linear regression (6 pts for second order, 7 pts for third order). | Check for outliers. Otherwise, optimize the instrument then repeat initial calibration. | | |
| Initial calibration verification (ICV) | After initial calibration | In the absence of PSR<br>All analytes within ± 20% of expected value except for the following compounds due to erratic chromatographic behavior: Bromomethane, Chloroethane, Chloromethane, Dichlorodifluoromethane within ± 35% of expected value. | Verify second source standard. Prepare fresh standard and rerun ICV. If that fails, Optimize instrument and repeat ICAL. | | |
| Evaluation of relative retention times (RRT) | Each sample | Within ± 0.06 RRT units | Correct the problem then reanalyze all samples analyzed since the last retention time check | | |
| Continuing Calibration verification (CCV) | Daily, before sample analysis and every 12 hours of analysis time | SPCCs: Min. RF same as ICAL<br>CCC : %Diff ≤ 20% (when using RFs) or drift (when using least squares regression or non-linear calibration) | Correct the problem then repeat initial calibration | | |
| Internal Standard (IS) | All samples | Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL;<br>EICP area within -50% to +100% of ICAL midpoint standard | Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning | | |
| Method blank (MB) | One per preparation batch | No analytes detected >½ LOQ | Determine the source of contamination and correct the problem. Re-prep and re-analyze MB and all associated samples. Otherwise, apply "B" to specific analyte(s) on associated samples | | |
| LCS | One LCS per preparation | Within project QC Limits | Re-prep and re-analyze the LCS and all associated samples | | |
| MS/MSD | One MS/MSD per every 20 project samples per matrix | Within project QC Limits | Check if sample was properly spiked. If indicative of matrix interference, discuss in case narrative, otherwise re-prep and re-analyze the sample | | |
| Surrogate | Every Sample, MB, LCS, MS/MSD, DCC | Within project QC Limits | Correct the problem then re-analyze | | |
| **Comments:** Refer to PSR for Flagging Criteria. Report values between LOD and LOQ. | | | Reviewed by: | | |
| | | | Date: | | |

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**Appendix 2:** **DEMONSTRATION OF CAPABILITY**

## Final Report - Soil / Hazardous Waste PT

## Study: HW0110

**Opening Date: January 18, 2010 - Closing Date: March 4, 2010**

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

| Volatiles (PT-VOA-SOIL) | | | | | | | | Lot #: 7039-12 |
|---|---|---|---|---|---|---|---|---|
| NELAC Code | Analyte | Method Code | Method Description | Units | Assigned Value | Result | Acceptance Limits | Evaluation |
| 4315 | Acetone | 10184802 | SW 5035/SW 8260 B | µg/kg | 303 | 240 | 103 - 495 | Acceptable |
| 4375 | Benzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 105 | 94.4 | 62.6 - 144 | Acceptable |
| 4395 | Bromodichloromethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 111 | 104 | 72.1 - 153 | Acceptable |
| 4400 | Bromoform | 10184802 | SW 5035/SW 8260 B | µg/kg | <9.3 | <5 | | Acceptable |
| 4410 | 2-Butanone (MEK) | 10184802 | SW 5035/SW 8260 B | µg/kg | 255 | 213 | 51.9 - 397 | Acceptable |
| 4455 | Carbon tetrachloride | 10184802 | SW 5035/SW 8260 B | µg/kg | <9.9 | <5 | | Acceptable |
| 4475 | Chlorobenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 179 | 176 | 102 - 248 | Acceptable |
| 4575 | Chlorodibromomethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 58.8 | 55.8 | 34.3 - 82.2 | Acceptable |
| 4505 | Chloroform | 10184802 | SW 5035/SW 8260 B | µg/kg | 110 | 111 | 66.4 - 153 | Acceptable |
| 4610 | 1,2-Dichlorobenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 131 | 129 | 63.4 - 185 | Acceptable |
| 4615 | 1,3-Dichlorobenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 50.5 | 48 | 17.6 - 74.7 | Acceptable |
| 4620 | 1,4-Dichlorobenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 97.0 | 95 | 33.5 - 138 | Acceptable |
| 4630 | 1,1-Dichloroethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 44.0 | 43.9 | 24.4 - 64.2 | Acceptable |
| 4635 | 1,2-Dichloroethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 45.0 | 54 | 26.7 - 63.9 | Acceptable |
| 4655 | 1,2-Dichloropropane | 10184802 | SW 5035/SW 8260 B | µg/kg | 80.8 | 79.9 | 47.5 - 109 | Acceptable |
| 4765 | Ethylbenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | <9.0 | <5 | | Acceptable |
| 4975 | Methylene chloride | 10184802 | SW 5035/SW 8260 B | µg/kg | 108 | 100 | 50.4 - 157 | Acceptable |
| 5000 | Methyl-tert-butyl ether (MTBE) | 10184802 | SW 5035/SW 8260 B | µg/kg | 144 | 142 | 60.9 - 213 | Acceptable |
| 4995 | 4-Methyl-2-pentanone (MIBK) | 10184802 | SW 5035/SW 8260 B | µg/kg | 232 | 176 | 102 - 337 | Acceptable |
| 5005 | Naphthalene | 10184802 | SW 5035/SW 8260 B | µg/kg | 93.3 | 78.3 | 52.8 - 134 | Acceptable |
| 5105 | 1,1,1,2-Tetrachloroethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 52.5 | 52.5 | 33.7 - 73.7 | Acceptable |
| 5110 | 1,1,2,2-Tetrachloroethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 152 | 133 | 78.9 - 220 | Acceptable |
| 5115 | Tetrachloroethene | 10184802 | SW 5035/SW 8260 B | µg/kg | 51.5 | 47.5 | 22.7 - 74.1 | Acceptable |
| 5140 | Toluene | 10184802 | SW 5035/SW 8260 B | µg/kg | 47.4 | 44.5 | 26.7 - 67.1 | Acceptable |
| 5155 | 1,2,4-Trichlorobenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 151 | 133 | 75.2 - 190 | Acceptable |
| 5160 | 1,1,1-Trichloroethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 44.8 | 44.9 | 23.6 - 63.5 | Acceptable |
| 5165 | 1,1,2-Trichloroethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 32.2 | 29.9 | 20.1 - 47.2 | Acceptable |
| 5170 | Trichloroethene | 10184802 | SW 5035/SW 8260 B | µg/kg | 113 | 99.6 | 58.1 - 162 | Acceptable |
| 5180 | 1,2,3-Trichloropropane | 10184802 | SW 5035/SW 8260 B | µg/kg | 61.0 | 53.9 | 42.5 - 72.3 | Acceptable |
| 5260 | Xylenes, total | 10184802 | SW 5035/SW 8260 B | µg/kg | 157 | 155 | 76.8 - 233 | Acceptable |
| **NELAC Experimental Analytes** | | | | | | | | |
| 4385 | Bromobenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 68.7 | 69.1 | 48.2 - 85.0 | Acceptable |
| 4950 | Bromomethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 100 | 74.7 | 20.0 - 137 | Acceptable |
| 4485 | Chloroethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 100 | 88.5 | 20.0 - 149 | Acceptable |
| 4960 | Chloromethane | 10184802 | SW 5035/SW 8260 B | µg/kg | <20 | 7.35 | | Acceptable |
| 4570 | 1,2-Dibromo-3-chloropropane (DBCP) | 10184802 | SW 5035/SW 8260 B | µg/kg | 124 | 97.6 | 71.2 - 161 | Acceptable |
| 4585 | 1,2-Dibromoethane (EDB) | 10184802 | SW 5035/SW 8260 B | µg/kg | 181 | 163 | 121 - 219 | Acceptable |
| 4625 | Dichlorodifluoromethane | 10184802 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4640 | 1,1-Dichloroethene | 10184802 | SW 5035/SW 8260 B | µg/kg | 110 | 98.2 | 63.3 - 161 | Acceptable |
| 4645 | cis-1,2-Dichloroethene | 10184802 | SW 5035/SW 8260 B | µg/kg | <10 | <5 | | Acceptable |
| 4700 | trans-1,2-Dichloroethene | 10184802 | SW 5035/SW 8260 B | µg/kg | 74.7 | 69.1 | 41.4 - 102 | Acceptable |
| 4680 | cis-1,3-Dichloropropene | 10184802 | SW 5035/SW 8260 B | µg/kg | 60.5 | 60.2 | 40.6 - 78.9 | Acceptable |
| 4685 | trans-1,3-Dichloropropene | 10184802 | SW 5035/SW 8260 B | µg/kg | <10 | <5 | | Acceptable |
| 4860 | 2-Hexanone | 10184802 | SW 5035/SW 8260 B | µg/kg | 177 | 145 | 67.6 - 257 | Acceptable |
| 4900 | Isopropylbenzene | 10184802 | SW 5035/SW 8260 B | µg/kg | 88.0 | 85.6 | 45.5 - 124 | Acceptable |
| 5100 | Styrene | 10184802 | SW 5035/SW 8260 B | µg/kg | 83.2 | 82 | 54.1 - 111 | Acceptable |
| 5175 | Trichlorofluoromethane | 10184802 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 5235 | Vinyl chloride | 10184802 | SW 5035/SW 8260 B | µg/kg | 140 | 85.6 | 60.9 - 181 | Acceptable |
| **Additional State Specific Analytes** | | | | | | | | |
| 4320 | Acetonitrile | 10184802 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4325 | Acrolein | 10184802 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4340 | Acrylonitrile | 10184802 | SW 5035/SW 8260 B | µg/kg | 76.0 | 70 | 22.7 - 129 | Acceptable |
| 4390 | Bromochloromethane | 10184802 | SW 5035/SW 8260 B | µg/kg | 136 | 135 | 40.9 - 232 | Acceptable |

**Appendix 2 (Cont.):** **DEMONSTRATION OF CAPABILITY**

| Volatiles (PT-VOA-SOIL) cont'd | | | | | | | | Lot #: 7039-12 |
|---|---|---|---|---|---|---|---|---|
| NELAC Code | Analyte | Method Code | Method Description | Units | Assigned Value | Result | Acceptance Limits | Evaluation |
| **Additional State Specific Analytes cont'd** | | | | | | | | |
| 4435 | n-Butylbenzene | 10184902 | SW 5035/SW 8260 B | µg/kg | 65.9 | 62 | 19.8 - 112 | Acceptable |
| 4440 | sec-Butylbenzene | 10184902 | SW 5035/SW 8260 B | µg/kg | 144 | 137 | 43.3 - 245 | Acceptable |
| 4445 | tert-Butylbenzene | 10184902 | SW 5035/SW 8260 B | µg/kg | 180 | 172 | 54.0 - 306 | Acceptable |
| 4450 | Carbon disulfide | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4465 | Chloroacetaldehyde | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 5765 | bis(2-Chloroethyl)ether | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 5760 | bis(2-Chloroethoxy)methane | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 5780 | bis(2-Chloroisopropyl)ether | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4500 | 2-Chloroethylvinylether | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4535 | 2-Chlorotoluene | 10184902 | SW 5035/SW 8260 B | µg/kg | 40.8 | 51 | 12.2 - 69.4 | Acceptable |
| 4540 | 4-Chlorotoluene | 10184902 | SW 5035/SW 8260 B | µg/kg | 153 | 151 | 45.9 - 260 | Acceptable |
| 4595 | Dibromomethane | 10184902 | SW 5035/SW 8260 B | µg/kg | 52.5 | 50.7 | 16.2 - 91.8 | Acceptable |
| 4660 | 1,3-Dichloropropane | 10184902 | SW 5035/SW 8260 B | µg/kg | 147 | 137 | 44.1 - 250 | Acceptable |
| 4665 | 2,2-Dichloropropane | 10184902 | SW 5035/SW 8260 B | µg/kg | 84.7 | 85.1 | 25.4 - 144 | Acceptable |
| 4670 | 1,1-Dichloropropene | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 9375 | DIPE | 10184902 | SW 5035/SW 8260 B | µg/kg | 113 | 108 | 34.0 - 193 | Acceptable |
| 4840 | Hexachloroethane | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4835 | Hexachlorobutadiene | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4835 | Hexachlorobutadiene | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 4910 | p-Isopropyltoluene | 10184902 | SW 5035/SW 8260 B | µg/kg | 40.4 | 39 | 12.1 - 68.7 | Acceptable |
| 5090 | n-Propylbenzene | 10184902 | SW 5035/SW 8260 B | µg/kg | 36.4 | 34.9 | 10.9 - 61.9 | Acceptable |
| 4370 | TAME | 10184902 | SW 5035/SW 8260 B | µg/kg | 56.1 | 54.8 | 16.8 - 95.4 | Acceptable |
| 5150 | 1,2,3-Trichlorobenzene | 10184902 | SW 5035/SW 8260 B | µg/kg | 99.1 | 91.1 | 29.7 - 168 | Acceptable |
| 5210 | 1,2,4-Trimethylbenzene | 10184902 | SW 5035/SW 8260 B | µg/kg | 155 | 149 | 46.4 - 263 | Acceptable |
| 5215 | 1,3,5-Trimethylbenzene | 10184902 | SW 5035/SW 8260 B | µg/kg | 42.8 | 42 | 12.9 - 72.8 | Acceptable |
| 5225 | Vinyl acetate | 10184902 | SW 5035/SW 8260 B | µg/kg | <20 | <5 | | Acceptable |
| 5250 | o-Xylene | 10174908 | SW 5035/SW 8021 B | µg/kg | 62.6 | 67.8 | 18.8 - 106 | Acceptable |
| 5250 | o-Xylene | 10184902 | SW 5035/SW 8260 B | µg/kg | 62.6 | 61.1 | 18.8 - 106 | Acceptable |
| 5240 | m+p-Xylene | 10184902 | SW 5035/SW 8260 B | µg/kg | 94.8 | 93.6 | 28.4 - 161 | Acceptable |

## Final Report - Water Pollution Proficiency Testing

## Study: WP0110

**Opening Date: January 4, 2010 - Closing Date: February 18, 2010**

Laboratory: EMAX Laboratories
1825 205th Street
Torrance, CA 90501

Contact: Kenette Pimentel, Quality Assurance Manager
310-618-8889 ext. 205

EPA Lab ID: CA00291

**Volatiles (PT-VOA-WP)** **Lot #: 8094-26**

| NELAC Code | Analyte | Method Code | Method Description | Units | Assigned Value | Result | Acceptance Limits | Evaluation |
|---|---|---|---|---|---|---|---|---|
| 4375 | Benzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 17.1 | 16 | 11.4 - 22.8 | Acceptable |
| 4395 | Bromodichloromethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 61.1 | 67 | 43.2 - 82.5 | Acceptable |
| 4400 | Bromoform | 10184902 | SW 5030 C/SW 8260 B | µg/L | 88.1 | 82.4 | 56.1 - 119 | Acceptable |
| 4950 | Bromomethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 30.0 | 21.4 | 12.0 - 48.0 | Acceptable |
| 4455 | Carbon tetrachloride | 10184902 | SW 5030 C/SW 8260 B | µg/L | 22.4 | 25.5 | 12.7 - 31.0 | Acceptable |
| 4475 | Chlorobenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 64.7 | 63.2 | 46.6 - 81.0 | Acceptable |
| 4485 | Chloroethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 90.5 | 80.3 | 36.2 - 145 | Acceptable |
| 4505 | Chloroform | 10184902 | SW 5030 C/SW 8260 B | µg/L | 80.8 | 82.4 | 56.0 - 104 | Acceptable |
| 4960 | Chloromethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 0.00 | <5 | | Acceptable |
| 4575 | Dibromochloromethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 0.00 | <5 | | Acceptable |
| 4610 | 1,2 Dichlorobenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 85.9 | 82.1 | 59.8 - 111 | Acceptable |
| 4615 | 1,3 Dichlorobenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 62.1 | 60.2 | 42.0 - 79.2 | Acceptable |
| 4620 | 1,4 Dichlorobenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 25.0 | 24.9 | 16.5 - 32.4 | Acceptable |
| 4635 | 1,2 Dichloroethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 21.5 | 21.8 | 14.9 - 29.2 | Acceptable |
| 4640 | 1,1-Dichloroethene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 25.3 | 26.1 | 13.4 - 37.0 | Acceptable |
| 4700 | trans-1,2-Dichloroethene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 23.2 | 22.1 | 12.3 - 34.6 | Acceptable |
| 4655 | 1,2-Dichloropropane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 61.1 | 59.2 | 40.0 - 80.7 | Acceptable |
| 4685 | trans-1,3-Dichloropropene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 0.00 | <5 | | Acceptable |
| 4765 | Ethylbenzene | 10174908 | SW 5030 C/SW 8021 B | µg/L | 12.6 | 12.8 | 8.31 - 16.8 | Acceptable |
| 4765 | Ethylbenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 12.6 | 12.1 | 8.31 - 16.8 | Acceptable |
| 4835 | Hexachlorobutadiene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 0.00 | <5 | | Acceptable |
| 4975 | Methylene Chloride | 10184902 | SW 5030 C/SW 8260 B | µg/L | 106 | 110 | 65.0 - 148 | Acceptable |
| 4995 | 4-Methyl-2-pentanone (MIBK) | 10184902 | SW 5030 C/SW 8260 B | µg/L | 36.9 | 31.9 | 13.5 - 58.0 | Acceptable |
| 5005 | Naphthalene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 0.00 | <5 | | Acceptable |
| 5100 | Styrene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 35.4 | 36.1 | 23.2 - 47.9 | Acceptable |
| 5110 | 1,1,2,2-Tetrachloroethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 140 | 120 | 83.3 - 202 | Acceptable |
| 5115 | Tetrachloroethene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 19.1 | 19.1 | 9.61 - 25.3 | Acceptable |
| 5140 | Toluene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 38.6 | 37.3 | 26.8 - 48.7 | Acceptable |
| 5155 | 1,2,4-Trichlorobenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 0.00 | <5 | | Acceptable |
| 5160 | 1,1,1-Trichloroethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 77.3 | 85.4 | 48.1 - 101 | Acceptable |
| 5165 | 1,1,2-Trichloroethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 32.9 | 31.2 | 23.0 - 43.5 | Acceptable |
| 5170 | Trichloroethene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 0.00 | <5 | | Acceptable |
| 5175 | Trichlorofluoromethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 60.6 | 75.4 | 24.2 - 96.9 | Acceptable |
| 5235 | Vinyl chloride | 10184902 | SW 5030 C/SW 8260 B | µg/L | 36.5 | 31.2 | 14.6 - 58.4 | Acceptable |
| 5260 | Xylenes, total | 10184902 | SW 5030 C/SW 8260 B | µg/L | 204 | 204 | 117 - 272 | Acceptable |
| **NELAC Experimental Analytes** | | | | | | | | |
| 4630 | 1,1-Dichloroethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | 73.7 | 72.9 | 50.7 - 101 | Acceptable |
| 4645 | cis-1,2-Dichloroethene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 110 | 93.9 | 80.8 - 145 | Acceptable |
| 4680 | cis-1,3-Dichloropropylene | 10184902 | SW 5030 C/SW 8260 B | µg/L | 67.2 | 69.1 | 47.0 - 87.4 | Acceptable |
| 4860 | 2-Hexanone | 10184902 | SW 5030 C/SW 8260 B | µg/L | 154 | 203 | 79.7 - 226 | Acceptable |
| 5000 | Methyl tert-butyl ether (MTBE) | 10184902 | SW 5030 C/SW 8260 B | µg/L | 89.4 | 87.5 | 57.2 - 125 | Acceptable |
| **Additional State Specific Analytes** | | | | | | | | |
| 4315 | Acetone | 10184902 | SW 5030 C/SW 8260 B | µg/L | 295 | 358 | 110 - 575 | Acceptable |
| 4320 | Acetonitrile | 10184902 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4325 | Acrolein | 10184902 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4340 | Acrylonitrile | 10184902 | SW 5030 C/SW 8260 B | µg/L | 108 | 101 | 43.2 - 173 | Acceptable |
| 4385 | Bromobenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 4390 | Bromochloromethane | 10184902 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4410 | 2-Butanone (MEK) | 10184902 | SW 5030 C/SW 8260 B | µg/L | 18.3 | 21.5 | 3.36 - 36.6 | Acceptable |
| 4435 | n-Butylbenzene | 10184902 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |

**Appendix 2 (Cont.):** **DEMONSTRATION OF CAPABILITY**

| Volatiles (PT-VOA-WP) cont'd | | | | | | | | Lot #: 8094-26 |
|---|---|---|---|---|---|---|---|---|
| NELAC Code | Analyte | Method Code | Method Description | Units | Assigned Value | Result | Acceptance Limits | Evaluation |
| **Additional State Specific Analytes cont'd** | | | | | | | | |
| 4440 | sec-Butylbenzene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 4445 | tert-Butylbenzene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 4450 | Carbon disulfide | 10184802 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4500 | 2-Chloroethylvinylether | 10184802 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4535 | 2-Chlorotoluene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4540 | 4-Chlorotoluene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 4570 | 1,2-Dibromo-3-chloropropane (DBCP) | 10184802 | SW 5030 C/SW 8260 B | µg/L | 102 | 96.7 | 40.8 - 163 | Acceptable |
| 4585 | 1,2-Dibromoethane (EDB) | 10184802 | SW 5030 C/SW 8260 B | µg/L | 110 | 103 | 44.0 - 176 | Acceptable |
| 4595 | Dibromomethane | 10184802 | SW 5030 C/SW 8260 B | µg/L | 119 | 114 | 47.6 - 190 | Acceptable |
| 4625 | Dichlorodifluoromethane | 10184802 | SW 5030 C/SW 8260 B | µg/L | 6.00 | <5 | 0.00 - 10.8 | Acceptable |
| - | Dichlorofluoromethane | 10184802 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4660 | 1,3-Dichloropropane | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 4665 | 2,2-Dichloropropane | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 4670 | 1,1-Dichloropropene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 4900 | Isopropylbenzene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 4910 | p-Isopropyltoluene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 5090 | n-Propylbenzene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <10 | <5 | | Acceptable |
| 5105 | 1,1,1,2-Tetrachloroethane | 10184802 | SW 5030 C/SW 8260 B | µg/L | 43.1 | 46.9 | 17.2 - 69.0 | Acceptable |
| 5150 | 1,2,3-Trichlorobenzene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 5180 | 1,2,3-Trichloropropane | 10184802 | SW 5030 C/SW 8260 B | µg/L | 62.4 | 59.6 | 25.0 - 99.8 | Acceptable |
| 5210 | 1,2,4-Trimethylbenzene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <20 | <5 | | Acceptable |
| 5215 | 1,3,5-Trimethylbenzene | 10184802 | SW 5030 C/SW 8260 B | µg/L | <20 | <5 | | Acceptable |
| 5225 | Vinyl acetate | 10184802 | SW 5030 C/SW 8260 B | µg/L | <5 | <5 | | Acceptable |
| 5240 | m+p-Xylene | 10184802 | SW 5030 C/SW 8260 B | µg/L | 136 | 137 | 54.4 - 218 | Acceptable |
| 5250 | o-Xylene | 10184802 | SW 5030 C/SW 8260 B | µg/L | 67.5 | 66.9 | 27.0 - 108 | Acceptable |

**8260FA:** **ANALYTICAL RUN LOG**

EMAX LABORATORIES, INC.

Page 1

# ANALYSIS LOG FOR VOLATILES

**SOP** ☐ EMAX-8260 Rev.No. 4 ☐ EMAX-524.2 Rev.No. 4 ☐ EMAX-CLP-VOA ☐ EMAX 624 Rev.No. 2 ☐

**Start Date:** ☐ 5-ml Purge ☐ 25-ml Purge **Book # AD3 -019**

BATCH _____

| Sample Prep. ID | Data File Name | Lab Sample ID | Sample Amount | DF | Matrix W pH | Matrix W $Cl_2$ | Matrix S | Notes |
|---|---|---|---|---|---|---|---|---|
| 01 | | | | | | | | |
| 02 | | | | | | | | |
| 03 | | | | | | | | |
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| Instrument No. | | D3 |
|---|---|---|
| INITIAL CALIBRATION REFERENCE | | |
| DATE | | |
| ICAL ID | | |
| STANDARDS | | |
| NAME | ID | CONC. (mg/L) |
| DCC | | |
| DCC | | |
| DCC | | |
| BFB | | |
| IS/SURR. | | |
| LCS | | |
| LCS | | |
| LCS | | |
| SOLVENT | ID | |
| METHANOL | | |
| DATA FILE | | |
| Electronic Data Archival | | |
| Location | | Date |
| HPCHEM_VOA/TOD3 | | |

Comments: _____

Analyzed By: _____

Date Disposed: _____

Disposed By: _____

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**8260FM:** **INSTRUMENT MAINTENANCE LOG**

EMAX LABORATORIES, INC.

Page 1

## INSTRUMENT MAINTENANCE LOG

Instrument No: 05 Month: Year: 201_ Book # : MD3-005

| DATE | | | | | | |
|---|---|---|---|---|---|---|
| Bake Trap (210°C-260°C) | | | | | | |
| Column Head Pressure (2-60 psi) | | | | | | |
| Injector Port Temperature (160°C-220°C) | | | | | | |
| Interface Temperature (250°C-280°C) | | | | | | |
| Verify Computer Date and Time | | | | | | |
| Check Gas Pressure (Daily) | | | | | | |
| Check IS/Surrogate auto injection vial as appropriate (Daily) | | | | | | |
| Check the foreline pump oil level (Weekly) | | | | | | |
| AutoTune the MSD (As needed) | | | | | | |
| Analyst's initial | | | | | | |
| **Trouble Shooting** | | | | | | |
| Problem(s) Encountered | | | | | | |
| Return-to-Control (Analyst Initial) | | | | | | |

| Code | Problems Encountered | Code | Corrrective Action |
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