# Final, Revision 3.0
# Installation-Wide Sampling and Analysis Plan
# McClellan, Anniston, Alabama

**Prepared for:**

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DEVELOPMENT AUTHORITY

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# PREFACE

This preface is to be added to the Final, Revision 3.0 Installation-Wide Sampling and Analysis Plan, McClellan, Anniston, Alabama dated April 2017, hereafter referred to as the SAP, prepared by Matrix Environmental Services, LLC (MES) on behalf of the McClellan Development Authority (MDA).

The preface and updated references is applicable to the SAP and all of the tables, figures, attachments, and appendices. All references will follow the most current final versions of the documents whether or not they are listed in the reference table updated April 2022.

The method detection limit (MDL) will be below the current screening levels unless it is not technically achievable. The laboratory method reporting limits (MRLs) and MDLs change with the most current study, the method, the instrument, and the laboratory. The most current EPA analytical methods will be used by the laboratory once the laboratory is certified in the method. The most appropriate lab certified method with MDLs at or below the screening levels may be used by the laboratory. Tables 1 and 2 in this preface compare current MRLs and MDLs to regulatory limits.

## Preface Table 1 - Aqueous Analytes MRL and MDL compared to Screening Levels

| Analyte | Method | Units | Screening Level* | MRL | MDL |
|---|---|---|---|---|---|
| Oil & Grease | E1664B | mg/L | NA | 5 | 1.4 |
| Ammonia (NH3-N) | E350.1 | mg/L | NA | 0.25 | 0.1 |
| Nitrogen, Kjeldahl, Total | E351.2 | mg/L | 10000 | 0.2 | 0.1 |
| Total Phosphorus [white] | E365.4 | mg/L | 0.04 | 0.1 | 0.041 |
| COD - Chemical Oxygen Demand | E410.4 | mg/L | NA | 10 | 5 |
| Ethane | RSK-175 | µg/L | NA | 1.1 | 0.3 |
| Ethene | RSK-175 | µg/L | NA | 1 | 0.31 |
| Methane | RSK-175 | µg/L | NA | 0.58 | 0.29 |
| TDS | SM2540C | mg/L | NA | 5 | 5 |
| TSS | SM2540D | mg/L | NA | 1 | 1 |
| BOD | SM5210B | mg/L | NA | 2 | 2 |
| Aluminum | SW6020B | µg/L | 2000 | 100 | 13 |
| Antimony | SW6020B | µg/L | 6 | 0.8 | 0.11 |
| Arsenic | SW6020B | µg/L | 10 | 1 | 0.2 |
| Barium | SW6020B | µg/L | 2000 | 1.2 | 0.21 |
| Beryllium | SW6020B | µg/L | 4 | 0.4 | 0.071 |
| Cadmium | SW6020B | µg/L | 5 | 0.8 | 0.1 |
| Calcium | SW6020B | µg/L | NA | 500 | 68 |
| Chromium, Total | SW6020B | µg/L | 100 | 0.8 | 0.17 |
| Cobalt | SW6020B | µg/L | 0.6 | 0.4 | 0.039 |
| Copper | SW6020B | µg/L | 1300 | 2 | 0.6 |
| Iron | SW6020B | µg/L | 1400 | 100 | 25 |
| Lead | SW6020B | µg/L | 15 | 0.8 | 0.2 |
| Magnesium | SW6020B | µg/L | NA | 250 | 20 |
| Manganese [non-diet] | SW6020B | µg/L | 43 | 2 | 0.46 |
| Nickel [soluble salts] | SW6020B | µg/L | 39 | 3 | 0.12 |
| Potassium | SW6020B | µg/L | NA | 1000 | 110 |
| Selenium | SW6020B | µg/L | 50 | 2.5 | 1 |
| Silver | SW6020B | µg/L | 9.4 | 0.4 | 0.055 |
| Sodium | SW6020B | µg/L | NA | 500 | 170 |
| Thallium [soluble salts] | SW6020B | µg/L | 2 | 1 | 0.065 |
| Tin | SW6020B | µg/L | 1200 | 5 | 1.4 |
| Vanadium | SW6020B | µg/L | 8.6 | 4 | 0.46 |
| Zinc | SW6020B | µg/L | 600 | 7 | 1.9 |
| Perchlorate | SW6860 | µg/L | 15 | 0.05 | 0.004 |
| Mercury | SW7470A | µg/L | 2 | 0.2 | 0.08 |
| 2,4,5-T | SW8151A | µg/L | 16 | 0.13 | 0.031 |
| 2,4,5-TP (Silvex) | SW8151A | µg/L | 50 | 0.13 | 0.031 |
| 2,4-D | SW8151A | µg/L | 70 | 1.1 | 0.18 |
| 2,4-DB | SW8151A | µg/L | NA | 0.25 | 0.075 |
| Dalapon | SW8151A | µg/L | 200 | 2.5 | 0.05 |
| Dicamba | SW8151A | µg/L | 57 | 0.25 | 0.043 |
| Dichloroprop | SW8151A | µg/L | NA | 0.25 | 0.075 |
| Dinoseb | SW8151A | µg/L | 7 | 0.5 | 0.08 |
| MCPA | SW8151A | µg/L | 0.75 | 60 | 8.5 |
| MCPP | SW8151A | µg/L | 1.6 | 60 | 9.5 |
| 1,1,1,2-Tetrachloroethane | SW8260C | µg/L | 0.57 | 0.3 | 0.027 |
| 1,1,1-Trichloroethane | SW8260C | µg/L | 200 | 0.2 | 0.025 |
| 1,1,2,2-Tetrachloroethane | SW8260C | µg/L | 0.076 | 0.2 | 0.056 |
| 1,1,2-Trichloroethane | SW8260C | µg/L | 5 | 0.2 | 0.07 |
| 1,1-Dichloroethane | SW8260C | µg/L | 2.8 | 0.2 | 0.025 |
| 1,1-Dichloroethene | SW8260C | µg/L | 7 | 0.2 | 0.035 |

### Preface Table 1 - Aqueous Analytes MRL and MDL compared to Screening Levels

| Analyte | Method | Units | Screening Level* | MRL | MDL |
|---|---|---|---|---|---|
| 1,1-Dichloropropene | SW8260C | µg/L | NA | 0.2 | 0.036 |
| 1,2,3-Trichlorobenzene | SW8260C | µg/L | 0.7 | 0.5 | 0.15 |
| 1,2,3-Trichloropropane | SW8260C | µg/L | 0.00075 | 0.2 | 0.05 |
| 1,2,4-Trichlorobenzene | SW8260C | µg/L | 70 | 0.5 | 0.17 |
| 1,2,4-Trimethylbenzene | SW8260C | µg/L | 5.6 | 0.3 | 0.072 |
| 1,2-Dibromo-3-Chloropropane | SW8260C | µg/L | 0.2 | 2 | 0.44 |
| 1,2-Dibromoethane | SW8260C | µg/L | 0.05 | 0.1 | 0.025 |
| 1,2-Dichlorobenzene | SW8260C | µg/L | 600 | 0.3 | 0.024 |
| 1,2-Dichloroethane | SW8260C | µg/L | 5 | 0.2 | 0.043 |
| 1,2-Dichloropropane | SW8260C | µg/L | 5 | 0.2 | 0.06 |
| 1,3,5-Trimethylbenzene | SW8260C | µg/L | 6 | 0.5 | 0.15 |
| 1,3-Dichlorobenzene | SW8260C | µg/L | NA | 0.3 | 0.05 |
| 1,3-Dichloropropane | SW8260C | µg/L | 37 | 0.2 | 0.025 |
| 1,4-Dichlorobenzene | SW8260C | µg/L | 75 | 0.3 | 0.05 |
| 2,2-Dichloropropane | SW8260C | µg/L | NA | 0.5 | 0.06 |
| 2-Butanone (MEK) | SW8260C | µg/L | 560 | 10 | 2.5 |
| 2-Chlorotoluene | SW8260C | µg/L | 24 | 0.5 | 0.12 |
| 2-Hexanone | SW8260C | µg/L | 3.8 | 3 | 0.94 |
| 4-Chlorotoluene | SW8260C | µg/L | 25 | 0.3 | 0.05 |
| 4-Methyl-2-Pentanone (MIBK) | SW8260C | µg/L | 630 | 10 | 1.7 |
| Acetone | SW8260C | µg/L | 1800 | 10 | 3.1 |
| Acrylonitrile | SW8260C | µg/L | 0.052 | 20 | 5.5 |
| Benzene | SW8260C | µg/L | 5 | 1 | 0.27 |
| Bromobenzene | SW8260C | µg/L | 6.2 | 0.2 | 0.035 |
| Bromochloromethane | SW8260C | µg/L | 8.3 | 0.2 | 0.025 |
| Bromodichloromethane | SW8260C | µg/L | 80 | 0.2 | 0.06 |
| Bromoform | SW8260C | µg/L | 80 | 0.5 | 0.16 |
| Bromomethane | SW8260C | µg/L | 0.75 | 0.5 | 0.062 |
| Carbon Disulfide | SW8260C | µg/L | 81 | 0.3 | 0.083 |
| Carbon Tetrachloride | SW8260C | µg/L | 5 | 0.2 | 0.025 |
| Chlorobenzene | SW8260C | µg/L | 100 | 0.2 | 0.025 |
| Chloroethane (Ethyl chloride) | SW8260C | µg/L | 830 | 5 | 4.6 |
| Chloroform | SW8260C | µg/L | 80 | 1 | 0.27 |
| Chloromethane | SW8260C | µg/L | 19 | 1 | 0.54 |
| Cis-1,2-Dichloroethene | SW8260C | µg/L | 70 | 1 | 0.25 |
| Cis-1,3-Dichloropropene [total] | SW8260C | µg/L | 0.47 | 1 | 0.26 |
| Dibromochloromethane | SW8260C | µg/L | 80 | 1 | 0.39 |
| Dibromomethane | SW8260C | µg/L | 0.83 | 0.2 | 0.062 |
| Dichlorodifluoromethane | SW8260C | µg/L | 20 | 0.4 | 0.13 |
| Ethylbenzene | SW8260C | µg/L | 700 | 1 | 0.2 |
| Hexachlorobutadiene | SW8260C | µg/L | 0.14 | 0.5 | 0.067 |
| Isopropyl Benzene (Cumene) | SW8260C | µg/L | 45 | 1 | 0.19 |
| Iodomethane | SW8260C | µg/L | NA | 10 | 3.9 |
| Methylene Chloride | SW8260C | µg/L | 5 | 5 | 3.2 |
| Mtbe | SW8260C | µg/L | 14 | 5 | 0.81 |
| Naphthalene | SW8260C | µg/L | 0.12 (use SW8270D_LL below) | 1 | 0.22 |
| N-Butylbenzene | SW8260C | µg/L | 100 | 1 | 0.23 |
| N-Propylbenzene | SW8260C | µg/L | 66 | 0.3 | 0.091 |
| P-Isopropyltoluene (Cymene) | SW8260C | µg/L | NA | 0.5 | 0.15 |
| sec-Butylbenzene | SW8260C | µg/L | 200 | 1 | 0.17 |
| Styrene | SW8260C | µg/L | 100 | 1 | 0.19 |
| tert-Butylbenzene | SW8260C | µg/L | 69 | 0.5 | 0.26 |

**Preface Table 1 - Aqueous Analytes MRL and MDL compared to Screening Levels**

| Analyte | Method | Units | Screening Level* | MRL | MDL |
|---|---|---|---|---|---|
| Tetrachloroethylene | SW8260C | µg/L | 5 | 0.5 | 0.35 |
| Toluene | SW8260C | µg/L | 1000 | 1 | 0.25 |
| Trans-1,2-Dichloroethene | SW8260C | µg/L | 100 | 1 | 0.34 |
| Trans-1,3-Dichloropropene [total] | SW8260C | µg/L | 0.47 | 0.2 | 0.092 |
| Trans-1,4-Dichloro-2-Butene | SW8260C | µg/L | NA | 2 | 1.3 |
| Trichloroethene | SW8260C | µg/L | 5 | 1 | 0.2 |
| Trichlorofluoromethane | SW8260C | µg/L | 520 | 1 | 0.33 |
| Vinyl Acetate | SW8260C | µg/L | 41 | 2 | 0.69 |
| Vinyl Chloride | SW8260C | µg/L | 2 | 1 | 0.4 |
| Xylenes (Total) | SW8260C | µg/L | 10000 | 1 | 0.23 |
| 2,4,5-Trichlorophenol | SW8270D | µg/L | 120 | 10 | 1.2 |
| 2,4,6-Trichlorophenol | SW8270D | µg/L | 1.2 | 10 | 0.85 |
| 2,4-Dichlorophenol | SW8270D | µg/L | 4.6 | 10 | 1.1 |
| 2,4-Dimethylphenol | SW8270D | µg/L | 36 | 10 | 4 |
| 2,4-Dinitrophenol | SW8270D | µg/L | 3.9 | 50 | 10 |
| 2,4-Dinitrotoluene | SW8270D | µg/L | 0.24 (use SW8330B below) | 10 | 1.2 |
| 2,6-Dinitrotoluene | SW8270D | µg/L | 0.049 (use SW8330B below) | 10 | 1.1 |
| 2-Chloronaphthalene | SW8270D | µg/L | 75 | 10 | 0.8 |
| 2-Chlorophenol | SW8270D | µg/L | 9.1 | 10 | 0.87 |
| 2-Methylnaphthalene | SW8270D | µg/L | 3.6 (use SW8270D_LL below) | 10 | 0.78 |
| 2-Methylphenol (O-Cresol) | SW8270D | µg/L | 93 | 10 | 0.89 |
| 2-Nitroaniline | SW8270D | µg/L | 19 | 50 | 1.3 |
| 2-Nitrophenol | SW8270D | µg/L | NA | 10 | 0.76 |
| 3 & 4 Methylphenol [lower] | SW8270D | µg/L | 37 | 10 | 1.3 |
| 3,3'-Dichlorobenzidine | SW8270D | µg/L | 0.13 | 60 | 30 |
| 3-Nitroaniline | SW8270D | µg/L | NA | 50 | 5 |
| 4,6-Dinitro-2-Methylphenol | SW8270D | µg/L | 0.15 | 50 | 10 |
| 4-Bromophenyl Phenyl Ether | SW8270D | µg/L | NA | 10 | 0.77 |
| 4-Chloro-3-Methylphenol | SW8270D | µg/L | 140 | 10 | 1 |
| 4-Chloroaniline | SW8270D | µg/L | 0.37 | 20 | 2.2 |
| 4-Chlorophenyl Phenyl Ether | SW8270D | µg/L | NA | 10 | 0.84 |
| 4-Nitroaniline | SW8270D | µg/L | 3.8 | 50 | 5 |
| 4-Nitrophenol | SW8270D | µg/L | NA | 50 | 1.9 |
| Acenaphthene | SW8270D | µg/L | 53 | 10 | 0.76 |
| Acenaphthylene | SW8270D | µg/L | NA | 10 | 0.85 |
| Acetophenone | SW8270D | µg/L | 190 | 10 | 0.57 |
| Anthracene | SW8270D | µg/L | 180 | 10 | 0.69 |
| Atrazine | SW8270D | µg/L | 3 | 10 | 1.2 |
| Benzaldehyde | SW8270D | µg/L | 19 | 10 | 1.1 |
| Benzo(A)Anthracene | SW8270D | µg/L | 0.03 (use SW8270D_LL below) | 10 | 0.55 |
| Benzo(A)Pyrene | SW8270D | µg/L | 0.2 (use SW8270D_LL below) | 10 | 0.71 |
| Benzo(B)Fluoranthene | SW8270D | µg/L | 0.25 (use SW8270D_LL below) | 10 | 2.6 |
| Benzo(G,H,I)Perylene | SW8270D | µg/L | NA | 10 | 0.87 |
| Benzo(K)Fluoranthene | SW8270D | µg/L | 2.5 (use SW8270D_LL below) | 10 | 1.2 |
| Biphenyl (Diphenyl) | SW8270D | µg/L | 0.083 | 10 | 0.58 |
| Bis(2-Chloroethoxy)Methane | SW8270D | µg/L | 5.9 | 10 | 0.94 |
| Bis(2-Chloroethyl)Ether | SW8270D | µg/L | 0.014 | 10 | 1.1 |
| Bis(2-Chloroisopropyl)Ether | SW8270D | µg/L | NA | 10 | 0.78 |
| Bis(2-Ethylhexyl)Phthalate | SW8270D | µg/L | 6 | 10 | 1.6 |
| Butylbenzylphthalate | SW8270D | µg/L | 16 | 10 | 1.2 |
| Caprolactam | SW8270D | µg/L | 990 | 10 | 0.79 |
| Carbazole | SW8270D | µg/L | NA | 10 | 0.71 |

### Preface Table 1 - Aqueous Analytes MRL and MDL compared to Screening Levels

| Analyte | Method | Units | Screening Level* | MRL | MDL |
|---|---|---|---|---|---|
| Chrysene | SW8270D | µg/L | 25 | 10 | 0.51 |
| Dibenz(A,H)Anthracene | SW8270D | µg/L | 0.025 (use SW8270D_LL below) | 10 | 1 |
| Dibenzofuran | SW8270D | µg/L | 0.79 | 10 | 0.79 |
| Diethylphthalate | SW8270D | µg/L | 1500 | 10 | 0.88 |
| Dimethylphthalate | SW8270D | µg/L | NA | 10 | 0.99 |
| Di-N-Butyl Phthalate | SW8270D | µg/L | 90 | 10 | 0.83 |
| Di-N-Octylphthalate | SW8270D | µg/L | 20 | 10 | 1.4 |
| Fluoranthene | SW8270D | µg/L | 80 | 10 | 0.74 |
| Fluorene | SW8270D | µg/L | 29 | 10 | 0.96 |
| Hexachlorobenzene | SW8270D | µg/L | 1 | 10 | 0.79 |
| Hexachlorobutadiene | SW8270D | µg/L | 0.14 | 10 | 0.62 |
| Hexachlorocyclopentadiene | SW8270D | µg/L | 50 | 10 | 2.5 |
| Hexachloroethane | SW8270D | µg/L | 0.33 | 10 | 0.76 |
| Indeno(1,2,3-Cd)Pyrene | SW8270D | µg/L | 0.25 (use SW8270D_LL below) | 10 | 1 |
| Isophorone | SW8270D | µg/L | 78 | 10 | 0.9 |
| Naphthalene | SW8270D | µg/L | 0.12 (use SW8270D_LL below) | 10 | 0.7 |
| Nitrobenzene | SW8270D | µg/L | 0.14 | 10 | 0.73 |
| N-Nitrosodi-N-Propylamine | SW8270D | µg/L | 0.011 | 10 | 0.72 |
| N-Nitrosodiphenylamine | SW8270D | µg/L | 12 | 10 | 0.92 |
| Pentachlorophenol | SW8270D | µg/L | 1 | 50 | 2 |
| Phenanthrene | SW8270D | µg/L | NA | 10 | 0.77 |
| Phenol | SW8270D | µg/L | 580 | 10 | 0.83 |
| Pyrene | SW8270D | µg/L | 12 | 10 | 0.63 |
| 1-Methylnaphthalene | SW8270D_LL | µg/L | 1.1 | 0.2 | 0.1 |
| 2-Methylnaphthalene | SW8270D_LL | µg/L | 3.6 | 0.2 | 0.1 |
| Acenaphthene | SW8270D_LL | µg/L | 53 | 0.2 | 0.1 |
| Acenaphthylene | SW8270D_LL | µg/L | NA | 0.2 | 0.1 |
| Anthracene | SW8270D_LL | µg/L | 180 | 0.2 | 0.1 |
| Benzo(A)Anthracene | SW8270D_LL | µg/L | 0.03 | 0.2 | 0.1 |
| Benzo(A)Pyrene | SW8270D_LL | µg/L | 0.2 | 0.2 | 0.1 |
| Benzo(B)Fluoranthene | SW8270D_LL | µg/L | 0.25 | 0.2 | 0.1 |
| Benzo(G,H,I)Perylene | SW8270D_LL | µg/L | NA | 0.2 | 0.1 |
| Benzo(K)Fluoranthene | SW8270D_LL | µg/L | 2.5 | 0.2 | 0.1 |
| Chrysene | SW8270D_LL | µg/L | 25 | 0.2 | 0.045 |
| Dibenz(A,H)Anthracene | SW8270D_LL | µg/L | 0.025 | 0.2 | 0.1 |
| Fluoranthene | SW8270D_LL | µg/L | 80 | 0.2 | 0.1 |
| Fluorene | SW8270D_LL | µg/L | 29 | 0.2 | 0.1 |
| Indeno(1,2,3-Cd)Pyrene | SW8270D_LL | µg/L | 0.25 | 0.2 | 0.1 |
| Naphthalene | SW8270D_LL | µg/L | 0.12 | 0.2 | 0.1 |
| Phenanthrene | SW8270D_LL | µg/L | NA | 0.2 | 0.1 |
| Pyrene | SW8270D_LL | µg/L | 12 | 0.2 | 0.1 |
| 1,3,5-Trinitrobenzene | SW8330B | µg/L | 59 | 0.2 | 0.023 |
| 1,3-Dinitrobenzene | SW8330B | µg/L | 0.2 | 0.2 | 0.022 |
| 2,4,6-Trinitrotoluene | SW8330B | µg/L | 0.98 | 0.2 | 0.041 |
| 2,4-Dinitrotoluene | SW8330B | µg/L | 0.24 | 0.2 | 0.054 |
| 2,6-Dinitrotoluene | SW8330B | µg/L | 0.049 | 0.2 | 0.034 |
| 2-Amino-4,6-Dinitrotoluene | SW8330B | µg/L | 0.19 | 0.2 | 0.02 |
| 2-Nitrotoluene | SW8330B | µg/L | 0.31 | 0.2 | 0.051 |
| 3-Nitrotoluene | SW8330B | µg/L | 0.17 | 0.2 | 0.053 |
| 4-Amino-2,6-Dinitrotoluene | SW8330B | µg/L | 0.19 | 0.2 | 0.027 |
| 4-Nitrotoluene | SW8330B | µg/L | 4.3 | 0.4 | 0.099 |
| HMX | SW8330B | µg/L | 100 | 0.2 | 0.036 |

**Preface Table 1 - Aqueous Analytes MRL and MDL compared to Screening Levels**

| Analyte | Method | Units | Screening Level* | MRL | MDL |
|---|---|---|---|---|---|
| Nitrobenzene | SW8330B | µg/L | 0.14 | 0.2 | 0.031 |
| Nitroglycerin | SW8330B | µg/L | 0.2 | 8 | 2.2 |
| Pentaerythritol Tetranitrate | SW8330B | µg/L | 17 | 12 | 4.4 |
| Picric Acid | SW8330B | µg/L | 4 | 0.2 | 0.022 |
| RDX | SW8330B | µg/L | 0.97 | 0.2 | 0.034 |
| Tetryl | SW8330B | µg/L | 3.9 | 0.4 | 0.15 |
| Sulfide | SW9034 | mg/L | NA | 1 | 1 |
| Chloride (as Cl) | SW9056A | mg/L | NA | 0.9 | 0.14 |
| Nitrate-N | SW9056A | mg/L | 10000 | 0.05 | 0.023 |
| Nitrite-N | SW9056A | mg/L | 1000 | 0.05 | 0.023 |
| Sulfate | SW9056A | mg/L | NA | 1.2 | 0.26 |
| Total Organic Carbon | SW9060 | mg/L | NA | 1 | 0.5 |
| Dissolved Organic Carbon | SW9060A | mg/L | NA | 1.5 | 0.38 |

**Notes:**

MRLs and MDLs change with time, instrument, and laboratory and an appropriate method will be used accordingly.

Alternate lab or methods may be used if a lab's method is certified and the MDL is less than the screening level.

Screening Level is the Maximum Contamination Level (MCL) is used, if no MCL, tap water RSL used.

Regional Screening Levels are based on TR - 1E-06 and THQ = 0.1 (accessed from USEPA September 2022).

*Updated screeening levels will be used as posted.

µg/L - micrograms per liter

mg/L - milligrams per liter

Yellow highlight indicates screening level exceeded.

MDL - Method Detection Limit

MRL - Method Reporting Limit

TR - Target risk

THQ - Target hazard quotient

[] - type of analyte used for RSL

**Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels**

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| Aluminum | SW6020B | 7700 | 110000 | mg/kg | 9.3 | 2 |
| Antimony | SW6020B | 3.1 | 47 | mg/kg | 0.93 | 0.093 |
| Arsenic | SW6020B | 0.68 | 3 | mg/kg | 0.28 | 0.093 |
| Barium | SW6020B | 1500 | 22000 | mg/kg | 0.47 | 0.056 |
| Beryllium | SW6020B | 16 | 230 | mg/kg | 0.047 | 0.014 |
| Cadmium [diet] | SW6020B | 0.71 | 10 | mg/kg | 0.047 | 0.014 |
| Calcium | SW6020B | NA | NA | mg/kg | 47 | 5.9 |
| Chromium [ CrVI] | SW6020B | 0.3 | 6.3 | mg/kg | 0.93 | 0.1 |
| Cobalt | SW6020B | 2.3 | 35 | mg/kg | 0.047 | 0.0093 |
| Copper | SW6020B | 310 | 4700 | mg/kg | 0.47 | 0.12 |
| Iron | SW6020B | 5500 | 82000 | mg/kg | 23 | 3.3 |
| Lead | SW6020B | 400 | 800 | mg/kg | 0.19 | 0.047 |
| Magnesium | SW6020B | NA | NA | mg/kg | 23 | 3.1 |
| Manganese | SW6020B | 180 | 2600 | mg/kg | 0.93 | 0.11 |
| Nickel [soluble salt] | SW6020B | 150 | 2200 | mg/kg | 0.93 | 0.24 |
| Potassium | SW6020B | NA | NA | mg/kg | 23 | 8.5 |
| Selenium | SW6020B | 39 | 580 | mg/kg | 0.47 | 0.093 |
| Silver | SW6020B | 39 | 580 | mg/kg | 0.093 | 0.0093 |
| Sodium | SW6020B | NA | NA | mg/kg | 37 | 9.3 |
| Thallium [soluble salts] | SW6020B | 0.078 | 1.2 | mg/kg | 0.093 | 0.047 |
| Tin | SW6020B | 4700 | 70000 | mg/kg | 9.3 | 1.3 |
| Vanadium | SW6020B | 39 | 580 | mg/kg | 0.47 | 0.25 |
| Zinc | SW6020B | 2300 | 35000 | mg/kg | 1.9 | 0.93 |
| Perchlorate | SW6860 | 5.5 | 82 | mg/kg | 0.5 | 0.082 |
| Mercury | SW7471B | 1.1 | 4.6 | mg/kg | 0.023 | 0.0074 |
| 4,4'-DDD | SW8081B/8082A | 0.19 | 2.5 | mg/kg | 0.0008 | 0.000085 |
| 4,4'-DDE | SW8081B/8082A | 2 | 9.3 | mg/kg | 0.0008 | 0.000085 |
| 4,4'-DDT | SW8081B/8082A | 1.9 | 8.5 | mg/kg | 0.0008 | 0.0001 |
| Aldrin | SW8081B/8082A | 0.039 | 0.18 | mg/kg | 0.0008 | 0.000071 |
| Alpha-BHC | SW8081B/8082A | 0.086 | 0.36 | mg/kg | 0.0008 | 0.000066 |
| Aroclor-1016 | SW8081B/8082A | 0.41 | 5.1 | mg/kg | 0.016 | 0.0054 |
| Aroclor-1221 | SW8081B/8082A | 0.2 | 0.83 | mg/kg | 0.016 | 0.0074 |

### Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| Aroclor-1232 | SW8081B/8082A | 0.17 | 0.72 | mg/kg | 0.016 | 0.0026 |
| Aroclor-1242 | SW8081B/8082A | 0.23 | 0.95 | mg/kg | 0.016 | 0.0025 |
| Aroclor-1248 | SW8081B/8082A | 0.23 | 0.94 | mg/kg | 0.016 | 0.004 |
| Aroclor-1254 | SW8081B/8082A | 0.12 | 0.97 | mg/kg | 0.016 | 0.0049 |
| Aroclor-1260 | SW8081B/8082A | 0.24 | 0.99 | mg/kg | 0.016 | 0.0047 |
| Beta-BHC | SW8081B/8082A | 0.3 | 1.3 | mg/kg | 0.0008 | 0.00016 |
| Chlordane (Technical) | SW8081B/8082A | 1.7 | 7.7 | mg/kg | 0.008 | 0.0014 |
| Delta-BHC [technical] | SW8081B/8082A | 0.3 | 1.3 | mg/kg | 0.0008 | 0.00009 |
| Dieldrin | SW8081B/8082A | 0.034 | 0.14 | mg/kg | 0.0008 | 0.00008 |
| Endosulfan I | SW8081B/8082A | 47 | 700 | mg/kg | 0.0008 | 0.00008 |
| Endosulfan II | SW8081B/8082A | NA | NA | mg/kg | 0.0008 | 0.000071 |
| Endosulfan Sulfate | SW8081B/8082A | 38 | 490 | mg/kg | 0.0008 | 0.000099 |
| Endrin | SW8081B/8082A | 1.9 | 25 | mg/kg | 0.0008 | 0.0001 |
| Endrin Aldehyde | SW8081B/8082A | NA | NA | mg/kg | 0.0008 | 0.0001 |
| Endrin Ketone | SW8081B/8082A | NA | NA | mg/kg | 0.0008 | 0.000094 |
| Gamma BHC (Lindane) | SW8081B/8082A | 0.071 | 1 | mg/kg | 0.0008 | 0.000066 |
| Heptachlor | SW8081B/8082A | 0.13 | 0.63 | mg/kg | 0.0008 | 0.00009 |
| Heptachlor Epoxide | SW8081B/8082A | 0.07 | 0.33 | mg/kg | 0.0008 | 0.000075 |
| Methoxychlor | SW8081B/8082A | 32 | 410 | mg/kg | 0.0008 | 0.00013 |
| Toxaphene | SW8081B/8082A | 0.49 | 2.1 | mg/kg | 0.08 | 0.0026 |
| 2,4,5-T | SW8151A | 63 | 820 | mg/kg | 0.16 | 0.004 |
| 2,4,5-TP (Silvex) | SW8151A | 51 | 660 | mg/kg | 0.0083 | 0.002 |
| 2,4-D | SW8151A | 70 | 960 | mg/kg | 0.02 | 0.0076 |
| 2,4-DB | SW8151A | NA | NA | mg/kg | 0.05 | 0.015 |
| Dalapon | SW8151A | 190 | 2500 | mg/kg | 0.1 | 0.02 |
| Dicamba | SW8151A | 190 | 2500 | mg/kg | 0.02 | 0.006 |
| Dichloroprop | SW8151A | NA | NA | mg/kg | 0.02 | 0.0076 |
| MCPA | SW8151A | 3.2 | 41 | mg/kg | 5 | 1.4 |
| MCPP | SW8151A | 6.3 | 82 | mg/kg | 5 | 1.4 |
| 1,1,1,2-Tetrachloroethane | SW8260D | 2 | 8.8 | mg/kg | 0.005 | 0.0024 |
| 1,1,1-Trichloroethane | SW8260D | 810 | 3600 | mg/kg | 0.005 | 0.00059 |
| 1,1,2,2-Tetrachloroethane | SW8260D | 0.6 | 2.7 | mg/kg | 0.005 | 0.0016 |

### Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| 1,1,2-Trichloroethane | SW8260D | 0.15 | 0.63 | mg/kg | 0.005 | 0.0013 |
| 1,1-Dichloroethane | SW8260D | 3.6 | 16 | mg/kg | 0.005 | 0.0011 |
| 1,1-Dichloroethene | SW8260D | 23 | 100 | mg/kg | 0.005 | 0.0015 |
| 1,1-Dichloropropene | SW8260D | NA | NA | mg/kg | 0.005 | 0.00095 |
| 1,2,3-Trichlorobenzene | SW8260D | 6.3 | 93 | mg/kg | 0.005 | 0.0016 |
| 1,2,3-Trichloropropane | SW8260D | 0.0051 | 0.11 | mg/kg | 0.005 | 0.0024 |
| 1,2,4-Trichlorobenzene | SW8260D | 5.8 | 26 | mg/kg | 0.005 | 0.00089 |
| 1,2,4-Trimethylbenzene | SW8260D | 30 | 180 | mg/kg | 0.005 | 0.0014 |
| 1,2-Dibromo-3-Chloropropane | SW8260D | NA | NA | mg/kg | 0.01 | 0.0044 |
| 1,2-Dibromoethane | SW8260D | 0.036 | 0.16 | mg/kg | 0.005 | 0.0015 |
| 1,2-Dichlorobenzene | SW8260D | 180 | 930 | mg/kg | 0.005 | 0.0013 |
| 1,2-Dichloroethane | SW8260D | 0.46 | 2 | mg/kg | 0.005 | 0.0011 |
| 1,2-Dichloropropane | SW8260D | 1.6 | 6.6 | mg/kg | 0.005 | 0.00086 |
| 1,3,5-Trimethylbenzene | SW8260D | 27 | 150 | mg/kg | 0.005 | 0.0017 |
| 1,3-Dichlorobenzene | SW8260D | NA | NA | mg/kg | 0.005 | 0.0016 |
| 1,3-Dichloropropane | SW8260D | 160 | 2300 | mg/kg | 0.005 | 0.0018 |
| 1,4-Dichlorobenzene | SW8260D | 2.6 | 11 | mg/kg | 0.005 | 0.00074 |
| 2,2-Dichloropropane | SW8260D | NA | NA | mg/kg | 0.005 | 0.0011 |
| 2-Butanone (MEK) | SW8260D | 2700 | 19000 | mg/kg | 0.025 | 0.0024 |
| 2-Chlorotoluene | SW8260D | 160 | 2300 | mg/kg | 0.005 | 0.002 |
| 2-Hexanone | SW8260D | 20 | 130 | mg/kg | 0.025 | 0.0033 |
| 4-Chlorotoluene | SW8260D | 160 | 2300 | mg/kg | 0.005 | 0.0017 |
| 4-Methyl-2-Pentanone (MIBK) | SW8260D | 3300 | 14000 | mg/kg | 0.025 | 0.0042 |
| Acetone | SW8260D | 7000 | 110000 | mg/kg | 0.05 | 0.011 |
| Acrylonitrile | SW8260D | 0.25 | 1.1 | mg/kg | 0.1 | 0.034 |
| Benzene | SW8260D | 1.2 | 5.1 | mg/kg | 0.005 | 0.00073 |
| Bromobenzene | SW8260D | 29 | 180 | mg/kg | 0.005 | 0.0017 |
| Bromochloromethane | SW8260D | 15 | 63 | mg/kg | 0.005 | 0.0033 |
| Bromodichloromethane | SW8260D | 0.29 | 1.3 | mg/kg | 0.005 | 0.00097 |
| Bromoform | SW8260D | 19 | 86 | mg/kg | 0.005 | 0.0015 |
| Bromomethane | SW8260D | 0.68 | 3 | mg/kg | 0.005 | 0.0015 |
| Carbon Disulfide | SW8260D | 77 | 350 | mg/kg | 0.005 | 0.0011 |

### Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| Carbon Tetrachloride | SW8260D | 0.65 | 2.9 | mg/kg | 0.005 | 0.00083 |
| Chlorobenzene | SW8260D | 28 | 130 | mg/kg | 0.005 | 0.00096 |
| Chloroethane (Ethyl chloride) | SW8260D | 540 | 2300 | mg/kg | 0.005 | 0.0027 |
| Chloroform | SW8260D | 0.32 | 1.4 | mg/kg | 0.005 | 0.0011 |
| Chloromethane | SW8260D | 11 | 46 | mg/kg | 0.005 | 0.001 |
| Cis-1,2-Dichloroethene | SW8260D | 16 | 230 | mg/kg | 0.005 | 0.0014 |
| Cis-1,3-Dichloropropene [total of isomers] | SW8260D | 1.8 | 8.2 | mg/kg | 0.005 | 0.00083 |
| Dibromochloromethane | SW8260D | 8.3 | 39 | mg/kg | 0.005 | 0.0017 |
| Dibromomethane | SW8260D | 2.4 | 9.9 | mg/kg | 0.005 | 0.0017 |
| Dichlorodifluoromethane | SW8260D | 8.7 | 37 | mg/kg | 0.005 | 0.00094 |
| Ethylbenzene | SW8260D | 5.8 | 25 | mg/kg | 0.005 | 0.0013 |
| Iodomethane | SW8260D | NA | NA | mg/kg | 0.005 | 0.0018 |
| Isopropyl Benzene (Cumene) | SW8260D | 190 | 990 | mg/kg | 0.005 | 0.0019 |
| m,p-Xylene [total] | SW8260D | 58 | 250 | mg/kg | 0.005 | 0.0026 |
| Methylene Chloride | SW8260D | 35 | 320 | mg/kg | 0.005 | 0.00098 |
| Mtbe | SW8260D | 47 | 210 | mg/kg | 0.005 | 0.001 |
| Naphthalene | SW8260D | 2 | 8.6 | mg/kg | 0.005 | 0.0012 |
| N-Butylbenzene | SW8260D | 390 | 5800 | mg/kg | 0.005 | 0.0024 |
| N-Propylbenzene | SW8260D | 380 | 2400 | mg/kg | 0.005 | 0.0027 |
| o-Xylene | SW8260D | 64 | 280 | mg/kg | 0.005 | 0.0011 |
| P-Isopropyltoluene (Cymene) | SW8260D | NA | NA | mg/kg | 0.005 | 0.0022 |
| Sec-Butylbenzene | SW8260D | 780 | 12000 | mg/kg | 0.005 | 0.0021 |
| Styrene | SW8260D | 600 | 3500 | mg/kg | 0.005 | 0.00093 |
| Tert-Butylbenzene | SW8260D | 780 | 12000 | mg/kg | 0.005 | 0.0018 |
| Tetrachloroethylene | SW8260D | 8.1 | 39 | mg/kg | 0.005 | 0.0019 |
| Toluene | SW8260D | 490 | 4700 | mg/kg | 0.005 | 0.00084 |
| Trans-1,2-Dichloroethene | SW8260D | 7 | 30 | mg/kg | 0.005 | 0.00063 |
| Trans-1,3-Dichloropropene [total] | SW8260D | 1.8 | 8.2 | mg/kg | 0.005 | 0.00087 |
| Trichloroethene | SW8260D | 0.41 | 1.9 | mg/kg | 0.005 | 0.0013 |
| Trichlorofluoromethane | SW8260D | 2300 | 35000 | mg/kg | 0.005 | 0.0012 |
| Vinyl Acetate | SW8260D | 91 | 380 | mg/kg | 0.01 | 0.0025 |
| Vinyl Chloride | SW8260D | 0.059 | 1.7 | mg/kg | 0.005 | 0.0015 |

**Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels**

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| Xylenes (Total) | SW8260D | 58 | 250 | mg/kg | 0.01 | 0.0011 |
| 2,4,5-Trichlorophenol | SW8270D | 630 | 8200 | mg/kg | 0.31 | 0.033 |
| 2,4,6-Trichlorophenol | SW8270D | 6.3 | 82 | mg/kg | 0.31 | 0.027 |
| 2,4-Dichlorophenol | SW8270D | 19 | 250 | mg/kg | 0.31 | 0.033 |
| 2,4-Dimethylphenol | SW8270D | 130 | 1600 | mg/kg | 0.31 | 0.042 |
| 2,4-Dinitrophenol | SW8270D | 13 | 160 | mg/kg | 1.6 | 0.79 |
| 2,4-Dinitrotoluene | SW8270D | 1.7 | 7.4 | mg/kg | 0.31 | 0.046 |
| 2,6-Dinitrotoluene | SW8270D | 0.36 | 1.5 | mg/kg | 0.31 | 0.04 |
| 2-Chloronaphthalene | SW8270D | 480 | 6000 | mg/kg | 0.31 | 0.033 |
| 2-Chlorophenol | SW8270D | 39 | 580 | mg/kg | 0.31 | 0.038 |
| 2-Methylnaphthalene | SW8270D | 24 | 300 | mg/kg | 0.31 | 0.036 |
| 2-Methylphenol (o-Cresol) | SW8270D | 3200 | 4100 | mg/kg | 0.31 | 0.026 |
| 2-Nitroaniline | SW8270D | 63 | 800 | mg/kg | 1.6 | 0.043 |
| 2-Nitrophenol | SW8270D | NA | NA | mg/kg | 0.31 | 0.039 |
| 3 & 4 Methylphenol [lower used] | SW8270D | 130 | 1600 | mg/kg | 0.31 | 0.041 |
| 3,3'-Dichlorobenzidine | SW8270D | 1.2 | 5.1 | mg/kg | 0.63 | 0.027 |
| 3-Nitroaniline | SW8270D | NA | NA | mg/kg | 1.6 | 0.044 |
| 4,6-Dinitro-2-Methylphenol | SW8270D | 0.51 | 6.6 | mg/kg | 1.6 | 0.16 |
| 4-Bromophenyl Phenyl Ether | SW8270D | NA | NA | mg/kg | 0.31 | 0.034 |
| 4-Chloro-3-Methylphenol | SW8270D | 630 | 8200 | mg/kg | 0.31 | 0.033 |
| 4-Chloroaniline | SW8270D | 2.7 | 11 | mg/kg | 0.63 | 0.049 |
| 4-Chlorophenyl Phenyl Ether | SW8270D | NA | NA | mg/kg | 0.31 | 0.042 |
| 4-Nitroaniline | SW8270D | 25 | 110 | mg/kg | 1.6 | 0.046 |
| 4-Nitrophenol | SW8270D | NA | NA | mg/kg | 1.6 | 0.31 |
| Acenaphthene | SW8270D | 360 | 4500 | mg/kg | 0.31 | 0.039 |
| Acenaphthylene | SW8270D | NA | NA | mg/kg | 0.31 | 0.034 |
| Acetophenone | SW8270D | 780 | 12000 | mg/kg | 0.31 | 0.027 |
| Anthracene | SW8270D | 1800 | 23000 | mg/kg | 0.31 | 0.024 |
| Atrazine | SW8270D | 2.4 | 10 | mg/kg | 0.31 | 0.022 |
| Benzaldehyde | SW8270D | 170 | 820 | mg/kg | 0.31 | 0.055 |
| Benzo(a)Anthracene | SW8270D | 1.1 | 21 | mg/kg | 0.31 | 0.026 |
| Benzo(a)Pyrene | SW8270D | 0.11 | 2.1 | mg/kg | 0.31 | 0.049 |

**Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels**

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| Benzo(b)Fluoranthene | SW8270D | 1.1 | 21 | mg/kg | 0.31 | 0.036 |
| Benzo(g,h,i)Perylene | SW8270D | NA | NA | mg/kg | 0.31 | 0.021 |
| Benzo(k)Fluoranthene | SW8270D | 11 | 210 | mg/kg | 0.31 | 0.062 |
| Biphenyl (Diphenyl) | SW8270D | 4.7 | 20 | mg/kg | 1.6 | 1.6 |
| Bis(2-Chloroethoxy)Methane | SW8270D | 19 | 250 | mg/kg | 0.31 | 0.037 |
| Bis(2-Chloroethyl)Ether | SW8270D | 0.23 | 1 | mg/kg | 0.31 | 0.043 |
| Bis(2-Chloroisopropyl)Ether | SW8270D | NA | NA | mg/kg | 0.31 | 0.028 |
| Bis(2-Ethylhexyl)Phthalate | SW8270D | 39 | 160 | mg/kg | 0.31 | 0.027 |
| Butylbenzylphthalate | SW8270D | 290 | 1200 | mg/kg | 0.31 | 0.025 |
| Caprolactam | SW8270D | 3100 | 40000 | mg/kg | 0.31 | 0.063 |
| Carbazole | SW8270D | NA | NA | mg/kg | 0.31 | 0.028 |
| Chrysene | SW8270D | 110 | 2100 | mg/kg | 0.31 | 0.02 |
| Dibenz(a,h)Anthracene | SW8270D | 0.11 | 2.1 | mg/kg | 0.31 | 0.037 |
| Dibenzofuran | SW8270D | 7.8 | 120 | mg/kg | 0.31 | 0.031 |
| Diethylphthalate | SW8270D | 5100 | 66000 | mg/kg | 0.31 | 0.035 |
| Dimethylphthalate | SW8270D | NA | NA | mg/kg | 0.31 | 0.032 |
| Di-N-Butyl Phthalate | SW8270D | 630 | 8200 | mg/kg | 0.31 | 0.028 |
| Di-N-Octylphthalate | SW8270D | 63 | 820 | mg/kg | 0.31 | 0.027 |
| Fluoranthene | SW8270D | 240 | 3000 | mg/kg | 0.31 | 0.03 |
| Fluorene | SW8270D | 240 | 3000 | mg/kg | 0.31 | 0.034 |
| Hexachlorobenzene | SW8270D | 0.078 | 0.96 | mg/kg | 0.31 | 0.037 |
| Hexachlorobutadiene | SW8270D | 1.2 | 5.3 | mg/kg | 0.31 | 0.034 |
| Hexachlorocyclopentadiene | SW8270D | 0.18 | 0.75 | mg/kg | 0.31 | 0.039 |
| Hexachloroethane | SW8270D | 1.8 | 8 | mg/kg | 0.31 | 0.027 |
| Indeno(1,2,3-cd)Pyrene | SW8270D | 1.1 | 21 | mg/kg | 0.31 | 0.027 |
| Isophorone | SW8270D | 570 | 2400 | mg/kg | 0.31 | 0.031 |
| Naphthalene | SW8270D | 2 | 8.6 | mg/kg | 0.31 | 0.028 |
| Nitrobenzene | SW8270D | 5.1 | 22 | mg/kg | 0.31 | 0.025 |
| N-Nitrosodi-N-Propylamine | SW8270D | 0.078 | 0.33 | mg/kg | 0.31 | 0.03 |
| N-Nitrosodiphenylamine | SW8270D | 110 | 470 | mg/kg | 0.31 | 0.031 |
| Pentachlorophenol | SW8270D | 1 | 4 | mg/kg | 1.6 | 0.31 |
| Phenanthrene | SW8270D | NA | NA | mg/kg | 0.31 | 0.026 |

**Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels**

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| Phenol | SW8270D | 1900 | 25000 | mg/kg | 0.31 | 0.032 |
| Pyrene | SW8270D | 180 | 2300 | mg/kg | 0.31 | 0.026 |
| Acenaphthene | SW8270E_SIM | 360 | 4500 | mg/kg | 0.0067 | 0.014 |
| Acenaphthylene | SW8270E_SIM | NA | NA | mg/kg | 0.0067 | 0.014 |
| Anthracene | SW8270E_SIM | 1800 | 23000 | mg/kg | 0.0067 | 0.013 |
| Benzo[a]anthracene | SW8270E_SIM | 1.1 | 21 | mg/kg | 0.0067 | 0.019 |
| Benzo[a]pyrene | SW8270E_SIM | 0.11 | 2.1 | mg/kg | 0.0067 | 0.021 |
| Benzo[b]fluoranthene | SW8270E_SIM | 1.1 | 21 | mg/kg | 0.0067 | 0.022 |
| Benzo[g,h,i]perylene | SW8270E_SIM | NA | NA | mg/kg | 0.0067 | 0.025 |
| Benzo[k]fluoranthene | SW8270E_SIM | 11 | 210 | mg/kg | 0.0067 | 0.019 |
| Chrysene | SW8270E_SIM | 110 | 2100 | mg/kg | 0.0067 | 0.018 |
| Dibenz(a,h)anthracene | SW8270E_SIM | 0.11 | 2.1 | mg/kg | 0.0067 | 0.019 |
| Fluoranthene | SW8270E_SIM | 240 | 3000 | mg/kg | 0.0067 | 0.017 |
| Fluorene | SW8270E_SIM | 240 | 3000 | mg/kg | 0.0067 | 0.012 |
| Indeno(1,2,3-cd)Pyrene | SW8270E_SIM | 1.1 | 21 | mg/kg | 0.0067 | 0.021 |
| 1-Methylnaphthalene | SW8270E_SIM | 18 | 73 | mg/kg | 0.0067 | 0.015 |
| 2-Methylnaphthalene | SW8270E_SIM | 24 | 300 | mg/kg | 0.0067 | 0.015 |
| Naphthalene | SW8270E_SIM | 2 | 8.6 | mg/kg | 0.0067 | 0.015 |
| Phenanthrene | SW8270E_SIM | NA | NA | mg/kg | 0.0067 | 0.014 |
| Pyrene | SW8270E_SIM | 180 | 2300 | mg/kg | 0.0067 | 0.018 |
| 1,3,5-Trinitrobenzene | SW8330B | 220 | 3200 | mg/kg | 0.1 | 0.014 |
| 1,3-Dinitrobenzene | SW8330B | 0.63 | 8.2 | mg/kg | 0.1 | 0.017 |
| 2,4,6-Trinitrotoluene | SW8330B | 3.6 | 51 | mg/kg | 0.1 | 0.031 |
| 2,4-Diamino-6-Nitrotoluene | SW8330B | NA | NA | mg/kg | 10000 | 99 |
| 2,4-Dinitrotoluene | SW8330B | 1.7 | 7.4 | mg/kg | 0.1 | 0.015 |
| 2,6-Diamino-4-Nitrotoluene | SW8330B | NA | NA | mg/kg | 10000 | 99 |
| 2,6-Dinitrotoluene | SW8330B | 0.36 | 1.5 | mg/kg | 0.1 | 0.019 |
| 2-Amino-4,6-Dinitrotoluene | SW8330B | 0.77 | 11 | mg/kg | 0.1 | 0.033 |
| 2-Nitrotoluene | SW8330B | 3.2 | 15 | mg/kg | 0.2 | 0.047 |
| 3-Nitrotoluene | SW8330B | 0.63 | 8.2 | mg/kg | 0.2 | 0.064 |
| 4-Amino-2,6-Dinitrotoluene | SW8330B | 0.77 | 11 | mg/kg | 0.1 | 0.03 |
| 4-Nitrotoluene | SW8330B | 25 | 140 | mg/kg | 0.2 | 0.037 |

**Preface Table 2 - Soil Analytes MRL and MDL compared to Screening Levels**

| | | Screening Level* | | | | |
|---|---|---|---|---|---|---|
| Analyte | Method | RSL (Residential) | RSL (Industrial) | Units | MRL | MDL |
| HMX | SW8330B | 390 | 5700 | mg/kg | 0.1 | 0.023 |
| Nitrobenzene | SW8330B | 5.1 | 22 | mg/kg | 0.3 | 0.085 |
| Nitroglycerin | SW8330B | 0.63 | 8.2 | mg/kg | 2 | 0.22 |
| Pentaerythritol Tetranitrate (PETN) | SW8330B | 57 | 530 | mg/kg | 2 | 0.49 |
| Picric Acid | SW8330B | 13 | 160 | mg/kg | 0.2 | 0.056 |
| RDX | SW8330B | 8.3 | 38 | mg/kg | 0.2 | 0.043 |
| Tetryl | SW8330B | 16 | 230 | mg/kg | 0.2 | 0.044 |

**Notes:**

MRLs and MDLs change with time, instrument, and laboratory and an appropriate method will be used accordingly.

Alternate lab or methods may be used if a lab's method is certified and the MDL is less than the screening level.

Screening Level is the Regional Screening Level (RSL) based on TR - 1E-06 and THQ = 0.1 (accessed from USEPA September 2022).

**Bold** indicates Residential RSL exceeded.

Yellow highlight indicates if Industrial RSL exceeded

*Updated screeening levels will be used as posted.

MCL - Maximum contamination Level

MDL - Method Detection Limit

MRL - Method Reporting Limit

TR - Target risk

THQ - Target hazard quotient

[] - type of analyte used for RSL

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# 1.0 INTRODUCTION

This installation-wide sampling and analysis plan (SAP) for McClellan, Anniston, Alabama, has been prepared by Matrix Environmental Services (MES) on behalf of the McClellan Development Authority (MDA). The MDA has assumed from the United States (U.S.) Department of the Army (Army) responsibility for certain environmental investigation, remediation, and related documentation necessary to satisfy CERCLA and the NCP requirements at the ESCA Early Transfer Sites throughout McClellan (formerly referred to as Fort McClellan). The basis for this transfer of property and responsibility is the Environmental Services Cooperative Agreement (ESCA) between the MDA and the Army. In addition the MDA has negotiated a Cleanup Agreement (CA) with the Alabama Department of Environmental Management (ADEM) that describes the responsibilities of both parties in completing the investigation and remediation of the sites at McClellan, as necessary.

This document represents part of the project work plans prepared to cover site work to be conducted by the MDA at McClellan. The Sampling and Analysis Plan includes the following documents:

- Installation-Wide Quality Assurance Plan (QAP)
- Monitoring Well Installation and Maintenance Plan (MWIP)
- Installation-Wide Investigation Derived Waste Management Plan (IDWMP)

Site-specific field sampling plans (SFSP) and McClellan-Specific Master Health and Safety Plan (HASP) are incorporated by reference.

## 1.1 Purpose

This SAP has been prepared to present general information regarding the requirements of field sampling activities, including environmental sampling and associated activities. Information specific to individual sites is presented in Corrective Measures Implementation Plans (CMIPs) or SFSPs supplements this SAP. Site-Specific Plans include the location and rationale of site samples, site-specific analytical requirements, and site-specific data quality objectives (DQO). Site-specific requirements supersede the requirements of this SAP.

These planning documents are intended to provide the basic requirements for activities at McClellan, and should be used on an installation-wide basis by parties conducting work associated with the ESCA and CA investigations and remediation.

The installation-wide QAP (Appendix A) has been prepared to provide guidance on overall site-wide Quality Assurance practices and the overall DQO process for McClellan.

## 1.2 Document Organization

This SAP has been organized to provide information regarding field activities at McClellan that are applicable to site-specific activities, as appropriate. The SAP is divided into six chapters, which are summarized as follows:

- Chapter 1.0 - Introduction
- Chapter 2.0 - Site Background and Project Objectives
- Chapter 3.0 - General Site Operation Procedures
    - Munitions and Explosives of Concern (MEC) Procedures
    - Buried Utility Location Procedures
    - Geophysical Surveys
    - Global Positioning System (GPS) and Traditional Land Surveying Techniques
- Chapter 4.0 - Geological and Hydrogeological Methods
    - Soil Boring Installation, Sampling and Abandonment
    - Monitoring Well Installation and Development
    - Aquifer Analysis
    - Water Level Monitoring
- Chapter 5.0 - Environmental Sampling and Measurement Procedures
    - Sampling Procedures
    - Quality Assurance/Quality Control (QA/QC) Sampling
    - Field Measured Parameters
    - Field Calibration Procedures and Frequency
    - Prevention of Cross-Contamination
    - Field Operations Documentation
    - Handling and Disposal of investigation derived waste (IDW)
    - Field Screening Methodologies
    - Soil Gas Surveys
- Chapter 6.0 – References
- Tables are incorporated into the sections of text where they are referenced.
- Figures supporting this document follow the text.
- A list of acronyms is provided in Attachment 1. Example forms referenced in the SAP text are found in Attachment 2. Standard operating procedures (SOPs) are located in Attachment 3.

In addition to the general procedures presented in the main text, this document includes several additional components of the SAP as appendices. These are:

- Appendix A – Installation-Wide QAP
- Appendix B – Monitoring Well Installation and Maintenance Plan
- Appendix C – Installation-Wide Investigation-Derived Waste Management Plan

# 2.0 SITE BACKGROUND AND PROJECT OBJECTIVES

## 2.1 Facility Description and History

McClellan was a U. S. Army facility (Fort McClellan) formerly under the control of the U. S. Army Training and Doctrine Command (TRADOC) that was closed under the Base Realignment and Closure (BRAC) program in September 1999. McClellan is located in northeast Alabama, and a portion of McClellan was annexed by the City of Anniston (Figure 2-1). While active, McClellan consisted of three portions of land: Main Post, Choccolocco Corridor, and Pelham Range. This SAP pertains only to portions of the Main Post transferred to the MDA.

The majority of past development at McClellan occurred in the northwest area of the Main Post. The main post is within the eastern and northern edge of the City of Anniston. Adjoining the Main Post to the east are the Choccolocco Mountains of the Talladega National Forest. The Main Post, consisting of 18,929 acres, was purchased by the federal government in March 1917 for the construction of a National Guard camp (Camp McClellan). Pistol and rifle ranges were established north of the camp, automatic rifle and machine gun ranges were established southwest of the camp, and artillery-firing ranges were established southeast of the camp toward the Choccolocco Mountains (New South Associates, Inc. [NSA], 1993). Camp McClellan expanded throughout the 1920s and 1930s. The advent of World War II in the 1940s brought continued growth for the installation. Most notably, the 22,245 acres of Pelham Range were purchased to the west of the Main Post in early 1940 for artillery, tank, and heavy mortar firing. Approximately 4,488 additional acres to the east of the Main Post (Choccolocco Corridor) were leased from the state to connect the Main Post to the Talladega National Forest (CH2M Hill, 1994). Historically, Choccolocco Corridor was also used for various range training activities. The lease was terminated in May 1998.

The post-war period initially brought a decline in operations at McClellan. The decrease in military spending placed the installation on inactive status. However, in 1950 the installation was reinstated to active status because of the Korean Conflict. The U.S. Army Chemical School was established at McClellan in 1951; the large outdoor training areas allowed for specialized chemical training involving chemical warfare protection, decontamination procedures, flamethrowers, and the operation of smoke generators. The Base hospital was renovated to specialize in chest diseases. The first permanent Women's Army Corps (WAC) training facility was established in 1955, although two WAC detachments had been established during the 1940s at the installation. Radiological training was conducted in the mid-1950s at Iron Mountain, Alpha Field, and Bromine Field, all located on the Main Post, as well as at Rideout Field on Pelham Range (NSA, 1993).

The mission of the installation was changed in 1966 and it became the U.S. Army School/Training Center. An Advanced Individual Training Infantry Brigade was activated in 1966 to meet requirements for the Vietnam War. The brigade was deactivated in 1970 due to continued force reduction in Vietnam.

In 1973, the Chemical Corps School closed, along with the U.S. Army Combat Developments Command Chemical/Biological Radiological Agency. Five years later, in 1978, the WAC was disbanded and the WAC school closed.

In 1979, the Military Police School was moved to McClellan. In the same year, the U.S. Army Chemical Corps school was re-established, along with a Brigade for Basic Training. U.S. Army Forces Command units, such as D Company, 46" Engineers, were also garrisoned at the post during the 1970s and 1980s.

The mid-1980s brought additional operations to Pelham Range, which is located approximately 2 miles northwest of The City of Anniston. This area was used for maneuver training and a wide range of activities from small-arms training to tank and artillery training. Pelham Range has also been used for chemical decontamination training and radiological training.

The main missions and support organizations at McClellan were:

- U.S. Army Chemical School
- U.S. Army Military Police School
- Training Center Command
- Training Brigade
- Directorate of Contracting
- Directorate of Community Activities
- Directorate of Resource Management
- Provost Marshal Office Directorate of Community Safety
- Office of the Staff Judge Advocate
- Safety Office
- Equal Employment Opportunity Office
- Office of the Inspector General
- Internal Review and Audit Compliance
- Public Affairs Office
- Directorate of Engineering and Housing
- Directorate of Environment
- Directorate of Information Management
- Directorate of Logistics
- Directorate of Plans, Training, Mobilization, and Security and Reserve Component Support.

Past tenant activities included the following:

- U.S. Army Medical Department Activity
- U.S. Army Dental Activity
- U.S. Department of Defense Polygraph Institute
- Defense Finance and Accounting Services
- Defense Investigative Service
- Marine Corps Administrative Detachment

- Criminal Investigation Division
- 902nd Military Intelligence Group
- Army National Guard
- U.S. Army Reserves
- TRADOC Manpower Activity
- 722nd Explosive Ordnance Detachment
- Army Air Force Exchange Service
- Defense Commissary Agency
- Defense Reutilization and Marketing Office
- U.S. Department of Defense Security Operation Testing Support
- Fort McClellan Elementary School
- Naval Construction Training Center Detachment
- U.S. Army Corps of Engineers (Mobile District)
- U.S. Air Force Disaster Preparedness School.

McClellan operations were deactivated and missions completed with the installation closure on September 30, 1999.

## 2.2 Environmental Setting

### 2.2.1 Physiography

Pelham Range and all but the easternmost portion of McClellan lie within the Valley and Ridge Province of the Appalachian Highlands. The portion of McClellan west of Choccolocco Creek lies within the Piedmont Province. Local relief on McClellan is in excess of 1,320 feet. The lower elevations (700 feet above mean sea level [amsl]) occur along Cane Creek, near Baltzell Gate Road, while the maximum elevations (2,063 feet amsl) occur on Choccolocco Mountain, which traverses the area in a north/south direction, with the steep easterly slopes grading abruptly into Choccolocco Valley. The western slopes are more continuous, with the southern extension maintaining elevations up to 900 feet amsl near the western reservation boundary. The northern extension decreases in elevation in the vicinity of Reilly Airfield. The central portion of McClellan is characterized by flat to gently sloping land. The topographic relief at Pelham Range is approximately 445 feet. The minimum elevation is 500 feet amsl, which occurs at the exit of Cane Creek from the range, and the maximum elevation is 945 feet amsl, near the southeastern boundary. The northern sector contains broad, rolling topography capped with isolated round knobs rising 75 to 90 feet above the surrounding terrain. A large, relatively flat area called Battle Drill Area is situated near the western boundary (Science Applications International Corporation [SAIC], 2000).

### 2.2.2 Climate

McClellan is situated in a temperate, humid climate. Summers are long and hot, and winters are usually short and mild to moderately cold. The climate is influenced by frontal systems moving from northwest to southeast, and temperatures change rapidly from warm to cool due to the inflow of northern air. The average annual temperature is 63 degrees Fahrenheit (°F). Summer temperatures usually reach 90°F or higher about 70 days per year, but temperatures above 100°F are rare. Freezing temperatures are common in winter but are usually of short duration. The first frost may arrive by late October. Snowfall averages 0.5 to 1 inch. On rare occasions, several inches of snow accumulate from a single storm. At Anniston, the average date of the first 32°F temperature is November 6, and the last is March 30. This provides a growing season of 221 days (Environmental Science and Engineering, Inc. [ESE], 1998).

The average annual rainfall is approximately 53 inches and is well distributed throughout the year. The more intense rains usually occur during the warmer months, and some flooding occurs nearly every year. Drought conditions are rare. Approximately 80 percent of the flood-producing storms are of the frontal type and occur in the winter and spring, lasting from 2 to 4 days each on average. Summer storms are usually thunderstorms with intense precipitation over small areas, and these sometimes result in serious local floods. Occasionally, several wet years or dry years occur in series. Annual rainfall records indicate no characteristic order or pattern.

Winds in the McClellan area are seldom strong and frequently blow down the valley from the northeast. However, there is no truly persistent wind direction. Normally, only light breezes or calm prevails, except during passages of cyclonic disturbances when destructive local wind storms develop, some into tornadoes, with winds of 100 miles per hour or more.

### 2.2.3 Demographics

McClellan included 45,679 acres of government-owned and formerly leased land situated in the foothills of the Appalachian mountains of northeast Alabama. McClellan is located in Calhoun County, approximately 60 miles northeast of Birmingham, approximately 75 miles northwest of Auburn, and approximately 90 miles west of Atlanta, Georgia. McClellan is within the eastern and northern portion of the City of Anniston. The City of Weaver is located approximately 1 mile northwest of the Main Post, and the city of Oxford is approximately 5 miles south of the City of Anniston. Pelham Range is approximately 5 miles due west of the Main Post and adjoins Anniston Army Depot along its northern boundary (SAIC, 2000).

### 2.2.4 Soils

The soil associations found at McClellan (U.S. Department of Agriculture [USDA], 1961), include:

- **Anniston-Allen, Decatur-Cumberland**. Alluvium, resulting from weathering of older residual soils developed from sandstone, shale and quartzite; deep, well-drained, level to moderately steep soil in valleys underlain by limestone and shale. Subsoil is dark red sandy clay loam. Cumberland and Decatur soils are dark reddish brown gravelly loam developed from weathered limestone.
- **Clarksville-Fullerton.** Well-drained to moderately well-drained stony or cherty soils developed in the residuum of cherty limestone. This association is limited to Pelham Range. The soils are generally dark brown to dark gray-brown silt loam.

- **Rarden-Montevallo-Lehew.** Moderately deep or shallow soils on ridgetops and steep slopes and in local alluvium in draws. Soils are developed from the residuum of shale and fine-grained, micaceous sandstone; reddish brown to dark gray-brown to yellow-brown silt loam, clay or silty clay.
- **Stony Rough Land**. Shallow, steep, and stony soils formed from the weathering of sandstone, limestone, and Talladega Slate. Infiltration is slow; the soils contain many boulders and fragments with clayey residuum. This association underlies a large portion of the Main Post at McClellan.

### 2.2.5 Geology and Hydrogeology

#### 2.2.5.1 *Geology*

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of McClellan, lies within the Appalachian fold-and-thrust structural belt (Valley and Ridge Province) where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold-and-thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust faulted, with major structures and faults striking in a northeast-southwest direction.

Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults, and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman, et al. (1960), Osborne and Szabo (1984), and Moser and DeJarnette (1992) and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group consists of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984) but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper, undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish-gray siltstone and mudstone. Massive to laminated, greenish-gray and black mudstone makes up the Nichols Formation, with thin interbeds of siltstone and very fine-grained sandstone (Szabo et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appears to dominate the unit and consists primarily of coarse-grained, vitreous quartzite and friable, fine- to coarse grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone, which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of McClellan belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east, and southwest of the Main Post and consists of interlayered bluish-gray or pale yellowish-gray, sandy dolomitic limestone and siliceous dolomite with coarsely crystalline, porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite. Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on McClellan (Osborne and Szabo, 1984). The character of the Shady Dolomite in the McClellan vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne, 1999).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southwest of the Main Post as mapped by Warman, et al. (1960) and Osborne and Szabo (1984). The Rome Formation consists of variegated, thinly interbedded grayish-red-purple mudstone, shale, siltstone, and greenish-red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman, et al., 1960; Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et al. 1997). The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline, medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weather to a chert residuum (Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone consists of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped together as undifferentiated at McClellan and in other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark-gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at McClellan and underlie much of the developed area of the Main Post.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Szabo et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark- to light-gray limestone with abundant chert nodules and greenish-gray to grayish-red phosphatic shale, with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian Age, which consists of thin-bedded, fissile, brown to black shale with thin intercalated limestone layers and interbedded sandstone. (Osborne and Szabo 1984) reassigned the Floyd Shale, which was mapped by Warman, et al. (1960) on the Main Post of McClellan, to the Ordovician Athens Shale on the basis of fossil data.

The Jacksonville Thrust Fault is the most significant structural geologic feature in the vicinity of both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama, and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City Fault (Osborne and Szabo, 1984). The Ordovician sequence comprising the Eden thrust sheet is exposed at McClellan through an eroded "window," or "fenster," in the overlying thrust sheet. Rocks, within the window, display complex folding, with the folds being overturned and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The McClellan window is framed on the northwest by the Rome Formation, north by the Conasauga Formation, northeast, east, and southwest by the Shady Dolomite, and southeast and southwest by the Chilhowee Group (Osborne et al., 1997).

#### 2.2.5.2 *Hydrogeology*

The Geologic Survey of Alabama (GSA) (Moser and DeJarnette, 1992) and the U.S. Geological Survey (USGS) in cooperation with the GSA (Warman et al., 1960) and ADEM (Planert and Pritchette, 1989) have investigated the hydrogeology of Calhoun County. Groundwater in the vicinity of McClellan occurs in residuum derived from bedrock decomposition, within fractured bedrock, along fault zones, and from the development of karst frameworks. Groundwater flow may be estimated to be toward major surface water features. However, because of the impacts of differential weathering and variable fracturing and the potential for conduit flow development, the use of surface topography as an indicator of groundwater flow direction must be exercised with caution in the area. Areas with well-developed residuum horizons may subtly reflect the surface topography, but the groundwater flow direction also may exhibit the influence of pre existing structural fabrics or the presence of perched water horizons on unweathered ledges or impermeable clay lenses. Because of the various geologic factors described above, the extension of groundwater elevation contours over distances on the size and scale of McClellan is not practical without closely spaced control points (SAIC, 2000).

Precipitation and subsequent infiltration provide recharge to the groundwater flow system in the region. The main recharge areas for the aquifers in Calhoun County are located in the valleys.

The ridges generally consist of sandstones, quartzite, and slate, which are resistant to weathering, relatively unaffected by faulting, and therefore relatively impermeable. The ridges have steep slopes and thin to no soil cover, which enhances runoff to the edges of the valleys (Planert and Pritchette, 1989).

The thrust fault zones typical of the county form large storage reservoirs for groundwater. Points of discharge occur as springs, effluent streams, and lakes. Coldwater Spring is the largest spring in the State of Alabama, with a discharge of approximately 32 million gallons per day. This spring is the main source of water for the Anniston Water Department, from which McClellan obtains its water. The spring is located approximately 5 miles southwest of Anniston and discharges from the brecciated zone of the Jacksonville Fault (Warman et al., 1960).

Shallow groundwater on McClellan occurs principally in the residuum developed from Cambrian sedimentary and carbonate bedrock units of the Weisner Formation and the Shady Dolomite and locally in lower Ordovician carbonates. The residuum may yield adequate groundwater for domestic and livestock needs but may go dry during prolonged dry weather. Groundwater within the residuum serves as a recharge reservoir for the underlying bedrock aquifers. Bedrock permeability is locally enhanced by fracture zones associated with thrust faults and by the development of solution (karst) features.

Two major aquifers were identified by Planert and Pritchette (1989), the Knox-Shady and Tuscumbia-Fort Payne aquifers. The continuity of the aquifers has been disrupted by the complex geologic structure of the region, such that each major aquifer occurs repeatedly in different areas. The Knox-Shady aquifer group occurs over most of Calhoun County and is the main source of groundwater in the county. It consists of the Cambrian and Ordovician aged quartzite and carbonates. The Conasauga Formation is the most utilized unit of the Knox-Shady aquifer, with twice as many wells drilled as any other unit (Moser and DeJamette, 1992).

The Tuscumbia-Fort Payne aquifer occurs in the extreme northwestern portion of the county. This aquifer consists of Mississippian age carbonates and shales. Because of its limited outcrops in the recharge area and the rugged terrain of the outcrop area, the Tuscumbia-Fort Payne aquifer is not considered a major groundwater supply in Calhoun County (Moser and DeJamette 1992). However, it is an important source of groundwater in counties to the west (Planert and Pritchette, 1989).

### 2.2.6 Surface Hydrology

The Choccolocco Mountains, located in the eastern portion of the Main Post, form a major surface water divide. East of this divide, the reservation consists of a relatively narrow strip called Choccolocco Corridor, which extends approximately 3.5 to 4 miles from the mountains across the floodplain of Choccolocco Creek, to the base of Rattlesnake Mountain. Choccolocco Creek and its tributaries drain this portion of McClellan and flow southward to the Coosa River.

The entire central portion of McClellan west of the drainage divide is drained by three major creeks and their tributaries. South Branch of Cane Creek receives runoff from the south-central portion, then joins Cane Creek before leaving the reservation on the western boundary. Cane Creek receives surface runoff from the central section. The north-central section of the Main Post is drained by Cave Creek, which leaves the post on the northwestern boundary. Other surface water features on the Main Post include Lake Yahou (13.5 acres), Reilly Lake (8.5 acres), Cappington Ridge (0.3 acres), Duck Pond (0.5 acre), and an aqueduct. Surface drainage is collected in small, independent networks that drain areas varying from 20 to 60 acres (SAIC, 1993).

The Cane/Cave Creek watershed is among the six major watersheds occurring within Calhoun County. Cane Creek, with its tributaries (Remount Creek, South Branch of Cane Creek, and Ingram Creek), originates on the McClellan Reservation. Cave Creek, which occurs as a separate body on McClellan, originates on post and discharges into Cane Creek off post. The on-post drainage area of this system covers approximately 20 square miles. Dothard Creek headwaters originate on post and flow north into the Tallasseehatchee Creek. These creek systems originate in the Choccolocco Mountains on the eastern boundary of the installation and flow west through the main cantonment. They are fed by springs originating from underlying strata.

### 2.2.7 Wetlands

Wetland habitats within McClellan are generally located in the valleys along creek floodplains, near streams, and in depressions. The indicator plant species that assist in defining a wetland include water oaks, sweet gum, bulrush, needlerush, and cattail. The Main Post, Pelham Range, and Choccolocco Corridor have an abundance of wetlands representing important habitats for a wide variety of plants and animals.

Wetland communities found on the Main Post are the Marcheta Hill Orchard Seep, Cave Creek Seep, South Branch of Cane Creek, and 200 acres west of Reilly Airfield (Endangered Species Management Plan [ESMP]) (Garland, 1996). Additionally, wetland habitat potentially exists at or around the installation's lakes, namely Lake Reilly and Lake Yahou, and along the creeks, namely Cane Creek and Cave Creek (Roy F. Weston [Weston], 1990).

### 2.2.8 Sensitive Habitats

Fort McClellan operated under the guidelines of the Endangered Species Act of 1973, the regulations of the U.S. Fish and Wildlife Service (USFWS), Army Regulation 200-3, and its ESMP. The overall objectives of the ESMP are to sustain the existing habitat that supports populations of species identified in the ESMP and to promote the augmentation of these species into unoccupied land that has similar habitats.

The ESMP identifies 11 Special Interest Natural Areas (SINA) on the Main Post. SINAs are locations where the habitat fosters one or more rare, threatened, or endangered species. Because these species are sensitive to environmental degradation, SINAs require management practices that promote the continued well being of these ecosystems. According to the ESMP, the 11 SINAs located on the Main Post include:

- Mountain Longleaf Community Complex
- Cave Creek Seep
- Moorman Hill Mountain Juniper
- Frederick Hill Aster Site
- Bains Gap Seep
- Marcheta Hill Crow-Poison Seep
- Marcheta Hill Orchid Seep
- South Branch of Cane Creek Seep
- Stanley Hill Chestnut Oak Forest
- Reynolds Hill Turkey Oak
- Davis Hill Honeysuckle.

### 2.2.9 Threatened and Endangered Species

Rare species deserving unofficial protection and management measures in the State of Alabama are inventoried and ranked by the Alabama Natural Heritage Program. The sensitivity of these rare species to environmental degradation is used to gauge the well being of the habitat as a whole.

### 2.2.10 Cultural Resources

Cultural resources include archeological resources, and historic and architectural resources as discussed below.

***Archaeological Resources.*** Over 70 archeological sites, both prehistoric and historic, have been identified within the boundaries of the Main Post of McClellan. Of these sites, 22 are potentially eligible or eligible for inclusion to the National Register of Historic Places (NRHP). Phase II archaeological testing is being conducted or has been conducted on these sites to determine final eligibility for the NRHP.

***Historic and Architectural Resources.*** McClellan contains three historic districts: post headquarters, industrial, and ammunition storage districts. Within these historic districts, 89 buildings are eligible for nomination to the NRHP. NSA completed a comprehensive architectural survey of McClellan in 1994 with the objective of identifying and evaluating all structures greater than 50 years in age (pre-1941); results are presented in *The Military Showplace of the South, Fort McClellan, Alabama: A Historic Building Inventory (NSA, 1993).*

## 2.3 Project Organization

Section A2.0 of the QAP discusses the project organization and shows the lines of communication and lines of responsibility among the various team members. The QAP also discusses the roles and responsibilities of MDA's subcontractors.

## 2.4 Scope and Objectives

This installation-wide SAP discusses the general information and requirements of field activities performed at McClellan, while the Site-Specific Plans provide details relevant to each site including the site-specific sampling strategies, analytical methodologies, and intended data use(s) so that the person who implements the plan will thoroughly understand the task. This SAP supplements the information presented in the Site-Specific Plans by giving the reader specific instructions on how to perform the procedures and conduct the various activities required to complete a task.

## 2.5 Data Quality Objectives

Data Quality Objectives (DQOs) are generally the result of an integrated set of thought processes that serve to achieve the following:

- Define the nature of the planned investigation/action
- Anticipate who are the data user(s)
- Determine what the data user needs for decision-making
- Establish what data quality requirements will meet the data user needs.

Following the steps of the DQO process is necessary to ensure that the planned project task generates a sufficient quantity of data that is of defensible quality and that the task meets its planned objectives. Through this process, specific task details such as the selection of the sampling and analytical methods are decided and documented for planning purposes. Of the utmost concern will be which sampling method will yield the most representative sample and what analytical method is the most appropriate to perform on the collected sample to achieve the desired level of data precision, accuracy, completeness and comparability.

The development of DQOs is presented in detail in Section A3.0 of the QAP for site tasks and is not repeated herein. Additional DQO development may be included in the Site-Specific Plans as required for remedial activities. This SAP discusses sampling procedures and field QA/QC procedures, whereas the information regarding sample analysis and laboratory QA/QC is presented in the QAP.

The sampling and analysis procedures specified during the development of DQOs will be taken from generally accepted, industry-standard methods, whenever possible. These methods include, EPA sampling methods and analytical methods such as those discussed in Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods, SW846 (EPA, 1986). Use of standard sampling and analytical methods helps to ensure a consistent data set will be generated for McClellan activities.

# 3.0 GENERAL SITE OPERATION PROCEDURES

This section of the SAP summarizes general site operational procedures that may be used to support a variety of field actions. These types of operational procedures include Munitions and Explosives of Concern (MEC) procedures, geophysical surveying, GPS-based and traditional land surveying techniques, and chemical agent site screening procedures.

## 3.1 Munitions and Explosives of Concern Procedures

MEC are a safety hazard and constitute an imminent and substantial danger to the local population and site personnel. The MDA may provide MEC support activities to handle encountered MEC or unexploded ordnance (UXO). If the MDA performs MEC clearance, avoidance, or disposal, it will be done in accordance with an approved work plan and the McClellan HASP. If instead, individual contractors are utilized, management and potential occurrences of MEC will be addressed in Site Specific Sampling Plans. A site-specific UXO work plan will be required for each project site suspected of containing MEC and/or UXO. These site-specific UXO work plans will be prepared and submitted for approval prior to conducting work.

## 3.2 Buried Utility Location Procedures

The on-Site project manager and safety staff will be responsible for determining whether utilities "reasonably may be expected to be encountered." Known utilities will be identified and marked prior to performing any intrusive activities. Utility locate activities will be coordinated by the on-Site project manager and safety staff in conjunction with local utility locate businesses. At McClellan, the Alabama Line Location Center (800-292-8525) shall be contacted a minimum of 48 hours prior to performing any scheduled intrusive activities. Upon completion of the buried utility clearance, the project manager or designee shall document the utility companies contacted in the project daily log. A copy of the field note will be retained at the field site by the Contractor geologist/scientist overseeing the intrusive/field activity.

## 3.3 Geophysical Surveys

Geophysical surveys using magnetometry, electromagnetic (EM) induction, and ground penetrating radar (GPR) techniques may be conducted at certain sites within McClellan. These surveys will be performed in accordance with the respective SOPs for geophysical investigations as provided in the Site Specific Plans.

## 3.4 Global Positioning System and Traditional Surveying Techniques

Generally, survey requirements for the investigations at McClellan sites will include the following:

- Establish grid corners of geophysical survey locations.

- Locate and document soil borings, sediment, and surface water sampling positions.
- Locate and document monitoring well locations.
- Locate, document, and establish elevations of installed monitoring wells and actual drilling sites of soil borings.
- Support remedial activities such as soil excavation/removal.

### 3.4.1 Coordinate System and Datums

Elevations will be referenced to the 1988 North American Vertical Datum (1988 NAVD). Horizontal coordinates will be referenced to the North American Datum of 83 (NAD-83), Alabama State Plane Coordinate System (SPCS).

### 3.4.2 Control Monuments

Control monuments will be used for individual sites, as necessary. If existing permanent control monuments are unavailable, new permanent control monuments will be provided after consultation with the MDA. Each new control monument will be located horizontally to the nearest 0.1 foot and referenced to the previously established site coordinate system. The elevation of each monument will be measured to the nearest 0.01 foot and referenced to the 1988 NAVD. The identification, elevation, and coordinates will be inscribed on the monument. Control monument data will be included with other surveying data in the final report.

Temporary benchmarks will be established as needed. Each new control monument will be located horizontally to the nearest 0.1 foot and referenced to the previously established site coordinate system. The elevation of benchmarks will be measured to the nearest 0.01 foot and referenced to the 1988 NAVD. The identification, elevation and horizontal coordinates will be recorded in the surveyor's field logbook.

### 3.4.3 Soil Screening and Soil Boring Locations

Each soil screening sampling location and soil boring will be established in the field by the site geologist/coordinator. Each location will be clearly marked with a stake, pin, or similar item upon sampling until it can be surveyed. The sample location identifier will be written in waterproof ink on each marker.

Soil screening and soil boring locations (samples below 1-foot depth), once grouted and properly marked, will be surveyed according to the Site-Specific Plans for horizontal coordinates and vertical data referenced to the NAD-83 SPCS and 1988 NAVD.

### 3.4.4 Soil Sample Locations

Soil sample locations will be surveyed according to the Site-Specific Plans for horizontal coordinates and vertical data and referenced to the NAD-83 SPCS and 1988 NAVD. These locations will be clearly marked with a surveyor's stake or flag after sampling until surveyed.

### 3.4.5 Surface Water and Sediment Sample Locations

Surface water and sediment sample locations will be surveyed according to Site-Specific Plans for horizontal coordinates and vertical data referenced to the NAD-83 SPCS and 1988 NAVD. These locations will be clearly marked with a surveyor stake or flag after sampling until surveyed. Locations in large surface water bodies (i.e., lake or pond) will be surveyed in real time during sample collection whenever possible.

### 3.4.6 Monitoring Well Locations

Horizontal coordinates for new monitoring wells will be measured to the nearest 0.1 foot and referenced to the SPCS. Elevations will be measured at of the top of the well casing to the nearest 0.01-foot.  Elevation measurements will be referenced to the 1988 NAVD. The measurement point on the top of the well casing will be clearly and permanently marked for future water level measurements. The unique monitoring well identification number will be permanently marked on the well's protective cover.

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# 4.0 GEOLOGICAL AND HYDROGEOLOGICAL METHODS

## 4.1 Soil Boring Installation, Sampling, and Abandonment

Soil borings may be installed to sample the subsurface soil for lithology, geotechnical testing, or chemical analysis. Soil sample collection methods will depend on the depth to which the boring will be advanced, and the purpose for which the sample is to be taken. Specific procedures on soil sampling are found in Section 5.1.1.1.

### 4.1.1 Drilling Methods

Proposed soil borings will be advanced to the specified total depth by using a variety of methods: hollow-stem auger, solid-stem auger, stainless-steel hand (bucket) auger, rotosonic or direct-push sampling techniques. These techniques are summarized in the following sections. Before beginning drilling operations, each proposed borehole location will be cleared of subsurface utilities as specified in Section 3.2. In addition, intrusive boring activities at sites where MEC may be present will require surface and downhole MEC avoidance as specified in Site-Specific Plans and the HASP.

#### 4.1.1.1 *Direct-Push Sampling*

In some instances, direct-push sampling techniques will be used to collect soil samples for lithologic description or laboratory analysis. A variety of equipment configurations may be employed; and share these basic elements:

- Hydraulic drive unit (Geoprobe®, Stratoprobe®, or equivalent)
- Stainless-steel sampling point
- Sampling rod

The hydraulic drive unit will first be positioned at the selected boring location. A hydraulically powered percussion hammer will drive either a 1.3- or 2.0-inch outside-diameter core barrel to the required depth. When the probe has reached the desired depth, the point will be retracted and the soil sampler driven forward and filled. The core barrel is a stainless-steel tube with an inner Teflon® or acetate sleeve. The rod and sampler will be retrieved, the sleeve containing the soil sample will be removed from the core barrel, and the sleeve split open using a decontaminated stainless-steel razor-knife.

#### 4.1.1.2 *Hand Auger Drilling*

The hand auger method for drilling and collecting soil samples may be used to collect subsurface soil samples for laboratory analysis and/or lithologic information in remote or difficult to access locations. The hand auger shall consist of a 4-inch inside diameter, 12-inch long (approximate), stainless steel bucket auger with stainless-steel extensions.

Collected soil samples will require the completion of a soil sample collection log. A Boring Log (Attachment 2) will also be completed and the sample interval selected for laboratory analysis will be recorded on the log.

Each sample interval collected will require headspace screening with an organic vapor meter photoionization detector or flame ionization detector (OVM-PID/FID). See Section 5.8.3 for details on headspace sampling. The headspace screening and sampling process will be repeated for the next sampled depth. If the soil collected from subsequently sampled depths contains an interval that displays higher OVM-PID/FID readings than those from any previously sampled depth, the deeper interval will be sampled for volatile organic compound (VOC) using the EnCore® samplers or other appropriate sample containers as described in the QAP (Appendix A) and SOPs (Attachment 3), and then homogenized and sampled for the additional chemical parameters (if they are required). The samples collected from the previously sampled interval will be discarded as IDW and the sample documentation (i.e., Soil Sample Collection Log and Boring Log [Attachment 2], and sample labels) will be completed to indicate the depth interval submitted for laboratory analysis.

#### 4.1.1.3 *Hollow-Stem Auger Drilling*

The hollow-stem auger drilling and sampling method will be used in accordance with American Society for Testing and Materials (ASTM) D1452 (ASTM, 2001a). Augers will have a nominal outside diameter of at least 8 inches and a minimum inside diameter of 4.25 inches. When used for well installation, the borehole will be of an adequate size with a minimum 2-inch annular space between the borehole wall and casing.

A split-spoon sampler will be used in conjunction with hollow-stem auger drilling methods and advanced beneath the auger to obtain undisturbed soil samples. Samples will be collected using a 24-inch-long, 2-inch or larger diameter, carbon steel or stainless-steel, split-spoon sampler. The sampler consists of two halves of a cylinder held together by a sub and shoe that thread onto the top and bottom of the cylinder, respectively. The sampler is threaded to the bottom of steel rod equipped with an anvil at the surface. The sampler shall be driven into undisturbed soil by the force of a 140 pound hammer dropped from approximately 30 inches above the anvil. Hydraulically driven or manually pulled hammers may be used.

Hollow-stem auger drilling and sampling will generally only be used for collecting soil samples for lithologic descriptions. However, in some situations the use of hollow-stem auger drilling to collect soil/residuum for laboratory analyses may be desired.

### 4.1.2 Borehole Abandonment

Soil borings should be abandoned according to the *Alabama Environmental Investigation and Remediation Guidance* (AEIRG [ADEM, 2017]) or most recent version. The following summarizes the abandonment procedures prescribed by the AEIRG.

- Boreholes should be measured for depth before sealing to ensure freedom from obstructions that may interfere with effective sealing.
- Borings should be sealed by backfilling with concrete, grout, neat cement or a grout/cement mixture.
- Backfill material should be placed into each borehole from the bottom to the top by pressure grouting via the positive displacement method.
- The top two feet of each borehole should be poured concrete to ensure a surface seal.

If alternate borehole abandonment procedures will be used, these procedures will be specified in the Site-Specific Plans and approved by ADEM. In any case, borehole and well abandonment activities should be documented using the Monitoring Well Abandonment form (Attachment 2).

## 4.2 Monitoring Well Installation and Development

Drilling, monitoring well installation activities, well development, and field documentation will be conducted according to the procedures provided in the MWIP, Appendix B of this SAP. There are several types of monitoring wells that may be installed at the Site depending on the type of geology and investigation requirements. These include Type I Temporary Monitoring Wells/Piezometers, Permanent Type II Monitoring Wells, Permanent Type III (Double-Cased) Monitoring Wells, Permanent Bedrock Wells, and Nested or Cluster Wells. Equipment decontamination procedures are outlined in Section 5.5.1. Monitoring well locations will be cleared of subsurface utilities as specified in the Site-Specific Plans and Section 3.1 MEC sites will undergo avoidance activities as specified in the approved Site-Specific Plans and HASP.

A geologist licensed in the State of Alabama will supervise the drilling of each borehole, and will maintain a record of the drilling, soil, and bedrock conditions encountered. The geologist will maintain a continuous detailed Boring Log recorded from examining drill cuttings, samples, and cores, and will note first-encountered and static groundwater levels for each borehole. During the advancement of the borings/monitoring wells, soils will be classified using the Unified Soil Classification System (USCS). Daily field notes will be kept in a field logbook and will include sufficient information to reconstruct the progress of drilling operations, materials used, problems encountered, well installation procedures, etc. A Monitoring Well Development Log and Completion Diagram (Attachment 2) will also be completed as outlined in Appendix B and in the Site-Specific Plans. After completion of database entry, field forms and field log books will be archived in the project files. Monitoring wells will be completed with stick-up or flush-mount construction as specified in the Site-Specific Plans.

Each monitoring well will be developed using one of the methods specified in the AEIRG. The purpose of developing a monitoring well after it has been installed is to remove residual materials from the well installation activities and try to reestablish natural hydraulic flow conditions of the geologic formation. Well development methods include over-pumping or backwashing using a submersible pump or bailer and a surge block as soon as practical, but no sooner than 24 hours after well completion. Well development will follow procedures outlined in Appendix B and documented according to the Site-Specific Plans.

When the sampling of an existing monitoring well is complete, the well will be abandoned as specified in Appendix B.

## 4.3 Aquifer Analysis

Aquifer tests will be conducted to address specific objectives:

- Slug tests (in situ permeability) will be conducted to provide hydraulic conductivity from the aquifer materials directly adjacent to the well screens.
- Step-drawdown tests may be conducted to establish the specific capacity and optimum pumping rates for performing constant rate pumping tests.
- Constant rate pumping tests will be conducted to provide quantitative estimates of hydraulic properties of the water table aquifer, including transmissivity, hydraulic conductivity, and storativity, as well as long-term aquifer performance and chemical concentrations during discharge within the area of contamination.

### 4.3.1 Slug Tests

Slug tests provide an estimate of the hydraulic properties of an aquifer in the immediate vicinity of a well where the test is conducted, and involves causing an instantaneous change in the water level in a well and measuring the recovery of the water level with time. Slug tests will be performed in accordance with the Aquifer Slug Testing (Attachment 3) and appropriate ASTM standard. Tests will be documented using a Slug Test Data form (Attachment 2) or similar form provided in the Site-Specific Plans.

Following the tests, the data recorded by the logging device will be recovered and stored on magnetic medium. Recovery data will be graphed and inspected in the field for consistency and completeness. Once the test is completed, the pressure transducer and bailer shall be decontaminated following the procedures outlined in Section 5.5.1.1.

### 4.3.2 Step-Drawdown Tests

Step-drawdown tests may be performed on wells selected to provide pumping rate information when considering long term pumping tests. Steps will be approximately 2 hours long (long enough for drawdown to stabilize) and pumping rates will range from 1 to 80 gallons per minute (gpm); however, higher rates or different durations may be used if necessary. The discharge rate from the well will be controlled by a gate valve or globe valve and measured using a flow-through meter. Calibration of the discharge-measuring device will be accurate to 10 percent or better, and capable of measuring flows of 1 to 100 gpm.

Additional details of site-specific drawdown tests will be provided in the Site-Specific Plans for these sites where step-drawdown tests will be required.

### 4.3.3 Constant Rate Pumping Tests

Contaminant levels are expected to change during long-term extraction well operations; thus, data on initial and flowing concentrations are required for long-term design purposes. Constant rate pumping tests will be conducted within the areas of known groundwater contamination. The pumping test locations will be chosen based on the contaminant concentrations in monitoring wells. Tests will be designed and performed in accordance with applicable ASTM standards.

Constant rate pumping tests will involve the following tasks:

- Selection of existing monitoring wells as observation points and potentially installing piezometers at selected points for observation
- Installation of pressure transducers at selected observation points
- Collection of static water levels in nearby wells and/or piezometers
- Collection of groundwater samples to determine the initial concentrations of the target compounds
- Performance of a step-drawdown test (Section 4.3.2) to determine the optimum discharge rate
- Recovery to near-static level

Additional details of specific pumping tests will be provided in the Site-Specific Plans for those sites where pumping tests will be required.

During the pumping tests, water levels will be monitored in the test well and in selected monitoring wells and piezometers. Water produced during the pumping test will be collected and transported to an on-site treatment facility, or disposed of via other approved discharge points as discussed in the IDWMP (Appendix C).

### 4.3.4 Pumping Test Analysis

Pumping test data are analyzed to obtain estimates of hydraulic parameters and to establish the presence of recharge and impermeable boundaries. Analyses are made by plotting drawdown versus time on log-log or semilog paper and applying either graphical curve matching or mathematical treatment to the data.

Data from pumping tests will be analyzed using aquifer models and analytical tools common to the industry and will comply with appropriate ASTM standards. Step-drawdown tests will be used to compute the specific capacity and, where possible, to determine the well efficiency. Constant rate test data will be graphically matched to theoretical type curves, and the appropriate aquifer model will be chosen for analysis.

## 4.4 Water Level Monitoring

The depth to water will be measured to the nearest 0.01 foot from the highest point on the riser (inner casing), which will be clearly marked and surveyed. Water levels will be measured with an electronic water level meter. The meter will be decontaminated following the procedures in Section 5.5.1.1 of the SAP before insertion into the well. Water level measurements will be recorded in the field logbook or in forms provided in the Site-Specific Plans.

## 5.0 ENVIRONMENTAL SAMPLING AND MEASUREMENT PROCEDURES

The McClellan program data will be acquired by conducting field sampling and measurements as well as field screening analysis (if required) and laboratory analysis. Quality-related activities associated with each sampling and measurement method will be performed in accordance with approved written work instructions using calibrated equipment as necessary. The samples collected will be properly identified and controlled to retain in situ characteristics and to preserve the integrity of the resulting data. Daily activities, data collection, data reduction, results, and variances to work instructions must be documented using standardized project forms.

The Site-Specific Plans document the scope and rationale of the sampling activities to be conducted at each specific site. The on-site activities include soil, sediment, surface water, groundwater and other types of sampling.

The following considerations form the basis for each site-specific sampling program and are preserved in the Site-Specific Plans:

- Selection of sampling points
- Frequency of sampling
- Method of sampling to be used (one method), other options methods listed in this SAP and associated SOPs are still allowable if field conditions, available equipment, or other variable require a change to the method proposed.
- Media to be sampled
- Number of samples to be collected
- Volume of samples to be collected
- Types and kinds of analyses to be performed in the field
- Types and kinds of analyses to be performed at the laboratories
- Sample turnaround time
- Procedures and precautions to be followed during sampling
- Methods of sample preservation and shipment.

Sampling will be conducted frequently enough to satisfy program objectives. The methods used during sampling will preserve the integrity of the material sampled. Field procedures for sample collection and analysis are presented in this SAP.

Any sample obtained during field sampling should be representative of the sample location and free of contaminants from sources other than the immediate environment being sampled. The equipment and techniques that will be employed to obtain representative samples will be in accordance with procedures specified in this SAP and the QAP (Appendix A).
'The equipment and sample collection, preparation, and shipment techniques that will be used will be in accordance with AEIRG protocols or ASTM guidance when no AEIRG protocol is

available. The rationale for the specific sampling program(s) are presented in the Site-Specific Plans.

## 5.1 Sampling Procedures

This section presents general instructions and protocols for collection of soil, sediment, surface water, groundwater, and other sample types. The procedures described in this section should be followed by field samplers during field investigations to maintain consistency in sample collection. Variances to the general sampling procedures may be necessary to accommodate site-specific conditions and will be specified in the Site-Specific Plans.

### 5.1.1 Procedures and Equipment

#### 5.1.1.1 *Surface and Subsurface Soil Sampling*

Surface and subsurface soil samples will be collected and analyzed for chemical and/or physical parameters. The resulting data will be used to meet the task objectives, which may include risk assessment. Soil samples may also be collected from stockpiles that have been generated as part of a removal action at a site to determine disposal options based on hazardous material classification. This section provides the general details for collection of soil samples.

Surface soil, defined as depths between 0 and 1 foot, will be collected using a split-spoon sampler, hand auger, spoon, trowel, or scoop. Borings drilled for subsurface soil samples greater than 1-foot depth will be advanced using hollow-stem augers or by steel hand augers, direct-push sampling probes, split-core samplers, or portable power augers. If a power auger is used, it will be used only to advance the boring to the desired depth and not to collect samples for chemical analyses. Soil sampling equipment that may come into contact with samples or sampling surfaces will be constructed of stainless-steel, borosilicate glass, or Teflon®. Subsurface soil samples will be collected by various drilling methods. A discussion of the different drilling methods is found in Section 4.1.1. Samples of the subsurface soil may be collected continuously with a split-spoon sampler for the first 12 feet and every 5 feet thereafter until refusal. A detailed lithologic log may be recorded for each borehole constructed by the on-site geologist.

The following step-wise soil sampling procedure is implemented as required depending on the planned sampling and analytical program:

***Soil Borings Collected Over Multiple Depths.*** Soil sampling will be performed continuously from ground surface to 12 feet bgs, and 5-foot intervals beyond 12 feet bgs unless otherwise specified in the Site-Specific Plans. The surface to 1-foot bgs interval is regarded as the surface soil sample interval. Sample intervals below 1-foot bgs are regarded as subsurface soil samples. The 1-foot to 2-foot bgs soil sample interval is regarded as the upper or first subsurface soil sample interval. If the OVM-PID/FID screening displays results equivalent to background, no samples will be retained for laboratory VOC analyses. Subsequent (deeper) subsurface soil samples collected with the stainless-steel split-spoon sampler will be field screened. The initial subsurface soil sample interval collected and screened with the OVM-PID/FID resulting in a OVM-PID/FID reading greater than background will be sampled with the EnCore® samplers or other sample containers appropriate for VOC analyses as described in Attachment 3. The remaining portion of the soil sample will be placed in either zip top bag or unpreserved glass jars, labeled, and stored in a cooler with ice preservative for consideration for additional laboratory chemical analysis. This initial subsurface sample interval exhibiting a field screening result greater than background will serve as the baseline for the boring. If a deeper sample interval exhibits an OVM-PID/FID screening result greater than the baseline interval, the interval exhibiting the higher reading will be designated as the new baseline interval, and the sample interval previously designated as the baseline interval will be discarded with soil cuttings from the borehole. The newly designated baseline interval will be sampled with the EnCore® samplers or other sample containers appropriate for VOC analyses as described in Attachment 3. If additional analyses are required, the remaining soil will be transferred to a stainless-steel container and homogenized by the quartering method before subsequent sample containers are filled. After the sample containers have been filled, the remaining portion of the soil sample will be disposed of as IDW as described in the IDWMP in Appendix C.

If no subsurface soil sample intervals from 2 to 12-feet bgs exhibit OVM-PID/FID readings greater than background, the soil sample from the 10-foot to 12-foot interval will be designated as the baseline interval and selected for chemical analyses. If a sample interval below 12-feet bgs is screened with the OVM PID/FID, and exhibits a reading greater than the baseline interval, the sample will be examined for physical characteristics of contamination, such as staining or discoloration, the presence of an immiscible fluid, and a solvent or petroleum hydrocarbon odor. If such characteristics are present, the soil will be sampled for laboratory analyses as previously described, and the sampler will notify the sample coordinator to obtain the proper sample identifier. If no physical characteristics are present, no sample will be submitted for chemical analyses.

No more than three subsurface soil samples from any boring will be collected for laboratory analyses. No soil samples from below the groundwater table will be submitted for chemical analyses. The boring locations and depths for each site are described in each Site-Specific Plan.

***VOC Sampling.*** If VOC analysis is required at a location, a soil sample will be collected in a zip top bag for headspace screening using an OVM-PID/FID. Screening over the split-spoon sampler, even if done immediately upon opening the sleeve, may not be a reliable measure for organic vapors in the soil. If the field geologist measures a sampled soil interval that displays elevated readings exceeding background, those readings will be recorded on the Boring Log. The geologist may collect the soil VOC sample from this interval using a series of three 5-gram EnCore® samplers or other sample containers appropriate for VOC analyses. If EnCore® samplers are used, samples will be collected by inserting each device into the soil contained in the core barrel sleeve until it is completely filled with soil. Each EnCore® device will be sealed with no headspace as described in the manufacturer's instructions, sealed in their foil zip top bags, and transferred into a designated sample cooler and chilled on ice to 4°C. Soil samples collected for VOC analysis may also be collected in a series of three 40 ml VOA vials with appropriate preservation methods or in 2 or 4 oz glass jars with septa. Proper sample containers, preservation methods, and holding times are discussed further in the SOPs in Attachment 3. Each soil sample will be sealed in a zip top bag and transferred into a designated sample cooler and chilled on ice to 4°C ±2°C.

If only VOC analysis is required, an additional 60-mL or 120-mL aliquot of soil will be collected for moisture analysis at the laboratory.

***Headspace Sampling and Analysis*.** If VOC analysis is required, headspace analysis for VOCs will be performed using a OVM-PID/FID by removing an aliquot of soil from each sample interval. This aliquot is transferred to a labeled zip top bag for headspace development and analysis per the method described in Section 5.8.3. When the headspace analysis is complete, that measured value is recorded on the Boring Log.

***Lithologic Description.*** Following the collection of samples for VOC and headspace analysis, the geologist will then proceed to evaluate the soil and record the lithologic description of the soil contained within the core barrel sleeve on the Boring Log. Soil samples will be described in accordance with ASTM Method D2488 (ASTM, 2001b) using the USCS.

***Additional Parameters.*** If additional chemical parameters other than VOCs are required at this location, the remaining soil in the core barrel sleeve will be transferred into a decontaminated, stainless-steel bowl. The soil will be homogenized using a complete mixing technique such as the quartering method described later in this section then transferred into the appropriate sample container(s) to fulfill the requirements for the remaining analyses.

***Boring Completion.*** Soil borings are considered complete upon encountering the groundwater table or refusal. If the soil boring reaches the soil/water interface or bedrock and no elevated OVM-PID/FID readings have been recorded, nor have samples have been collected for chemical analysis, and there have been no observable indicators of potential soil contamination, then the soil interval immediately above the groundwater table or refusal will be submitted for the required chemical analyses.

Intrusive soil sampling locations will be cleared of subsurface utilities and, if appropriate for the site, MEC anomalies as specified in the Site-Specific Plans. Drill cuttings generated during the boring installation will be placed adjacent to the borehole on plastic to prevent contact with the ground surface. Cuttings and other IDW will be handled as specified in Appendix C.

***Sample Documentation.*** A Soil Sample Collection Log (Attachment 2) will be completed for each sample. This form will be used to document the sample location, identification, type, number of sample bottles filled, and any additional QC samples collected in conjunction with the field sample. When specified in the Site-Specific Plans, collected soils will be described using the USCS soil taxonomy nomenclature. For surface soil samples, the soil description will be kept in the logbook Section 5.6.1 discusses the use of logbooks to document various site activities including soil sampling. A boring log (Attachment 2) may be kept for soil borings that have been advanced to depths greater than 1 foot.

Thorough and detailed documentation of the procedures used to collect the samples in the field is essential to the project. The information required to complete the forms and the logbook entries must be recorded by the technician in the field during sample collection and should be peer reviewed by other technicians before leaving the sampling location. Following this procedure will help ensure that the field data records are accurate and complete for each sample collected. In areas of the form and the logbook entries that require observations and notes to be recorded by the technician, an effort will be made to record factual, observed characteristics such as a visual description, odor, surrounding area, and problems encountered during field activities. The technician must use judgment to record observations that are based on what actually occurred or was observed and not what was inferred or interpreted (e.g., sample odor or visual inspection indicated chemical contamination).

***Method 5035 VOC Sampling and Analysis.*** To comply with method requirements and the AEIRG, any soil samples requiring VOC analysis will be collected in either EnCore® samplers (or equivalent) or 40 ml vials persevered with methanol (high concentrations) or sodium bisulfate (low concentrations) as described in the SOPs (Attachment 3). Expected sample concentrations will also determine containers used. Low concentrations are considered to be less than 200 µg/kg. High concentrations are greater than 200 µg/kg.

Samples will be packaged in accordance to the SOPs (Attachment 3), and placed in a cooler on ice and chilled to 0-6°C upon collection, then prepared for same-day (or at the latest next-day) laboratory shipment. VOC samples collected using the EnCore® sampler must be frozen by the analytical laboratory within 48 hours of collection. With this restriction, no soil VOC samples can be collected on a Saturday or a Sunday**.** Generally, laboratories will accept and prepare VOC samples on Saturday that were collected and shipped on Friday.

Decontamination of instruments used in the collection of soil samples will be decontaminated between sample locations using methods described in the SOPs (Attachment 3). Note that using the EnCore® samplers does not require field decontamination of the sampler, but the T-bar should be wiped using damp paper towels between locations.

***Surface Soil Sampling.*** Before collecting a surface sample, nonrepresentative debris such as rocks and vegetative material will be cleared from the immediate area. Samples for VOC analysis will be directly collected from the surface soil sampling device and placed in an appropriate container as described in the QAP (Appendix A). After the VOC sample is collected, the soil will be homogenized as thoroughly as possible in a stainless-steel bowl. To be representative of the matrix, the sample must be free of excess vegetation or rock. These materials can be removed by hand during the sample mixing/homogenization step. Surface soil samples may be analyzed via headspace screening method. Samples collected for chemical analysis will be placed in the appropriate sample containers, labeled for proper identification, and placed in a designated cooler with ice to chill the sample to 0-6°C pending shipment to the laboratory or transfer to the on-site sample storage refrigerator. The criteria for sample selection will be documented in the logbook. Notes on location, identification, methodology, analysis program, and other information will be recorded on the Soil Sample Collection Log and in the associated logbook.

Special care must be taken with soil samples for VOC analysis not to cause volatilization and loss of compounds through agitation of the matrix during collection. This will be prevented if sampling precautions are taken and the material is transferred directly from the sampling device into the designated sample container or EnCore® samplers (Attachment 3). To maintain integrity, samples must be preserved as specified in Section 5.1.3 and packaged as specified in Section 5.1.6 and in accordance with the appropriate SOPs (Attachment 3).

If collection techniques are performed that require compositing or homogenization, the following recommended procedures will be used:

- Extrude the sample from the sampling device.
- Place sample in a glass or stainless-steel mixing bowl.
- Divide into four equal quarters using a stainless-steel spatula or glass rod.
- Mix each quarter individually.
- Combine the quarters into a central composite.
- Redivide the sample into four equal quarters and repeat the procedure until the soil is homogenized as much as possible.
- Divide the sample into four equal quarters for a final time and withdraw aliquots from the four quarters equally to fill each sample container.

This procedure will always be used, especially in cases where field duplicate or split samples are performed. <u>This procedure is not to be performed on samples requiring VOC analysis.</u> VOC samples will be collected into the designated sample container(s) or EnCore® sampler(s) directly from the sampling device.

Equipment used for collection, transfer, and homogenization will be properly decontaminated before collecting samples and between sampling locations, as described in Section 5.5.1.1.

***Excavation Confirmation.*** The excavation confirmation sample is a particular type of surface soil sample, that is collected from the surfaces of an excavation. It is usually used to determine the extent of the excavation to judge completeness. The surfaces sampled may consist of the excavation floor, sidewalls, or perimeter. Exact sample locations may be slightly different than traditional surface soil samples. The Site-Specific Plans will describe the number and the relative position of the excavation confirmation samples on a case-by-case basis, as this will vary with the size and shape of the excavation pit. The Site-Specific Plan text must describe the process for establishing a representative sample location and whether the sample collected will be a grab sample submitted for individual analysis or an aliquot of a larger composite sample. Supplementary confirmation samples may be required if additional excavation is performed based on the results of the first round of confirmation samples. The Site-Specific Plans must include a sampling strategy to address how these supplemental samples will be collected.

***Subsurface Soil Samples.*** Subsurface soil samples refer to samples collected below 1 foot. Additional requirements for soil borings are presented in Section 4.1. Soil borings will be advanced using the hollow-stem auger method, by stainless-steel bucket hand auger, stainless steel split-core sampler, direct-push sampler, portable power auger or backhoe bucket (as necessary).

Soil borings will be logged in accordance with ASTM Method D2488 (ASTM, 2001b) or subsequent appropriate ASTM standard using the USCS soil taxonomy. Soil samples may be continuously collected from ground surface to 12 feet bgs, and on 5-foot intervals below 12 feet bgs to the total depth of the boring unless otherwise noted in the Site-Specific Plan. The entire length of the sample collected from the sampler will be field-screened for the presence of organic vapors using a hand-held organic vapor meter-photoionization detector/flame ionization detector (OVM-PID/FID) and the soil will be visually classified as required. Depending on task-specific objectives, the headspace vapors of an aliquot of the collected soil may also be measured. Soil screening and classification procedures will be detailed in the Site-Specific Plans. The depth interval and OVM-PID/FID reading in units of ppm will be recorded on the Boring Log (Attachment 2) and in the logbook for any portion of the sample where organic vapors are detected. Soil sampling equipment used for trace analysis sampling will be constructed of stainless steel. Soil collected for VOC analysis or headspace screening will be collected directly from the subsurface soil sampling device into the designated sample jar, EnCore® sampler(s) and/or zip top bag as soon as possible after the device is opened. The remaining soil will be transferred to a stainless-steel container and homogenized by the quartering method before subsequent sample containers are filled.

Samples for chemical analysis will be placed in the appropriate sample containers and labeled for proper identification. To maintain integrity, samples must be preserved as specified in Section 5.1.3 and packaged as specified in Section 5.1.6 and in accordance with the SOPs (Attachment 3).

For each subsurface soil boring, the site geologist will maintain a detailed Boring Log during the drilling of each borehole and keep detailed entries in the logbook. To supplement the Boring Log, a Soil Sample Collection Log (Attachment 2) will be completed for each sample collected from deep and shallow borings, and will document the following information about the sample: location, identity, sampling team members, soil boring number, sample number, screening results, sample depth interval, analytical parameters, sample containers, QA/QC information, and any comments or observations.

Soil cuttings generated during the drilling of deep subsurface soil borings will be handled in accordance with the IDWMP (Appendix C).

***Soil Samples for Geotechnical Analyses.*** Selected soil samples may be collected for geotechnical analysis. Soil and sediment samples collected and submitted to the laboratory for chemical analysis will also undergo a moisture content analysis to allow the laboratory to report results on a dry weight basis. In addition to this analysis, certain samples may be submitted for geotechnical analyses that may include one or more of the following:

- Sieve analysis (grain size with hydrometer) - ASTM D421/D422 (ASTM, 2001 c)/(ASTM, 2001d)
- Atterberg limits - ASTM D4318 (ASTM, 2001e)
- USCS classification - ASTM D2488 (visual) (ASTM, 2001b) or ASTM D2487 (if laboratory data are available) (ASTM, 2001f).

The numbers of samples to be submitted for geotechnical analysis will be summarized in the Site-Specific Plans.

#### 5.1.1.2 *Sediment Sampling*

Sediment samples obtained from ponds, streams, or similar water bodies will be collected with an Eckman, Peterson, or Ponar dredge (as appropriate for the sediment type), a bucket auger, a spoon, or a scoop or similar sampling device. The sample technician should assess the entire area and unless the sample location is predefined in the Site-Specific Plan, he should use his judgment on selecting the most representative location. The samples will be analyzed for chemical and/or physical parameters and the data used to meet the objectives of the task, which may include risk assessment. Sediment sampling equipment that may come in contact with samples or sampling surfaces will be constructed of stainless steel and will be properly cleaned and decontaminated as described in Section 5.5.1.1 before collecting samples and between sampling locations. Collected sediment samples will be handled in a similar way as surface soils in that VOC aliquots will be collected directly from the sampling device using appropriate sample containers.

Remaining sediment will be transferred to a stainless-steel mixing bowl, any free water will be decanted from the sediment, and the sediment homogenized. The homogenized sediment will be transferred from the mixing bowl to fill the appropriate sample container for each requested analysis. To maintain integrity, samples must be preserved as specified in Section 5.1.3 and packaged as specified in Section 5.1.6. Physical characteristics of the sediment will be described in the logbooks and sample collection information will be documented using a Sediment Sample Collection Log (Attachment 2). Sampling equipment will be properly decontaminated before collecting samples and between sampling locations (Section 5.5.1.1).

Sediment samples taken from ponds or sumps will be collected with an appropriate dredge, bucket auger, or a similar sampling device specified in the Site-Specific Plan. The sampler will be used to collect a sample from the upper sediment layer as follows:

- The sample line will be attached to the pre-cleaned dredge or other device as required.
- Sediment samples will be collected in a downstream to upstream fashion to minimize potential impacts from sediments disturbed during sampling on downstream location.
- The distance from water surface to bottom will be measured and marked so that the equipment-lowering rate can be reduced, thus preventing unnecessary bottom disturbance.
- The sampler jaws will be opened by attaching the support cables to the messenger tripping mechanism.

- The free end of the sample line will be tied to a fixed support to prevent accidental loss of the sampler.
- The sampler will be lowered very slowly as the bottom depth is approached.
- Once contact with the bottom is made, the sample line will be slackened to allow the sampler to penetrate into the sediment.
- The messenger, which slips around the sample line, will be released to trigger the closing of the dredge.
- The dredge will slowly be raised to the surface.
- Using a stainless-steel spoon, the sample will be removed from the dredge and transferred to a mixing bowl.
- Sample aliquots for VOC analysis will be collected using EnCore® sampling devices or other appropriate container(s). If the sediments are not cohesive enough to be collected using EnCore samplers, the sediments will alternatively be collected using preservation techniques specified for SW-846 Method 5035A by collecting the samples in two VOA vials.
- Free water from the sediment will be decanted carefully in a manner not to lose the fine-grained material, and the remaining sediment will be homogenized using the quartering approach (as described in Section 5.1.1).
- Homogenized sediment will then be transferred into sample container(s) for non-VOC analysis aliquots.
- Once the sample containers are completely filled with sediment, the containers will be wiped clean and dry, and labeled with a pre-printed label, preserved as specified in Section 5.1.3 and packaged as specified in Section 5.1.6.
- Sample collection documentation will be completed including the Sediment Sample Collection Log (Attachment 2) and logbook entries.

In cases where sediment and surface water samples are to be collected at the same sampling location, the surface water sample will be collected first, followed by the sediment sample, to avoid disturbing the sediment and possibly biasing the surrounding surface water with suspended sediment.

#### 5.1.1.3 *Surface Water Sampling*

Surface water samples will be collected from standing water, lakes, ponds, streams, creeks, or seeps located at McClellan. The sampling points will be selected to obtain information related to surface water and groundwater interactions and to detect contamination. The proposed sampling locations are discussed in the Site-Specific Plans.

***Surface Water Sampling Equipment.*** The equipment required for surface water sampling includes:

- Pyrex ladle, Teflon® dipper, or stainless-steel scoop/pitcher
- Nylon rope
- Oxidation reduction potential (ORP), dissolved oxygen, pH, temperature, conductivity, and turbidity meters

- Appropriate sample bottles and cooler with ice (if required)
- Plastic sheeting
- 5-gallon buckets with lids
- Shallow draft rowboat, personal floatation action devices (if necessary).

Surface water sampling, like groundwater sampling, is also generally considered to be "trace level" in nature. Many of the same QA concerns, such as representativeness and introduction of bias either from contamination or analyte loss, are also of immediate concern when collecting surface water samples. In addition to these issues, the sampling technician who collects surface water samples must also be careful to thoroughly document the following:

- Location of the sample in the body of water sampled
- The presence or absence of possible interfering surface water features such as Tributaries
    - Outfalls
    - Disturbances (eddies, rapids, falls)
    - Subsurface stratification (in still water or slow flow bodies)
- Evidence of local watershed erosion (e.g., stream banks)
- Sample collection method
- Physical description of the collected sample
- Water depth
- Measured field parameters

Use of the Surface Water Sampling Data form (Attachment 2) and detailed logbook entries will prompt the technician to investigate and document these conditions that may impact the selection of sampling location, technique, or equipment.

To collect a representative sample of a stream or canal, the technician must also take into account the approximate depth and width of the body at the anticipated location. For most locations where the depth and width of the stream is not great, a single sample collected in midstream at mid-depth is usually sufficient. A subsurface water grab-sampling (such as the Kemmerer sampler) allows the technician to submerge a sample collection contained beneath the surface and then open it to collect a single-point, single depth sample. Alternatively, surface water samples may be collected using a peristaltic pump and Teflon® tubing (if the total depth of the surface water body is less than 25 to 35 feet). A peristaltic pump will allow the technician to collect either surface water at a single, discrete depth or integrated sample collected over a range of depths (by building a composite sample in a separate container). Note a compositing approach over a range of depths using the peristaltic pump is not applicable when collecting samples for VOC analysis. VOC samples will be collected from a single depth (using a Kemmerer sampler or peristaltic pump) and not composited. Multiple VOC samples may be taken from multiple depths to yield a profile of a large surface water body. The Site-Specific Plan will specify which sampling approach will be used to meet the intended objective of the task.

In cases where surface water and sediment samples are to be collected in the same location, the surface water will be collected first, followed by the sediment sample to avoid undue disturbance of the sediment and possible contaminant release into the surrounding surface water.

Compositing samples in response to observed subsurface stratification poses an additional problem to the sampling technician. Evidence of stratification includes significant differences in measured pH, dissolved oxygen, or temperature at different depth intervals. To maintain sample representativeness in a body of deep, still water or a low-flow water body where stratification is obvious, the technician should prepare a composite sample of the major layers using depth integrated sampling devices, or submit a sample of the largest, most representative layer.

Overall, adequate documentation of the sampling approach used by the technician in the field is the key to understanding how to interpret the associated analytical data.

A representative sample for water quality testing will be collected at each surface water sampling location. The following sample collection QA procedures will be used to collect these samples:

- Determine if the surface water body is stratified by measuring the field parameters (pH, temperature, dissolved oxygen, etc.).
- If stratified, determine which sampling technique will achieve the most representative sample (i.e., multiple samples collected at single depths or an integrated, multi-depth composite sample). If multiple samples at single depths are collected, then measure and document the field parameters for each sampled interval separately. If an integrated composite sample is collected, measure the field parameters using an aliquot of the composited sample that is representative of the entire sampling interval.
- If reusable equipment is used, it will be decontaminated as per Section 5.5.1.1, and will be protected from contact with foreign materials and contamination through use of clean plastic sheeting.
- Grab samples will be collected using a Teflon®, glass, or stainless-steel sampling device. Where pond samples are being collected, the mouth of the sample collection device will be maintained completely under water, when possible. Note that chemical preservatives will not be added until the sample aliquots for analysis are transferred from the collection vessel to the sample collection jars.
- Sample handling requirements will be generally the same as for groundwater samples (Section 5.1.1.5).
- Samples collected for VOC analysis will be collected first into volatile organic analysis (VOA) vials before any other parameters.
    - Each VOA vial will be filled by slowly pouring the water sample down the side of the vial from the sample collection device to avoid turbulence and possible VOC loss. Each VOA vial will be checked for the presence of trapped air bubbles after sealing.

These vials will contain sufficient hydrochloric acid (added by the laboratory) to lower the pH of the sample to less than 2.

- Sample containers will be completely filled with water preserved as specified in Section 5.1.3 and packaged as specified in Section 5.1.6.
- Sampling information including instrument readings for field measured parameters and final preserved sample pH will be logged on the Surface Water Sample Data form and in logbook entries at the time of collection.
- Samples submitted for metals analysis will not be filtered unless specified in the Site-Specific Plan . Criteria and methods for filtering samples will be in accordance with the procedure outlined in Attachment 3.

#### 5.1.1.4 *Seep Sampling Using Syringe Technique*

A "syringe-sampling" device may be utilized to collect the spring and seep samples. The syringe-sampling device consists of a 60-milliliter (mL) sterile medical syringe attached to a length of polyethylene capillary tubing, which in turn is attached to a length of tubing. Alternatively, a peristaltic pump and Teflon® tubing may be used to collect samples if the pump flow rate is adjusted to below the seep flow rate (so that water from the sample source spot will be collected). The length of tubing shall be selected so that the disposable tubing volume is at least 1.5 times the volume of the syringe (i.e., at least long enough to provide 90-mL of sample volume). The tubing will be affixed to an extendable rod, with the syringe at the handle end. In this way, the suction provided by the syringe will draw water up into, but not beyond, the length of disposable tubing. Between 2-6 syringe volumes will be extracted from the base of the water column within the spring or seep (or where active flow is visually observed) to fill the appropriate sample bottles. The disposable Teflon® tubing will then be discarded after each use.  In addition, field parameters (temperature, specific conductance, pH, dissolved oxygen, ORP, and turbidity) will be measured at the time of sample collection using a calibrated multi parameter probe.

#### 5.1.1.5 *Groundwater Sampling*

Groundwater monitoring well locations and rationale will be shown in the figures presented in the Site-Specific Plan. The analyses to be performed on samples collected from each of the wells will also be identified in Site-Specific Plan.

Sampling of newly installed monitoring wells will take place no sooner than 14 days after well development has been completed. Whenever analytical data are available, groundwater sampling generally will be conducted from the areas assumed to be least contaminated to the areas assumed to be most contaminated.  Sampling and purging equipment (pumps, tapes, discharge piping) will be decontaminated before use and before each successive use in accordance with the decontamination procedures in Section 5.5.1.1.  Dedicated tubing will be used at each sample location to prevent cross-contamination.  Alternatively disposable tubing will be used for collecting groundwater samples, with new tubing used at each well for each sampling event.  Collection of groundwater samples will be documented in the Groundwater Sampling Log (Attachment 2) and in logbook entries.

The specific groundwater sample collection methodology to be used at McClellan is summarized in Attachment 3 of this document. If alternate techniques are proposed for use, these techniques will be discussed in the Site-Specific Plans.

***Discrete Groundwater Sample Collection.*** At known contaminated sites, determining the saturated interval with the greatest mass of contaminants may be necessary to properly select the screened interval for monitoring wells. In these situations, collection of discrete groundwater samples at selective intervals while coring bedrock, or drilling with rotary or sonic methods, allows for the qualitative vertical delineation of groundwater contaminants in the groundwater saturated zone. Groundwater sampling methodology outlined in Attachment 3 will be followed when collecting groundwater samples. Attached SOPs address the necessary supplies, equipment, and procedures to be used to advance borings and collect discrete groundwater samples for chemical analysis.

#### 5.1.1.6 *Drum Sampling*

The specific sample collection methodology used to sample the contents of drums at McClellan is summarized in the prepared SOPs included as Attachment 3. The SOP covers the equipment requirements, safety precautions, and liquid and solid matrix sampling procedures.

#### 5.1.1.7 *Demolition and Investigation Derived Waste Sampling*

To characterize different waste streams for disposal, composite samples are typically collected of each matrix and analyzed by a variety of analytical methods including the toxicity characteristic leaching procedure (TCLP) method described in SW-846. The Installation-Wide Waste Management Plan (Appendix C) includes a discussion about sampling SOPs for the collection of solid IDW (such as soil in roll off boxes), liquid IDW (such as well development and decontamination water in sumps and tanks), and residual sediments in tank bottoms.

When building materials are demolished and removed that may have been contaminated with potentially hazardous substances, they will require characterization as a hazardous or non hazardous waste prior to disposal. To perform this characterization, core samples or chip samples are often collected. Core and chip samples involve removing small sections of the matrix using a blade, saw, or other cutting device and building a representative sample from these removed sections. One of the main sampling concerns is generating a representative sample by removing these small sections from a number of locations within the waste stream. Additionally, the number of small sections removed to form the sample should be increased as much as possible by decreasing the particle size as much as practical. This will help reduce sampling bias. Core and chip samples typically will be crushed or ground into a fine powder by the receiving laboratory prior to analysis. The analysis is carried out as a typical solid matrix sample and the results are reported on a "weight/weight" basis (such as milligrams per kilogram).

Another form of disposal characterization sampling is rinsate sampling which is typically performed on substrates such as the interior of decontaminated pipes or porous surfaces where wipe or chip sampling is impractical. Rinsate sampling involves pouring analyte-free water over, through, and around the decontaminated surfaces and collecting the rinsate as an analytical sample. The rinsate sample is treated as any typical water matrix sample by the laboratory. The sample results are reported on a "weight/volume" basis (such as milligrams per liter).

#### 5.1.1.8 *Air Sampling*

Air sample locations and rationale will be discussed in the site-specific CMIPs. The analyses to be performed on the air samples will also be identified in the CMIPs. The procedure for collecting the air samples is outlined in Attachment 3. If other additional site-specific techniques are required, these techniques will be discussed in the site-specific CMIP.

### 5.1.2 Sample Containers

Samples must be placed in sample containers certified by the manufacturer to be precleaned to EPA specifications that are compatible with the matrix and intended analysis, and properly prepared and preserved to maintain sample integrity. Table A 4-1 of the QAP (Appendix A) specifies the sample quantities and types of containers typically needed for each analytical method. Analytical laboratories often have a laboratory-specific quantity requirement or specify a certain sample container type. Generally the laboratory will furnish the sampling technician with sufficient quantity of containers to complete a sampling task.

### 5.1.3 Sample Preservation

Physical and chemical preservation includes techniques designed to stabilize the concentrations of analytes in the sample matrix during the time from sample collection through preparation and analysis. Examples of physical preservation include filling to zero headspace for volatile samples, sealing, and chilling samples to 0-6°C. Examples of chemical preservation include adding strong acids (nitric acid, $HNO_3$) or bases (sodium hydroxide, NaOH) to adjust sample pH. Whenever possible, chemical preservatives will come prepared from the laboratory in single-use disposable vials that will be separated by type and stored in a designated area away from sources of ambient contamination. Stock will be rotated out and consumed in the order in which it was received to minimize shelf life. If any source of chemical preservative is in question as a possible source of contamination, the use of this source will be immediately discontinued and replaced with fresh stock. Material blanks and preservative blanks will be collected annually (or as needed) to assess ambient contamination sources.

For those samples requiring field pH adjustment, the final pH of the preserved sample will be checked using pH paper and the result recorded on the sample label, the sample collection log and chain of custody (COC). Attainment of the correct sample pH is critical to ensuring that constituent concentrations do not change between the time of collection and the time of analysis. Therefore, the pH of the preserved samples will be checked at the time of collection by the sample technician by pouring some of the preserved sample over pH-indicating paper. The paper will not be dipped into the sample container to measure pH. If the pH check indicates further pH adjustment is necessary, additional preservation will be added to attain the correct sample pH. If after l0 mL of preservative has been added and the sample pH is not within acceptable range for preservation, no additional preservative will be added. Instead, sample personnel will note the final pH on the sample bottle and COC form and note the situation on the sample collection log.

When sampling water matrix sample for VOC analysis, periodically an extra VOA vial will be collected and the pH of this extra vial will be measured using pH paper. The vial will be discarded as IDW and not shipped to the laboratory for analysis. The results of this pH check will be documented in the logbook and on the sample collection log.

A sample "holding time" establishes the recommended maximum time that a sample may be held under preservation before extraction and analysis without compromising sample representativeness. Preservation techniques and suggested holding times are standardized by the EPA according to analytical method. Table A 4-1 of the QAP summarizes the latest information on preservation techniques and holding times for the most commonly requested McClellan analyses.

Chemical preservation is not usually recommended for solid matrix samples nor for samples known to contain high concentrations of organic solvents. Unpreserved or specially preserved samples sent to the laboratory should be indicated on the sample label and should be flagged on the shipment COC form to identify these samples to the laboratory receiving personnel as requiring special handling.

### 5.1.4 Sample Identification and Numbering

Sample identification is a process that begins in the work planning stage when planned field and QA/QC samples have a unique sample number and location identifier assigned. This section of the SAP describes the sample numbering approach that will be used at McClellan. Section A8.0 of the QAP describes data management activities including use of the project database on McClellan. The sample numbering system to be utilized in the field has been developed to uniquely identify each sample collected at McClellan. Each sample will be assigned a sample number. The sample number will be incorporated into a sample description comprised of six elements and formatted as described in the SOPs (Attachment 3).

The sample number and the entire sample description will be preassigned prior to the initiation of the field sampling effort. The samples to be collected at each site and their designated descriptions are presented in the Site-Specific Plan. Depth of the sample collected and other collection information is retrieved by linking the sample number to the collection data entered into the sample tracking/field module of the McClellan database. Section A8.0 of the QAP discusses use of the database in more detail.

***QC Sample Identification.*** Field QC samples will be identified in accordance with the procedures outlined in this section; however, they will be identified as QC samples by the sample purpose field.

### 5.1.5 Sample Labels

Physical samples for laboratory analysis collected at the sites will be placed in an appropriate sample container for shipment to the respective laboratories. Samples will be adequately marked for identification from the time of collection and packaging through shipping and storage. The sample identification and collection information will be presented on a label attached to the sample container. The label will be completed with permanent ink or preprinted from the database sample tracking system. An example of a typical sample label sheet has been included in Attachment 3. At a minimum, sample labels will include the the following sample information:

- Field sample number
- Project name and number
- Analysis requested for the sample collected
- Method of preservation/conditioning
- Date and time of collection
- Initials of the person collecting the sample.

### 5.1.6 Sample Packaging and Shipment

When the sample technician completes sample collection, labeling, and chemical preservation (if required), the sample will be sealed in an outer zip top storage bag and placed into a designated sample cooler, on ice, to chill the sample to 0-6°C (if required). Sample collection logs will be used to inventory the samples collected that are in the cooler for field storage. The COC (Attachment 2) forms will be filled out in the field, at the time of sample collection. After the sample cooler and the sampling team return to the field office trailer, laboratory, or mobilization area, the samples can be thoroughly inventoried and segregated for field screening or for shipment to the analytical laboratory. Samples collected for off-site analysis should be shipped within 24 to 48 hours of collection by an overnight delivery service or laboratory courier, or hand carried by the sampling team to the laboratory. Special consideration must be made for soil VOC samples collected in EnCore® samples (see Section 5.1.1.1). The packaging and shipping requirements for air samples are included in Attachment 3.

Samples that are collected for off-site laboratory analysis that require overnight shipment will be generally prepared by:

- Sealing the container in an outer zip top storage bag.

- Securely wrapping each collected sample in bubble wrap (or other similar shock-absorbing material). At least three sides of the container must be wrapped or surrounded with material when placing the samples into the sample shipping container. Adequate ice will be placed in

> zip top bags and added to the cooler around and over the top of the sample containers to form a cooling layer to help ensure proper preservation during shipment. Completed and signed laboratory COC forms will be placed into the cooler in a protective zip top bag and taped to the underside of the cooler lid. Custody seals will be applied across the opening of the cooler and the lid secured by wrapping the cooler with clear plastic packing tape or duct tape. The cooler will then be ready for shipment according to the methods required by the overnight delivery service. At a minimum, the laboratory address, telephone, and contact name should be included on the original airbill and, if multiple packages are sent, on each sample cooler.

If samples are transported by common carrier, or any other means other than hand-carrying to an on-site laboratory or direct transport by a laboratory courier, the sample shipment must be prepared in accordance with the applicable Department of Transportation (DOT) and/or the International Air Transport Association (IATA) regulations and specifications. These regulations and specifications may stipulate the use of sealed, inner packaging (e.g., metallic paint cans, fiberboard canisters) and outer packaging that meets specific testing requirements. Certain small quantity exemptions apply, as do exemptions for samples of unknown characteristics (such as environmental samples). Waste samples and chemical solvents or preservatives with known characteristics (i.e., flammable, corrosive, toxic) that are shipped for environmental studies are not exempt. Sample shipments containing dry ice, such as biota samples, must be specially labeled, and the total weight of dry ice included in the shipment must be reported in the shipping papers. The requirements of the DOT/IATA, the overnight courier, and the destination laboratory will be evaluated, and the procedures will be detailed in the Site-Specific Plan in advance of instituting any field sampling events.

For samples that will be hand-carried to the laboratory for analysis or delivered by laboratory courier, elaborate packaging is not required so long as the samples are adequately protected from breakage and sample temperature is maintained. Custody seals also are not required if a direct transfer of sample custody from the sample collection team member to laboratory receiving personnel occurs and is documented on the COC form. From the point of sample collection in the field through storage, inventory, preparation, and shipment, the samples must remain sealed, protected from sources of contamination, and adequately preserved by chilling.

### 5.1.7 Sample Custody Procedures

Sample possession during sampling efforts must be traceable from the time of collection until the results are verified and reported. The sample custody procedures provide a mechanism for documentation of information related to sample collection and handling to achieve this objective. The sample handling procedures, sample custody practices, and analytical holding times are also discussed in Section A4.0 of the QAP.

#### 5.1.7.1 *Field Custody Procedures*

The sampling team, sample coordinator, and site manager will maintain overall responsibility for the care and custody of the samples collected until they are transferred or properly dispatched to the on-site screening facility and/or fixed-base laboratory. Shipping or sample transfer information will be recorded on COC form(s) (Attachment 2).

Transfer of custody and shipping procedures are as follows:

- Before sampling begins, the field coordinator will instruct site personnel in the proper COC procedures.
- The quantity and types of samples and sample locations are presented along with the rationale in the Site-Specific Plan. Any special shipping, handling and/or custody requirements will also be outlined in the Site-Specific Plans.
- COC records initiated in the field will be placed in a plastic bag and taped to the underside of the top of the shipping container used for sample transport.
- A COC entry will be made in the field for each sample. This document will accompany the samples in shipment, and a copy will be maintained at the site for placement in the project files at the conclusion of field activities. The custody of individual sample containers will be documented by recording each sample number on the appropriate COC form.
- Each time responsibility for custody of the sample changes, the new custodian will sign and date the record. This does not include overnight courier personnel whenever samples are shipped in coolers that have been sealed with signed custody seals.
- Coolers must be secured at the site with custody seals prior to transport. Custody seals should be signed and dated by the person relinquishing custody of the samples being shipped. They should be placed on each container so that the container cannot be opened without breaking the seal.Shipping containers should be secured using plastic wrapping tape or duct tape and custody seals to ensure that samples are not disturbed during transport.

#### 5.1.7.2 *Transfer of Custody and Shipment*

Before the sampling personnel have completed the necessary shipping papers and consigned samples to a commercial carrier, the sample coordinator will notify the laboratory by telephone or fax of the outgoing shipment. The number of samples, types of analyses, and special QC requirements will be discussed as they relate to the shipment. If the samples are to be transported by sampling personnel or laboratory courier, pickup is arranged, the estimated time of arrival at the laboratory should be verified. No samples will be accepted or logged in by the receiving laboratory personnel unless they are properly labeled and sealed.

General custody of the sample will be maintained by the sample collection team members from the time of collection in the field through preparation and shipment to the laboratory. The main custody transfer will occur when the sample shipment is received into the laboratory from the field and is documented. The COC form records custody in a series of signature spaces provided at the bottom of each form cover page. The transfer of sample custody is initiated by a member of the sample team who signs the chain of custody in the first "Relinquished by" space on the form and records the date and time of his signature. Custody is then accepted by the receiving laboratory technician, either in person or after shipment, by his signature in the corresponding "Received by" space on the form, along with the date and time of his signature. During sample shipment, if shipped under custody and the custody seals are intact upon laboratory receipt, custody is considered to be adequately transferred and laboratory internal custody procedures are then in affect after receipt. Copies of completed and signed COC forms are returned from the laboratory as part of the data deliverable package and filed with the corresponding set of analytical data.

#### 5.1.7.3 *Laboratory Receipt and Entry of Samples*

Upon receipt in the laboratory, the laboratory sample receipt personnel will open the shipping container(s), measure and record the cooler temperature compare the identity of the samples received with those listed on the COC forms, and sign and date the COC form to acknowledge custody transfer. Laboratory personnel will also verify and record the overnight carrier and waybill number on the original COC. The laboratory personnel will then assign laboratory sample numbers to the samples as per their internal procedures, and will complete the coding process.

Any missing, broken, or unlabeled samples will be noted on the COC, and a laboratory nonconformance report form will be prepared to document the condition and identify the affected samples. This report will be distributed to the laboratory project manager (PM) and the field sample coordinator. Additional project personnel will be contacted as needed to assist in making an assessment of the situation and formulating a decision to correct the nonconformance. The results of the assessment and corrective actions taken will be documented by the receiving laboratory. A copy of the report form will be attached to the signed COC form and included in the data deliverable package.

#### 5.1.7.4 *Pre-analysis Storage*

After receipt, samples will be placed into storage that will be adequate to prevent damage, loss, contamination, or unacceptable deterioration. Storage methods will consider the following:

- Analysis type (e.g., chemical and/or geotechnical methods)
- Sample media
- High, low, or trace level contamination anticipated
- Requested analysis program.

Samples will not be subjected to excessive moisture, large temperature variations, excessive light, or freezing, unless required by the method (e.g., Encores® samplers for VOC analysis). Ideally, a refrigerated, secure sample storage unit in the laboratory will be designated to provide a controlled environment for the sample from receipt through analysis. If a sample is stored in a different container from that in which it was received, as is the case with solvent extracts or acid digestates, the original sample identification or internal laboratory tracking identification will be transferred to new supplemental containers. Laboratory sample storage and internal custody will be the responsibility of the manager of contracted laboratory.

#### 5.1.7.5 *Post-analysis Storage*

In general, samples not completely consumed during testing will be kept until completion of the analysis and data reporting, unless otherwise specified by MDA. The testing laboratory will then either properly dispose of the samples by approved waste removal methods or return the samples to the site for disposal.

## 5.2 Quality Assurance/Quality Control Sampling

As established by the DQO process, certain field and laboratory QA/QC indicator samples and analyses will be planned to support the task objectives. These samples and analyses will yield critical information concerning the measured quality and usability of the field sample data. Measured quality indicators will include precision, accuracy, and representativeness. Types of field QC samples collected during a task may include: field duplicates, matrix spike/matrix spike duplicate (MS/MSD) aliquots, and blank samples. Section A6.3 of the QAP discusses these QC sample types in detail. The type and frequency of these QC samples for each investigation will be specified in the Site-Specific Plan.

Consideration will be given during planning to the types of media sampled, the analysis program, the expected duration of the task, and the number of sample shipments or events. Table 5-1 outlines the types of QC samples and the expected frequency.

When these QC samples are specified in the Site-Specific Plans to be collected, the field investigation personnel will review the requirements of the plan, and select the sites where these samples will be collected to meet the planned frequency. The selected sites may be chosen randomly, every tenth sample for example, or may be selected based on historical data or field indications of the potential contamination present. It is recommended that field duplicate sample locations be selected based on the probability that the samples will contain moderate to high concentrations of the targeted analytes so that the resulting analytical data will be able to yield a valid precision estimate. Equipment rinsate blanks, if required, are recommended to be collected after the expected highest concentration location has been sampled to assess cross contamination under the most likely conditions. A representative location of the matrix sampled will be selected for the MS/MSDs and should contain relatively low concentrations of the site contaminants so that the laboratory applied spikes can be recovered and quantified. The specific location where the field QC sample is collected is always recorded on the sample collection log by the sampling technician during collection. Allowing the field personnel to select the location aids in meeting selection criteria and prompts the field personnel to collect the additional sample volume necessary to perform the multiple analyses specified. The analyte-free water used during field sampling will either be deionized (DI) and organic-free water prepared to EPA standards using an on-site water filtration system or be purchased certified as analyte-free. Daily inspection and quarterly maintenance of the DI water system will be performed to ensure analyte-free water is being produced. Samples from an on-site system will be collected at least annually and submitted for laboratory analysis, as discussed in Section 5.2.5.

**Table 5-1. Suggested Field QC Sample Types, Matrix, and Frequency**

| **QC Sample Type** | **QA Sample Matrix** | **Applicable Field Sample Matrix** | **Analysis Program** | Frequency |
|---|---|---|---|---|
| QA Split Samples | Same as the field sample matrix | All | Same as the corresponding field sample | 1 in 20 (5%) or as specified in Site-Specific Plans |
| MS/MSD | Same as the field sample matrix | All | Organic compounds, metals, and ion chromatography parameters | 1 in 20 (5%) or as specified in Site-Specific Plans |
| Trip Blanks(') | Water | Water | VOCs only | 1 per shipment or ice chest that contains aqueous VOA vials |
| Equipment Rinse Blanks | Water | All | Same as the corresponding field sample | At least once per week |
| Material Blank | Varies(') | All | Same as the corresponding field sample | As specified in Site-Specific Plans (or annually for the DI water filtration system) |

**Notes:**

,'Trip blanks are required only if water matrix samples for VOC analysis are collected.

[b] Material blank samples will consist of an unused or unexposed sample of the media used to collect the sample (e.g., the source water or chemical reagent source) and, therefore, may be of any media.

| | | | |
|---|---|---|---|
| DI | Deionized | MS/MSD | Matrix spike/matrix spike duplicate |
| QA | Quality assurance. | QC | Quality control. |
| VOA | Volatile organic analysis. | VOC | Volatile organic compound. |

The information in the following sections defines and describes how QC samples will be collected, identified, and documented. Field QC samples will be given unique station names except for MS/MSD aliquots.

## 5.2.1 Field Duplicates

Field duplicate samples are a second sample(s) collected at the same location as the original sample. Duplicates are shipped to the same analytical laboratory as the original field sample. Field duplicates are used to assess analytical reproducibility (precision). Duplicate samples will be collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. For duplicate samples, the sample containers will be assigned a unique identification number in the field such that they cannot be identified (as much as possible) as duplicate samples by the laboratory personnel performing the analysis. The original field sample and field duplicate aliquots will be sent to the contractor laboratory. Both the original and duplicate sets of samples will be analyzed for the same parameter by the same analysis methods.

Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection. The Site-Specific Plan will specify the field duplicate sample frequency (duplicates are typically 10 percent), applicable matrices, and analytical parameters.

### 5.2.2 Matrix Spike and Matrix Spike Duplicate Samples

An MS is an aliquot of sample that is spiked with known concentrations of specified analytes of interest. The spiking occurs prior to sample preparation and analysis. An MS is used to measure accuracy by determining analytical bias of the method given the sample matrix analyzed. An MSD is an intra-laboratory split sample spiked with the same concentrations of target analytes as the MS. Results of the MSD are used to evaluate the precision of the accuracy assessment given the matrix analyzed. In the laboratory, often the results of MS/MSDs are compared to spikes prepared on blank matrices to assess accuracy on the actual sample method matrix. An MS/MSD pair will be collected for every 20 environmental samples collected for each matrix sampled. In the field, separate aliquots of the same sample are collected and submitted to the laboratory in separate sets of sample containers for the original sample, the MS, and the MSD. MS/MSD analyses will be conducted using the samples designated as such by the field team. MS/MSDs will be requested for analytical parameters required for the original sample as applicable. For analyses where MS/MSDs are not appropriate (e.g., pH, total suspended solids, total dissolved solids, etc.), laboratory duplicates may be performed.

### 5.2.3 Trip Blanks

Trip blanks measure possible contamination of the field samples due to handling and storage. The trip blank consists of VOA sample vials that have been filled in the laboratory with ASTM Type II reagent-grade water (or an equivalent) and preserved with hydrochloric acid. These blanks are transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. They are provided by the laboratory to the sampling team. Trip blanks are not opened in the field but are labeled and handled with the field samples. Trip blanks are required only when water matrix samples for VOC analysis are collected. One trip blank set will accompany coolers that contain water matrix samples for VOC analysis for shipment.

### 5.2.4 Temperature Blanks

Temperature blanks will be provided by the laboratory for more accurate measurement of cooler temperatures taken upon receipt at the laboratory. A temperature blank, which consists of a reusable, labeled sample container filled with potable water, will accompany each cooler shipped to the laboratory. The temperature of the water measured from the temperature blank will be considered indicative of the cooler temperature and, subsequently, the samples it contains.

### 5.2.5 Material Blanks

A material blank sample is defined for the purpose of this SAP as a sample of a "clean" reagent source such as a DI water, a chemical reagent source, or a sampling medium such as air filter or sorbent cartridge that would represent "analyte-free" or "background" contamination. If material blanks show elevated concentrations of target analytes, the corresponding data set may be considered biased and corrective action implemented to eliminate this bias source.

Material blank samples are collected from the analyte-free DI water used for decontamination purposes to certify this source as analyte-free.

For sites utilizing passive diffusion bag (PDB) samplers, the material blank consists of a PDB blank filled with ASTM I DI water by the PDB manufacturer. This material blank will be transferred to appropriate VOA vials at the conclusion of the sampling event, and included with the other water samples in the cooler to be transported to the designated laboratory. This material blank will be analyzed for the same parameters as the associated samples. Further information about PDB sampling is included in the SOPs (Attachment 3).

### 5.2.6 Equipment Rinsate Blank Samples

To determine the representativeness of the field sampling data, equipment rinsate blank samples will be collected during investigation and monitoring events to verify the effectiveness of sampling equipment decontamination and to monitor the potential for cross-contamination between samples. Equipment rinsate blanks are collected from the final analyte-free DI water rinse of the equipment decontamination process for reusable sampling equipment. Once a piece of sampling equipment is fully decontaminated, analyte-free water is poured over, across, and through sample collection surfaces and the water is directly collected into appropriate water matrix sample containers. Equipment rinsate samples are collected at a frequency of at least once per week. This frequency may be reduced depending on the type and amount of sampling performed. Equipment rinsate blanks are generally analyzed for the same parameters as the associated samples. To maximize the effectiveness of this blank check, it is recommended that if historical data are available, the equipment rinsate blank be collected immediately after the decontamination of equipment used to collect the potentially highest concentration samples. If dedicated or disposable sampling equipment is used for each sampling event, rinsate blanks are not required.

## 5.3 Field Measured Parameters

### 5.3.1 Temperature, pH, ORP, Dissolved Oxygen, Turbidity and Conductivity Measurements

Water quality measurements consisting of temperature, pH, ORP, dissolved oxygen, turbidity, conductivity  will be taken during site activities. Conductivity, pH, dissolved oxygen, turbidity, and temperature measurements will be taken using a water quality meter such as the Horiba U-22 or equivalent.  Measurements will be made in the field according to instrument manufacturer's recommendations. Calibration procedures are summarized in Section 5.4. The instrument will be checked and calibrated once at the start of each day using standard calibration solutions as recommended by the manufacturer. Calibration records will be documented in the field logbook. In the event that an instrument fails a calibration or calibration check, the device will be tagged as out of service, repaired in the field, or returned to the manufacturer for repair.

Manufacturer's guidelines will be followed when collecting water quality parameters. During collection of the water sample for water quality parameters, care should be taken to not agitate the sample. Data are recorded on the appropriate form (Attachment 2) and the bound logbook.

### 5.3.2 Gas, Organic Vapor Monitoring

A calibrated OVM-PID such as the MiniRAE 2000 (or equivalent) or OVM-FID such as the Photovac Microfid Detector (or equivalent) will be used to monitor the drilling and sampling locations and worker breathing zones to screen for the presence of organic vapors. Screening results will be used to select samples for laboratory analysis and for safety and health purposes as per the HASP. Original calibrations to the manufacturers' specifications are performed by the instrument supplier. Daily calibration checks are performed by onsite safety and health personnel. For the OVM-PID, a certified isobutylene standard of 100 ppm (in air) is used in accordance with manufacturer's instructions. The acceptable tolerance range for the calibration check of the OVM-PID is 98 to 102 ppm (±2%). For the OVM-FID, a certified methane standard of 500 ppm (in air) is used in accordance with manufacturer's instructions. The acceptable tolerance range for the calibration check of the OVM-FID is 490 to 510 ppm (±2%).

If appropriate, a combustible gas indicator (CGI) shall be used at specific work sites to monitor the possible presence of explosive gas as discussed in the HASP. This type of instrument is used to monitor worker breathing zones at drilling and sampling locations to determine the presence of any combustible vapors or atmospheres or potential oxygen displacement for safety and health purposes as per the HASP. When in use, daily calibration of this instrument is performed by the onsite safety and health personnel in accordance with manufacturer's instructions using a gas mixture of 58% LEL (pentane), 15% 02, and 60 ppm CO. The acceptable tolerance range for the calibration check of this instrument is 56 to 60% LEL, 14.5 to 16.0% 02, and 58.5 to 61.5 ppm CO. In addition to the CGI instrument, safety and health personnel also use real-time dust monitors such as the MIE PDR-1000AN (or equivalent). This type of instrument is used to monitor worker breathing zones at drilling and sampling locations to determine dust and particulate levels for safety and health purposes as per the HASP.

## 5.4 Field Calibration Procedures and Frequency

### 5.4.1 Field Calibration Procedures

Field equipment calibration will follow the protocols given in Table 5-2, including calibration criteria and frequencies.

Field testing and monitoring equipment will be inspected and calibrated against standards before use. Testing and monitoring equipment includes OVM-PID/FID instruments for monitoring soil vapor, combination pH/temperature/specific conductivity meters, and ORP, turbidity, and dissolved oxygen meters. Standards for these instruments will be kept on site and in good condition.

The date, time, and results will be noted in an Instrument Calibration Log (Attachment 2) and in the field logbook. If an instrument is out of calibration, it will be recalibrated and noted in the log. Calibrated equipment will be uniquely identified using the manufacturer's serial number or other unique identification.

Equipment that fails calibration or becomes inoperable during use will be removed from service and separated from serviceable equipment to prevent inadvertent use. Such equipment will be repaired and recalibrated or replaced as appropriate. Equipment that has failed calibration will be tagged as out of service, a notation will be made on the instrument's maintenance log. The instrument will not be used until it has been repaired, recalibrated, or replaced.

### 5.4.2 Field Calibration and Maintenance Records

Equipment to be used during the field sampling will be examined upon receipt and at the beginning of each day the equipment will be verified that it is in operating condition. This examination includes checking the manufacturer's operating manuals and instrument instructions to ensure that maintenance items are being observed. The instrument's maintenance log and previous calibration logs (if available) will be reviewed to ensure that any prior equipment problems have been remedied.

Field calibration logs will be kept for instruments that are used during fieldwork and will be documented in field logbooks. These logs will document:

- Type and identification number of instrument
- Calibration frequency and acceptable tolerances
- Identification of individual(s) and/or organizations performing the calibration
- Reference standards, including sources and lot numbers used for each calibration
- Calibration data.

## Table 5-2. Equipment Maintenance and Calibration Protocols

| Equipment | Calibration | Frequency' | Acceptance Criteria |
|---|---|---|---|
| Dissolved Oxygen Meter | In accordance with manufacturer's instructions | Start and end of each day | ± 0.2 mg/L |
| Temperature | Check against an NBS thermometer (record value) | Start and end of each day | ± 0.5°C |
| Specific Conductance | Calibrate with one calibration solution | Start and end of each day | ± 3% of full scale |
| ORP Meter | In accordance with manufacturer's instructions | Start and end of each day | ± 15 mV |
| PH Meter | Calibrate with two pH buffer solutions | Start and end of each day | ± 0.1 units |
| Turbidity Meter | Blank and 3-point standard set | Start and end of each day | ±5% |
| OVM-PID | Isobutylene 100 ppm in air | Start and end of each day | ±2% |
| OVM-FID | Methane 500 ppm in air | Start and end of each day | ±2% |
| CGI/LEL/$O_2$/CO Meter | Pentane 58% LEL, 15% $0_{2i}$ 60ppm CO | Start and end of each day | 56-60% LEL 14.5-16%$0_2$ 58.5-61.5 ppm CO |
| Dust Monitor | Zero Bag Calibration | Daily | Zero |
| Rechargeable Equipment | Charge | After use, as required- | -- |
| Sampling Accessories (tubing, submersible pumps) | Periodic maintenance performed and recorded in equipment maintenance log | As required | -- |

**Note:**

Calibration information shall be documented using calibration forms or logbooks.

[a] Assumes instrument is used daily.

| | | | |
|---|---|---|---|
| °C | Degrees Celsius | NBS | National Bureau Standards |
| CGI | Combustible gas indicator | $O_2$ | Oxygen |
| CO | Carbon monoxide | ORP | Oxidation-Reduction Potential |
| mg/L | Milligrams per liter | OVM-FID | Organic vapor meter-flame ionization detector |
| Mv | Millivolts | ppm | Part per million |

## 5.5 Prevention of Cross-Contamination

Drilling and sampling equipment decontamination will be performed at a temporary or fixed decontamination pad to maintain integrity of the environmental samples collected. If a temporary decontamination pad is constructed, the area will be covered and protected using high density polyethylene sheeting. Containment measures will be taken to prevent any contamination from reaching adjacent areas. In addition, the decontamination pad will be constructed so that the drill rigs can be driven onto the pad for decontamination and so that decontamination water can be collected into a sump, pit, or appropriate portable containers (tanks). General procedures for decontamination of nonsampling and sampling equipment are described in the following sections.

To ensure sample integrity, new unpowdered latex or nitrile surgical-type gloves will be used during sampling and related activities. The following guidelines will be employed when using these gloves (EPA, 1997):

- New gloves shall be worn at each sampling location and replaced with clean gloves immediately before sample collection.
- If the gloves become torn, they should be replaced immediately.
- If there is any possibility that the gloves have been contaminated from any source other than the sample (i.e., tape, fuel, insect repellant), they should be considered contaminated and replaced.

### 5.5.1 Decontamination Requirements

One purpose for defining an equipment decontamination procedure is to ensure adequate steps are taken to remove residual chemical contamination before the equipment is used to collect a sample for environmental analysis. Decontamination procedures are also important in reducing the risk of cross-contamination and worker exposure when removing contaminated nonsampling equipment from a contaminated area, as discussed in the Site-Specific Plans and the HASP. Different levels of decontamination stringency are applied for the different types of equipment used. For sampling  equipment used to collect environmental samples, the most stringent program will be required, and it is this program that is the focus of this discussion. For sampling equipment used to collect samples for geotechnical analysis or soil classification and general non-sampling equipment, a simple soap and water rinse or a high-pressure steam cleaning with soap and water should be sufficient to remove contamination. specific health and safety requirements are imposed that require a further level of decontamination for grossly contaminated equipment, additional decontamination steps may be required. Usually in both cases, an area of the site will be designated as the decontamination area and decontamination supplies, water, and decontamination solvents will be staged in the area for use.

Field instruments, such as water level meters and pH and temperature probes that come in direct contact with the sample matrix, will be decontaminated between measurements by detergent solution wash, DI water rinsing, wiping, and final rinsing with DI water. Grossly contaminated or stained probes can be cleaned by dipping the probe momentarily in strong acids such as a 70 percent hydrochloric acid solution. Electrometric probes will be stored between use in a clean environment in the manner specified by the manufacturer. Generally, decontaminated water level meters will be stored in their original shipping case.

#### 5.5.1.1 *Sampling Equipment*

To minimize the possible contribution of even trace levels of contamination from sampling equipment, adequate equipment decontamination must be completed prior to the first use of the equipment (if new) or reuse at a different sampling location. The decontamination procedure may vary depending on the sample matrix, the analytical program, or the materials or construction of the sampling equipment used; therefore, Site-Specific Plan should address the specific decontamination procedures. The following general guidelines will be followed:

- Post-Sample Collection Cleanup. After the required samples have been properly prepared at a given sampling location, residual visible soil will be removed as much as possible from the sampling equipment by scraping or shaking. These residues will be handled as IDW. For water sampling equipment, residual water should be drained and placed into a waste container (i.e., groundwater purge water tanks) and handled as IDW.

- Gross Wash and Water Rinse. Sampling equipment will be transported to the decontamination area. There it will undergo a vigorous brushing with laboratory-grade, phosphate-free detergent in water and will then be rinsed with tap water to remove visible particulate.

- Acid Rinse. If glass equipment are part of the analysis program, rinse the interior and exterior surfaces of the glass equipment that will come in contact with the sample matrix with 10 percent nitric acid solution.

- Isopropyl Alcohol Rinse. If soil or sediment samples are collected, rinse interior and exterior surfaces with pesticide-grade isopropyl alcohol. Decontamination personnel must take precautions not to expose any groundwater or surface water sampling equipment to isopropyl alcohol.

- Analyte-Free Water Rinse. Rinse the equipment with analyte-free DI water. The water used should be certified as analyte-free by the manufacturer and prepared using filters, an activated carbon bed filtration apparatus, and deionizing resin columns. Water that has been field or laboratory prepared using this equipment and has been sampled, analyzed for target parameters, and verified to contain less than detectable quantities may also be used. For water sources, verify that the same lot or batch that has been documented as analyte-free is consistently used or that documentation exists for multiple lots. Analyte-free water will be delivered using labeled laboratory-grade Teflon® spray/squirt bottle(s).

- Protective Wrap. Prepare decontaminated equipment for storage by draining residual DI water from the equipment, then allowing equipment to air dry (if possible) or towel dry. If the equipment is not immediately reused, the sampling surfaces will be wrapped in a layer of aluminum foil (if applicable) and stored in a designated storage location, free from sources of contamination. Seal the foil wrapped equipment in plastic and label.

When sampling equipment is used to collect samples that contain high concentration organic compounds, oil, grease, or other hard to remove materials, it may be necessary to rinse the equipment several times with pesticide-grade acetone, hexane, or petroleum ether to remove the materials before proceeding with the soap and water wash. If acetone, hexane, or petroleum ether is used, special precautions will be taken to segregate that rinsate waste from regular decontamination fluids for disposal purposes. In extreme cases, it may be necessary to steam-clean the field equipment before washing. If the field equipment cannot be adequately cleaned using these procedures, it should be discarded and possibly substituted with equipment constructed from a more resistant material.

Pumps will be cleaned prior to use and between each monitoring well, and between mobilizations from site to site. The following procedures will be used for pump decontamination:

1. Pump a sufficient amount of detergent solution through the hose to flush out any residual groundwater.
2. Using a brush, scrub the exterior of the contaminated hose (to the length placed into the well) and pump with detergent solution. Rinse the soap from the outside of the hose with tap water. Rinse the hose with analyte-free water and recoil onto the spool.
3. Pump a sufficient amount of tap water through the hose to flush out detergent solution (approximately two gallons).
4. Pump a sufficient amount of analyte-free water through the hose to flush out the tap water (purge the line with the pump in the reverse mode, if possible).
5. Rinse the outside of the pump housing and hose with analyte-free water(approximately 2 gallons).
6. Place pump and reel (if possible) in clean plastic bag. If the pump is placed in storage, identify using a label that the pump is decontaminated and ready for reuse.

#### 5.5.1.2 *Non-sampling Equipment*

Equipment that may contact the interior of a boring or that may contact other equipment that will enter the boring (including, but not limited to, drill rods, bits, and tools) shall be thoroughly cleaned at the decontamination pad by using non-phosphate detergent and steam- or high pressure hot water from a steam cleaner prior to setting up on the first hole, between each hole, and following drilling of the final hole. No tools or drilling equipment may contact the ground or become contaminated after cleaning until used in drilling. If ground contact or contamination occurs, contaminated items shall again be cleaned before use in the previously specified manner. At the drill site, cleaned equipment shall be stored on cleaned metal racks or on clean polyethylene sheeting. The drilling rig shall be cleaned between drilling each monitoring well and prior to mobilization to each new site.

In addition to these requirements, non-sampling equipment used at a chemical agent site will be decontaminated with bleach and potable water rinse prior to a steam rinse in the event that the presence of chemical agents is detected by site screening during field activities.

### 5.5.2 Decontamination Supplies

The following decontamination supply list will generally be required for most sites during field operations:

- Laboratory-grade nonphosphate detergent
- Potable water source
- Analyte-free DI water
- 10 percent Nitric acid rinse solution (if needed)
- Pesticide-grade isopropyl alcohol (only for dry equipment, if needed)
- Hexane, acetone, or petroleum ether (only for dry equipment, if needed)
- Plastic sheeting
- Aluminum foil
- Teflon® squirt bottles (to contain analyte-free DI water for rinsing equipment)
- Stainless-steel sprayers (to contain potable water)
- Wash tubs or buckets
- Scrub brushes.

## 5.6 Field Operations Documentation

### 5.6.1 Logbooks

The details of the daily activities that were performed by technicians, geologists, and other personnel will be manually recorded in bound field logbooks. Several series of logbooks will be kept during the McClellan field activities. A logbook series will correspond to each type of general field activity. These activities will include (but are not limited to): soil sampling, groundwater sampling, surface water/sediment sampling, drilling and well installation, well development, surveying, MEC support, site remediation activities, and geophysics. Specific personnel will be responsible for completing the logbook on a daily basis depending on their role and the activity in which they are participating.

Logbook entries are real-time records and efforts will be made to keep logbook information current (i.e., entries will be made at a minimum frequency of every 15 to 20 minutes during the day). The level of detail required for logbook entries should be sufficient to accurately recreate the events that occurred and include pertinent facts. Information recorded will be adequate to reconstruct the progress of the described operation and include the problems encountered and discuss any deviations from approved procedures.

The following are other general requirements of logbook entries:

- Logbook entries will be legible.
- Strikeouts will be one line through the word or item, followed by initials and the date of the strikeout.
- Each page in the logbook will be numbered and dated.
- The relevant project number and parcel identification will be included on each page.
- Each logbook entry will be preceded by a notation of the current time in 24-hour(military) format.
- At the end of a particular event or at the conclusion of each day, the person maintaining the logbook will draw a diagonal line and initial and date indicating the conclusion of the entry for the event or the day.
- Since field records are the basis for later written reports, language should be objective and factual. Personal interpretations or other terminology which might prove inaccurate will not be recorded.
- The logbook will be kept by the same person throughout the day in order to maintain consistency and eliminate confusion about who is recording the information. If the logbook does change hands from one person to another during the day's activities, a note of the personnel involved and the time of the change will be recorded in the logbook.
- Signatures of the person keeping the logbook are required at the bottom of each daily logbook entry.

The following lists the information that is generally included in the logbook:

- Name and title of person maintaining the logbook.
- Purpose of site visit or sampling activity.
- A brief description of the weather will be recorded at the beginning of each workday and any significant weather changes that occur throughout the day.
- A list of people at each site including MDA, Contractor personnel, subcontractors, drill crew members, oversight, other site visitors. This list will include the name and organization name of each person.
- Note in the field logbook that the daily tailgate health & safety meeting was conducted and any major topics that were discussed.
- Calibration of field instrumentation: Note in the field logbook the *serial number(s)*of each piece of equipment used for each day. Make note of any instrument calibration, the calibration requirements (i.e., *"equipment was calibrated in accordance with the manufacturer's specifications')* and record the location of the calibration records.
- Samples collected, method of collection, and related handling situations such as filtration, decanting, and preservatives as well as visual observations.

- Types of equipment used including sample collection equipment with serial number or other unique identification.
- Calculations and results for field analytical and field physical measurement equipment.
- Sample location identification and a unique sample number where appropriate.
- Sample numbers, volumes, and containers (number, size and type) used for each sample collected. Note the date and time of each sample, identify any associated QC samples (field splits, field duplicates, etc.) or any factors that may affect quality. Specifically:
  - Description of the sample.
  - Who collected the sample.
  - How the sample was collected.
  - Diagrams of processes (if applicable).
  - Maps/sketches of sampling locations (as appropriate).

- The condition of the equipment to be used at each location and any decontamination procedures used for sampling and non-sampling equipment with each use of the equipment.
- IDW information such as volumes, storage containers, and disposal procedures.

Once daily activities are completed, the corresponding logbook pages are copied and included with the appropriate documentation (such as the sample collection forms, well development logs, etc.). Completed field logbooks are project accountable documents and must be maintained as part of the central files.

### 5.6.2 Variances and Nonconformances

#### 5.6.2.1 *Variances*

Changes (variances) to this SAP and the Site-Specific Plan may be initiated either in the field or in the office as necessary. Variances will be noted in the logbook by the person that identifies the need for a variance. It will be formally documented using a Variance Log (Attachment 2). Variances will be approved by the MDA quality assurance officer (QAO) and the PM prior to implementation of the change. Variances that affect the project scope, cost, or schedule must be approved by the MDA before being implemented.

#### 5.6.2.2 *Nonconformances*

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner. A nonconformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate. The originator of a Nonconformance Log (Attachment 2) will describe the nonconformance on the form provided for this purpose and will notify the MDA QAO and PM. Each nonconformance will be reviewed and a corrective action determined for the nonconforming item, activity, or condition. The disposition of a non-conformance will be documented and approved by involved project personnel. The QAO will concur with the disposition of the non-conformance.

The project chemist and data validation staff are responsible for assessing QC sample information. For laboratory data, the subcontractor laboratory project manager will be responsible for identifying and summarizing data that do not meet the laboratory QC goals. The Contractor project chemist will be notified on an ongoing basis whenever laboratory nonconformance issues arise that will impact data quality or usability. The Contractor project chemist will consult the necessary project and task management personnel and a decision will be made concerning the nonconforming event or item, taking of the project objectives into account. The contractor laboratory project manager will be responsible for documenting the event and its resolution in the case narrative section of the impacted analytical data package(s). The procedures for laboratory non-conformances are discussed in more detail in the QAP.

The modification, repair, rework, or replacement of nonconforming equipment, items, or activities will require the re-verification of acceptability. In certain instances, as determined by the MDA QAO or PM, these actions may require that corrective action be completed and verified before site work continues.

The equipment, item, or activity that has the deficiency may be temporarily stopped while the nonconformance is being investigated. If, in the opinion of the MDA QAO and the PM, the nonconformance does not significantly affect the technical quality or use of the work, the work may continue pending resolution of the nonconformance. The basis for such decisions will be documented on the Nonconformance Report and submitted to the QAO for review and approval. The documentation will state that the decision was made prior to continuing with the work. The records of nonconformance and their dispositions in the form of completed nonconformance report forms will be kept in the project central files.

In addition, the Contractor PM will notify the MDA PM of significant nonconformances that could impact the task schedule or the scope and will indicate the corrective action taken or planned.

### 5.6.3 Site Photographs

Photographs are an accurate and convenient record of observations. Keeping a record of photographs taken is crucial to establishing their validity as a representation of a situation and understanding the content of the photograph. For each photo taken, the following items should be noted in the field logbook, as well as the Photographic Field Log (Attachment 2):

- Date
- Time
- Name of the photographer
- Name of site
- General direction faced
- A brief, but accurate description of what the photograph shows, including the name of the facility or site and the location

- Sequential number of the photograph taken and the roll number (when applicable)
- Reference point or reference scale (if appropriate)
- Site photo map/sketch.

#### 5.6.3.1 *Digital Photography*

Digital photos offer significant advantages over traditional film-based photography especially in the ability to name, organize, and share the images. As such, digital photography will be performed whenever possible at McClellan. Digital photos will be downloaded from the camera storage media onto a computer for electronic filing as soon as possible. When the pictures are downloaded to the designated computer, the picture file name may be renamed to be more descriptive of the photograph's content. An effort will be made to organize the photographs into meaningful subdirectories (i.e., by parcel or by activity) and keep the sequential number of the photograph as part of the file name. Digital photos will routinely be stored to compact disk, or other similar media, and archived in the MDA project files.

#### 5.6.3.2 *Film Photography*

When film-based photographs are used, the prints will be developed in duplicate and the back of each print will be labeled with the pertinent information about the content of the image. One set of prints will be archived onsite and the original will be sent to the MDA project files along with the original negative.

## 5.7 Handling and Disposal of IDW

This SAP has been developed to address field sampling procedures and activities to be conducted at McClellan. During these field activities, various types of solid and liquid IDW will be generated.

The IDWMP (Appendix C) summarizes the specific IDW handling, testing, and disposal procedures.

## 5.8 Field Screening Methodologies

### 5.8.1 Laboratory Analysis

#### 5.8.1.1 *On-Site Laboratory Analysis*

Some investigations may utilize analysis in an on-site laboratory to provide fast turnaround for soil and water samples. As dictated by the site contaminants of concern, this analysis is sometimes performed onsite with a field instrument such as a portable gas chromatograph (GC) or X-ray fluorescence (XRF) instrument. On-site laboratory analysis is used to produce data on a real-time basis so same-day interpretation in the field is possible. Additional sample points may be located or deeper depths sampled as determined from the interpretation to further characterize the site. Knowing the objective of the investigation, the task manager can plan DQOs for on-site analysis to meet either "definitive" or "field screening" data quality levels. These DQOs in turn would then be applied to the investigation by the on-site analyst, who would be responsible for implementing and documenting the corresponding QA/QC program. An analysis program would include the use of standard methods such as those from the EPA or ASTM, with as few modifications as possible. The analyses as implemented should follow method guidance for the following procedures:

- Initial and continuing calibrations, including the establishment of reporting units and method detection limits
- Method blanks
- Surrogate spiking and recovery calculation (where applicable)
- Blank spike analysis (where applicable)
- Sample matrix spiking and recovery calculation
- Sample calculations and quantification of results
- Data reporting.

Field analysis data generated by a direct-push subcontractor should be reported to the Contractor task leader on a daily basis. The report should provide raw data summaries that include the results of the field and QA/QC samples analyzed. Analytical methods and reporting limits, internal QC checks, and target precision and accuracy acceptance criteria for the common field GC methods will be developed prior to implementation and will be included in Site-Specific Plans. This way, the QA/QC indicators can be evaluated relative to these target goals and the results interpreted on an ongoing batch basis. The data that show suspect results can be flagged and reanalyzed or resampled as needed.

#### 5.8.1.2 *Off-Site Confirmation Analysis*

In addition to the method QC checks, the Site-Specific Plans will specify a frequency criterion for off-site confirmation analysis. To meet this frequency, field samples analyzed on site will have sufficient additional volume to perform off-site confirmation analysis (as appropriate). When the on-site data have been reviewed, the samples will be selected for confirmation, based on the absence or presence of contamination determined by the on-site laboratory. A mixture of both contaminated and uncontaminated samples should be sent for conformation. No sample aliquots for VOC analysis will be archived on site for longer than 7 days from collection (special circumstances apply when using EnCore samplers, these procedures are described below). Archived samples will be stored in a secure refrigerator on site that will be monitored for temperature compliance.

An interpretive final report of the investigation results will be provided that includes a thorough discussion of the QC program, its results, and the impact on data quality and usability.

When using EnCore samplers, the samplers should not be held onsite and should instead be immediately sent to the laboratory where they must be preserved per the sampling protocol.

### 5.8.2 Field Analysis Procedures

Field analysis procedures such as the analysis of groundwater or surface water samples for monitored physical parameters (temperature, pH, and conductivity) and use of an OVM-PID/FID to "field screen" headspace vapors of soil or water samples are commonly performed. A headspace screening procedure is provided in Section 5.8.3. These analysis data are recorded and documented as part of the logbook and any appropriate forms. Because the instruments used to perform such analyses are designed for field use and are relatively stable in fluctuating field environments, daily calibration checks should be a sufficient indicator of performance. Calibration checks are performed by the methods described in Section 5.4. These methods consist of a linearity check of the instrument reading while analyzing single point or multiple-point standards of known concentration or value. If the instrument reading is inconsistent with the reference value, the instrument calibration will be adjusted or the instrument will undergo maintenance or replacement, if warranted. Instrument calibration checks and maintenance activities are documented on project data forms and placed in the permanent field data record file.

***Test Kits.*** In addition to field meters, other methods or instruments, including field test kits such as those from HACH or immunoassay test kits may be used to generate on-site data. HACH test kits are usually specified in Site-Specific Plans to measure water quality parameters such as ferrous iron, sulfite, dissolved oxygen, or alkalinity. This occurs primarily where a field meter may not exist for the parameters of interest or off-site laboratory results may not provide the accuracy required. Immunoassay test kits are used to generate soil sample screening data for a variety of organic compounds and are semi-quantitative in nature. Both types of kits use chemical reagents and some type of quantification meter to analyze the tested sample aliquot. The kit manufacturer produces explicit step-by-step instructions that must be followed consistently by the field analyst. The project chemist will review the purpose of the kits and the procedures for analysis, and assist in the development of analysis-specific checklist forms that incorporate the manufacturer's procedures and any additional project-specific QC procedures. These forms would be developed during plan preparation and be incorporated with the example forms presented in the Site-Specific Plans. Text will be included in the Site-Specific Plans to address the off-site confirmation analysis strategy and include a frequency of analysis and sample selection criteria.

For HACH kits, duplicate analysis should be periodically performed to assess precision. Blank analysis and the analysis of check standards should be performed as applicable. The instrumentation used to complete the quantification should be calibrated daily or be checked daily against standards as required by the manufacturer. Results will be recorded on reporting forms that include the documentation of the QC checks performed. For immunoassay kits, duplicate analyses, blanks, and calibration checks shall be performed routinely at a frequency assigned in the Site-Specific Plans and documented on the appropriate predesigned result summary forms. Completed forms will be reviewed in the field by a peer or task leader and by the project chemist during report preparation, and discussed in the text of the final report.

If the analytical equipment or water quality meter(s) are inoperative or malfunctioning, then field analyses will cease and the data objectives reviewed with project personnel. If field screening measurements are considered noncritical, then field activities may continue until a replacement part or meter can be used. For critical measurements, data-gathering activities will cease until the test equipment or field meters are functioning properly.

### 5.8.3 Headspace Screening Analysis

Soil samples will be screened for VOCs using a OVM-PID/FID in accordance with the following procedure:

- Upon opening the split spoon, the sample shall be split in half lengthwise.
- The sampling technician will use a calibrated OVM-PID/FID to screen along the length of the split spoon by passing the instrument inlet tubing slowly from one direction to another.
- A sample of soil from each interval will be collected in a zip top bag and the headspace will be measured using the OVM-PID/FID
- The technician will not allow the soil to enter the OVM-PID/FID inlet tubing
- Any positive field readings will be documented along with the soil description on the sample collection log and in the logbook.

If the OVM-PID/FID is used on a day that has a high humidity or in an environment where the air has a high moisture content (in rain or in fog, e.g.), the meter may be susceptible to false elevated readings. The technician will make a note of observed field conditions in the sample logbook and on the sample collection logs.

### 5.8.4 X-Ray Fluorescence Analysis

In areas at McClellan where contamination from metals have been previously identified or suspected as site contaminants of concern, a portable XRF (such as the Niton or Spectrace instruments) may be used. The data generated is typically considered "field-screening" quality level. This instrument will be able to quantify the metals present by either direct in situ soil readings or from collected soil samples. In situ readings will be conducted directly on the surface of the soil using the XRF instrument probe. Soil samples will be collected from surface and subsurface locations by the procedures outlined in Section 5.1.1.1, and taken to an on-site laboratory for preparation and subsequent XRF analysis in accordance with the SOP (Attachment 3). Results from the on-site analysis will be augmented by an extensive QA/QC program. This includes sending at least 10 percent of field samples to an off-site laboratory for confirmatory metals analysis by EPA SW-846 Methods. At McClellan, XRF is not typically used to produce data for risk assessment or for site closure; however, the XRF will be used to identify where and when "definitive" data should be gathered (i.e., laboratory samples collected). The individual Site-Specific Plans will summarize the DQOs for XRF-based applications.

#### 5.8.4.1 *In Situ Measurements*

For sites utilizing the Niton XL3t XRF or equivalent, in situ analysis will be conducted in accordance with the SOP (Attachment 3). For samples analyzed in situ, all large or non-representative debris, such as rocks, pebbles, leaves, vegetation, roots, and concrete from the soil surface will be removed before analysis. The soil should be leveled to create a smooth surface to ensure the probe window makes good contact with the soil. This should be accomplished by using a stainless-steel trowel or like equipment. Prior to soil analysis, the soil should also be tamped to increase soil density and compactness. To protect the analysis window from damage, thin Mylar® film is placed on the measurement location in accordance with the *Field X-Ray Fluorescence Measurement, SESDPROC-107-R3*, (EPA, 2015). After the window is pressed to the Mylar® film, the window is opened for a programmed, nominal sixty seconds. Soils completely saturated with water or under water will not be analyzed via the in-situ method.

#### 5.8.4.2 *On-Site Laboratory Samples*

Surface and subsurface soil samples for on-site laboratory analysis will be collected using appropriate sampling equipment as described in Section 5.1.1.1. The sampling area will be cleared of vegetation, debris, or visible bullet residues (if present). The soil collected with the sampling device will then be transferred to a stainless-steel mixing bowl or disposable aluminum mixing tray and thoroughly homogenized. Stainless-steel spoons or disposable plastic or wooden spatulas will be used to mix the collected soil. Complete homogenization in the field is of utmost importance because it has been demonstrated that metals contamination varies extensively as a function of analyte distribution in the sample. Due to the possibility of Pyrex® glass breakage and subsequent sample loss and health and safety concerns, stainless-steel or aluminum mixing bowls are recommended for soil sample homogenization in the field. As the use of stainless-steel or aluminum may possibly impact the concentration of chromium and aluminum with a positive bias, on those sites where chromium and aluminum have been identified as a contaminant of concern, the Site-Specific Plans should address the issue. In addition, only bowls in good condition will be used.

Soil samples must be mixed as thoroughly as possible to ensure that the sample is as representative as possible of the sampled interval. The quartering mixing technique (Section 5.1.1.1) will be used whenever possible. The samples will be transferred as soon as possible upon collection to the XRF analyst for processing and analysis.

#### 5.8.4.3 *Calibration, Sample Preparation, and On-Site Analysis*

The portable XRF instrument that may be used at some sites is the Niton XL3t XRF or equivalent. It utilizes a high energy x-ray tube instead of the sealed radioactive sources used in other models. The unit uses an integrated USB and Bluetooth TM communications to provide direct data transfer to a PC or equivalent storage device, and improved electronics that help to increase instrument sensitivity and shorten the instrument time required to perform the analyses. Table 5-3 specifies the detection limits that are typically achievable in “blank” soil matricides (i.e., silica sand). The actual sample detection limits will be higher due to interferences present in a site soil matrix.

***Calibration.*** The XRF is factory-calibrated to pure element standards for the 25 elements detected. Calibration will be performed in accordance with procedures outlined by the manufacturer’s operating manual and SOPs (Attachment 3). A blank sample of quartz or silica dioxide sand should be analyzed at least at the start of each day. Additional check samples may also be analyzed during the course of the day and at the end of the day.

***Instrument Setup.*** The instrument will be shipped to the field for use by the XRF analyst. Upon receipt, the analyst will perform initial instrument calibration and performance checks necessary to ensure the instrument is functioning at its full sensitivity before sample analysis.

**Table 5-3. Typical Limits of Detection in Silica Sand Blank RCRA and Other Metals Detected by Niton XL3t Model 600 XRF**

| Metal | Average LOD (ppm) | Metal | Average LOD (ppm) | Metal | Average LOD (ppm) |
|---|---|---|---|---|---|
| Antimony | 30 | Iron | 75 | Selenium | 6 |
| Arsenic | 9 | Lead | 8 | Silver | 10 |
| Barium | 90 | Manganese | 55 | Tin | 20 |
| Cadmium | 10 | Mercury | 7 | Titanium | 100 |
| Chromium | 65 | Nickel | 50 | Zinc | 15 |
| Copper | 25 | | | | |

**Notes:**
LOD is typically achievable in a clean, silica sand matrix. Actual sample detection limits will be higher due to the sample matrix interferences.

LOD = Limit of Detection
ppm = parts per million

### 5.8.4.4 *Preparation and Analysis and Data Reporting*

Sample analysis begins by exposing the sample to primary radiation from the source. The Niton XL3t has two options for sample presentation to the instrument – direct analysis or the integrated test stand. See the SOP (Attachment 3) for details.

## 5.9 Soil Gas Surveys

To locate areas of possible contamination, soil gas surveys may be used as a screening tool at sites where little is known of previous site activities. Surveys will locate hot spots and provide a better selection of sampling locations. Two types of soil gas surveys, passive and active, may be used at McClellan.

Passive surveys comprise installing a reactor vessel into the ground and allowing soil gas to migrate through the vessel. Contaminants that are entrained in the pore-space air react with the specially designed vessels. The vessels are then removed from the ground after a period of time, and sent to a laboratory for analysis.

Active soil gas surveys comprise installing a drive rod to a specified depth, and removing pore space air through the rod. Soil gas is then collected into containers (e.g., Tedlar® bag, SUMMA®

canister), which are subsequently submitted for analysis. Active surveys are generally limited to the more volatile fractions of organic contaminants (fuel compounds and solvents).

Selection of the type of gas sampling technique to be used will depend on the type of contaminants associated with a particular area. Active soil gas surveys will be conducted in areas where suspected contaminants are volatile fractions of organic compounds or solvents. Passive surveys, conversely, can better detect heavier organic fractions, such as semivolatile compounds and pesticides, due to the longer residence time in the soil. If volatile contaminant distributions are required on a same-day basis, then active soil gas surveys are the more suitable. Passive gas surveys require a residence time from 7 to 21 days in the ground, plus additional time for shipment, analysis, and reporting. The Site-Specific Plans will detail which type(s) of soil gas program will be used at a given site.

Active and passive soil gas sample collection methods employ two primary types of standard QC types: duplicate samples and blanks. With active soil gas, a duplicate or split sample can be collected from a single location by splitting the sample stream into two individual containers. Passive surveys will collect duplicate samples at the same location using identically-prepared collection setups. Blanks such as media blanks are applicable to both passive and active soil gas methods. Specific QC types and their collection frequency will be discussed in Site-Specific Plans where soil gas methods will be used. The frequency will be sufficient to provide adequate QC data but should not be considered "significant" in comparison to the number of field samples collected.

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*As documents are revised, the most current version will be used.

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# FIGURES

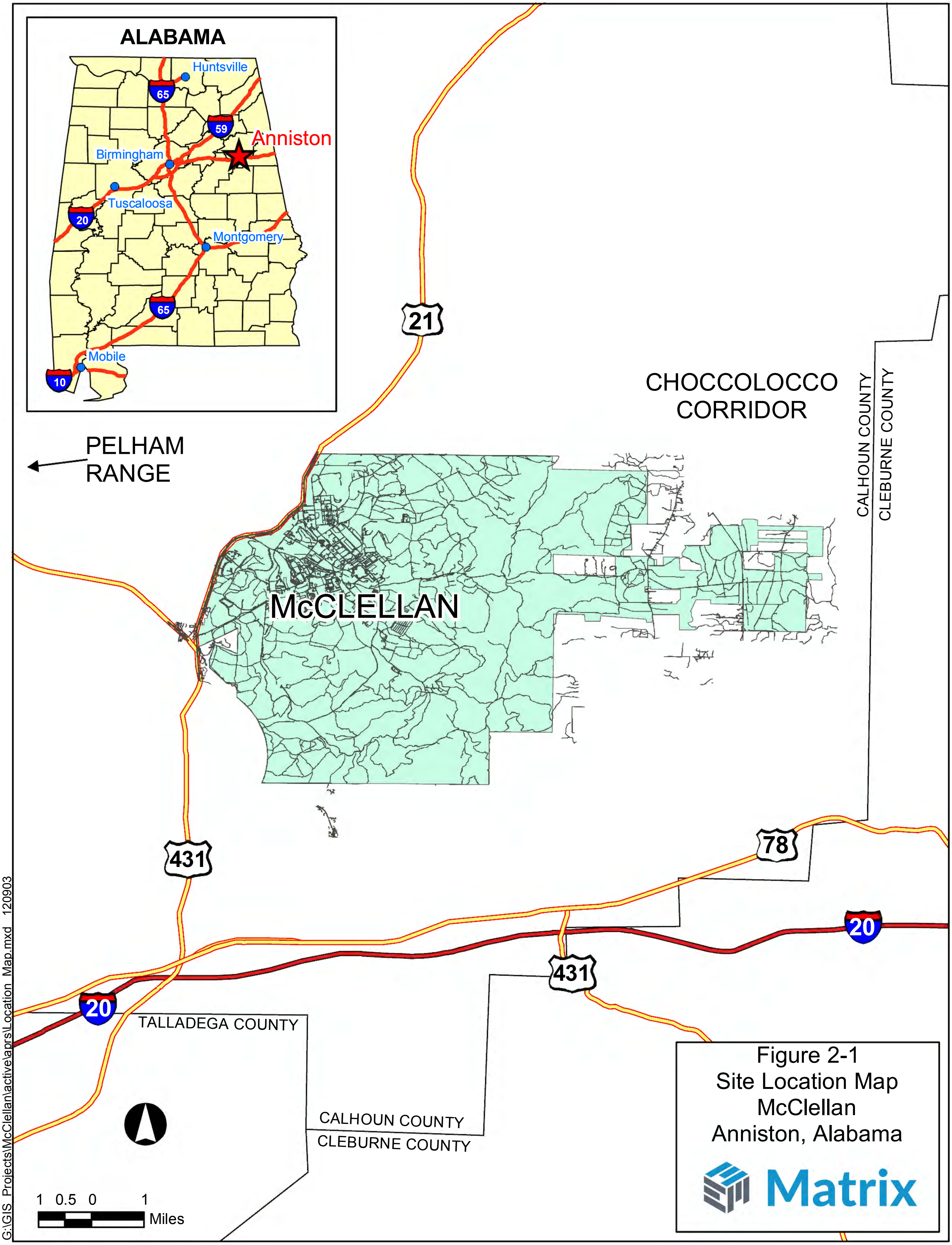

Figure 2-1
Site Location Map
McClellan
Anniston, Alabama

Matrix

G:\GIS_Projects\McClellan\active\aprs\Location_Map.mxd 120903

# List of Abbreviations and Acronyms

| | |
|---|---|
| %D | Percent difference |
| %R | Percent recovery |
| °C | Degrees Celsius |
| °F | Degrees Fahrenheit |
| AB | Ambient blank |
| ADEM | Alabama Department of Environmental Management |
| AEIRG | *Alabama Environmental Investigation and Remediation Guidance* |
| amsl | Above mean sea level |
| AOC | Area of Concern |
| Army | United States Department of the Army |
| ASTM | American Society for Testing and Materials |
| BFB | 4-bromofluorobenzene |
| bgs | Below ground surface |
| BIRTC | Branch Immaterial Replacement Training Center |
| BRAC | Base Realignment and Closure |
| CA | Cleanup Agreement |
| CA | Cleanup Agreement |
| CBR | Chemical, biological, and radiological |
| CCV | Continuing calibration verification |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CGI | Combustible Gas Indicator |
| CMIP | Corrective measures Implementation Plan |
| COC | Chain of Custody |
| Consultant | A contracted environmental consulting firm |
| D&I | Detection and Identification |
| DFTPP | Decafluorotriphenylphosphine |
| DI | Deionized |
| DMP | Data management plan |
| DOT | Department of Transportation |
| DQO | Data Quality Objectives |
| DQS | Data quality summary |
| EB | Equipment rinsate blank |
| EDD | Electronic data deliverable |
| EM | Electromagnetic |
| EPA | United States Environmental Protection Agency |
| ESCA | Environmental Services Cooperative Agreement |
| ESE | Environmental Science and Engineering, Inc. |
| ESMP | Endangered Species Management Plan |

| | |
|---|---|
| FD | Field duplicate |
| FID | Flame ionization detector |
| FS | Feasibility Study |
| GC | Gas chromatograph |
| GIS | Geographic information system |
| gpm | Gallons per minute |
| GPR | Ground penetrating radar |
| GPS | Global Positioning System |
| HASP | Health and Safety Plan |
| HASP | Health and Safety Plan |
| HDD | Hardcopy data deliverable |
| HPLC | High performance liquid chromatography |
| HTRW | Hazardous, Toxic, and Radioactive Waste |
| IATA | International Air Transport Association |
| ICP | Inductively coupled plasma |
| ICV | Initial calibration verification |
| IDL | Instrument detection limit |
| IDWMP | Installation-Wide Investigation Derived Waste Management Plan |
| IS | Internal Standards |
| IT | IT Corporation |
| LC | Liquid chromatography |
| LCS | Laboratory control sample |
| LCSD | Laboratory control sample duplicate |
| LEL | Lower explosive limit |
| MB | Method Blank |
| McClellan | The Former Fort McClellan |
| MCL | Maximum contamination level |
| MD | Matrix duplicate |
| MDA | McClellan Development Authority |
| MDL | Method detection limit |
| MEC | Munitions and Explosives of Concern |
| MES | Matrix Environmental Services, LLC |
| mL | Milliliter |
| MQL | Method quantitation limit |
| MRL | Method reporting limit |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| MWIP | Monitoring Well Installation and Maintenance Plan |
| NAVD | North American Vertical Datum |
| NIST | National Institute of Standards and Technology |
| NRHP | National Register of Historic Places |

| | |
|---|---|
| NSA | New South Associates, Inc. |
| OE | Ordnance and Explosives |
| ORP | Oxidation reduction potential |
| OVM | Organic vapor meter |
| PA | Preliminary Assessment |
| PARCCS | Precision, accuracy, representativeness, comparability, completeness, and sensitivity |
| PBMS | Performance Based Measurement System |
| PDB | Passive diffusion Bag |
| PID | Photo ionization detector |
| PM | Project Manager |
| POC | Point of contact |
| QA | Quality Assurance |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAP | Installation-Wide Quality Assurance Plan |
| QC | Quality Control |
| RA | Remedial Action |
| RCRA | Resource Conservation and Recovery Act |
| RD | Remedial Design |
| RI | Remedial investigation |
| RPD | Relative percent difference |
| RSD | Relative standard deviation |
| RTC | Recruiting Training Center |
| SAIC | Science Applications International Corporation |
| SAP | Sampling and Analysis Plan |
| SDG | Sample delivery group |
| SFSP | Site-specific Field Sampling Plan |
| SHSM | Site Health and Safety Manager |
| SI | Site investigation |
| SINA | Special Interest Natural Areas |
| SOP | Standard Operating Procedure |
| SOP | Standard Operating Procedure |
| SPCS | State Plane Coordinate System |
| SRM | Standard Reference Materials |
| SVOC | Semivolatile organic compound |
| SWMU | Solid waste management unit |
| TB | Trip Blank |
| TCLP | Toxicity characteristic leaching procedure |
| TRADOC | U.S, Army Training and Doctrine Command |
| U.S. | United States |

| | |
|---|---|
| US | United States |
| USACE | United States Army Corps of Engineers |
| USAEHA | United States Army Environmental Hygiene Agency |
| USATHAMA | United States Army Toxic and Hazardous Material Agency |
| USCS | Unified Soil Classification System |
| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UST | Underground Storage Tank |
| UXO | Unexploded Ordnance |
| VOC | Volatile organic compound |
| WAC | Women's Army Corps |
| Weston | Roy F. Weston |
| XRF | X-Ray fluorescence |

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1601 Blake Street, Suite 200
Denver, Colorado 80202
(303) 572-0200
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# AQUIFER TEST DATA

PROJECT NUMBER:

PROJECT NAME:

Well Number:

Well Location:

Static Water Level: ____ ft.

| Time | Total Elapsed Time t= (min) | Time Since Pumping Stopped t= (min) | Water Level (ft) | Drawdown S (ft) | Corrected Drawdown $S_c$ (ft) | Recovery R (ft) | Corrected Recovery $R_c$ (ft) | Discharge Q gpm |
|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  |  |  |  |  |

Recorded By:

Date:

Checked By:

Date:

Matrix Environmental Services
1601 Blake Street, Suite 200
Denver, Colorado 80202
(303) 572-0200
(303) 572-0202

# HTRW BORING LOG

| | | | |
|---|---|---|---|
| **Logged By** | | **Driller** | |
| **Start Date** | **End Date** | **Drilling Equipment** | |
| **Project** | | **Drilling Method** | |
| **Project Number** | | **Sample Equipment** | |
| **Location (Site)** | | **Sample Method** | |
| **Conditions** | | **Boring Depth** | |

**Sketch/Description**

| | | |
|---|---|---|
| **Elevation** | **Depth to Water** | **Borehole Dia.** |
| **Well/Boring ID** | | |

| **Depth (feet)** | **Drilling Run** | **Recovery** | **Field Screening Results** | **Analytical Sample Sample ID** | **Sample Time** | **Description: Lithology - Petrology - Soil** | **Lithologic Unit** | **Graphic Log** | **Notes:** | **Well Completion** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
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| 10 | | | | | | | | | | |

Checked By ______________________ Date ______________________ Page ________ of ________

Rev 12/5/2013

Matrix
ENVIRONMENTAL

# BORING - LITHOLOGIC LOG

Date/Time

Well/Boring ID

| Depth (feet) | Sample Run | Recovery | Field Screening Results | Analytical Sample Sample ID | Sample Time | **Description:**<br>Lithology - Petrology - Soil | Lithologic Unit | Graphic Log | **Notes:** | Well Completion |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
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Checked By (initial) ________

Page ________ of ________

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| | |
|---|---|
| **Project** | **Project Number** |
| **Personnel** | **Date/Time** |

# INSTRUMENT CALIBRATION LOG

| | Equipment/Parameter | Calibration Requirement | Calibration Standard Value(s) | Calibration Reading(s) | Acceptance Criteria | Accept Calibration? |
|---|---|---|---|---|---|---|
| Multimeter Components | Dissolved Oxygen Meter<br>Equip. ID:___________ | In accordance with manufacturers instructions. | _____mg/L | | ± 0.2 mg/L | Y/N |
| | Temperature<br>Equip. ID:___________ | Check against NBS thermometer, record value: | _____ °C | | ± 0.5 °C | Y/N |
| | Specific Conductance<br>Equip. ID:___________ | Calibrate with one calibration solution | | | + 3% of full scale | Y/N |
| | ORP Meter<br>Equip. ID:___________ | In accordance with manufacturers instructions. | | | ± 15 mV | Y/N |
| | pH Meter<br>Equip. ID:___________ | Calibrate with two pH buffer solutions | | | ± 0.1 units | Y/N |
| Turbidity Meter<br>Equip. ID:___________ | | Blanks and 3 point standard set | | | ± 5% | Y/N |
| OVM-PID<br>Equip. ID:___________ | | Isobutylene 100 ppm in air | | | ± 2% | Y/N |
| OVM-FID<br>Equip. ID:___________ | | Methane 500 ppm in air | | | ± 2% | Y/N |
| CGI/LEL/$O_2$/CO Meter<br>Equip. ID:___________ | | Pentane 58% LEL, 15% $O_2$, 60 ppm CO | | | ± 2% LEL, 14.5-16% $O_2$, ± 1.5 ppm CO | Y/N |
| Dust Monitor<br>Equip. ID:___________ | | Zero Bag Calibration | | | Zero | Y/N |
| Rechargeable Equipment<br>Equip. ID:___________ | | Charge | | | --- | Y/N |
| Sampling Accessories (tubing, subersible pumps, etc.) | | Periodic maintenance performed and recorded in equipment maintenance log | | | --- | Y/N |

Notes:

-If initial calibration fails, instrument must be repaired and recalibrated or replaced, as appropriate.  NBS - National Bureau of Standards

| | |
|---|---|
| **Signature/Date** | **Checked/Date** |

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**Station Name/Sample ID**

**Project**

**Date**

| **Time** | **Volume removed (gallon)** | **Temp (°C)** | **Cond (µS/cm)** | **DO (mg/L)** | **ORP (mV)** | **TDS (mg/L)** | **Turbidity (NTU)** | **pH** | **Description (e.g. odor, clarity, color)** |
|---|---|---|---|---|---|---|---|---|---|
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|---|---|---|---|
| **Total Time (min.)** | **Total Volume Removed** | **Well pumped dry (yes/no)** | **Notes** |

| | |
|---|---|
| **QA/QC Samples** | **Signature** |

**Page** ________ **of** _____

Rev 3/3/08

# Chain of Custody

| | | |
|---|---|---|
| **McClellan**<br>**Lab:** | **Site:**<br>**SMCode (circle):** Grab(G), Composite (C), Discrete(D), Disturbed(S), Undiscrete (U), Unknown(z) | **COC#:**<br>**Station:**<br>**StationType:**<br>**QCCode:** |
| **Sample Date:** | **Sampling Technique (circle):** Bailer(B), Bladder Pump(BP), Core(C) Submersible Pump (SU), Encore(EN), Hydropunch(HP), Spoon(SN), Hand Auger(HA), Stainless Bucket(SS), Peristaltic Pump(PP), Grab(G) | **Matrix:**<br>**Task#:**<br>**CoolerID:** |

| | | | |
|---|---|---|---|
| **Contractor:**<br>**Sampler Signature(s):** | **TBLot:**<br>**EBLot:**<br>**ABLot:** | **SampleTop:** | **SampleBottom (Units):** |

| **Time:** | **Label#:** | **Bottle, Preservative:** | **Method:** |
|---|---|---|---|
| | 1 | x , | |

QCCode: NS = Investigative Sample, FD = Field Duplicate, MS = Matrix Spike, MSD = Matrix Spike Duplicate, EB = Equipment Blank, TB = Trip Blank, WQ = Water Quality, WS = Source Water, SP = Seep
StationType: MW = Monitoring Well, BH = Bore Hole, DS = IDW Soil, SD = Sediment Point, SW = Surface Water, SE = Seep, SS = Surface Soil

White Original COC (Lab Copy) - Yellow COC (Field Office) - Pink COC (Data Managment)

| | | |
|---|---|---|
| Relinquished by (Signature) : | Date/Time: | Received by (Signature) : |
| Relinquished by (Signature) : | Date/Time: | Received by (Signature) : |
| Relinquished by (Signature) : | Date/Time: | Received by (Signature) : |
| Airbill Number: | | |

Matrix ENVIRONMENTAL

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**Station Name/Sample ID**

**Project**

**Project Number**

# GROUNDWATER SAMPLING LOG

**Groundwater Depth (TOC)**
feet

**Well Depth (TOC)**
feet

**Water Column Thickness**
feet

**Casing Diameter**
inches

**Casing Volume**
gallons

1"=x0.04 2"=x0.16 4"=x0.65 6"=x1.47 8"=x10.

**Well Elevation (TOC)**
feet

**Groundwater Elevation**
feet

**Equipment**

____ Bailer
____ Check Valve
____ Grundfos
____ Peristaltic
____ Bladder Pump
____ PID/FID
____ Other (describe)

**Conditions (temp, weather, precip)**

**Parameter Stabilization**
temp +/- 1° DO +/- 10% Turbidity +/- 10%
cond +/- 3% ORP +/- 10mV pH +/- 0.1 unit

**Sampler**

**Date**

**Location (Site)**

**Begin Time**

**Laboratory**

**Sample Depth**

**Sample Suite**

**Meters**

**Serial numbers**

**Calibration**

**Ferrous Iron (Fe II) (mg/L) (for MNA sampling)**

**Product Observed (yes/no)**

**Depth to product**

| Time | Volume removed (gallon) | Temp (°C) | Cond (µS/cm) | DO (mg/L) | ORP (mV) | TDS (mg/L) | Turbidity (NTU) | pH | Description (e.g. odor, clarity, color) |
|---|---|---|---|---|---|---|---|---|---|
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**Total Time (min.)**

**Total Volume Removed**

**Well pumped dry (yes/no)**

**Notes**

**QA/QC Samples**

**Signature and Date**

**Checked and Date**

Rev 1/26/09

**Page** ________ **of** ________

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**Station Name/Sample ID**

**Project**

**Date**

| **Time** | **Volume removed (gallon)** | **Temp (°C)** | **Cond (µS/cm)** | **DO (mg/L)** | **ORP (mV)** | **TDS (mg/L)** | **Turbidity (NTU)** | **pH** | **Description (e.g. odor, clarity, color)** |
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**Total Time (min.)**

**Total Volume Removed**

**Well pumped dry (yes/no)**

**Notes**

**QA/QC Samples**

**Signature**

**Page** ________ **of** _____

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| | |
|---|---|
| **Project** | **Project Number** |
| **Personnel** | **Date/Time** |

# NONCONFORMANCE LOG

Notes:

Nonconforming equipment, items, activities, conditions, and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner using this Nonconformance Report form. A nonconformance is defined as a malfunction, failure, deficiency, or deviation that renders the quality of an item unacceptable or indeterminate. The originator of the report will describe the nonconformance on this form and will notify the MDA QAO and PM. Each nonconformance will be reviewed and a corrective action determined. The disposition of a nonconformance will be documented and approved by all involved project personnel (including the QAO) using this form. If, in the opinion of the MDA QAO and the PM, the nonconformance does not significantly affect the quality or use of the work, the work may continue pending resolution of the nonconformance. The basis for such decisions will be documented using this report form and submitted to the QAO for review and approval.

| | | |
|---|---|---|
| **Signature/Date** | **PM Signature/Date** | **QAO Signature/Date** |

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|  |  |
|---|---|
| **Project** | **Location (Site)** |
| **Personnel** | **Date** |

**sketch**

**sketch**

**Description/Conditions**

# Photographic Field Log

| # | Camera Log ID | Direction | Description | # | Camera Log ID | Direction | Description |
|---|---|---|---|---|---|---|---|
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Direction - Direction camera is facing when picture taken

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**Sampling Event**

**Location (Site)**

**Date**

# Soil Sample Collection Log

| | Sample ID | Date | Time | Depth | to | Depth | Sample Type | Analytical Suite | PID | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 27 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 28 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 29 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
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| 34 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 35 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 36 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
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| 43 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
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| 57 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 58 | | | | | to | | inv dup ms/msd<br>composite grab | | | |

PID = photoionization detector inv = investigative dup = duplicate ms/msd = matrix spike/matrix spike duplicate

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**Sampling Event**

**Location (Site)**

**Date**

**Sampler**

**Laboratory**

**Sampling Equipment**

**Method**

**Screening Equipment/Meters** **Serial Numbers**

**Conditions**

**sketch**

# Sediment Sample Collection Log

| | Sample ID | Date | Time | Dist. from ___ Bank | Depth to Sed | Analytical Suite | Sample Type | Description |
|---|---|---|---|---|---|---|---|---|
| 1 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 2 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 3 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 4 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 5 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 6 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 7 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 8 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 9 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 10 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 11 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 12 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 13 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
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| 22 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 23 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 24 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 25 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |

Dist - distance Sed - sediment inv - investigative dup - duplicate ms/msd - matrix spike/matrix spike duplicate

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**Sampling Event**

**Location (Site)**

**Date**

# Sediment Sample Collection Log

| | Sample ID | Date | Time | Dist. from ___ Bank | Depth to Sed | Analytical Suite | Sample Type | Description |
|---|---|---|---|---|---|---|---|---|
| 26 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 27 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 28 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 29 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 30 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 31 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 32 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
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| 56 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 57 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |
| 58 | | | | feet | feet | | inv dup ms/msd<br>composite grab | |

Dist - distance Sed - sediment inv - investigative dup - duplicate ms/msd - matrix spike/matrix spike duplicate

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# Slug Test Data

Location ________________________ Geologic Unit __________ Well Number _________ Sheet _______ of _____

Field Team Member Signature

(Print name and title, then sign)

Test Method: ___ Slug Injection or ___ Slug Withdrawal Slug Dimensions or volume ______________

Well Construction Details (attach diagram): ________________________________________________________________

Test Started __________________ Test Stopped _______________ Test ID ____________________________________

Method of Water-Level Measurement: ______________________________________________________________________

Comments: ______________________________________________________________________________________

______________________________________________________________________________________________

______________________________________________________________________________________________

| **Time of Measurement** | **Elapsed Time (minutes)** | **Depth to Water (feet)** | **Time of Measurement** | **Elapsed Time (minutes)** | **Depth to Water (feet)** |
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☐ Check here if continued on the back of this sheet.

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(303) 572-0202

**Sampling Event**

**Location (Site)**

**Date**

**Sampler**

**Laboratory**

**Sampling Equipment**

**Method**

**Screening Equipment/Meters** **Serial Numbers**

**Conditions**

**sketch**

# Soil Sample Collection Log

| | Sample ID | Date | Time | Depth | to | Depth | Sample Type | Analytical Suite | PID | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 2 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 3 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 4 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 5 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 6 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 7 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 8 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 9 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 10 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 11 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 12 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 13 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 14 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 15 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 16 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 17 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 18 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 19 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 20 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 21 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 22 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 23 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 24 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 25 | | | | | to | | inv dup ms/msd<br>composite grab | | | |

PID = photoionization detector inv = investigative dup = duplicate ms/msd = matrix spike/matrix spike duplicate

**Page** ________ **of** ________

Rev 12/05/13

| | | |
|---|---|---|
| Matrix Environmental Services<br>1601 Blake Street, Suite 200<br>Denver, Colorado 80202<br>(303) 572-0200<br>(303) 572-0202 | **Sampling Event** | |
| | **Location (Site)** | **Date** |

# Soil Sample Collection Log

| | Sample ID | Date | Time | Depth | to | Depth | Sample Type | Analytical Suite | PID | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 27 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 28 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 29 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 30 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 31 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 32 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 33 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 34 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 35 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 36 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 37 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 38 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 39 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 40 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 41 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 42 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 43 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 44 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 45 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 46 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 47 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 48 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 49 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 50 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 51 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 52 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 53 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 54 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 55 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 56 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 57 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 58 | | | | | to | | inv dup ms/msd<br>composite grab | | | |

PID = photoionization detector inv = investigative dup = duplicate ms/msd = matrix spike/matrix spike duplicate

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**Sampling Event**

**Location (Site)**

**Date**

# Soil Sample Collection Log

| | Sample ID | Date | Time | Depth | to | Depth | Sample Type | Analytical Suite | PID | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 59 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 60 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 61 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 62 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 63 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 64 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 65 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 66 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 67 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 68 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 69 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 70 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 71 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 72 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 73 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 74 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 75 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 76 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 77 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 78 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 79 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 80 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 81 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 82 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 83 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 84 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 85 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 86 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 87 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 88 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 89 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 90 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 91 | | | | | to | | inv dup ms/msd<br>composite grab | | | |

PID = photoionization detector inv = investigative dup = duplicate ms/msd = matrix spike/matrix spike duplicate

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**Sampling Event**

**Location (Site)**

**Date**

# Soil Sample Collection Log

| | Sample ID | Date | Time | Depth | to | Depth | Sample Type | Analytical Suite | PID | Description |
|---|---|---|---|---|---|---|---|---|---|---|
| 92 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 93 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 94 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 95 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 96 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 97 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
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| 99 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
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| 101 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 102 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 103 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 104 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 105 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 106 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 107 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 108 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
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| 110 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 111 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 112 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 113 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 114 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 115 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 116 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 117 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 118 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 119 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 120 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 121 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 122 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 123 | | | | | to | | inv dup ms/msd<br>composite grab | | | |
| 124 | | | | | to | | inv dup ms/msd<br>composite grab | | | |

PID = photoionization detector inv = investigative dup = duplicate ms/msd = matrix spike/matrix spike duplicate

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| | |
|---|---|
| **Station Name/Sample ID** | |
| **Project** | **Project Number** |

# SURFACE WATER SAMPLING DATA

| | |
|---|---|
| **Elevation (ft amsl)** | **feet** |
| **Temperature** | **ºC** |
| **pH** | |
| **Conductance** | **µS/cm** |
| **Turbidity** | **NTU** |
| **TDS** | **mg/L** |
| **ORP** | **mV** |
| **DO** | **mg/L** |

**Containers Used:**

____ **VOA Vial**

____ **1 L Jar**

____ **Bailer**

____ **Other (describe)**

**Conditions (temp, weather, precip)**

**Specific Sample Location within Water Body**

| | |
|---|---|
| **Sampler** | **Date** |
| **Location (Site)** | **Begin Time** |
| **Laboratory** | **Sample Depth** |
| **Sample Suite** | |
| **Meters** | **Serial numbers** |
| **Calibration** | |
| | |
| **Product Observed (yes/no)** | **Description of Product** |

**Field Notes:**

*Surface water samples should be collected prior to sediment samples and also in a downstream to upstream fashion to prevent cross-contamination

| | | |
|---|---|---|
| **QA/QC Samples** | **Signature and Date** | **Checked and Date** |

**Page** ________ **of** ________

Rev 1/26/09

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**Station Name/Sample ID**

**Project**

**Date**

| Time | Volume removed (gallon) | Temp ($^oC$) | Cond (µS/cm) | DO (mg/L) | ORP (mV) | TDS (mg/L) | Turbidity (NTU) | pH | Description (e.g. odor, clarity, color) |
|---|---|---|---|---|---|---|---|---|---|
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**Total Time (min.)**

**Total Volume Removed**

**Well pumped dry (yes/no)**

**Notes**

**QA/QC Samples**

**Signature**

**Page** ________ **of** _____

| | | | |
|---|---|---|---|
| Matrix ENVIRONMENTAL | Matrix Environmental Services<br>1601 Blake Street, Suite 200<br>Denver, Colorado 80202<br>(303) 572-0200<br>(303) 572-0202 | **Project** | **Project Number** |
| | | **Personnel** | **Date/Time** |

# VARIANCE LOG

Notes:

Changes (variances) to the Sampling & Analysis Plan (SAP) or Site-Specific Field Sampling Plans (SFSPs) may be initiated in the field or in the office as neccesary. All variances will be noted in the log book using this Variance Log form by the person who identifies the need for a variance. Variances will be approved by the MDA quality assurance officer (QAO) and project manager prior to implementation of the change. Variances that affect project scope, cost or schedule must be approved by the MDA before being implemented.

| **Signature/Date** | **PM Signature/Date** | **QAO Signature/Date** |
|---|---|---|
| | | |

**Page** ________ **of** ______

Rev 1/26/09

Matrix Environmental Services, L.L.C.
Integrated Environmental Solutions

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**Groundwater Event**

**Project**

**Project Number**

# GROUNDWATER LEVELS

**Field Personnel**

**Measuring Equipment**

**Serial Number**

**Date**

**Conditions**

**Location (Site)**

| Well ID | Casing Diameter | Date | Time | Depth to Water (feet) | | Depth to Product (feet) | | Product Thickness (feet) | | Well Depth (feet) | | Initials |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**Signature/Date:**

**Checked/Date:**

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ENVIRONMENTAL

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**Groundwater Event**

**Location (Site)**

**Date**

# GROUNDWATER LEVELS

| Well ID | Casing Diameter | Date | Time | Depth to Water (feet) | | Depth to Product (feet) | | Product Thickness (feet) | | Well Depth (feet) | | Initials |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
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**Page** ________ **of** ________

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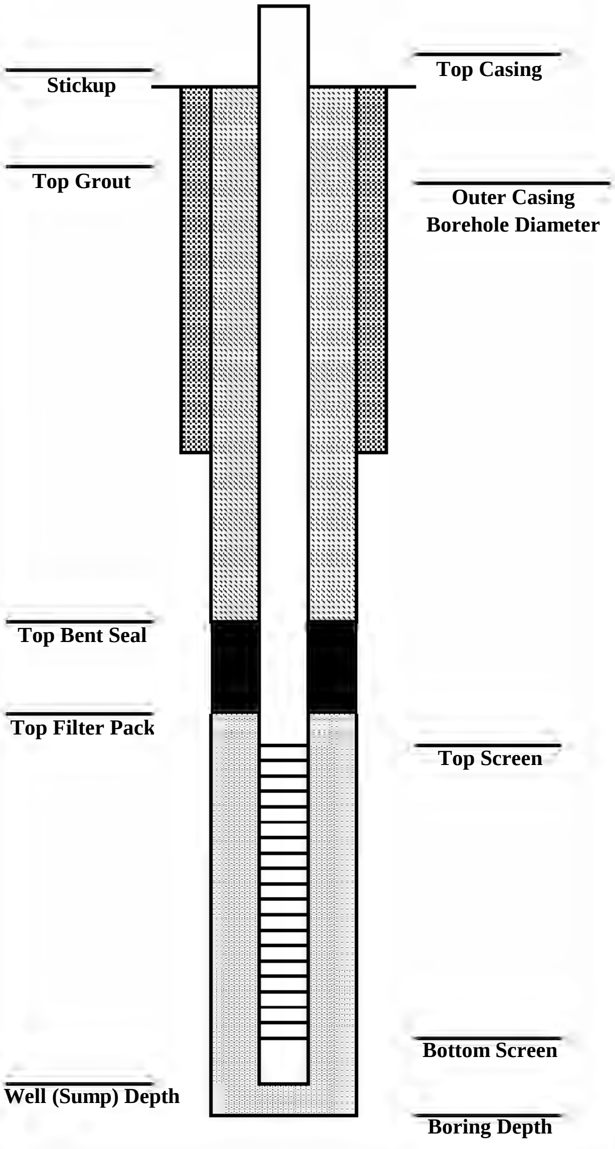
| | |
|---|---|
| **Project** | **Well ID** |
| **Project No.** | **Location (Site)** |

# MONITORING WELL ABANDONMENT

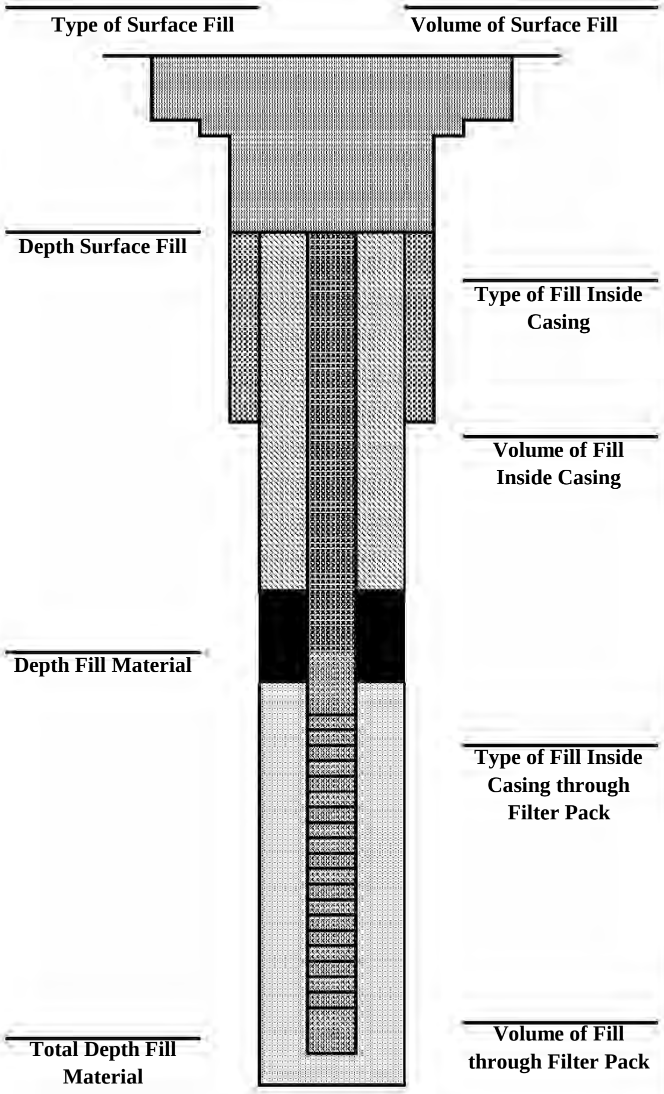
| **Abandoned By** | **Date** | **Well Type** | **Northing** | **Easting** |
|---|---|---|---|---|
| | | | | |

## Well Summary Prior to Abandonment

*data presented in feet bgs*



## Well Summary After to Abandonment



**notes:**

| | No | Yes | NA |
|---|---|---|---|
| Concrete Pad Removed | ☐ | ☐ | ☐ |
| Protective Posts Removed | ☐ | ☐ | ☐ |
| Flush Mount Removed | ☐ | ☐ | ☐ |
| Outer Casing Removed | ☐ | ☐ | ☐ |

| | No | Yes | Partial |
|---|---|---|---|
| Inner Casing Removed | ☐ | ☐ | ☐ |

Length of Inner Casing Removed ____________ feet

Revision 1.0, Dec 2013

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| | |
|---|---|
| **Project** | **Well ID** |
| **Project No.** | **Location (Site)** |

# MONITORING WELL DEVELOPMENT LOG AND COMPLETION DIAGRAM

| | | | |
|---|---|---|---|
| **Developed By** | **Date** | **Method** | **Casing or Well Volume (gallons)** |
| | | | |

| **Time** | **Volume removed (gallon)** | **Temp (°C)** | **Cond (uV/sec)** | **DO (mg/L)** | **ORP (mV)** | **Turbidity** | **pH** | **Description** |
|---|---|---|---|---|---|---|---|---|
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## WELL MATERIALS

| | | |
|---|---|---|
| **Inner Casing** | **feet** | |
| **Outer Casing** | **feet** | |
| **Screen** | **feet** | |
| **End Cap** | **feet** | |
| **Filter Pack** | **pounds** | |
| **Bentonite Seal** | **pounds** | |
| **Grout/Cement** | **gallons** | |

| | |
|---|---|
| **Filter Pack Placement** | **Bentonite Seal Placement** |
| **Grout Placement/Well Finish** | |

**Borehole Collapse** **feet (bgs) to** **feet (bgs)** *indicate on diagram*

**Surface Completion:**

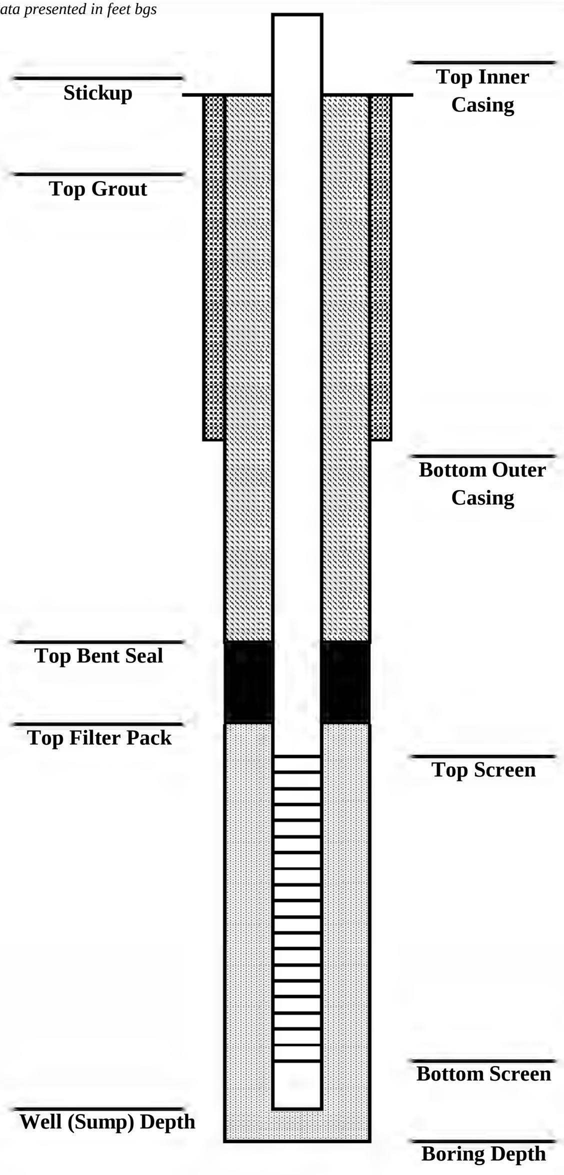
**notes:**

## WELL COMPLETION

| | |
|---|---|
| **Outer Borehole Diameter (inches)** | **Completion Date** |
| **Inner Borehole Diameter (inches)** | **Elevation (TOC)** **feet amsl** |
| **Northing** | **Elevation (Ground)** **feet amsl** |
| **Easting** | **Driller** |

**notes:**

*data presented in feet bgs*



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**Date**

**Well ID**

**Developed By**

**Location (Site)**

# MONITORING WELL DEVELOPMENT LOG (CONTINUED)

| Time | Volume removed (gallon) | Temp (°C) | Cond (uV/sec) | DO | ORP | Turbidity | pH | Description |
|---|---|---|---|---|---|---|---|---|
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# STANDARD OPERATING PROCEDURE - 1

# AQUIFER PUMP TESTS

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide technical guidance for performing aquifer tests that utilize both pumping and observation wells. This procedure outlines methods for conducting step-drawdown/recovery and constant discharge/recovery tests and providing documentation of this data.

This procedure does not discuss analysis of the data collected during aquifer pumping tests. Numerous analytical methods are available. Each method includes unique assumptions and limitations; hence, the particular analytical method must be tailored to site-specific conditions under which the aquifer test was conducted. Consult Section 5.0 of this procedure for specific sources on aquifer analysis.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Aquifer*: A geologic formation capable of yielding significant quantities of water to wells.

*Electronic Data Logger*: An electronic instrument capable of recording electrical impulses and converting them into data usable for scientific analysis. This instrument, when connected to a transducer probe, can record rapid changes in water levels over short time intervals.

*Hydraulic Conductivity*: A measure of the ability of a porous medium to transmit fluids. It is dependent on both the fluid and the medium. The hydraulic conductivity is generally defined as a rate of flow through a unit cross-sectional area under a unit hydraulic gradient. English units for hydraulic conductivity are commonly expressed either in gallons per day per square foot (gal/day/ft$^2$) or feet per day (ft/day). International System of Units (SI) units are often expressed in centimeters per second (cm/s).

*Hydraulic Gradient*: It is defined as dh/dl, which is the ratio of the change in total hydraulic head (dh) per length of flow (dl). It dimensionally has the units of feet per foot (ft/ft).

*Piezometer*: A well designed for groundwater level measurements. Typically, a piezometer consists of a small diameter pipe screened over the aquifer interval.

*Specific Capacity*: The discharge from a well expressed as a rate of yield per unit drawdown (gpm/ft).

*Storage Coefficient*: The volume of water that an aquifer releases from storage per unit surface area of aquifer per unit decline in the component of hydraulic head normal to that surface (dimensionless).

*Transmissivity*: It is expressed as Kb where K is the hydraulic conductivity and b is the saturated thickness of the aquifer. The transmissivity is defined as a rate of flow through a unit width of aquifer thickness b under a unit hydraulic gradient. English units for transmissivity are commonly expressed either in gal/day/ft or $ft^2$/day. SI units are often expressed in square meters per second ($m^2$/s).

*Transducer Probe*: The pressure transducer responds to pressure changes caused by groundwater level fluctuations. Pressure changes are converted to an electrical impulse and sent to an electronic data logger.

### 2.2 Abbreviations

| | |
|---|---|
| cm/s | centimeters per second |
| dh | total hydraulic head |
| dl | length of flow |
| ft/d | feet per day |
| $ft^2$/d | feet squared per day |
| ft/ft | feet per foot |
| gal/day/ft | gallons per day per foot |
| gal/day/$ft^2$ | gallons per day per square foot |
| gpm/ft | gallons per minute per foot of drawdown |
| $m^2$/s | meters squared per second |
| PM | Project Manager |
| SI | International System of Units |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks in accordance with this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This is accomplished by reviewing documents (Exhibits) and data produced during work performance. Activities and data collected shall be recorded in the field log book.

## 4.0 PROCEDURES

### 4.1 Introduction

The assessment of aquifer characteristics is vital to any investigation of groundwater contamination. Pump tests are one of the primary methods to quantitatively estimate aquifer characteristics. Depending upon the duration of the test, pump testing may also simulate actual pumping during groundwater remediation and provide valuable information for future recovery systems.

Drawdown pump tests may be conducted to determine both the performance characteristics of a well and the hydraulic parameters of an aquifer. In a well performance test, well yield and drawdown are measured so that the specific capacity can be calculated. These data, taken under controlled conditions, give a measure of the productive capacity of the completed well and also provide information needed for the selection of pump equipment.

Aquifer pump tests also provide data from which the principal aquifer properties, transmissivity and storage coefficient, can be calculated. These properties are essential in determining not only the radius of influence for individual or multiple pumping wells but also are necessary in establishing groundwater flow velocities.

An aquifer test consists of pumping a well at either constant or variable pumping rates and measuring the drawdown in the pumping well and in any nearby observation wells. There are generally two types of aquifer tests; one is a constant rate test and the other is a step-drawdown test. In a constant rate test, pumping is sustained at a constant discharge rate for the duration of the test, whereas in a step-drawdown test a constant discharge rate is maintained for relatively short periods of time, after which time the rate is usually increased. Although data from both types of aquifer pumping tests can be utilized for aquifer analyses, step-drawdown data tend to be more difficult to interpret. Step-drawdown data from this type of test do not easily lend themselves to conventional analysis and require a special analytical method. In addition, as pumping rates are increased, fluctuations in step-drawdowns may occur as the well experiences the effects of well development concurrent with pumping. If possible, a constant rate pump test should be conducted to determine aquifer properties.

Data requirements for aquifer tests include static water level measurements made prior to commencement of the test, discharge rate(s) and time of change in discharge rates; drawdown measurements made during pre-established time intervals, and the time pumping stopped. A recovery test should also be conducted following a step-drawdown pump test to assure the precision and validity of resulting data. Recovery water levels should be measured at preset time intervals after the pump is stopped.

For well performance tests, well yield and drawdown are measured usually near the end of the test. Although aquifer testing is more involved than well testing, the following methods for determining well yields and drawdowns are similar in both types of tests. These methods and procedures apply primarily to constant discharge, step-drawdown aquifer and recovery tests.

### 4.2 Decontamination

Prior to lowering the equipment into any well or boring, decontaminate each item coming in contact with the groundwater in accordance with SOP-13, Equipment Decontamination.

### 4.3 Pre-Test Data Recording

Complete the applicable portions of the Aquifer Test Data form, prior to conducting the aquifer test. Use a separate form for each well. Also, obtain the following information (from existing logs) for each well to be used in the test prior to performing the test:

- Casing diameter;
- Borehole diameter;
- Location of surveyed measuring point;
- Total casing depth;
- Static water level of each monitor well;
- Screen depth and interval;
- Filter pack depth and interval; and
- Lithology of screened interval.

Assemble the equipment necessary to conduct the aquifer pumping test. A list of useful equipment is presented in Exhibit 1-1, Aquifer Testing Equipment List.

### 4.4 Pumping Test Design

Aquifer testing and analysis methods are generally based upon the following assumptions:

- The aquifer is homogenous and isotropic;

- The aquifer is infinite in extent in the horizontal direction from the well and has a constant thickness;

- The well screen interval fully penetrates the aquifer;

- Groundwater flow within the aquifer and pumped well is laminar; and

- The initial static water level is horizontal.

Typically, these assumptions may be invalidated by the nature of the subsurface geologic conditions and materials that comprise the aquifer. However, under many hydrogeologic conditions, conventional pump test analyses are appropriate to use. (Under conditions where the above assumptions may be invalidated, there are a variety of specific analytical techniques that can accommodate them.) In these situations, it is recommended that these highly specific methods of analyses be utilized.

Prior to the start of the pump test, a pretest should be conducted to determine the general characteristics and anticipated response of the aquifer. Data to be obtained from this test include the following:

- The maximum sustained discharge rate that will effectively stress the aquifer but will not dewater the test well;

- The maximum anticipated drawdown. For most pumping tests, a major portion of the drawdown will occur in the first few hours of pumping; and

- An estimate of the total volume of water to be produced from the pumping test. Appropriate disposal methods must be considered before any pumping can occur.

The actual pump test should not be started until water levels in the aquifer have returned to (pre-test) static levels.

The accuracy of drawdown data measured during a pumping test depends upon the following:

- Maintaining a constant yield during the test (only for a constant rate test);

- Measuring the drawdown carefully in the pumping well and observation wells;

- Recording drawdown readings at appropriate time intervals;

- Evaluating how changes in barometric pressures, stream levels, and tidal oscillations affect drawdown data;

- Comparing recovery data with drawdown data taken during the pumping portion of the test; and

- If possible and conditions allow, continue the pumping test for at least 8 hours for a confined aquifer and 24 hours for an unconfined aquifer during constant discharge. For step-drawdown tests, 24 hours is usually sufficient for either type of aquifer.

The accuracy of data collected from a pumping well is usually less reliable than data collected from an observation well because of turbulence created by the pump. Therefore, if possible, drawdown measurements should be obtained from several observation wells within the expected radius of influence. Also select and monitor drawdown in an observation well that is located at a sufficient distance to be unaffected by the pumping well. Data from this well may provide an important understanding of the effects of not only evapotranspiration, but other external stresses that may cause groundwater levels to fluctuate.

Drawdown data from an observation well are necessary to calculate the storage coefficient accurately, whereas transmissivity values may be calculated from either a pumping or an observation well. Generally, in unconfined aquifers, observation wells should be less than 100 feet from the pumped well. For thick, confined aquifers that are considerably stratified, observation wells should be within 300 to 700 feet from the pumped well.

If drawdown measurements are obtained with an electronic data logger, refer to SOP-2, Aquifer Slug Testing, Section 4.4.1 for verification procedures prior to testing. Measurement intervals are discussed in Section 4.4.2 of SOP-2, Aquifer Slug Testing.

### 4.5 Background Water Level Measurements

The objective of background measurements is to identify any naturally-occurring temporal and diurnal changes to the groundwater system. When these observed fluctuations occur, drawdown data should be adjusted to reflect background fluctuations. Perform the following steps during the pump test to record background water levels:

- Measure water levels in at least one well not expected to be influenced by the pumping well. Continue monitoring for the duration of the test;
- Use an electronic water level indicator to measure water levels in background wells; and
- Measure water levels to within 0.01 foot.

### 4.6 Drawdown/Recovery Test

Perform the following steps to conduct a drawdown test:

- Measure static water levels in the pumping well and selected monitor wells and piezometers. Record measurements in the field log book and on the Aquifer Test Data form (Attachment 2). Use a separate Exhibit page for each well;
- Prior to installing the pump, measure the static water level in the pumping well. Depending on site restraints, place the pump above the bottom of the well to avoid pumping fines that have accumulated on the bottom of the well. This will prolong the operating life of the pump. Keep the pump intake at least two feet above the bottom of the well, if possible;
- If measurements are to be obtained with an electric logger, install the transducer probe in the well so that it will not move during the test; carefully secure the transducer cable to the top of the well casing;
- Program the data logger for logarithmic cycle measurements so that water-level measurements are recorded at the times shown in Exhibit 1-2, Time Intervals for Drawdown Measurements in a Pumped Well;
- Measure and record water levels in wells with an electronic water level indicator;
- Start the electronic data logger;
- Start the pump at the discharge rate determined in the pretest;
- Measure water levels in wells after pumping starts. Record times in the field log book and on the Aquifer Test Data form (Attachment 2). Exhibit 1-2, Time Intervals for Drawdown Measurements in a Pumped Well, and Exhibit 1-3, Time Intervals for Drawdown Measurements in Observation Wells, provide suggested time measurement intervals.

Always record these measurements in a log book or on appropriate field forms in case the electronic data logger fails;

- Calculate drawdown during the test;

- Do not change water level measurement devices during a test; and

- Plot data on semilog graph paper in the field, where the X-axis is time (minutes) since pumping began on the log scale and the Y-axis is drawdown (feet) in the arithmetic scale.

## 4.7 Step-Drawdown/Recovery Test

Follow steps described in Section 4.5 on drawdown test procedures. Incorporate the following changes to the above procedures:

- Maintain constant discharge rates for each step. Discharge measurements can be made with a totalizing flow meter or by timing flow into a five-gallon bucket. These measurements should be performed at regular intervals of approximately 15 minutes.

- On the Aquifer Test Data form (Attachment 2) and in the field log book, note the actual time that the discharge rate in the pumped well is increased and note the time the pump is shut off. Also note any other unusual and routine occurrences.

- Ideally, the step-drawdown test will employ several different discharge rates with each subsequent flow rate greater than the previous flow rate.

- Consider the water level in the pumping well when selecting the next pumping step. In low permeability sediments, it is recommended that the flow rate be increased by approximately 1.5 times. This conservative approach tends to preclude dewatering the well.

- Maintain the current flow rate if no increase in the flow rate can be sustained by the well beyond the first step. Continue the test as a constant rate test and analyze the data accordingly. Prior to dewatering, shut off the pump and perform a recovery test.

- The duration of a step depends on the observed water level in the pumping well. The target duration of each step is at least 60 minutes. If the water level in the test does not change by more than 0.1 foot after 10 minutes of pumping for a particular step, increase the discharge to the next step. If the water level in the test well comes within a foot of the top of the pump, then pumping should be eased to prevent dewatering and possible pump damage. If within a step, the pumping level reaches equilibrium (maintains a steady level), maintain the flow rate for at least 30 minutes. Usually such cases indicate a large transmissivity or recharge.

### 4.7.1 Well Recovery Test

The recovery portion of the drawdown pumping test is the same as it is for a step-drawdown test. It begins immediately after pumping ceases. Perform the following steps for recovery testing:

- Measure water levels in wells;
- Before the pump is shut off, prepare the electronic data logger for restart of the logarithmic cycle;
- When the pump is shut off, immediately re-start the electronic data logger and begin water level measurements per the intervals outlined in Exhibit 1-2, Time Intervals for Drawdown Measurements in a Pumped Well, and Exhibit 1-3, Time Intervals for Drawdown Measurements in Observation Wells;
- Continue monitoring water level recovery until water levels in the wells return to their static level (within 0.1 foot); and
- Terminate recovery measurements if the water level returns to the static level. (Do not remove the pump from the well until the recovery test is complete).

### 4.8 Review

Personnel performing aquifer pumping tests will record the applicable field data in the field log book and on the Aquifer Test Data form (Attachment 2), and will sign and date the “measured by” and “date” blanks. Electronic data logger printouts will be stapled to the appropriate Exhibit for each monitor well. These personnel will also sign and date electronic data logger printouts and calculations prepared during aquifer pumping test analyses.

The PM or designee will check the Aquifer Test Data form, electronic data logger printouts and calculations prepared during aquifer test analyses for completeness and accuracy. Any discrepancies will be noted and the documents will be returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the applicable reviewed documents.

## 5.0 REFERENCES

Matrix Environmental Services LLC (MES), 2013. Standard Operating Procedure - 13, “Equipment Decontamination”, SAP Attachment 3.

MES, 2013. Standard Operating Procedure - 2, “Aquifer Slug Testing”, SAP Attachment 3.

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## 6.0 EXHIBITS

| | |
|---|---|
| Exhibit 1-1 | Aquifer Testing Equipment List |
| Exhibit 1-2 | Time Intervals for Drawdown Measurements in a Pumped Well |
| Exhibit 1-3 | Time Intervals for Drawdown Measurements in Observation Wells |

## EXHIBIT 1-1
## Aquifer Testing Equipment List

The following list represents field equipment necessary to successfully conduct a proper pump test:

- Field Log Book
- Pickup truck with hitch and trailer
- Submersible pump and control box
- Pump discharge pipe or hose (with quick connect fittings)
- Manifold system with flowmeters (with quick connect fittings)
- Discharge hose (with quick connect fittings)
- 5 KW or 10 KW generator with compatible AC plug system
- Support boom with swing arm (to support pump in extraction well)
- Five-gallon fuel cans and funnel
- Electric sounders (plus extra batteries)
- Duct tape
- Teflon® tape
- Work gloves
- Tools (especially pipe wrenches)
- Tape measures (with increments in 0.01 ft)
- Rinse bottle and extra deionized water (prevents cross-contaminating wells)
- Mirror
- Flashlight
- Stopwatch
- Five-gallon bucket
- Rubber gloves
- Aquifer test data form (Exhibit 1-1)
- Four-cycle semilog graph paper
- Clipboard
- Project site map, well logs, well detail sheets
- Checklist
- Keys to well locking devices
- Pencils, rulers, calculator
- Buckets with extra fittings, etc. (spare parts)
- Appropriate safety equipment
- Technical Standard Operating Procedure 1, Aquifer Pump Tests

Optional equipment may be required for the following reasons: (1) a long-duration test is required (24 hours or longer), (2) groundwater sampling is required, or (3) climatic conditions.

### Optional Equipment

- Lantern with extra fuel
- Foul weather gear
- Sampling equipment
- Folding chair
- Hat
- Sunscreen
- Drinking water (many sites do not have this available)
- One-inch PVC discharge line (as needed)
- Toilet facilities

## EXHIBIT 1-2
## Time Intervals for Drawdown Measurements in a Pumped Well

| Time Since Pumping Started (or Stopped) (in minutes) | Time Intervals Between Measurement (in minutes) |
|---|---|
| 0 - 10 | 0.5 - 1 |
| 10 - 15 | 1 |
| 15 - 60 | 5 |
| 60 - 300 | 30 |
| 300 - 1440 | 60 |
| 1440 - termination of test | 480 (8 hr) |

## EXHIBIT 1-3
## Time Intervals for Drawdown Measurements in Observation Wells

| Time Since Pumping Started (or Stopped) (in minutes) | Time Intervals Between Measurements (in minutes) |
|---|---|
| 0 - 60 | 2 |
| 60 - 120 | 5 |
| 120 - 240 | 10 |
| 240 - 360 | 30 |
| 360 - 1,440 | 60 |
| 1,440 - termination of test | 480 (8 hours) |

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# STANDARD OPERATING PROCEDURE - 2

# AQUIFER SLUG TESTING

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide technical guidance and methods for performing slug tests on piezometers and monitor wells. It outlines methods and provides for documentation of field data.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Aquifer*: A geologic formation capable of yielding significant quantities of water to wells.

*Electronic Data Logger*: An electronic instrument capable of recording electrical impulses and converting them to data usable for scientific analysis. This instrument, when connected to a transducer probe, can record rapid changes in water levels over short time intervals.

*Hydraulic Conductivity*: A measure of the ability of a porous medium to transmit fluids. It is dependent on both the fluid and the medium. The hydraulic conductivity is generally defined as a rate of flow through a unit cross-sectional area under a unit hydraulic gradient. English units for hydraulic conductivity are commonly expressed either in gallons per day per square foot (gal/day/$ft^2$) or feet per day (ft/day). International System of Units (SI) metric units are often expressed in centimeters per second (cm/s).

*Hydraulic Gradient*: It is defined for any fluid as dh/dl, which is the ratio of the change in total hydraulic head (dh) per length (dl) of flow. It dimensionally has the units of feet per foot (ft/ft).

*Measuring Point*: A survey mark on a well casing from which measurements are taken.

*Piezometer*: A well designed for groundwater level measurements. Typically, a piezometer consists of a small diameter pipe screened over the aquifer interval.

*Slug*: Sealed pipe or other object which is used to produce rapid head change in a well by displacement. The head change can be produced by either quickly lowering the slug into the water or, after submerging the slug and allowing the water level to equilibrate, by quickly raising the slug above water.

*Transducer Probe*: The pressure transducer responds to pressure changes caused by groundwater level fluctuations. Pressure changes are converted to an electrical impulse and sent to an electronic data logger.

### 2.2 Abbreviations

| | |
|---|---|
| cm/s | centimeters per second |
| dh | total hydraulic head |
| dl | length of flow |
| ft/d | feet per day |
| ft/ft | feet per foot |
| gal/day/$ft^2$ | gallons per day per square foot |
| PM | Project Manager |
| SI | International System of Units |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks in accordance with this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This is accomplished by reviewing documents (Exhibits) and data produced during work performance.

## 4.0 PROCEDURES

### 4.1 Introduction

A slug test is conducted by measuring water level responses over time to an “instantaneous” withdrawal or addition of a “slug” of water. The addition of water is generally referred to as a falling head slug test whereas the removal of water is commonly called a rising head slug test. The falling head slug test is performed by adding a slug and measuring the fall in water levels subsequent to the initial instantaneous rise. The rising head slug test is usually performed by lowering a solid slug below the water table and allowing the water level to equilibrate to static conditions. The slug is quickly withdrawn from the well and the subsequent rise in water levels is measured.

Both types of tests can usually be performed at a monitoring well site. Although procedures described below are for a rising head slug test they can be considered applicable to both types of tests.

Do not perform slug tests simultaneously in adjacent monitor wells (i.e., within 50 feet of each other vertically or horizontally). Typically, use a 5- to 10-foot long slug of appropriate diameter to fit the well casing to provide the “instantaneous” head change.

### 4.2 Decontamination

Prior to lowering the equipment into any well or boring, decontaminate each item coming in contact with the groundwater in accordance with SOP-13, Equipment Decontamination.

### 4.3 Pre-Test Data Recording

Complete the Slug-Test Data prior to conducting each slug test. Obtain the following information from existing well logs prior to the slug test and record the information:

- Casing diameter;
- Borehole diameter;
- Location of surveyed measuring point;
- Total casing depth;
- Static water level (prior to introducing slug);
- Screen depth and interval;
- Location of filter pack;
- Lithology of screened interval; and
- Volume of slug.

### 4.4 Field Methods

#### 4.4.1 Setup

- Measure the static water level from the surveyed location measuring point on the well head with an electronic water level indicator. Record water levels to the nearest 0.01 foot. Determine the total monitor well depth with a weighted measuring tape from the measuring point.

- Measure water levels during the slug test with either an electronic data logger or an electronic water level indicator. Refer to the equipment operations manual for any instructions needed. Using the manufacturer's operations manual, select the appropriate transducer probe for the monitor well to be tested.

- Set the transducer probe in the monitor well at the appropriate depth as determined by the sensitivity of the transducer, height of the water column in the well, and length of the slug. Secure the probe cable so that it will not move during the test. If using an electronic data logger follow the manufacturer's operating instructions to complete the test setup and verify that the equipment is working correctly.

- After completion of the initial test setup and pre-run check, lower the solid slug into the monitor well so that the top of the slug is approximately two to three feet below the initial static water level. If there is insufficient water in the monitor well to allow complete submergence of the slug, immerse the slug as fully as possible without disturbing the transducer probe. Allow the water level in the monitor well to equilibrate to static water level conditions.

### 4.4.2 Testing

- Prior to slug removal, start the electronic data logger. Then quickly remove the slug from the monitor well. The transducer probe must remain stationary during the entire test. Continue the test until the water level returns to within 10 percent of the static water level or until 24 hours have elapsed.

  Set recording intervals on the data logger using either default time intervals or the intervals presented below as appropriate for test conditions.

| Elapsed Time (After removing slug) | Water Level Measurement Interval |
|---|---|
| 0-30 sec. | 1.0 sec. |
| 30-120 sec. | 3.0 sec. |
| 2-10 min. | 5.0 sec. |
| 10-100 min. | 2 min. |
| 100-1,000 min. | 10 min. |
| 1,000-10,000 min. | 100 min. |

- Measure the water level in the monitor well periodically with the water level indicator to verify that the data logger is functioning properly. Record the data on Slug Test Data form (Attachment 2). The required test completion time will depend upon the hydraulic conductivity of the surrounding formation. Slug tests may vary in duration from several minutes to more than a day.

- If available, print out logger data in the field using a compatible printer. Otherwise, periodically download data from the data logger onto the appropriate forms. Staple the printout of the slug test data to the corresponding Slug Test Data form.

- Slug tests performed in monitor wells that are anticipated to exhibit slow water level response (as indicated by monitor well development records), may be measured with an electronic water level indicator.

### 4.5 Analysis Methods

Analyze slug test data using an analytical method appropriate for the monitor well and local aquifer conditions. Methods may include: Hvorslev (1951); Cooper and others, (1967); Cooper and Jacob (1946); Bouwer and Rice (1976); and Bouwer (1989). Refer to the reference list in Section 5.0, References, for actual analytical methods.

In the field, an estimate of the hydraulic conductivity may be made by using Hvorslev's method (1951), where the hydraulic conductivity K is estimated by the following equation:

$$K= (r^2 \ln(L/R))/(2LT_0)$$

where: $K$ = hydraulic permeability
$r$ = radius of the well casing
$L$ = length of the well screen
$R$ = radius of the well screen
$T_o$ = the time it takes for the water level to rise or fall to 37 percent of the initial change

### 4.6 Review

Personnel performing slug tests will record the applicable field data in the field log book and on Slug Test Data form (Attachment 2), as determined by the PM. Staple electronic data logger printouts to the appropriate Exhibit for each monitor well. The personnel performing slug tests must sign and date Slug Test Data form, in the “measured by” and “date” blanks. These personnel must also sign and date electronic data logger printouts and calculations prepared during slug test analyses.

The PM or designee will check the slug test data, electronic data logger printouts, and calculations prepared during slug test analyses for completeness and accuracy. Any discrepancies will be noted and the documents will be returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating Slug Test Data form, and the applicable reviewed documents.

## 5.0 REFERENCES

Bower, H. 1989. “The Bower and Rice Slug Test - An Update.” Groundwater, 27: 3: 304-309.

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# STANDARD OPERATING PROCEDURE - 3

# USE AND MAINTENANCE OF FIELD LOG BOOKS

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the methods for use and maintenance of field log books. This procedure outlines methods, lists examples for proper data entry into a field log book.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

Not applicable.

### 2.2 Abbreviations

| | |
|---|---|
| DMP | Data Management Plan |
| PM | Project Manager |
| QC | Quality Control |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks in accordance with this procedure when conducting work related to environmental projects. Daily logs will be kept during field activities by a Field Team Member to provide records of events, observations and measurements taken in the field.

The PM or an approved designee is responsible for checking work performance and verifying that the applicable tasks required by this procedure have been performed. This will be accomplished by reviewing documents (Exhibits) and data produced during work performance.

## 4.0 PROCEDURE

### 4.1 Introduction

Field log books provide a means for recording observations and activities at a site. Field log books are intended to provide sufficient data and observation notes to enable participants to reconstruct events which occurred while performing field activities and to refresh the memory of field personnel while writing reports or giving testimony during legal proceedings. As such, entries will be as factual, detailed and as descriptive as possible so that a particular situation can be reconstructed without reliance on the collector's memory. Field log books are not intended to be used as the sole source of project or sampling information. Sufficient log books will be assigned to a project to ensure that each field team has a logbook with it at all times. If a logbook is not available, field forms should be used until a field log book becomes available.

### 4.2 Field Log Book Identification

Field log books shall be bound books with consecutively numbered pages. Log books will be permanently assigned to field personnel for the duration of a project, but are to be stored in site project files when not in use. If site activities stop for an extended period of time (i.e., two weeks or more) field log books will be stored in the project files. Each log book will be identified by a Site Name either prior to or after the completion of sampling.

The cover of each log book will contain the following information:

- Person or organization to whom the book is assigned;
- Book number;
- Project number (if different than site number); and
- Site name.

### 4.3 Log Book Entry Procedure

Every field team will have a logbook and each field activity will be recorded in the logbook by a designated field team member to provide daily records of significant events, observations, and measurements during field operations. Beginning on the first blank page and extending through as many pages as necessary, the following list provides examples of useful and pertinent information which may be recorded (optional).

- Serial numbers and model numbers for equipment which will be used for the project duration;
- Formulas, constants, and example calculations;
- Useful phone numbers; and
- County, state, and site address.

Entries into the log book may contain a variety of information. At a minimum, log book entries must include the following information at the beginning of each day:

- Date, initials and signature at top of each page;
- Start time;
- Weather;
- Decontamination methods to be used;
- Field personnel present and directly involved;
- Level of personal protective equipment being used on the site;
- Signature of the person making the entry;
- Equipment used and procedures followed; and
- Any field calculations.

In addition, information recorded in the field log book during the day will include (but is not limited to) the following:

- Sample description including sample numbers, time, depth, volume, containers, preservative, and media sampled;
- Information on field quality control (QC) samples (i.e., duplicates);
- Observations about site and samples (odors, appearance, etc.);
- Information about any activities, extraneous to sampling activities, that may affect the integrity of the samples;
- Any public involvement, visitors, or press interest;
- Equipment used on site including time and date of calibration;
- Background levels of each instrument and possible background interferences;
- Instrument readings for the borehole, cuttings, or samples in the breathing zone and from the specified depth of the borehole, etc.;
- Field parameters (pH, specific conductivity, etc.);
- Unusual observances, irregularities or problems noted on site or with instrumentation used;
- Maps or photographs acquired or taken at the sampling site, including photograph number and description (SOP-4, Sample Location Documentation); and
- Forms numbers and any information contained therein used during sampling should be referenced.

Log book entries will be made in indelible black or blue ink. No erasures are permitted. If an incorrect entry is made, the data will be crossed out with a single strike mark and initialed and dated by the originator. Entries will be organized into easily understandable tables if possible.

Log book pages will be initialed and dated at the top of the page. Times will be recorded next to each entry.

No pages or spaces will be left blank. If the last entry for a day is not at the end of the page, a diagonal line will be drawn through the remaining space and the line will be initialed and dated. Logbooks can become contaminated when used in the field. Every effort should be made by the field team to avoid contaminating the logbook. Logbooks can be kept in zip top plastic bags or temporary plastic covers can be used.

### 4.4 Review

The PM or an approved designee will check field log books, daily logs, and Exhibits for completeness and accuracy on an appropriate site specific schedule determined by the PM. Any discrepancies in these documents will be noted and returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the applicable reviewed documents.

## 5.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 1987. “A Compendium of Superfund Field Operations Methods.” EPA/540/P-87/001 (OSWER Directive 9355.0-14). December 1987.

U.S. Environmental Protection Agency (EPA). 1986. “RCRA Groundwater Monitoring Technical Enforcement Guidance Document.” September 1986.

Matrix Environmental Services LLC (MES). 2013. “Standard Operating Procedure 4, Sample Location Documentation”, SAP Attachment 3.

# STANDARD OPERATING PROCEDURE – 4

# SAMPLE LOCATION DOCUMENTATION

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the methods for permanently marking sample points and documenting site conditions. The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

Not applicable.

### 2.2 Abbreviations

| | |
|---|---|
| PM | Project Manager |
| SFSP | Site-Specific Field Sampling Plan |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks in accordance with this procedure on environmental projects.

The PM or an approved designee is responsible for checking work performed and ensuring that the work required by this procedure is performed in a satisfactory manner. This is accomplished by reviewing documents and data produced.

## 4.0 PROCEDURE

### 4.1 Introduction

It is important to adequately document sample locations in environmental investigations because additional sampling events may become necessary. An identifiable record of the previous sampling locations prevents replicate sample locations and increases the efficiency of the investigation.

### 4.2 Sample Point Marking

Sample points should be located by the criteria presented in the Site-Specific Field Sampling Plan (SFSP) or Site-Specific Corrective Measures Implementation Plan (CMIP) for the site. When a sample point is located, it will be permanently marked so any investigator working on the project can locate it. The following practical methods can be used to permanently locate sample points:

- A wooden stake driven securely into the ground (when possible) and identified with a unique site identification code;

- A metal spike or concrete nail driven into asphalt or concrete and the site identification code recorded on an attached tag; and/or

- The location and identification code spray-painted on the ground or ground cover surface. The location of each sample point should be recorded on a site map and referenced, if possible, to a permanent landmark. By using a compass, a bearing from the landmark can be determined and the distance between the landmark and sample point can be measured by pacing or with a tape. Sample points will not be surveyed until they have been sampled, as field operating conditions can dictate the movement of any sample point and a slight change would invalidate a surveyed sample point's location. Massive metal objects may cause interference when a compass is used.

### 4.3 Photographic Documentation

Identification and documentation of the sample point by photography can also be a useful tool. A photograph of the sample point can be particularly useful when the sample point has been intentionally located near a particular feature, structure, or suspected contamination.

Initially, the camera (and lenses, if applicable) that will be used for site pictures shall be recorded in the Photographic Field Log form. Identify the particular picture number in the form to identify which sampling site is recorded in the photograph. If a film camera is used, the roll number should also be recorded.

Other information which will be recorded in the Photographic Field Log form includes:

- Name of photographer and any individuals in photograph;
- An accurate description of what the photograph shows, including the name of the facility or site;
- The specific project name and project code;
- Location, weather conditions, date, and time the photograph was taken; and
- Orientation of the photographic view and distance to subject.

If film cameras are used, the following procedures also apply. Unexposed film will be recorded in the form as such. The location of film development and the date of processing will be recorded in the log book. The negatives will be supplied uncut, and two sets of prints will be supplied, one for permanent document control and one for investigative use. Each photograph is then identified and labeled on the back with the appropriate information with the use of a photo label Exhibit 4-1. The negatives and one set of prints will be stored in the project files

### 4.4 Review

Personnel performing sample location documentation are to record the applicable information on documents (e.g., field log books, photographs, etc.) as outlined in this procedure.

The PM or an approved designee shall check field log books, daily logs, and photographs for complete and accurate documentation. Any discrepancies will be noted and the documents will be returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the applicable reviewed documents.

## 5.0 REFERENCES

U.S. Environmental Protection Agency (EPA). 1986. "Engineering Support Branch. Standard Operating Procedures and Quality Assurance Manual." U.S. EPA Region IV. Environmental Services Division. Athens, Georgia. April 1986.

EPA. 1987. "A Compendium of Superfund Field Operations Methods." EPA/540/P-87/001 (OSWER Directive 9355.0-14). December 1987.

## 6.0 EXHIBITS

Exhibit 4-1 Photograph Label

# EXHIBIT 4-1
# Photograph Label

PHOTO NO.: ________________________________
PROJECT NAME:______________________________
PROJECT NO.:_______________________________
PHOTOGRAPHER:______________________________
LOCATION:__________________________________
DATE/TIME/DIRECTION:_______________________
ID OF PERSONS IN PHOTO:____________________
COMMENTS/DESCRIPTION:______________________
___________________________________________
___________________________________________
___________________________________________
___________________________________________

# STANDARD OPERATING PROCEDURE - 5

# SURFACE AND SUBSURFACE SOIL SAMPLING

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the equipment and procedures used for sampling surface and subsurface soils. This procedure outlines the methods for soil sampling with routine field operations on environmental projects.

The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Decision Unit (DU):* A decision unit (DU) is a specific area (or volume of soil) about which a decision is to be made. A DU may be composed of a single sampling unit (SU), or multiple SUs if the DU is large in size.

*Grid Cell:* A grid cell is a sub-division of a DU or SU. DUs or SUs are divided into uniform size grid cells and one increment is collected from each cell.

*Sampling Unit (SU):* A SU is the area and depth of soil to be characterized by the average concentration of an ISM sample. Sampling units are restricted to actual source zones and incorporate only areas that are similar in regards to impact (i.e., not to “dilute” contamination) and future use.

*Soil:* Unconsolidated materials above bedrock.

*Surface Soil:* Soil located zero to six to twelve inches below ground surface (bgs).

*Subsurface Soil:* Soil located above the bedrock surface and below six to twelve inches bgs.

*Shallow Subsurface Soil:* Soil located from six inches bgs to depths where manual collection techniques can be used.

### 2.2 Abbreviations

| | |
|---|---|
| AEIRG | Alabama Environmental Investigation and Remediation Guidance |
| bgs | below ground surface |
| DU | Decision Unit |
| EPA | Environmental Protection Agency |
| FSP | Field Sampling Plan |
| ISM | Incremental Soil Sampling |
| PM | Project Manager |
| POC | Purgeable organic compound |
| POX | Purgeable organic halogens |
| PRP | Potentially Responsible Party |

| | |
|---|---|
| SAP | Sampling and Analysis Plan |
| SOP | Standard Operating Procedure |
| SU | Sampling Unit |
| SVOC | Semivolatile organic compounds |
| TOC | Total organic carbon |
| TOX | Total organic halogens |
| VOC | Volatile organic compound |

## 3.0 RESPONSIBILITIES

Sampling personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The PM or an approved designee is responsible for ensuring that performance standards specified by this SOP are achieved. This will be accomplished by reviewing documents, forms, logs, and field procedures.

## 4.0 PROCEDURES

The objective of surface and subsurface soil sampling is to ascertain the type, degree, and extent of soil contamination at a site. The data can be used to evaluate potential threats to human health or the environment, to evaluate potential exposure pathways, or to calculate environmental risks. This section presents the various sampling equipment, approaches, collection techniques, and procedures that may be used during soil sampling. Specific soil sampling requirements will be outlined in the field sampling plan (FSP). A sampling method will be specified in the FSP, however the other options are still allowable if field conditions, available equipment, or other variables require a change to the method proposed.

### 4.1 Sampling Equipment

Equipment used for surface and subsurface soil sampling may include:

- Stainless steel mixing bowl
- Stainless steel trowels or spoons
- Stainless steel hand auger
- Stainless steel shovel
- Stainless steel direct push core sampler with stainless steel, PVC, or Telfon® liners (optional)
- EncoreTM Samplers or equivalent soil core sampler (optional)
- Disposable syringe samplers (optional)
- Push tubes samplers, e.g., Shelby tubes (optional)
- Barrel sampler (optional)
- Sealed (piston) sampler (optional)
- Post-hole diggers (optional)

Subsurface soil sampling may also use one or more of the following mechanical equipment:

- Drill rig
- Power auger
- Backhoe

## 4.2 Decontamination

Before initial use, and after each subsequent use, sampling equipment must be decontaminated using the procedures outlined in SOP-13, Equipment Decontamination, and in accordance with the Alabama Environmental Investigation and Remediation Guidance (AEIRG). For Incremental Soil Sampling (ISM), sampling devices can be used within a sampling unit (SU), or decision unit (DU) if the DU consists of one SU, without decontamination; but should be decontaminated or disposed of between SUs.

## 4.3 Sampling Location/Site Selection

Follow the sample design criteria outlined in the Sampling and Analysis Plan (SAP). Mark and document the sample locations as outlined in SOP-4, Sample Location Documentation (Attachment 3). Relocate the sample sites when conditions dictate, such as natural or artificial obstructions at the proposed sample location (e.g., boulders, asphalt, etc.). Document the actual sample locations on a topographic map or site sketch and photograph sample locations.

## 4.4 Sampling Approaches

It is important to select an appropriate sampling approach for accurate characterization of site conditions. Prior to undertaking any soil sampling program, it is necessary to establish appropriate measurement and system Data Quality Objectives. Refer to the U.S. Environmental Protection Agency (EPA) Soil Sampling Quality Assurance User's Guide (listed in Section 5.0, References) for guidance in establishing Data Quality Objectives, statistical sampling methodologies and protocols for each of the sampling approaches. Each approach is defined below.

### 4.4.1 Judgmental or Biased Sampling

Judgmental or Biased sampling is used primarily for documenting an observed release to the groundwater, surface water, air or soil exposure pathways. This form of sampling is based on the subjective selection of sampling locations where contamination is most likely to occur. Locations are based on relative historical site information and on-site investigation (site walk-over) where contamination is most likely to occur.

There is no randomization associated with this sampling approach because samples are primarily collected at areas of suspected highest contaminant concentrations. Any statistical calculations based on the results of this sampling technique will be biased.

### 4.4.2 Random Sampling

Random sampling, used for the characterization of a heterogeneous non-stratified waste, involves arbitrary collection of samples within a defined area. This method is most effective and accurate if the chemical heterogeneity of the waste remains constant from batch to batch. The easiest method for Random Sampling is to divide the area for sampling into an imaginary grid, assign a series of numbers to the units of the grid, and select the numbers or units to be sampled through the use of a random-numbers table, which can be found in the text of any basic statistics book. Note that haphazardly selecting sample numbers or units is not a suitable substitute for a randomly selected sample.

### 4.4.3 Stratified Random Sampling

Stratified random sampling, used for the characterization of a heterogeneous stratified waste, involves arbitrary collection of samples within a defined area and strata. This method is most effective and accurate if the chemical heterogeneity of the waste remains constant from batch to batch. The easiest method for stratified random sampling is to divide the area for sampling into an imaginary grid, assign a series of numbers to the units of the grid, and select the numbers or units to be sampled through the use of a random-numbers table, which can be found in the text of any basic statistics book. A random sample is then collected from each strata at the selected numbers or units on the grid. Note that haphazardly selecting sample numbers or units is not a suitable substitute for a randomly selected sample.

### 4.4.4 Systematic Grid Sampling

Systematic grid sampling involves dividing the area of concern into smaller sampling areas using a square or triangular grid. Samples are then collected from the intersection of the grid lines or “Nodes.” The origin and direction for placement of the grid should be selected by using an initial random point. The distance between nodes is dependent upon the size of the site or area of concern and the number of samples to be collected. Generally, a larger distance is used for a large area of concern.

### 4.4.5 Systematic Random Sampling

Systematic random sampling involves dividing the area of concern into smaller sampling areas. Samples are collected within each individual grid cell using random selection procedures.

### 4.4.6 Search Sampling

Search sampling utilizes a systematic grid or systematic random sampling approach to define areas where contaminants exceed clean-up criteria. The distance between the grid lines and number of samples to be collected are dependent upon the acceptable level of error (i.e., the chance of missing a hot spot). This sampling approach requires that assumptions be made regarding the size, shape, and depth of hot spots.

### 4.4.7 Transect Sampling

Transect sampling involves establishing one or more transect lines, parallel or non-parallel, across the area of concern. If the lines are parallel, this sampling approach is similar to systematic grid sampling. The advantage of transect sampling over systematic grid sampling is the relative ease of establishing and relocation transect lines versus an entire grid. Samples are collected at regular intervals along the transect line at the surface and/or at a specified depth(s). The distance between the sample locations is determined by the length of the line and the number of samples to be collected.

### 4.4.8 Incremental Soil Sampling Methodology (ISM)

Incremental sampling is a structured sampling protocol that reduces data variability and increases sample representativeness. The objective of ISM is to obtain a single sample for analysis that has an analyte concentration representative of a specific area or decision unit. Levels of statistical confidence and decision uncertainty that would require a large number of discrete analyses can often be obtained with a few incremental samples. ISM is described in more detail in Section 4.9.

## 4.5 Sampling Collection Techniques

Boreholes and pits will be filled in with the material removed during sampling unless otherwise specified in the Project Plan. Where a vegetative turf has been established, fill in with native soil or potting soil and replace the turf if practical in the holes or trenches when sampling is completed.

### 4.5.1 Homogenizing Samples

Homogenizing is the mixing of a sample to provide a uniform distribution of the contaminants. Proper homogenization ensures that the containerized samples are representative of the total soil sample collected. Samples to be composited or split should be homogenized after the aliquots have been combined. **DO NOT HOMOGENIZE (MIX OR STIR) SAMPLES FOR VOLATILE ORGANIC COMPOUND (VOC) ANALYSIS.** The following procedure will be used for homogenizing soil samples:

- Extrude the sample from the sampling device.
- Place sample in a glass or stainless-steel mixing bowl.
- Divide into four equal quarters using a stainless-steel spatula or glass rod.
- Mix each quarter individually.
- Combine the quarters into a central composite.
- Re-divide the sample into four equal quarters and repeat the procedure until the soil is homogenized as much as possible.
- Divide the sample into four equal quarters for a final time and withdraw aliquots from the four quarters equally to fill each sample container.

### 4.5.2 Compositing Samples

Compositing is the process of physically combining and homogenizing several individual soil aliquot of the same volume or weight. Compositing samples provides an average concentration of contaminants over a certain number of sampling points.

### 4.5.3 Splitting Samples

Splitting samples (after preparation) is performed when multiple portions of the same samples are required to be analyzed separately. Fill the sample containers for the same analyses one after another in a consistent manner (e.g., fill EPA volatile organic compound

(VOC) container, fill Potentially Responsible Party's (PRP) VOC container, fill EPA semivolatile organic compounds (SVOC) container, fill PRP SVOC container, etc.).

### 4.6 Surface Soil Sampling

Steps for performing surface soil sampling. Refer to the FSP for specific soil sampling requirements.

- Prior to sampling, remove leaves, grass, and surface debris using decontaminated stainless steel trowel.
- Identify and label the sample container as per SOP-15, Sample Identification, Labeling, and Packaging (Attachment 3).
- Collect surface soil samples with a decontaminated stainless steel trowel, spoon, or hand auger and transfer to a decontaminated stainless steel bowl for homogenizing. If VOC analyses are to be conducted, fill the appropriate VOC sample containers first and then proceed to transfer the appropriate aliquot of soil to the decontaminated stainless steel bowl for homogenizing.

For composite soil sampling, collect surface soil aliquots with a decontaminated stainless steel spoon, trowel or hand auger and add to a stainless steel bowl and homogenize. Prior to homogenizing, remove an aliquot for VOC analysis (if appropriate) and then homogenize.

Collect samples in the order of volatilization sensitivity. The most common collection order is as follows:

  - VOCs;
  - Purgeable organic carbon (POC);
  - Purgeable organic halogens (POX);
  - Total organic halogens (TOX);
  - Total organic carbon (TOC);
  - Extractable organics;
  - Total metals;
  - Dissolved metals;
  - Phenols;
  - Cyanide;
  - Sulfate and chloride;
  - Turbidity;
  - Nitrate and ammonia; and
  - Radionuclides.

EncoreTM, disposable syringe, or push tube samplers may also be used to collect surface soil samples for VOC analysis.

- Immediately transfer the sample into a container appropriate to the analysis being performed (SOP-14, Sample Containers, Preservation and Maximum Holding Times [Attachment 3]).
- Samples should be preserved and stored as per SOP-14 until ready for transport to the analytical laboratory.
- Complete the Chain-of-Custody Record and associated documentation.

- Record applicable information in the field log book as outlined in SOP-3, Use and Maintenance of Field Log Books (Attachment 3). This information may also be entered in a Soil Sample Collection Log (see Attachment 2).
- Excess soil sample media shall be treated as investigation derived waste.
- Decontaminate sampling equipment (SOP-13, Equipment Decontamination [Attachment 3]).

Surface soil samples may also be collected in conjunction with the collection of subsurface soil samples, see Sections 4.7 and 4.8.

### 4.7 Subsurface Soil Sampling Using Manual Techniques

Manual techniques are typically used for collecting shallow depth subsurface soil sampling. The more commonly used equipment for manual techniques are stainless steel spoons, shovels, hand-augers, and post-hole diggers. Refer to the project-specific FSP for project-specific equipment requirements and protocols.

Steps for performing shallow depth subsurface soil sampling using manual technique equipment are as follows.

- Remove leaves, grass, gravel, concrete, and any other surface debris that is present at or near the surface.
- Use a decontaminated stainless steel shovel to remove the top layer of soil.
- Excavate soil to the desired sampling depth by using a decontaminated hand auger (stainless steel spoons, shovel or post-hole digger may also be used). Periodically, remove the cuttings from the auger.
- When the proper sample depth is reached, remove the hand auger and cuttings from the hole.
- Lower the decontaminated core sampler or hand auger to the bottom of the hole. When using a core sampler, it must contain a decontaminated liner appropriate for the constituents to be analyzed.
- Mark the sample interval (i.e., one foot above ground level) on the hammer stem or auger.
- Operate the slide hammer on the core sampler to drive the sampler head into the soil, or advance the auger until it is flush with the interval mark at ground level.
- Record weight of hammer, length of slide, blow counts and geologic soil data for samples collected with a core sampler in the field log book as outlined in SOP-3, Use and Maintenance of Field Log Books (Attachment 3). This information may also be entered on a Soil Sample Collection Log.
- When the core sampler liner or auger has been advanced the total depth of the required sample, remove it from the bottom of the hole.
- Immediately remove the liner from the core sampler and transfer the sample into a container or stainless steel bowl for compositing and homogenizing as specified in the project-specific Field Sampling Plan appropriate to the analysis being performed using a stainless steel spoon or trowel.

Prior to compositing and homogenizing, fill the appropriate container (SOP-14) for VOC analysis (if conducted) and then composite and homogenize.

- Samples will be identified and label as per SOP-15, Sample Identification, Labeling, and Packaging (Attachment 3).
- Samples will be preserved and held as per SOP-14, Sample Containers, Preservation and Maximum Holding Times (Attachment 3).
- Complete the Chain-of-Custody Record and associated documentation.
- Record applicable information in the field log book as outlined in SOP-3, Use and Maintenance of Field Log Books (Attachment 3). This information can also be entered on a Soil Sampling Collection Log (Attachment 2).
- Decontaminate sampling equipment (SOP-13, Equipment Decontamination).

### 4.8 Subsurface Soil Sampling Using Direct Push Technology

Direct push technology uses hollow steel rods to advance into the soil and is most applicable in unconsolidated soils typically to depths less than 100 feet bgs. Direct push technology uses a single-rod system or cased (i.e., dual-tube) system and produces less IDW than manual techniques. Equipment used for advancing direct push rods include manual hammers, hand-held mechanical hammers, percussion hammers, hydraulic presses, and drill rigs. Direct push core samplers used to collect the soil samples include non-sealed samplers such as barrel, split-barrel (i.e., split-spoon), and push tube (e.g., Shelby tube), and sealed soil (piston) samplers. Refer to the FSP for project-specific equipment requirements and protocols.

Steps for performing subsurface soil sampling using the direct push sampling method are as follows.

- Remove gravel, concrete, surface debris, etc. that is present at or near the surface.
- For the single-rod direct push system (best for collecting a single sample), the direct push sampler is advanced on the end of a single sequence of rods to the desired sampling depth. Once sampling tool is full, withdraw sampler and rods from the ground. To collect another sample, the rods and sampler must be re-inserted into the hole and pushed to the next sampling depth.
- For the cased direct push system (best for continuous sampling), the direct push sampler is attached to the inner rods, and the sampler, inner rods, and outer rods are advanced into the soil simultaneously. To collect the sample, only remove the sampler and inner rods, leaving the outer casing in the ground. To collect a deeper sample, re-insert the sampler and inner rods and advance along the outer drive casing to the next sampling depth. Remove outer casing only after the last sample has been collected.
- Record geologic soil data for samples collected with a core sampler in the field log book, if required, as outlined in SOP-3, Use and Maintenance of Field Log Books (Attachment 3). This information may also be entered on a Soil Sample Collection Log.
- Immediately transfer the sample into a container or stainless steel bowl for compositing and homogenizing as specified in the project-specific FSP appropriate to the analysis being performed using a stainless steel spoon or trowel. Prior to compositing and homogenizing, fill the

appropriate container (SOP-14) for VOC analysis (if conducted) and then composite and homogenize.

- Samples will be identified and label as per SOP-15, Sample Identification, Labeling, and Packaging (Attachment 3).

- Samples will be preserved and held as per SOP-14, Sample Containers, Preservation and Maximum Holding Times (Attachment 3).

- Complete the Chain-of-Custody Record and associated documentation.

- Record applicable information in the field log book as outlined in SOP-3, Use and Maintenance of Field Log Books. This information can also be entered on a Soil Sampling Collection Log (Attachment 2).

- Decontaminate sampling equipment (SOP-13, Equipment Decontamination).

### 4.9 Incremental Soil Sampling Methodology (ISM)

ISM surface and subsurface soil sampling is designed to obtain a single aliquot for analysis that has all constituents in the same proportion as an explicitly defined volume of soil. The methodology provides reasonably unbiased, reproducible estimates of the mean concentration of analytes in the specified volume of soil. The data produced can be used to evaluate potential threats to human health or the environment, to evaluate potential exposure pathways, or to calculate environmental risks.

### 4.9.1 ISM Sampling Equipment

Proper equipment should be used that results in the collection of samples that do not contain more soil particles from one part of the sample than from other parts. The heterogeneous distribution of contaminated particles in the soil could lead to biased sample results. Therefore, sample increments should be collected in a manner that produces a cylindrical or core-shaped sample. Cylindrical or core-shaped samples can be accomplished using a soil core sampler (preferred) or a trowel or large spoon (if used to collect a core shaped sample). The most appropriate type of sampling device depends in part on the hardness of the soil or how rocky it is. It is important to understand field conditions and to test proposed sampling tools and methods at the site before selecting a particular type or combination of tools. The following tools and equipment represent the most common sampling equipment needed to collect an ISM sample:

- Compass
- Calculator
- Tape measure
- Spray paint
- Survey stakes
- Pin-flags
- Survey twine
- Stake hammer
- GPS handheld unit
- Disposable soil core sampler (e.g., En Core® sampler or equivalent)
- Appropriate sample containers (e.g., clean zip-lock bags, 5-gallon plastic containers, etc.) that

are adequate to hold the sample volume (i.e. 1-2 kilograms [Kg])
- Pre-tared, pre-preserved volatile sample containers (if ISM sampling will occur for volatile samples)
- Large stainless steel spoons or scoops
- Small stainless steel spatula or spoon
- Stainless steel trowels
- Digital camera
- Field notebooks
- Coolers with ice for cold storage of samples after collection

### 4.9.2 Decision Units, Sampling Units, and Grids

A decision unit (DU) is a specific area (or volume of soil) about which a decision is to be made, and may be composed of a single sampling unit (SU), or multiple SUs. SUs must be delineated so that the mean analyte concentrations obtained are directly relevant to well defined project objectives. They are the smallest volume of soil for which a concentration value will be obtained, and the basic unit about which a decision or conclusion based on an analytical result can be made.

The entire area of a DU (and SU) must be consistent concerning contamination distribution and future use/exposure scenarios. All or a percentage of the SUs composing the DU may be sampled in an ISM fashion, the number of SUs sampled depends on the confidence of the data that are extended from the SUs to the DU.

Care should be taken when designing and constructing DU grids. It is assumed that the planning requirements for establishing DUs are in place prior to the implementation of this SOP. If planning the DU and/or the SUs within a DU is required, the ITRC's Incremental Sampling Methodology Guidance document (ITRC, 2012) may be followed.

There are three approaches to establishing a DU grid for sampling: 1) systematic random/grid sampling with a random start (Figure 4-1), 2) random sampling within a grid (Figure 4-2), and 3) simple random sampling within an entire DU (Figure 4-3).

The most common approach for ISM, and the most representative (i.e. least biased) estimate of the mean, is a systematic random sampling where the DU is divided into a grid pattern, a random sample location is identified in the first cell, and then increments are collected from each cell sequentially in a serpentine pattern using the same relative location in each cell (Figure 4-1).

Another approach is random sampling within a grid (Figure 4-2), wherein samples are obtained sequentially from adjacent grid cells, but the location of the sample within each cell is random.

A third approach is simple random sampling, where the samples are taken from random locations across the DU (without gridding) (Figure 4-3).

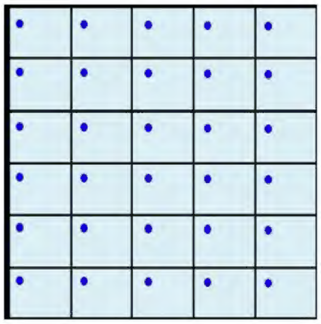
Figure 4-1

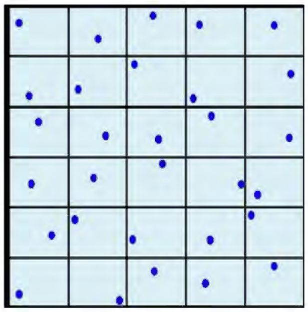
Figure 4-2

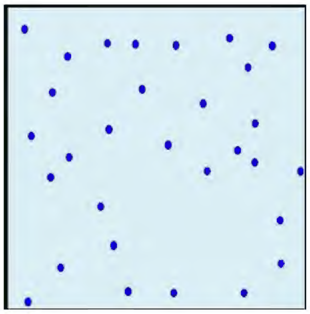
Figure 4-3

If the DU is subdivided into SUs the same chosen sampling approach should be used within each SU.

The following procedures should be used for DU layout and sample grid construction:

1. Lay out the DU corners according to the sample design indicated in the site-specific sampling plan. If the orientation of the DU isn't predefined in the site specific sampling plan, the ISM sample grids should be constructed with top of the grid to grid by using one of the following methods:
   - Use survey or GPS coordinate locations.
   - Consider proximity to landmarks or features (for example, 10 feet west of the southwest corner of Building XYZ).
   - Use indicators of historical activities (for example, less mature vegetative growth that might indicate the edge of a historical use area).
   - Center around a specific location.
2. Once the DU grid corners are determined and staked, simple random sampling without a grid can begin. If a grid pattern is being followed, then start to subdivide the DU into a minimum of 30 equally sized increment grid cells. Begin by placing stakes at each row and column division along the boundaries of the DU.
3. Use flags, spray paint, or survey twine to define the edges of each grid cell and complete construction of the ISM sample grid.
4. If a predefined figure of the DU and grids employed is not included in the project specific work plans, then a sketch the DU and sample grid design, orientation (compass bearing), overall dimensions, cell dimensions, nearby features, and any other valuable information will be recorded in the field notebook. Photograph the completed DU and sample grid for future reference. Survey the center and corner stake locations of the DU or record them with a GPS unit.

### 4.9.3 ISM Sampling

ISM samples are composed of increments collected from specific points throughout the DU or a SUs within a DU. The positioning of the collection points are set using one of the three approaches described in Section 4.9.2. Incremental soil samples are prepared by collecting multiple increments of soil (typically 30) from a specified DU or SU and physically combining these increments into a single sample, referred to as the "incremental sample." When the individual increment mass is adequate, this number of increments generally results in a soil sample with a contaminant concentration representative of the estimate of the mean contaminant level within a DU (i.e., a representative sample). The number of increments collected depends on the amount of distributional heterogeneity present within the DU for the constituent of interest, and the goals of the sampling being performed. For example, USEPA SW-846 Method 8330B recommends collecting 30 or more evenly spaced increments to build a sample with a total mass of >1 kg. The number of samples will vary from project to project and should be defined in the associated project specific work plan documents.

Although ISM sample collection may be performed by a single individual, a two-person team is often the most efficient method: ideally one person collects the increments and the other holds the sample container (e.g., clean polyethylene bag) and keeps track of the number of increments. However, site conditions may dictate that three or more individuals are required for the collection of a single ISM sample.

#### 4.9.3.1 Selection of Random Increment Locations

As mentioned in Section 4.9.2, the most common approach in ISM is a systematic random sampling (Figure 4-1). The random location can be determined using a random number generator, or the following method is provided for field use if the locations are not predetermined prior to field work. The method used to determine the selection of random increment locations should be documented in project specific work plans, or in the appropriate field log book if determined in the field.

Field staff may use the following procedures to determine the random sample location within each grid cell in the absence of a predefined location:

1. Begin by theoretically subdividing each grid cell into four quadrants as follows:

| | |
|---|---|
| NW=1 | NE=2 |
| SW=3 | SE=4 |

2. Randomly determine which quadrant will be sampled within each grid cell using a list of randomly generated numbers in Table 1, below. To select a random quadrant to sample, ask a random individual to select a number between 1 and 30.
3. Find the number that the individual selected in the first column of Table 1 and determine the corresponding number between 1 and 4 next to the selected number. The corresponding number between 1 and 4 denotes which quadrant should be sampled in each grid cell. Collect samples from the same selected quadrant in all grid cells. The random numbers in the second column of Table 1 were generated using the Microsoft Excel® RANDBETWEEN random number function. If additional random numbers are needed for a grid design with more than 30 cells, they can be generated using the same Excel function.
4. Once a number is selected and used, cross out that selected number in Table 1 and do not reuse that number for another ISM DU. If an individual selects a previously selected number, ask the person to select another number instead. Continue to use numbers from Table 1 until all 30 selection values are used, then repeat as needed until all DUs are sampled.

Table 1. List of Randomly Generated Values and Corresponding Grid Cell Quadrants

| Selected Number | Randomly Generated Number | Quadrant to Sample |
|---|---|---|
| 1 | 4 | SE |
| 2 | 1 | NW |
| 3 | 2 | NE |
| 4 | 2 | NE |
| 5 | 2 | NE |
| 6 | 3 | SW |
| 7 | 1 | NW |
| 8 | 4 | SE |
| 9 | 3 | SW |
| 10 | 3 | SW |
| 11 | 4 | SE |
| 12 | 2 | NE |
| 13 | 3 | SW |
| 14 | 2 | NE |
| 15 | 2 | NE |
| 16 | 3 | SW |
| 17 | 4 | SE |
| 18 | 1 | NW |
| 19 | 3 | SW |
| 20 | 4 | SE |
| 21 | 1 | NW |
| 22 | 3 | SW |
| 23 | 2 | NE |
| 24 | 1 | NW |
| 25 | 4 | SE |
| 26 | 3 | SW |
| 27 | 4 | SE |
| 28 | 4 | SE |
| 29 | 1 | NW |
| 30 | 4 | SE |

#### 4.9.3.2 Sample Collection

ISM sampling will vary depending on whether or not volatile organic compounds (VOCs) will be collected. ISM samples for VOC analyses must be collected before non-VOC analyses, and each sample increment must be deposited directly into a methanol- or or sodium bisulfate- preserved vial to reduce contaminant losses due to volatilization. To minimize the potential loss of VOCs, sample increments should be collected with minimal disruption and as quickly as possible to minimize exposure to ambient air. In addition, sieving must not be performed for VOC samples.

The following procedures should be used for ISM sampling for VOC analyses:

1. Prepare to collect ISM sample increments by putting on a new pair of disposable nitrile gloves immediately before collecting soil samples. The same pair of gloves can be worn to collect each sample increment in the DU as long as care is taken to avoid cross contamination. If personnel are transitioning between using hand tools to excavate and to collect samples, a new pair of disposable nitrile gloves should be put on before collecting samples.
2. Proceed to the first predetermined location. Collect a 2- to 5-gram ISM sample increment for VOC analysis at approximately 6 inches bgs for surface soils, or from a predetermined depth for subsurface soils using a soil core sampler. Immediately place the soil increment directly into the pre-tared vials containing methanol or sodium bisulfate provided by the laboratory. Immediately replace the lid on the container. Note: when a DU or SU consists of both surface and subsurface soils, the soils should be collected in layers in the same general location to the extent possible.

3. Repeat Step 3 at the same location and sample depth for any additional VOC analyses.
4. Collect a second 2- to 5-gram ISM sample increment for percent moisture analysis using the same core sampler from the same previous location and sample depth. Place the soil increment in an unpreserved 4- or 8-ounce sample container. This unpreserved sample must be submitted to the laboratory for a percent moisture determination for the VOC analyses.
5. For systematic random sampling, proceed to the next grid cell and repeat Steps 2 through 5, collecting sample increments from the same grid cell quadrant and same sample depth. For random sampling within a grid, proceed to the next cell, and repeat steps 2-5 at a predetermined random sample location. For a random sampling pattern within the entire DU, proceed to the next sample location and repeat steps 2-5. Extrude each soil increment into the same methanol preserved and unpreserved sample containers, as appropriate, until all grid cells in the DU are sampled. It is acceptable to use the same hand tools, soil core sampler, and disposable sample syringe or tip without decontamination because the ISM sample increments are combined.
6. Collect non-VOC and ISM duplicate and triplicate samples at the designated grid cells and DUs as discussed below.
7. Once ISM increments are collected from all the grid cells in the DU seal the sample containers.
8. Label each sample container appropriately and complete the chain-of-custody form. Place the samples in a cooler at approximately 4 degrees Celsius (°C) (±2°C) and package the samples for delivery to the laboratory according to SOP-015, Sample Identification, Labeling and Packaging (Attachment 3).
9. Record ISM activities in the field notebook as follows:
    - Sketch the ISM DU and grid pattern if a predefined pattern is not provided in site work plans.
    - Indicate which grid cell quadrant was sampled in the notes.
    - Show the collection locations of all the ISM sample increments on the field notebook sketch or on a predefined map from associated work plans.
    - Take photographs of the sampling activities and DU grid, including post-sampling photographs of the area to document the sampling locations.
    - Describe and classify the surface and subsurface soils collected according to Universal Soil Classification System (USCS) nomenclature. The soil should be described at each significant change in lithology type encountered across the DU.
    - Note any observed staining or obstructions, colors, odors, or any other sensory observation that may be important.
    - Document any deviation from the planned ISM approach, including if a different cell quadrant was sampled.

The following procedures should be used for ISM for non-VOC analyses:

1. Prepare to collect ISM sample increments by putting on a new pair of disposable nitrile gloves immediately before collecting soil samples. The same pair of gloves can be worn to collect each of the sample increments within the DU as long is care is taken to avoid cross-contamination. If personnel are transitioning between using hand tools to excavate and to collect samples, a new pair of disposable nitrile gloves should be put on before soil sampling.
2. Collect all VOC samples before collecting non-VOC samples according to steps provided above.
3. Begin by collecting a 35- to 60-gram ISM sample increment from the predetermined surface or subsurface location with a decontaminated large spoon or scoop, or other coring device. Avoid

collecting material larger than 2 mm, such as stones and roots. All material greater than 2 mm will be sieved out, so more mass may be needed to achieve the required minimum 30 laboratory subsamples after sieving.

4. Immediately place the soil increment directly into the large, clean, unpreserved sample container, such as a 1-gallon Ziploc® bag or plastic pail. If Ziploc® bags are used, double-bagging the sample is recommended in case the bag tears.
5. For systematic random sampling, proceed to the next grid cell and repeat Steps 1 through 4, collecting sample increments from the same grid cell quadrant and same sample depth. For random sampling within a grid, proceed to the next cell, and repeat steps 1 to 4 at a predetermined random sample location. For a random sampling pattern within the entire DU, proceed to the next sample location and repeat steps 1 to 4. A bulk sample volume of approximately 2.5 to 5 kilograms, or 1-gallon of material, should be collected from the DU. It is acceptable to use the same hand tools and sample spoon or scoop between sample increments without decontamination because the ISM sample increments are combined.
6. Once ISM sample increments are collected from all the grid cells in the DU, seal the sample containers and verify that sufficient bulk sample volume has been collected.
7. Label each sample container appropriately and complete the chain-of-custody form.

Place the samples in a cooler at approximately 4°C (±2°C). If the samples will be sent directly to the project laboratory, package the samples for delivery to the laboratory according to SOP-015, Sample Identification, Labeling and Packaging.

8. Record the ISM activities in the field notebook as follows:
    - Sketch the ISM DU and grid pattern if a predefined pattern is not provided in site work plans.
    - Indicate which grid cell quadrant was sampled in the notes.
    - Show the collection locations of all the ISM sample increments on the field notebook sketch or on a predefined map from associated work plans.
    - Take photographs of the sampling activities and DU grid, including post-sampling photographs of the area to document the sampling locations.
    - Describe and classify the surface and subsurface soils collected according to USCS nomenclature. The soil should be described at each significant change in lithology type encountered across the DU.
    - Note any observed staining or obstructions, colors, odors, or any other sensory observation that may be important.
    - Document any deviation from the planned ISM approach, including if a different cell quadrant was sampled.

#### 4.9.3.3 Special Considerations for Subsurface Soils

Sampling approaches for subsurface soils differ from those applied to surface soils because access to the subsurface is more difficult. For subsurface sampling to be representative, the entire core depth interval should be considered as an increment, collected, combined with additional increments for an ISM sample and submitted to the laboratory. Collection of the complete core interval as an increment is the recommended subsurface ISM procedure. This method can result in large ISM samples (approximately 5–10 kg), making logistics, such as field storage and shipping, problematic. Additionally, the selected laboratory must have facilities available to store, dry (if required), and process these large amounts of soil mass. Consequently, depending on the core diameter and interval depth, inclusion of the entire core increment across a targeted depth interval in an ISM sample may be impractical. In such cases, individual cores may be subsampled to reduce the final mass of the ISM sample. Two alternative, but less preferred, options are described below. In all cases, project specific work plans should describe the subsurface soil sampling approach used.

Alternate Option 1: The first option for collecting a representative subsample from a subsurface core increment for nonvolatile contaminants is to collect a "core wedge" sample. The simplest approach is to split the core in half vertically along the axis, reducing the increment mass by half. Alternatively, a single wedge of soil is taken from the entire length of the targeted depth interval. Removing a wedge of soil across the length of a larger core to encompass the entire depth interval rather than collecting the entire core depth interval as a whole, constitutes the mass of an individual increment of an ISM sample. Individual wedges from 30 or more separate DU cores are then combined to form the complete subsurface ISM sample. This option results in a more biased and less precise estimate of the DU mean as compared with collecting the entire core. However, since the mass of each increment (and thus the ISM sample mass) is reduced, some of the practical constraints associated with handling full core increments are addressed.

Alternate Option 2: The least preferred option for subsampling individual subsurface cores for nonvolatile contaminants is to collect a "core slice" from the targeted DU layer. In this approach, a randomly selected perpendicular "slice" from within the larger targeted depth interval is collected as the ISM increment. For example, if the targeted depth interval was 2 feet in length (e.g., 8–10 feet bgs), a 4-inch perpendicular slice is randomly selected from within the targeted depth interval of each individual core and collected as the ISM increment. Individual, randomly selected core slices from 30 or more separate DU cores are then combined to form the complete subsurface ISM sample. This option introduces more bias than whole-core increment or core-wedge approaches. However, by reducing the increment mass, some of the logistical issues associated with handling the full core or the wedge increments are addressed. This is the least recommended approach for subsurface ISM core sampling since it is least likely to accurately represent the complete vertical length of the targeted DU layer.

#### 4.9.3.4 Special Considerations for Stockpile Sampling

Special considerations for selecting DUs during the systematic planning process for sampling soil stockpiles include the following:

- the source of the soil in the stockpile
- how the stockpile was created (over time, if applicable)
- how best to access the pile for sampling, (e.g., large or unstable)
- contaminants targeted for lab analyses

One of the best options for sampling a stockpile is to coordinate sampling with the formation of any stockpiles on the site. When the stockpile is being formed, there is generally good access to sampling each portion of the pile over time, and ensuring access to the entire stockpile DU is provided for good sample representativeness. If an existing stockpile is relatively small, good options may include moving the pile and collecting the increments while it is being moved (e.g., from the front-end loader buckets, at appropriate intervals), or flattening or spreading out the stockpile sufficiently so that it is safely accessible to sample with a hand coring or other device. If the stockpile is very large or unstable, all available sampling tools or methods that safely provide access should be considered, with the goal of coming as close as possible to collecting a minimum of 30 systematic random or random within grids increments throughout the stockpile (both vertical and horizontal locations).

Replicates are important to evaluate the precision of stockpile sampling and should be collected similarly to the original sample except in separate random locations.

#### 4.9.3.4 Collection of Field Replicate ISM Samples

When ISM sampling is included in a sampling program, replicate incremental samples (three or more) should be taken to ensure reliable estimates of the mean concentration within the DU. The number of replicates and frequency of taking replicate incremental samples should be specified in project specific work plans and comply with project DQOs. In general, the triplicate sample set should come from a DU with a known or suspected reportable level of contamination.

To statistically evaluate sampling precision for each DU, additional completely separate replicate ISM samples are collected. The increments are collected in simple random, systematic random, or random within grid locations within the DU that are different from those used for the initial ISM sample. ISM field replicates are made of the same number of increments collected in the initial ISM sample and collected using the same sampling pattern from within the same DU. The replicate samples are prepared and analyzed in the same manner as the initial sample. Three replicate samples (i.e., the initial ISM sample plus two additional samples) should be considered the minimum. In some cases, more replicates may be necessary to reduce data variability and/or to calculate a 95% upper control limit of the mean that is closer to the actual mean of the DU.

If only one DU is being investigated, a minimum of three replicate samples should be collected to provide a measure of variability. For sites with multiple similar DUs, “batch” type replicates may be a consideration; for example, three replicates in one DU could be used to provide an estimate of variability that is extrapolated to a number of similar DUs. For sites with multiple or similar DUs, triplicate sample sets will be collected at a rate of 10 percent. Each site and/or project is unique in terms of numbers of DUs and how similar these DUs are, so decisions on numbers of replicates are unique to each site and should be addressed clearly in project related work plans.

### 4.10 Mechanical Equipment

Mechanical Equipment is typically used to advance a soil boring to depths that does not allow the use of manual boring devices. Mechanical equipment commonly used includes power augers, drill rigs, and backhoes.

- Power augers are commonly used to aid in the collection of subsurface soil samples at depths where hand augering is impractical, i.e., approximately up to 40 feet bgs. A power auger is used to advance a hole to the required sampling depth, at which point a hand auger, push tubes or split-spoons may be used to collect the samples.
- Drill rigs offer the capacity of collecting soil samples from great depths. When used in conjunction with drilling, split-spoon samplers are usually driven either inside a hollow stem auger or inside an open borehole after rotary-drilling equipment has been temporarily removed. The

spoon is driven with a 140-lb hammer through a distance of up to 24 inches and removed. Continuous split-spoon samplers are commonly used to obtain 5-foot long continuous samples.

- Backhoes may be used in shallow to deep subsurface soil sampling programs. Samples are collected from the bucket or from the trench wall. Prior to collecting samples from trench walls, the wall surface should be dressed with a stainless steel shovel, spatula knife, or spoon to remove the surface layer of soil that was smeared across the trench wall as the bucket passed. Samples from the bucket should be collected from within the large chunks that have not come into contact with the bucket surface.

Refer to the project-specific FSP for project-specific equipment requirements.

### 4.11 Abandonment Procedures

Abandon boreholes and fill to grade as described in the SAP.

### 4.12 Review

The PM or an approved designee shall check forms and field log books used to record information during sampling for completeness and accuracy. Any discrepancies will be noted and the documents will be returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the “checked by” and “date” blanks on the field forms and at the applicable places in the log book.

## 5.0 REFERENCES

Alabama Department of Environmental Management. 2005. “Alabama Environmental Investigation and Remediation Guidance”. September.

ITRC. 2012. “Technical and Regulatory Guidance: Incremental Sampling Methodology”.

U.S. Environmental Protection Agency (EPA). 1989. “Soil Sampling Quality Assurance User's Guide.” EPA/600/8-89/046, U.S. Environmental Protection Agency, Washington, DC.

# STANDARD OPERATING PROCEDURE - 6

# MONITOR WELL INSTALLATION

**See the *Monitoring Well Installation Plan* (Appendix B to the *Installation-Wide Sampling and Analysis Plan*), Matrix Environmental Services, LLC, January 2004, Revised December 2013.**

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# STANDARD OPERATING PROCEDURE - 7

# MONITOR WELL DEVELOPMENT

**See the *Monitoring Well Installation Plan* (Appendix B to the *Installation-Wide Sampling and Analysis Plan*), Matrix Environmental Services, LLC, January 2004, Revised December 2013.**

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# TECHNICAL STANDARD OPERATING PROCEDURE - 8

# WATER LEVEL MEASUREMENT

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the methods used for obtaining accurate water level measurements from groundwater monitor wells. This procedure outlines the equipment available for water level measurement and its operation. The Project Manager (PM) must approve site-specific deviations from the methods presented in this procedure.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

Not applicable.

### 2.2 Abbreviations

| | |
|---|---|
| DNAPL | Dense Non-Aqueous Phase Liquid |
| LNAPL | Light Non-Aqueous Phase Liquid |
| PM | Project Manager |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Personnel obtaining water level measurements are responsible for performing the applicable tasks outlined in this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents and data produced during work performance.

## 4.0 PROCEDURE

### 4.1 Introduction

Accurate groundwater level measurements are a fundamental requirement of any groundwater characterization study. Groundwater level measurements are used to construct water table maps, to determine gradient, to provide basic data during aquifer testing, to determine permeability and hydrologic conductivity, and to determine purge volume for well development and sampling. Static water levels should be measured before any other sampling or monitoring activities disturbs the wells. Water levels, for a group of wells, should be taken within as short a time span as possible to ensure compatible readings. If there is a rush of air in or out of the well when the well cap is removed, take water level readings every two minutes until the water level stabilizes with three consecutive readings within 0.1 foot.

A measuring point is marked on each well casing stickup, either by an impressed mark or paint mark. Measurements should be taken from this measuring point. If a measuring point is not marked, then the water levels should be taken from the north side of the casing stickup. The measuring point used to obtain the water level reading (mark or north side of casing) should be noted in the field log book.

The depth to water and the depth to the bottom of the well, to the nearest 0.1 foot, should be recorded on both the appropriate field form and in the field log book, along with any observation such as field monitoring reading, sediment on bottom, damage to well stickup, etc. The Groundwater Levels Form (Attachment 2) is used when the groundwater well is not sampled. The Groundwater Sampling Log (Attachment 2) is used when water levels are measured during groundwater sampling activities.

Groundwater level measurements will be taken with an optical/electronic interface probe or electric water level indicator. Read and follow the specific Manufacturer's Operating Instructions before using any equipment.

### 4.2 Interface Probe

The following describes an ORS brand interface probe. Read and follow the specific Manufacturer's Operating Instructions before using any type of interface probe.

The interface probe consists of a dual sensing probe utilizing an optical liquid sensor and electrical conductivity probe to distinguish between water and immiscible non-conducting liquids. A coated steel measuring tape graduated in fractions of feet or meters transmits the sensor's signals to a reel assembly, where an audible alarm sounds a continuous tone when the sensor is immersed in immiscible non-conducting liquids and an intermittent tone when immersed in water. The interface probe is accurate to within 0.1 of a foot.

When using the interface probe to measure water levels in wells or sumps containing a floating (Light Non-Aqueous Phase Liquid [LNAPL]) or sinking (Dense Non-Aqueous Phase Liquid [DNAPL]) layer of product, it is necessary to compensate for the effects of differing densities of the product and water. This is accomplished by using the following calculation:

(Immiscible Layer Thickness) (Product Density) + (Water Elevation) = Corrected Water Elevation

Note: An averaged product density for petroleum hydrocarbons (LNAPL) is 0.8.

After the interface probe has been decontaminated as described in Section 4.4, Inspection and Decontamination, it is lowered into the well or sump until an audible alarm is heard. The depth is read from the tape by comparing it with the measuring point. The probe is then lowered until a second alarm is heard (if applicable) indicating the interface level within the well. The probe can then be lowered until it touches the bottom of the well, to determine the height of the water column, and to detect any possible DNAPL. When the product/water interface is reached, the probe should be “jiggled” slightly to ensure that any adhering fluids are removed from the probe to provide the most accurate measurement of the interface. Record these depths in the field log book. Depths may also be recorded on the Groundwater Levels Form or the Groundwater Sampling Log.

### 4.3 Electrical Water Level Indicator

An electric water level indicator consists of a metallic probe on the end of a steel or plastic tape graduated in fractions of feet or meters. The tape contains wires that transmit the probe's signals to a reel containing an audible alarm or light. The electrical probe is not capable of indicating the presence of an immiscible non-conducting liquid.

The probe is used by lowering it into the well or sump until the alarm activates. The alarm should be tested prior to use. The depth on the tape is then compared with the measuring point and the depth is recorded on the Water Level Form the Monitoring Well Sampling Data form, and the field logbook. The probe can then be lowered until it touches the bottom of the well to determine the height of the water column.

### 4.4 Inspection and Decontamination

It is important to check the condition of electrical lines for nicks or breaks before each use. Breaks must be repaired before attempting to use the equipment. Periodically, the scale on the instrument tape should be compared to a tape of known accuracy as stretching of the instrument tape may occur after prolonged use. Personnel using the equipment will perform periodic tape calibration.

Probes and tapes must be decontaminated after each use. The tape will be decontaminated at the beginning of each day and after each use. This is best accomplished as described below:

- Wipe tape with laboratory-grade detergent solution saturated cloth;
- Wipe with distilled water saturated cloth;
- Wipe with methanol saturated cloth; and
- Wipe with distilled water saturated cloth.

Special considerations for the water level indicators are the connections between the tape and probe, which are often “jiggled” up and down at the water surface and LNAPL/water and DNAPL/water interfaces, as well as in sediment on the well bottom. Particles and fluids can lodge in the connections, so special efforts must be made to invasively clean these areas.

Measure water levels in monitoring wells in order of increasing contaminant level, where levels of contamination can be determined. Wells containing immiscible liquids should be measured last.

### 4.5 Review

The PM or an approved designee shall check the Groundwater Levels Form, Groundwater Sampling Log and/or logbooks for completeness and accuracy. Any discrepancies will be noted and the forms and logs will be returned to the originator for correction. The reviewer will acknowledge that review comments have been incorporated by signing and dating the “reviewer” and “date” blanks on each form and log.

## 5.0 REFERENCES

Alabama Department of Environmental Management. 2005. “Alabama Environmental Investigation and Remediation Guidance”. September.

U.S. Environmental Protection Agency (EPA). 1989. Superfund Ground Accuracy of Depth to Water Measurements.

EPA. 1991. “A Compendium of ERT Groundwater Sampling Procedures.” OSWER Directive 9360.4-06, January 1991. U.S. Environmental Protection Agency.

# STANDARD OPERATING PROCEDURE - 9

# WATER SAMPLE FIELD MEASUREMENTS

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) outlines the types of measurements and data requirements associated with the collection of either groundwater or surface water samples. Accurate measurement of water parameters is required when collecting water samples so that baseline conditions can be established, thus allowing later evaluations of how these parameters may have affected the sample results.

Site-specific deviations from the methods presented in this procedure must be approved by the Project Manager (PM).

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

Not applicable.

### 2.2 Abbreviations

| | |
|---|---|
| PM | Project Manager |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Sampling personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents and data produced during work performance.

## 4.0 PROCEDURE

Read and follow the specific Manufacturer's Operating Instructions before using any equipment.

Calibrate equipment as specified in the Manufacturer’s Operating Instructions. Additionally, calibrate equipment prior to and at the commencement of sampling activities to ensure proper equipment operation. Record the measurements for the field water parameters (e.g., temperature, pH, conductivity, oxidation-reduction potential, dissolved oxygen, total dissolved solids, turbidity) in the field log book or in an instrument log book. The methods used to collect the field water parameters measurements will be dependent on the sampling methods used to collect the groundwater and surface water samples (outlined in SOP-10 and SOP-11, respectively). Sample collection will occur when the groundwater chemistry parameters stabilize. Stabilization of the groundwater chemistry parameters occurs when pH measurements remain constant within 0.1 Standard Unit (SU), specific conductance varies no more than 10 percent, the temperature is constant for at least three consecutive readings, and turbidity is either less than 10 NTU or varies no more than 10 percent. These types of measurements are described below.

### 4.1 Flow-Through Cell

A flow-through cell will be used to collect water quality field sample measurements for groundwater sampling using a submersible pump (e.g., bladder pump). Groundwater is pumped through the flow-through cell, limiting exposure to air.

- Connect the submersible pump to a flow-through cell equipped with a YSI Model Multiprobe Water Quality Meter (or equivalent) using clean, dedicated Teflon tubing or Teflon-lined tubing.
- Lower the pump into the well to the desired depth (see SOP-10) and record the initial (baseline) measurement.
- Continue to collect water field parameters measurements at regular intervals until the readings have stabilized. Check the meter settings to be sure the desired scale is being used. Record all readings in the field log book and on the Groundwater Sampling Log (Attachment 2).
- Decontaminate the sampling equipment, including the flow-through cell, multi-probe, and submersible pump, following the Manufacturer's Operating Instructions and as outlined in SOP-13. Use new or dedicated tubing for each well sampled.

### 4.2 Bailer/Grab Samples

This method will be used for surface water grab sampling and groundwater sampling using a bailer.

- Collect the groundwater sample using a clean a bailer (see SOP-10) or the surface water sample as outlined in SOP-11.
- Place the water sample in a clean receptacle such as a plastic cup or glass beaker. Note: the water should be poured carefully down the side of the receptacle so as not to create bubbles which may affect the accuracy of the measurements for some of the parameters, e.g., dissolved oxygen.
- Insert the probe from the YSI Model Multiprobe Water Quality Meter (or equivalent) into the water according to the Manufacturer's Operating Instructions and record the field parameter measurements in the field log book and on the Groundwater Sampling Log (Attachment 2) or Surface Water Sampling Data form (Attachment 2). Check the meter settings to be sure the desired scale is being used.
- Collect groundwater samples and record the water field parameters measurements at regular intervals until the readings have stabilized. Record all readings in the field log book and on the Groundwater Sampling Log (Attachment 2).
- Decontaminate the probe and receptacles following the Manufacturer's Operating Instructions and as outlined in SOP-13.

### 4.3 In Situ Groundwater Field Measurements

The in-situ field parameters collection method involves inserting the probe directly into the groundwater (in situ). This method can only be used for groundwater wells where the probe can be lowered into the groundwater within the screened interval, i.e. shallow wells.

- Prior to collecting groundwater from the well, slowly lower a probe from the YSI Model Multiprobe Water Quality Meter (or equivalent) into the groundwater to the desired depth (see SOP-10) and record the initial (baseline) measurement.

- Continue collecting water field parameters measurements at regular intervals until the readings have stabilized. Check the meter settings to be sure the desired scale is being used. Record all readings in the field log book and on the Groundwater Sampling Log (Attachment 2).
- Decontaminate the probe following the Manufacturer's Operating Instructions and as outlined in SOP-13.

### 4.4 Review

The PM or an approved designee shall check the field log book as well as the Groundwater Sampling Log or the Surface Water Sampling Data form, for completeness and accuracy. Any discrepancies will be noted and the data will be returned to the originator for correction. The reviewer will acknowledge that review comments have been incorporated by signing and dating the "checked by" and "date" blanks on the Groundwater Sampling Log or the Surface Water Sampling Data form (Attachment 2).

## 5.0 REFERENCES

U.S. Geological Survey (USGS). 1984. National Handbook of Recommended Methods for Water-Data Acquisition.

Matrix Environmental Services LLC (MES), 2013. "Standard Operating Procedure 10, Groundwater Sampling", SAP Attachment 3.

MES, 2013. "Standard Operating Procedure 11, Surface Water Sampling", SAP Attachment 3.

MES, 2013. "Standard Operating Procedure 13, Equipment Decontamination", SAP Attachment 3.

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# STANDARD OPERATING PROCEDURE - 10

# GROUNDWATER SAMPLING

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the equipment and protocols for sampling groundwater monitor wells. This procedure outlines methods for well purging, sample collection, and filtration, when using bailers, submersible pumps and bladder pumps.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Blank*: An artificial sample designed to monitor the introduction of contaminants into a process. For aqueous samples, reagent water is used as a blank matrix.

*Field Blanks*: Blanks used to assess potential contamination resulting from exposure to ambient field conditions.

*Trip Blanks*: Blanks obtained from the laboratory or prepared by the field sampling team with reagent grade water at a designated clean location prior to sampling activities. Trip blanks are not opened in the field and act as a check for sample contamination originating from sample transport and site conditions.

*Rinsate Blanks*: Blanks prepared in the field from reagent-grade water that is poured over or passed through the sample collection device after the device has been decontaminated, then collected in a sample container and returned to the laboratory for analysis. Rinsate blanks check the effectiveness of decontamination procedures. Rinsate blanks can also serve as field blanks if they are prepared at the site.

*Specific Capacity*: The discharge of a well expressed as rate of yield per unit drawdown.

### 2.2 Abbreviations

| | |
|---|---|
| FID | Flame ionization detector |
| PID | Photo ionization detector |
| POC | Purgeable organic carbon |
| POX | Purgeable organic halogens |
| SAP | Sampling and Analysis Plan |
| SOP | Standard Operating Procedure |
| TOC | Total organic carbon |
| TOX | Total organic halogens |

| | |
|---|---|
| VOC | Volatile organic compound |

## 3.0 RESPONSIBILITIES

Sampling personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents and data produced during work performance.

## 4.0 PROCEDURES

- Read and follow the specific Manufacturer's Operating Instructions before using any equipment.
- Prior to initiating sampling of a groundwater well, check that equipment to be used is in good operating condition.
- If possible and where applicable, begin sampling event at those wells that are the least contaminated and proceed to those wells that are the most contaminated.
- Clean equipment entering the well by methods in SOP-13, Equipment Decontamination.
- Remove well casing cap, noting in the log book the following: personnel, well number, date, time and weather conditions, as well as any evidence of damage or disturbance to the well. This information may also be recorded on the Groundwater Sampling Log (see Attachment 2).
- If required by site-specific conditions, monitor headspace of well with a photo ionization detector (PID), a flame ionization detector (FID), or other appropriate monitoring instrument and record in the logbook.
- Check water level as per SOP-8, Water Level Measurement.
- Purge well.
- Sample well as per Section 4.2, Sampling Procedures.
- Filter and preserve samples as per Section 4.4, Sample Filtration and Preservation.

### 4.1 Well Purging

In order to obtain a representative sample of groundwater from a monitoring well, the water that has stagnated and/or thermally stratified within the well casing and filter pack must be purged. This procedure allows representative formation water to enter the well. The preferred method of ensuring representative formation water is being sampled is to monitor groundwater parameters during purging.

Measure pH, temperature, specific conductance, dissolved oxygen, and turbidity at regular volumetric intervals (i.e., one-half casing volume) during well purging using the methods outlined in SOP-9, Water Sample Field Measurements.

The purge volume of static water can be calculated by using the following formula:

V = (H) (r) (0.163*)

Where: V = Static volume of well in gallons
H = Linear feet of static water in well
r = Inside radius of well casing in inches
* = The constant conversion factor for a 2" diameter well is 0.163. For a 4" diameter well, use 0.653.

Where possible, the well should be sampled within two hours of purging. Record the results on the Groundwater Sampling Log (Attachment 2). When parameters vary less than ±10% (pH will vary less than 0.1 pH units) over three consecutive measurements the well may be considered to be adequately purged (stabilized). In wells with poor recovery, purge to near dryness and allow the well to recover prior to sampling. In wells with slow recharge rates, it may be necessary to wait several hours or until the next day to collect the sample.

When well water parameters do not stabilize the well can be sampled after four purge volumes have been removed.

Prior to initiating well purging, record the following groundwater parameters on the Groundwater Sampling Log (see Attachment 2):

- Static water level;
- Depth of well bottom;
- Height of water column;
- Volume of water in borehole;
- Time;
- Temperature;
- Conductivity;
- pH;
- Visual appearance; and
- Monitoring equipment (HNu/OVA or equivalent) readings.

### 4.2 Sampling Procedures

Sample the well within two hours after purging the required volume of water, where possible. Do not exceed two hours between purging and sampling, except in cases when a slow recharge rate requires more time between well purging and sample collection, and in cases where high turbidity concentrations in the groundwater is an issue. In those cases where high turbidity is an issue, the well may be allowed to re-charge 24 hours between well purging and sample collection. To ensure the groundwater sample is representative of formation water, it is important to minimize the possibility of cross-contamination by performing the following steps:

- Use only Teflon®, stainless steel or disposable sampling devices, which have been decontaminated prior to use.

- Use dedicated sampling equipment. If dedicated sampling equipment is not available, thoroughly decontaminate the equipment prior to any sampling and between sampling events according to the methods outlined SOP-13, Equipment Decontamination. Collect rinsate blanks as outlined in the Project Plans to verify that cross-contamination has not occurred.
- Specify the order in which the samples are to be collected. Collect samples in the order of volatilization sensitivity. Volatile organics should be collected when flow rate is less than 100 ml/minute. Fill sampling vial(s) completely making sure that there is no head space. The collection order for most common groundwater parameters is as follows:

    - Volatile organic compound (VOC);
    - Purgeable organic carbon (POC);
    - Purgeable organic halogens (POX);
    - Total organic halogens (TOX);
    - Total organic carbon (TOC);
    - Extractable organics;
    - Total metals;
    - Dissolved metals;
    - Phenols;
    - Cyanide;
    - Sulfate and chloride;
    - Turbidity;
    - Nitrate and ammonia; and
    - Radionuclides.

Transfer the groundwater sample to a sample container in such a manner that will minimize agitation and aeration. Samples should also be immediately placed in a cool place out of direct sunlight, such as a cooler. The cooler should be kept at an appropriate temperature for preservation requirements for the applicable analyses.

Immediately after the sample is collected, record applicable information in the field log book. This information may also be recorded on the Groundwater Sampling Log (Attachment 2).

#### 4.2.1 Sample Containers

The proper sample containers to be used for specific analysis and sample preservation are outlined in Table A4-1 of the Quality Assurance Plan (Appendix A of the Sampling and Analysis Plan [SAP]).

### 4.3 Sampling Methods

#### 4.3.1 Bailer Method

Collect groundwater samples with a bailer by lowering the bailer into the well using a disposable nylon line. Avoid contacting the ground or any other surface with the line and bailer. A plastic sheet can be used as an apron. Lower the bailer into the well in a controlled manner to avoid slapping the ground water surface with the bailer as this may cause outgassing of the water from the bailer's impact.

After the desired depth is reached, raise the bailer to the surface and empty it through the
bottom by a clamp valve. If the bailer is not equipped with a clamp valve, pour the sample from the bailer into the appropriate container. Empty the bailer at a slow, controlled rate to minimize sample aeration. After the sample containers have been filled, measure sample pH, temperature, and conductivity. Record applicable information on the Groundwater Sampling Log (Attachment 2).

The advantages to bailers are that they are portable, easily cleaned, and do not require an outside power source. The disadvantage to bailer sampling is that this method is slow when large volumes of water are required or when the well is deep.

#### 4.3.2 Bailer Decontamination

Decontaminate bailers prior to use in each well as per SOP-13, Equipment Decontamination. The bailer cord should be replaced prior to each sampling. Disposable bailers may be used in place of Teflon® or stainless steel bailers. Disposable bailers do not require decontamination.

#### 4.3.3 Bladder Pump Method

The bladder pump consists of a stainless steel housing that encloses a flexible membrane or bladder made of Teflon®. A screen is attached below the bladder to filter any material that may clog the bladder check valves. The pump may be operated by using an air compressor, compressed air, or compressed nitrogen.

The pump is lowered into the well to the desired depth. The air supply line is attached to the controller and the discharge line is placed into a suitable receptacle. When collecting samples for analysis of volatile constituents, do not exceed a pumping rate of 100 milliliters/minute. Higher pumping rates may increase the loss of volatile constituents and may cause fluctuation in pH and pH-sensitive analytes. For non-sensitive analysis, higher pumping rates may be used. Do not allow the sampling flow rate to exceed the flow rate used while purging. Place the samples in sample containers as outlined in SOP-14, Sample Containers, Preservation, and Maximum Holding Times. Record applicable sampling information on the Groundwater Sampling Log (Attachment 2).

The advantages to bladder pumps include ease of operation, ability to pump larger volumes of water. The disadvantages are that a power source is needed, some loss of volatile constituents is possible, and the decontamination process is difficult.

#### 4.3.4 Bladder Pump Decontamination

Decontaminate the bladder pump prior to use in each well. Disassemble and inspect the pump prior to cleaning. Decontamination is completed by the methods outlined in the owner's manual for the specific type of bladder pump, and SOP-13, Equipment Decontamination.

#### 4.3.5 Submerged Electrical Pump

The electrical pump is constructed of stainless steel. Consult the specific Manufacturer's Operating Instructions before operation. The pump is lowered into the well to the desired depth. The purge volume calculations should be determined prior to placing the pump in the well. Purge rates should not cause drastic drawdown, which results in water cascading into the well. When collecting samples for analysis of volatile constituents, do not exceed a pumping rate of 100 milliliters/minute. Higher pumping rates may increase the loss of volatile constituents and may cause fluctuation in pH and pH-sensitive analytes. For non-sensitive analysis, higher pumping rates may be used. Do not allow the sampling flow rate to exceed the flow rate used while purging. Place the samples in sample containers as outlined in SOP-14, Sample Containers, Preservation, and Maximum Holding Times. Record applicable sampling information on the Groundwater Sampling Log (Attachment 2).

### 4.4 Sample Filtration and Preservation

Some samples require field filtering within four hours of collection from the well. Filter samples by using a disposable in-line filter housing, or equivalent setup, equipped with a 0.45 micron glass fibre filter. Change filters for each sample. Collect the sample water directly into the sample container.

After the samples have been filtered and placed in appropriate containers, preserve samples as stated in SOP-14, Sample Containers, Preservation, and Maximum Holding Times.

### 4.5 Chain-of-Custody

Samples shall be accompanied by an appropriate Chain-of-Custody form at the time of transfer. The procedures for filling out a Chain-of-Custody form, transporting samples, and transferring custody of samples are outlined in the SAP.

### 4.6 Sample Labeling

Label samples according to the methods outlined in SOP-15, Sample Identification, Labeling, and Packaging.

### 4.7 Potable Water Sampling

During certain phases of field investigations, it may be necessary to collect samples from existing domestic or municipal water supply systems.

When samples are collected from domestic wells, the wells should be purged before the sample is collected. Residential wells often have holding tanks, which must be evacuated. Evacuation of the holding tank volume helps assure that representative samples are being collected from the aquifer. Information about well construction (casing diameter, depth to water, total depth, screened interval, and holding tank volume) should be obtained, if possible, in order to determine the appropriate volume of water to purge before sampling. If specific well information is not available, a 15-minute evacuation period is the minimum acceptable time. Temperature pH, conductivity and flow rate should be measured during purging. The well is considered purged
when field parameters stabilize.

The name, mailing address, and the resident's home and work telephone numbers are always entered into the sampling log book. This information will assist in informing the owner/operator of the water supply of the results of the sampling program.

Potable water samples must be representative of water quality within a given segment of the distribution network. Taps selected for sampling should be supplied with water from a service pipe connected directly to a water main in the segment of interest and should not be separated from the segment of interest by holding or storage tanks.

Taps should be opened for sufficient time to allow for clearing of the service line. Water samples can then be collected directly from this line into the appropriate sample containers.

### 4.8 Review

The reviewer shall check the Groundwater Sampling Log, for completeness and accuracy. Any discrepancies will be noted and the logs will be returned to the originator for correction. The reviewer will acknowledge that the review comments have been incorporated by signing and dating the “checked by” and “date” blanks on the Groundwater Sampling Log (Attachment 2).

## 5.0 REFERENCES

Alabama Department of Environmental Management. 2005. “Alabama Environmental Investigation and Remediation Guidance”. September.

Scalf, R. D. 1980. “Manual of Groundwater Sampling Procedures.” National Water Well Association and the U.S. Environmental Protection Agency (EPA) Robert S. Kerr Environmental Research Laboratory.

U.S. Environmental Protection Agency (EPA). 1991. “A Compendium of ERT Groundwater Sampling Procedures.” OSWER Directive 9360.4-06, January 1991. U.S. Environmental Protection Agency.

Matrix Environmental Services LLC (MES), 2013. “Sampling and Analysis Plan”.

MES, 2013. “Standard Operating Procedure 8, Water Level Measurement”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 9, Water Sample Field Measurements”, SAP Attachment 3.

MES, 2013. "Standard Operating Procedure 13, Equipment Decontamination", SAP Attachment 3.

MES, 2013. "Standard Operating Procedure 14, Sample Containers, Preservation, and Maximum Holding Times", SAP Attachment 3.

MES, 2013. "Standard Operating Procedure 15, Sample Identification, Labeling, and Packaging", SAP Attachment 3.

# STANDARD OPERATING PROCEDURE - 11

# SURFACE WATER SAMPLING

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the methods for surface water sampling. It describes the procedures and equipment to be used to obtain representative surface water samples that are capable of producing accurate quantification of water quality.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Aliquot*: Fractional amount.

*Composite Samples*: Samples composed of more than one aliquot collected at various sampling sites and/or at different times.

*Epilimnetic zone*: The uppermost layer of water in a lake, characterized by an essentially uniform temperature that is generally warmer than elsewhere in the lake and by a relatively uniform mixing caused by wind and wave action. Specifically, the light (less dense), oxygen-rich layer of water in a thermally stratified lake.

*Grab Samples*: Samples that are collected at one particular point and time.

*Hypolimnetic zone*: The lowermost layer of water in a lake, characterized by an essentially uniform temperature (except during turnover) that is generally colder than elsewhere in the lake and often characterized by relatively stagnant or oxygen-deficient water.

*Reach*: Segments of surface water with similar hydrologic characteristics commonly defined by a length of stream between two confluences or lake or pond, or any length of a stream between two points.

*Rinsate*: Waste water generated as a result of rinsing sampling equipment during decontamination procedures.

*Surface water samples*: Samples of water collected from streams, ponds, rivers, lakes, or other impoundments open to the atmosphere.

### 2.2 Abbreviations

| | |
|---|---|
| MES | Matrix Environmental Services |
| PM | Project Manager |
| SAP | Sampling and Analysis Plan |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks in accordance with this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents and data produced during work performance.

## 4.0 PROCEDURE

### 4.1 Introduction

The objective of surface water sampling is to evaluate the surface water quality entering and/or leaving a site. It is also used to obtain data on waste loads, water quality and characteristics that will permit prediction or modeling of the water system (to describe probable water quality), and effects on uses under a variety of conditions.

### 4.2 Sampling Equipment

There is a variety of equipment available for surface water sampling. Because each site may contain varied surface water conditions, collection of a representative sample may be difficult. In general, a sampling device will include the following characteristics:

- Be constructed of disposable or non-reactive material (Teflon® or stainless steel); and
- Have a minimum capacity of 500 ml to minimize sample disturbance.

Surface water sampling equipment will be designed to maintain sample integrity and to provide the desired level of quality in achieving desired analytical results.

Sampling equipment includes sampling devices and containers that are used to collect or contain a sample prior to final sample analysis.

### 4.3 Decontamination

Prior to and after each sampling event, sampling equipment must be thoroughly decontaminated following the methods outlined in SOP-13, Equipment Decontamination. The primary purpose of equipment decontamination is to prevent the potential of cross-contamination within the samples collected.

## 4.4 Sampling Location/Site Selection

Prior to sampling, consideration must be given to the specific sampling locations in order to provide a representative sample. This and other considerations are detailed in the Sampling and Analysis
Plan (SAP).

The general determining factors in the selection of a sampling device for sampling liquids in lakes, ponds, lagoons, and surface impoundments are listed below:

- Accessibility:
  - Boat: If the water is navigable, any sampling location is accessible by boat.
  - Bridges: Provide ready access, are readily identifiable, and permit water sampling at any point across the width of the water body.
  - Wading: Personnel safety must be paramount. Wading is not recommended in areas where bottom deposits are easily disturbed, thereby increasing the possibility of increased sediment in the samples.
- Rivers, streams, and creeks:
  - Sampling stations will be located wherever a marked physical change occurs in the stream channel. For example, between a rapids-to-deep water transition, as well as at both ends of the reach.
  - Sampling stations will be located short distances above and below dams and weirs to determine the effects on dissolved oxygen concentrations of water downstream.
  - A minimum of three sampling locations will be established between any two points of major change in a stream.
  - Sampling stations will be located upstream and downstream of any waste discharge site. Since the inflow frequently hugs the stream bank with very little lateral mixing, care must be taken to establish the sampling station after complete mixing with the main stream.
  - Samples will be collected in a downstream to upstream fashion to minimize potential impacts from sediments disturbed during sampling on a downstream location.
  - A tributary sampling station will be established near the mouth and upstream of any effects from the main stream. The station on the main stream will be just upstream from the confluence.
  - Sample as close as is practical to areas or points of important water uses.

  - At stations where wastes and tributary waters are well-mixed, one sampling point near mid-channel is usually adequate. At stations where mixing is inadequate, the station will be sampled at quarter points across the width of the station.

- Lakes, ponds, and impoundments:
  - A single station at the deepest point may be sufficient for naturally-formed ponds (near the center) and for impoundments (near the dam or spillway).
  - A sampling grid is the most representative for lakes and large impoundments.
  - In lakes with irregular shapes and with several bays and coves that are protected from the wind, sampling stations should be established in these areas.
  - A control station above a waste source is usually necessary to compare background water quality. It should be carefully selected and it may be necessary to have two or three control stations to establish the rate at which unstable material is changing. The time of travel between stations should be sufficient to permit accurate measurement of the change in the constituents under consideration.

## 4.5 Sampling Methods

### 4.5.1 General

The specific sampling method utilized will depend on the accessibility to, the size, and the depth of the water body, as well as the type of samples being collected.

In most ambient water quality studies, grab samples will be collected. However, the objectives of the study will dictate the sampling method.

For rivers, streams and creeks, the type of samples collected will be dependent upon the size and the amount of turbulence in the water body. Approximate the depth and location of samples in order to assure consistency. Flow rates will be measured using an appropriate method as described in SOP-17, Flow Measurement.

- With small streams less than 20 feet wide, a single grab sample collected at mid-depth in the center of the channel is usually adequate to represent the entire cross-section. In small streams and creeks less than 10 feet wide, a single grab sample can be collected by immersing the bottle directly under the surface of the water as close to the center of the channel as possible. This method reduces the potential for cross contamination as it does not require the decontamination of equipment. Clean non-reactive surgical or nitrile gloves are worn while the sample jar is immersed and filled in the sample media.

- For slightly larger streams, a vertical composite sample in the center of the channel may be required. The composite sample consists of samples taken just below the surface, at mid-depth and just above the bottom.
- For rivers, several vertical composite samples are collected across the water body. The vertical composite samples will be collected at points in the cross-section approximately proportional to flow. The number of vertical composites required and the number of depths sampled for each are usually determined in the field. This determination is based on a reasonable balance between two considerations:
    - The larger the number of subsamples, the more nearly the composite sample will represent the water body; but
    - Taking many subsamples is time-consuming and increases the chance of cross-contamination.
- For lakes, ponds and impoundments, the greater tendency to stratify and the relative lack of adequate mixing usually requires that more subsamples be collected. The flow rate of impoundments will be measured as described in SOP-17, Flow Measurement.
    - In ponds and small impoundments, a single vertical composite sample at the deepest point is usually adequate.
    - In lakes and larger impoundments, several vertical composites should be combined into a single sample. In some cases, it may be useful to form several composites of the epilimnetic and hypolimnetic zones. Normally, however, a composite consists of several verticals with subsamples collected at various depths.

### 4.5.2 Weighted Bottle Sampler

Collecting a representative sample from a larger body of water requires the gathering of samples from various depths and locations. For this type of sampling a weighted bottle sampler is used. The sampler consists of a Teflon® bottle, a weighted sinker, a bottle stopper and a wire cord used to raise, lower and open the samples. This type of sampler can be fabricated or purchased. The following procedures will be followed when sampling with a weighted bottle sampler.

- Decontaminate equipment in accordance with the procedures described in SOP- 13, Equipment Decontamination;
- Assemble the weighted bottle sampler in accordance with the sampler instruction manual;
- Gently lower the sampler to the desired depth so as not to remove the stopper prematurely. Do not let sampler disturb bottom sediments;
- Pull out the stopper with a sharp jerk of the sampler line;

- Allow the bottle to fill completely, as evidenced by the cessation of air bubbles;
- Raise the sampler, seal, wipe clean, label or identify and prepare the bottle for transport in accordance with project guidelines;
- Record the applicable information in the field log book and the Surface Water Sampling Data form; and
- Mark sample location and approximate depth, if possible, and note on maps and in field log book in accordance with SOP-3, Use and Maintenance of Field Log Books.

One additional grab sample from each location will be collected and described in terms of pH, conductivity, temperature, turbidity, odors and other significant characteristics. This sample will not be used for laboratory analysis.

### 4.5.3 Pond Sampler

The pond or dip sampler consists of a scoop or container attached to the end of a telescoping or solid pole. The sampler will be of non-reactive material such as wood, plastic, or metal. The sample will be collected in a jar or beaker made of stainless steel or Teflon®. Preferably, a disposable beaker that can be replaced prior to each sampling will be used at each station. Liquid wastes from water courses, ponds, pits, lagoons or open vessels will be “ladled” into a sample container.

Perform the following procedures when sampling with a pond sampler:

- Decontaminate sampling equipment in accordance with the procedures described in SOP-13, Equipment Decontamination;
- Assemble pond sampler in accordance with manufacturer's instructions;
- Extend pole to length that will allow safe access to desired sample location;
- Submerge pond sampler to desired sample depth. Submerge the sampler very slowly to minimize surface disturbance;
- Allow the sampler to fill very slowly;
- Retrieve the sampling device with minimal surface water disturbance;
- Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the sampler edge;
- Empty the sampler slowly, allowing the sample stream to flow gently down the side of the bottle with minimal entry turbulence. Fill sample bottle to appropriate head space, if any;

- Seal sample bottle, wipe clean, label or identify and prepare for transport in accordance with project guidelines;
- Collect additional grab samples to acquire field measurements such as temperature, pH, conductivity, turbidity and other significant characteristics;
- Record applicable data in the field log book and the Surface Water Sampling Data form;
- Mark sample location and approximate depth, if possible, and note location on maps and in field log book in accordance with SOP-3, Use and Maintenance of Field Log Books; and
- Decontaminate equipment in accordance with procedures described in SOP-13, Equipment Decontamination.

#### 4.5.4 Manual Hand Pumps

Manual pumps are available in various sizes and configurations. Manual hand pumps are commonly operated by peristaltic, bellows or diaphragm, and siphon action. Manual hand pumps that operate by a bellows or diaphragm, and siphon action should not be used to collect samples that will be analyzed for volatile organics. These types of pumps should be constructed out of inert materials; i.e., Teflon® or stainless steel.

Perform the following procedures when collecting surface water samples with a manual hand pump:

- Assemble and operate the pump in accordance with the manufacturer's instructions;
- The inlet hose and any surface of the pump used for sampling will be constructed of materials that are operable and non-reactive;
- To avoid agitation, insert the sampling tube into the liquid sample prior to pump activation;
- Insert a liquid trap (preferably the sample container) into the sample inlet hose to collect the sample and to prevent pump contamination;
- Sample bottles will be sealed, wiped clean, labeled or identified and prepared for transport in accordance with appropriate SOPs;
- Record applicable data in the field log book. Data may also be recorded on the Surface Water Sampling Data form;
- Decontaminate equipment in accordance with procedures described in SOP-13, Equipment Decontamination; and

- Mark sample locations and approximate depth, where possible, and note location on map and in field log book in accordance with SOP-3, Use and Maintenance of Field Log Books.

### 4.5.5 Peristaltic Pump

Gathering surface water samples with the assistance of a peristaltic pump is another commonly used sampling technique. In this method the sample is drawn through heavy-walled tubing and pumped directly into the sample container. This system allows the operator to extend into the liquid body to sample from depth, or sweep the width of narrow streams. Medical-grade silicon tubing is often used in the peristaltic pump and the system is suitable for sampling almost any parameter, including most organics:

Peristaltic pumps are available with a range of power sources. For field use the battery operated units have proven most convenient and very reliable.

Perform the following procedures when sampling with a peristaltic pump:

- Prepare the peristaltic pump in accordance with manufacturer's instructions. When using a battery-operated pump, be sure battery is fully charged prior to entering the field.
- In most situations, it is necessary to change the Teflon® suction line and the silicon pump tubing between sample locations to avoid cross-contamination. This action requires maintaining a sufficiently large stock of tubing material to avoid having to decontaminate the tubing in the field.
- Gently lower the pump intake tube to the desired sample depth. Avoid unnecessary agitation (aeration) of the liquid to be sampled and bottom sediments.
- Prior to activating the pump, note in which direction the pump will be rotating. (Most peristaltic pumps are capable of rotating in two directions.) Accidental reverse rotation of the pump will cause aeration of the liquid to be sampled.
- Run the pump until no air bubbles are noted in the discharge.
- Discharge water shall be released down stream from sampling area during sampling event.
- To prevent excess agitation and/or aeration of the sampler, fill the sample containers by tilting the container and flow the sample water down the side of sampling container.
- Record applicable data in the field log book (i.e. color, turbidity, pH, degree of turbulence, and weather conditions). Data may also be recorded on the Surface Water Sampling Data form (see Attachment 2).

- In most cases, no specific decontamination procedures are required due to the use of disposable tubing. However, site-specific sample procedures may require additional decontamination. Check with the PM prior to commencing field operations.
- Mark sample location and approximate depth, if possible, and note location on map and in field log book in accordance with SOP-3, Use and Maintenance of Field Log Books.

When medical grade silicon tubing is not available for analytical requirements, the system can be altered. In this configuration, the sample volume accumulates in a vacuum flask and does not enter the pump. This system will provide excellent sample integrity for most analyses; however, the potential for losing volatile fractions to the reduced pressure of the vacuum flask renders this method unacceptable for sampling of volatiles.

It may sometimes be necessary to sample large bodies of water where a near-surface sample will not sufficiently characterize the body as a whole. In this instance, the above-mentioned pump is appropriate. It is capable of lifting water from slightly deeper than six meters. It should be noted that this lift ability decreases somewhat with higher density fluids and with increased wear on the silicone pump tubing. Similarly, increases in altitude will decrease the pump's ability to lift from depth. When sampling a liquid stream that exhibits a considerable flow rate, it may be necessary to weight the bottom of the suction line.

#### 4.5.6 Optional Sampling Methods

The above-mentioned methods of surface water sampling will be used most often on environmental projects; however, choice of sampling equipment depends on site-specific conditions. Additional types of samplers available are:

- Kemmerer sampler;
- Wheaton sampler;
- Bacon Bomb sampler;
- Open tube sampler;
- D.O. Punker sampler; and
- Bailer.

Prior to any fieldwork, the PM will review the available sampling equipment and choose the sampler that will best suit the project requirements.

### 4.6 Sample Collection Records

Surface water samples gathered in the field will be labeled, shipped and documented in accordance with the site-specific requirements set forth in the following:

- Samples will be transported in accordance with the procedures outlined in the SAP;
- Samples will be labeled or identified in accordance with procedures outlined in SOP-15, Sample Identification, Labeling, and Packaging;
- Quality assurance and quality control procedures outlined in the SAP;
- The Surface Water Sampling Data form contained in Attachment 2 must be filled out for each surface water sample collected; and
- Detailed Field Log Books documenting the sampling event must be kept. Field notes will be in accordance with procedures outlined in the SOP-3, Use and Maintenance of Field Log Books.

### 4.7 Review

The PM or an approved designee shall check Exhibits and field log books used to record information during sampling for completeness and accuracy. Any discrepancies will be noted and the documents will be returned to the originator for correction.

The reviewer will acknowledge that these review comments have been incorporated by signing and dating the “checked by” and “date” blanks on the forms and at the applicable places in the log books.

## 5.0 REFERENCES

Matrix Environmental Services LLC (MES), 2013. “Standard Operating Procedure 3, Use and Maintenance of Field Log Books”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 13, Equipment Decontamination”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 15, Sample Identification, Labeling, and Packaging”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 17, Flow Measurement”, SAP Attachment 3.

# STANDARD OPERATING PROCEDURE - 12

# SEDIMENT SAMPLING

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes the guidelines for sediment sampling using a variety of sampling devices. Methods for preventing sample and equipment cross-contamination are included. Proper sediment sampling ensures that any evaluations of sediment contamination are based on actual contaminant levels and are not based on improper sampling techniques.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

Not applicable.

### 2.2 Abbreviations

| | |
|---|---|
| cm | centimeters |
| ft/sec | feet per second |
| MES | Matrix Environmental Services, LLC |
| PM | Project Manager |
| QAP | Quality Assurance Plan |
| SAP | Sampling and Analysis Plan |
| SOP | Standard Operating Procedure |
| VOC | Volatile Organic Compounds |

## 3.0 RESPONSIBILITIES

Field personnel collecting sediment samples are responsible for performing the applicable tasks outlined in this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents (Exhibits) and data produced during work performance.

## 4.0 PROCEDURES

### 4.1 Non-Subaqueous Sediment Sampling

Non-subaqueous sediment sampling will consist of the following:

- Field personnel will record data in the field log books as described in SOP-3, Use and Maintenance of Field Log Books; SOP-4, Sample Location Documentation; and the Sediment Sample Collection Log (Attachment 2).
- Insert a decontaminated Teflon® or stainless steel spoon, scoop or trowel into sediment surface and remove sample; or rotate auger into the sediment and remove sample.
- Collect samples for volatile organic compounds (VOC) analysis from the sampling device or from unmixed sediment placed into a stainless steel bowl.
- Place the sample in a decontaminated stainless steel bowl. Stir sample thoroughly (non-VOC samples only) with a decontaminated stainless steel spoon or spatula to provide a homogeneous mixture prior to filling sampling containers.
- Fill the appropriate sample containers as specified in SOP-14, Sample Containers, Preservation, and Maximum Holding Times.
- Identify or label samples according to SOP-15, Sample Identification, Labeling, and Packaging.
- Samples will be preserved and held as per the Quality Assurance Plan (QAP) (Appendix A).
- Decontaminate the sampling equipment as described in SOP-13, Equipment Decontamination.

### 4.2 Subaqueous Sediment Sampling

Subaqueous sediment sampling will consist of the following:

- Specific sediment sampling devices are described in Exhibit 12-1, Sampling Equipment and Techniques.
- Decontaminate sampling equipment according to SOP-13, Equipment Decontamination.
- If sampling from a boat, attempt to collect the sample with the boat engine off or attempt to ensure that exhaust fumes are directed away from the sample collection area until the sample has been collected.
- Lower the sampler at a controlled descent of approximately one foot per second (ft/sec.), until the sampler reaches the bottom as indicated by a slackening of the cable. Slowly retrieve the sampler and raise it at a controlled speed. When the sampler is at the water surface, attach a tag line(s) to steady and pull the sampler back into the boat. If large samplers are used, a motorized winch will be required for retrieval.
- Open and tie back any vent flaps on the sampler and carefully siphon off any overlying water over the side of the boat.
- Visually inspect the sample for acceptability (e.g., determine if an undisturbed surface layer is evident, the overlying water is not excessively turbid, and adequate penetration is achieved);

if the sample is not acceptable, discard it and collect another sample from an adjacent location.

- Carefully extrude the sediment from the sampler by slowly lifting on the winch cable and sliding the sample out the bottom of the sampler. If using core liners, remove the front face of the core liner to expose the side of the core.
- Visually inspect the side of the sample to identify any obvious stratification (e.g., different sediment types, sizes or colors), and if no patterns are evident, collect a sample from the surface and mid-core depth. During some investigations, it may be necessary to collect separate samples from the surface and mid-core depths. This may best be accomplished by gently scraping the side of the core with a decontaminated stainless steel scraper or knife. Scrape from the bottom to the top of the core only. If the sediment is unconsolidated, do not scrape.
- Remove a sample from the upper two centimeters (cm) of the sample using a decontaminated Teflon® or stainless steel scoop and place it in the sample container. From an undisturbed area of the sample surface, scoop a two-cm sample only if grain size analysis is required. After grain size analysis samples are collected, scrape off the upper sediment layer and discard overboard. Collect samples from the mid-section of the sediment. Sediment must be removed with caution to avoid contaminating the sample (i.e., from exposure to engine exhaust, rust, or grease).
- Nonrepresentative materials such as twigs or debris should not be included in the sample. Sediments contacting the side of the sampler or core liner should not be included for analysis. Aliquot size (i.e., mass), container type, storage conditions, and holding times will follow guidelines in the project plans and QAP.
- Identify or label samples as outlined in SOP-15, Sample Identification, Labeling, and Packaging.

### 4.3 Stream Sediment Sampling

Stream sediment sampling will include the following:

- The sample should be collected in an area of sediment accumulation, such as the inside of stream meanders, quiet shallow areas, and low velocity zones. Avoid areas of net erosion, such as high velocity, turbulent flow zones.
- Sediment samples will be collected in a downstream to upstream fashion to minimize potential impacts from sediments disturbed during sampling on downstream locations.
- If possible, remain on the stream bank. If the sample cannot be obtained from the bank, enter the stream from a point downstream of the sediment sampling location. Entering a river may be hazardous, hence, consult the Site Health and Safety Plan for specific safety procedures. Collect the sediment sample by reaching into the stream with a decontaminated stainless steel spoon or Teflon® scoop and scooping a sample in an upstream direction. Attempt to minimize the loss of fine material.
- Place sample in a stainless steel beaker or bowl and gently mix with a stainless steel spoon (non VOC samples only). Transfer the sediment samples to the appropriate sample containers using the stainless steel spoon. Do not mix samples for volatile organic analysis. If duplicate

or split samples are to be obtained, transfer the sediment directly from the stainless steel bowl into the sample containers in the same manner as standard samples.

- Identify or label sample containers in accordance with SOP-15, Sample Identification, Labeling, and Packaging, and store as specified in the QAP.
- Decontaminate sampling equipment as outlined in SOP-13, Equipment Decontamination.
- Record data in field log books and on the Sediment Sample Collection Log (Attachment 2).

### 4.4 Review

The PM or an approved designee shall check documents generated during sampling operations for completeness and accuracy. Any discrepancies will be noted and the documents will be returned to the originator for correction. The reviewer will acknowledge that these review comments have been incorporated by signing and dating the applicable reviewed documents.

## 5.0 REFERENCES

Alabama Department of Environmental Management. 2005. “Alabama Environmental Investigation and Remediation Guidance.” September.

Matrix Environmental Services LLC (MES), 2013. “Standard Operating Procedure 3, Use and Maintenance of Field Log Books”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 4, Sample Location Documentation”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 13, Equipment Decontamination”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 14, Sample Containers, Preservation, and Maximum Holding Times”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 15, Sample Identification, Labeling, and Packaging”, SAP Attachment 3.

## 6.0 EXHIBITS

| | |
|---|---|
| Exhibit 12-1 | Sampling Equipment and Techniques |

## EXHIBIT 12-1
## Sampling Equipment and Techniques

Sediment samples may be obtained using on-shore or off-shore techniques. Sediment sampling equipment and techniques must be designed to minimize the risk of dilution or loss of material as the sample is moved through the water column. For situations where boats are required for sampling, extra precautionary measures must be employed. At a minimum, life preservers must be provided and two individuals will undertake the sampling and an additional person will remain in visual contact on-shore to observe the operations. Sediment sampling is described below.

### Dip Sampler

A dip sampler consists of a pole with a jar or scoop attached. The pole may be made of bamboo, wood, Teflon®, or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is attached by a clamp.

The dip sampler is operated by submerging the jar or scoop and pulling it through the sediments to be sampled. The samples retrieved are then transferred into the appropriate sample container after decanting the liquid. Further decanting can occur while the sample is present in the sample jar. Avoid contact with sampler's gloves. Transferring the sample may require the use of a stainless steel or Teflon® spoon/spatula.

### Hand Operated Core Samplers

Hand operated sediment core samplers are used to obtain sediment samples in shallow water (less than three feet). These samplers operate in a manner similar to soil core samplers. However because of the saturated conditions of most sediments, provisions must be made to retain the sample within the core. Core samplers are generally constructed of a rigid metal outer tube into which a two-inch plastic core sleeve fits with minimum clearance. The cutting edge of the core sampler has a recessed lip on which the plastic sleeve rests and which accommodates a core retainer. This retainer is oriented such that when the sampler is pressed into the sediment, the core is free to move past the retainer. Due to construction of the retainer, the core will not fall through the retainer upon removal of the sampler from the sediment.

When the sampler is removed from the sediment, the plastic sleeve is removed. The sediment is removed from the sleeve and placed in the appropriate sample container. Chlorinated organics will not be collected using core samplers because core sleeves and retainers are generally made of plastic. The hand operated core sampler will not be useful for obtaining samples of gravelly, stony or consolidated sediments.

### Gravity Core Samplers

Gravity core samplers are used to obtain sediment samples in water bodies or lagoons with depths of greater than three to five feet. These types of samplers can be used for collecting one- to two-foot cores of surface sediments at depths of up to 100 feet beneath the water surface.

As with most core type samplers, gravity core samplers are not suitable for obtaining samples of coarse, gravelly, stony, or consolidated deposits. They are, however, useful for fine grained inorganic sediment sampling.

The gravity core sampler operates in a manner similar to the hand operated core in that a two-inch plastic sleeve fits within a metal core housing fitted with a cutting edge. Plastic nests are used to retain the core within the plastic sleeve. An opening exists above the core sleeve to allow free flow of water into and through the core as it moves vertically downward to the sediment. The sampler has a messenger-activated valve assembly which seals the opening above the plastic sleeve following sediment penetration. This valve is activated by the messenger creating a partial vacuum to assist in sample retention during retrieval.

Samples are obtained by allowing the sampler, which is attached to approximately 100 feet of aircraft cable, to drop to the benthic deposits. The weight of the sampler drives the core into the sediment to varying depths depending on the characteristics of the sediments. The messenger is then dropped on the taut aircraft cable to seal the opening above the plastic sleeve. The sampler is then carefully retrieved.

Upon retrieval of the sampler, the plastic core sleeve is removed and the sample placed in the appropriate sample container. Care should be exercised in labeling in order to properly identify sample orientation.

**Dredges**

Dredges are generally used to sample sediments which cannot easily be obtained using coring devices or when large quantities of materials are required. Various dredge designs are available for sampling in deep or turbulent waters and for obtaining samples from gravelly, stony or dense deposits.

Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a messenger. Dredges are commonly quite heavy and therefore require use of a winch and crane assembly for sample retrieval.

Upon retrieval of the dredge, the sample can either be sieved or transferred directly to a sample container for labeling and storage. Dredge types which could be used for sampling include Ponar, Petersen and Ekman dredges.

**Hand Auger**

Sediment samples may be collected using a hand auger. When using a hand auger, provisions must be made to ensure that sediment samples remain in the auger. Hand augers are best utilized when sampling non-subaqueous sediments.

## STANDARD OPERATING PROCEDURE - 13

## EQUIPMENT DECONTAMINATION

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the techniques used to decontaminate sampling and field measurement equipment. Proper decontamination ensures that cross-contamination does not occur.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Potable water*: Water suitable for drinking.

*10 percent nitric acid solution*: A solution composed of 1 part concentrated nitric acid and 9 parts distilled water (e.g., a 100 milliliter (ml) aliquot of 10 percent nitric acid contains 10 ml concentrated nitric acid and 90 ml distilled water).

### 2.2 Abbreviations

| | |
|---|---|
| ml | milliliter |
| PM | Project Manger |
| PPs | project plans |
| SAP | Sampling and Analysis Plan |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks outlined in this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents and data produced during work performance.

## 4.0 PROCEDURES

### 4.1 Methods

Field personnel shall routinely document equipment decontamination. Decontamination procedures shall be documented in the field log books. Documentation of decontamination procedures shall include the following information:

- Serial number and model number of each piece of equipment (where applicable); and
- Method of decontamination if it deviates from the method described herein.

Specific formatting information for documentation of decontamination procedures in field log books is contained in SOP-3, Use and Maintenance of Field Log Books.

Each piece of sampling equipment shall be decontaminated as follows:

- Brush with bristle or steel wire brush to remove gross particulates (as appropriate);
- Scrub thoroughly with a laboratory-grade detergent/potable water solution;
- Rinse thoroughly with potable water;
- Rinse with reagent-grade methanol and/or 10 percent nitric acid solution (as applicable);
- Rinse thoroughly with reagent-grade water; and
- Rinse with solvent (as applicable) and allow to air dry.
- For storage purposes, wrap the equipment in one layer of aluminum foil. Seal foil wrapped equipment in plastic and label.

Oversized and drilling equipment will be decontaminated using a high pressure water sprayer.

Equipment rinsate samples will be collected according to the specifications in the SAP.

Field measurement equipment such as pH and conductivity meters will be decontaminated by double rinsing with distilled water only and blotting dry. In instances where samples have water insoluble contaminants, additional rinses may be necessary. A hexane rinse may be used and followed by a distilled water rinse and air drying if water insoluble contaminants are of concern in the sample.

### 4.2 Review

The PM or designee shall check field log books and daily logs for completeness and accuracy. Any discrepancies in these documents will be noted and returned to the originator for correction. The reviewer will acknowledge that corrections have been incorporated by signing and dating in the appropriate manner.

## 5.0 REFERENCES

Alabama Department of Environmental Management. 2005. “Alabama Environmental Investigation and Remediation Guidance”. September.

Matrix Environmental Services LLC (MES), 2013. Standard Operating Procedure 3, “Use and Maintenance of Field Log Books”, SAP Attachment 3.

U.S. Environmental Protection Agency (EPA). 1984. “Standard Operating Safety Guides.” Office of Emergency and Remedial Response.

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# STANDARD OPERATING PROCEDURE 14

# SAMPLE CONTAINERS, PRESERVATION, AND MAXIMUM HOLDING TIMES

## 1.0 PURPOSE

The purpose of this procedure is to list acceptable sample containers and describe sample preservation and maximum holding times to be used during hazardous waste investigations for low-, medium-, or high-concentration samples of liquid, sediment and sludge matrices.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve site-specific deviations from the methods described herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Low-Concentration Sample*: In general, the contaminant of highest concentration is present at a level less than 10 parts per million (ppm). Examples include background environmental samples, perimeter, and lagoon samples.

*Medium-Concentration Sample*: In general, the contaminant of highest concentration is present at a level greater than 10 ppm and less than 15 percent by volume (150,000 ppm). Examples include weathered material.

*High-Concentration Sample*: In general, at least one contaminant is present at a level greater than 15 percent by volume. Samples from drums and tanks are assumed to be high concentration unless information indicates otherwise.

### 2.2 Abbreviations

| | |
|---|---|
| CMIP | Corrective Measures Implementation Plan |
| PM | Project Manager |
| ppm | Parts per million |
| SAP | Sampling and Analysis Plan |
| SFSP | Site Field Sampling Plan |
| SOP | Standard Operating Procedure |
| µg/l | micrograms per liter |
| $^{o}$C | degrees Celsius |

## 3.0 RESPONSIBILITIES

Sampling personnel (samplers) are responsible for performing the applicable tasks outlined in this procedure.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents (Exhibits) and data produced during work performance. Activities and data collected shall be recorded in the field log book.

## 4.0 PROCEDURE

The sampling and analysis program must comply with the analytical procedures outlined by the Sampling and Analysis Plan (SAP).

The purpose of sample preservation is to prevent or retard the degradation and modification of chemicals or to retard biological activity in samples during transit and storage. Efforts to preserve the integrity of the samples must be initiated as soon as possible after the time of sampling and continue until analyses are performed. Preservatives must be added to the sample container as soon as possible after the time of sample collection. The recommended procedure is to take pre-measured volumes of the preservatives in sealed ampules to the field.

Complete and unequivocal preservation of samples, domestic sewage, industrial wastes, or natural waters, is impossible in practice. Regardless of the nature of the sample, complete stability for every constituent is not likely to be achieved. At best, preservation techniques can retard the chemical and biological changes that inevitably continue after the sample is removed from the parent source. Degradation of the sample ceases only if it is preserved at a temperature of absolute zero (-273 degrees Celsius [°C]), a temperature that is impossible at this time to achieve. Additionally, freezing of a sample to extend hold times is not permitted. Therefore, as a general rule, it is best to analyze the samples as soon as possible after collection. This is especially true when the analyte concentration is expected to be in the low microgram per liter (µg/l) range.

Methods of preservation are relatively limited and are intended generally to perform the following:

- Retard biological action;
- Retard hydrolysis of chemical compounds and complexes;
- Reduce volatility of constituents; and
- Reduce absorption effects.

Preservation methods are generally limited to:

- pH control;
- Chemical addition; and
- Refrigeration.

The recommended preservative for various constituents is given in Exhibit 14-1. Preservation techniques for some analyses requiring more than simple refrigeration or filtering are discussed in Section 4.2. Exhibit 14-1 provides the estimated volume of sample required for the analysis, the suggested type of container, and the maximum recommended holding times for samples to be properly preserved.

**When selecting preservation techniques and sample container type, always refer to the guidance provided in the documentation of the analytical methods to be used.**

### 4.1 Sample Containers

Select sample containers based on the analytical parameters of interest. Use containers made of materials that are nonreactive. Glass and polyethylene containers are the most commonly accepted, and both are used when sampling many constituents. When metals are the analytes of interest, however, polyethylene containers with Teflon®-lined caps are preferred. When organics are the analytes of interest, use amber glass containers with Teflon®-lined caps.

### 4.2 Sample Preservation

Perform appropriate chemical preservation in the field for various analytical parameters as soon as possible after the time of sample collection. When appropriate, cool samples after collection and during shipment. Samples should be kept out of direct sunlight and stored in the dark (e.g., in a cooler). Regardless of the method of preservation, perform analyses as soon after sampling as is possible.

Some samples require field filtering per the Site Field Sampling Plan (SFSP) or Corrective Measures Implementation Plan (CMIP). Samples will be filtered by using a disposable in-line housing, or equivalent setup, equipped with a 0.45 micron glass fiber filter. Filters will be changed for each sample. Sample water will be collected directly into the sample container. After the samples have been filtered and placed in appropriate holding containers with the prescribed preservative.

In some instances, the optimal method for sample preservation may be inappropriate due to the restrictions placed on the transport of certain chemicals by shippers. When shipping restrictions prevent the use of some reagents for sample preservation, use the most appropriate and permissible technique.

Refer to Exhibit 14-1 for preservation requirements for common analyses.

### 4.3 Maximum Holding Time

Complete and unequivocal preservation of a sample for an extended period of time is a practical impossibility. Regardless of the nature of the sample, complete stability for every constituent is not likely to be achieved. Maximum holding times are assigned to each analyte and are designed for quality assurance purposes to minimize degradation effects on the analysis. Therefore, as a rule, it is better to analyze the sample as soon as possible after collection. This is especially true when low contaminant concentrations are expected. Suggested maximum holding times for some of the more common analytes are listed in Exhibit 14-1.

### 4.4 Review

The PM or an approved designee shall check sample control documentation to ensure that the samples, transport, and analysis events have met the criteria outlined in this Standard Operating Procedure (SOP). Any discrepancies shall be noted and the documentation will be returned to the originator for correction. The reviewer will acknowledge that corrections have been incorporated by signing and dating each reviewed document.

## 5.0 REFERENCE

American Public Health Association (APHA). 1983. "Standard Methods for the Examination of Water and Wastewater." 14th ed.

Alabama Department of Environmental Management. 2005. "Alabama Environmental Investigation and Remediation Guidance." Alabama Department of Environmental Management.

U.S. Environmental Protection Agency (EPA)/National Water Well Association (NWWA). 1981. "Manual of Groundwater Sampling Procedures." EPA/NWWA Series.

U.S. Environmental Protection Agency (EPA). 1983. "Methods for the Chemical Analysis of Water and Wastes." EPA-600./4-79-020. March 1983.

U.S. Environmental Protection Agency (EPA). 1983. “RCRA Permit Writer's Manual: Groundwater Protection.” (40 CFR Part 264, Subpart F), Geotrans Inc., EPA Contract No. 68-01-6464.

U.S. Environmental Protection Agency (EPA). 1984. Federal Register Part VIII, 40 CFR Part 136, October 26, 1984.

U.S. Environmental Protection Agency (EPA). 1986. “Test Methods for Evaluating Solid Waste.” SW-846.

U.S. Environmental Protection Agency (EPA). 1988. “Users Guide to the Contract Laboratory Program.” 9240.0-1, December 1988.

U.S. Environmental Protection Agency (EPA). May 2004. “Standard Operating Procedure, Sample Preparation and Calculations for Dissolved Gas Analysis in Water Samples Using a GC Headspace Equilibration Technique,” downloaded 1/13/09: http://www.epa.gov/region1/info/testmethods/pdfs/RSKsop175v2.pdf

U.S. Environmental Protection Agency (EPA). March 2007. “Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act; National Primary Drinking Water Regulations; and National Secondary Drinking Water Regulations; Analysis and Sampling Procedures,” Downloaded on 1/13/09: http://www.epa.gov/fedrgstr/EPA-WATER/2007/March/Day-12/w1073.htm

## 6.0 EXHIBITS

| | |
|---|---|
| Exhibit 14-1 | Sample Containers, Preservatives, and Holding Time Requirements |

## EXHIBIT 14-1
## Sample Containers, Preservatives, and Holding Time Requirements
(Page 1 of 5)

| Name | Analytical Methods [a] | Matrix | Sample Container Size [b,e] | Preservation [c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Alkalinity | E310.1/SM2320B | water | P, G (50 ml) | 0-6°C | 14 days |
| Common anions | SW9056A/ E300.0/E300.1 | water | P, G (50 ml) | 0-6°C | 28 days for Br, F, Cl, SO$_4$;<br>48 hours for NO$_3$, NO$_2$, PO$_4$ |
| Perchlorate | E314.1 | water | P, G (50 ml) | 10°C from field to lab, 0 - 6°C until analysis | 28 days |
| Cyanide, total and amenable to chlorination | SW9010C/ SW9012B/ SM4500-CN E | water | P, G (500 ml) | 0-6°C, NaOH to pH > 12, 0.06 g ascorbic acid | 14 days |
| | | soil | P, G (4 oz) | 0-6°C | 14 days |
| Total Dissolved Solids (TDS) | SM2450C/ E160.1 | water | P, G (100 ml) | 0-6°C | 7 days |
| Total Suspended Solids (TSS) | SM2540D/ E160.2 | water | P, G (100 ml) | 0-6°C | 7 days |
| Hydrogen ion (pH) | SW9040C/ SM4500-H B | water | P, G (25 ml) | None | Analyze immediately[d] |
| | SW9045D | soil | P, G (20 g) | None | Analyze immediately[d] |
| Nitrate+Nitrite as Nitrogen | SM4500-NO3 N/ E353.3 | water | P, G (500 ml) | 0-6°C, H$_2$SO$_4$ to pH < 2 | 28 days |
| Conductance | SW9050A/E120.1 | water | P, G (100 ml) | 0-6°C | 28 days[d] |
| Temperature | E170.1 | water | P, G (NA) | None | Analyze immediately[d] |
| Dissolved oxygen | E360.1 | water | G (500 ml) | None | Analyze immediately[d] |
| Turbidity | E180.1 | water | P, G (NA) | 0-6°C | 48 hours |
| Total organic carbon | SM5310B/ SW9060A | water | P[i], G (500 ml) | 0-6°C, HCl or H$_2$SO$_4$ to pH < 2 | 28 days |
| | SW9060A | soil | P,G (4 oz) | 0-6°C | 28 days |
| Chromium VI (CrVI) | SW7196A | water | P, G (500 ml) | 0-6°C | 24 hours |
| | | soil | P, G (8 oz) | 0-6°C | 30 days to extraction, 4 days from extraction to analysis |
| Mercury (Hg) | SW7470A | water | P, G (500 ml) | HNO$_3$ to pH<2, 0-6°C | 28 days |
| | SW7471B | soil | P, G (8 oz) | 0-6°C | 28 days |
| Metals (except CrVI and Hg) | SW6010D/ SW6020B | water | P, G (600 ml) | HNO$_3$ to pH<2, 0-6°C | 180 days |
| | | soil | P, G (8 oz) | 0-6°C | 180 days |
| Total petroleum hydrocarbons - volatile[h] (TVPH) | SW8015D (modified) | water | GS (2 x 40 ml) | 0-6°C, HCl to pH<2;<br>0-6°C | 14 days preserved water;<br>7 days unpreserved water |
| | | soil | E | 0-6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | GC (3x40ml) | 0-6°C | 48 hours |
| | | | GC (3x40ml) | 0-6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | GS (4 oz) | 0-6°C, methanol (high) or sodium bisulfate (low) | 14 days |

## EXHIBIT 14-1
## Sample Containers, Preservatives, and Holding Time Requirements,
(Page 2 of 5)

| Name | Analytical Methods [a] | Matrix | Sample Container Size [b,e] | Preservation [c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Total petroleum hydrocarbons - extractable (TEPH) (i.e, DRO) | SW8015D (modified) | water | GS (1 liter) | 0-6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Aromatic and halogenated volatiles | SW8021B | water | GS (2 x 40 ml) | 0-6°C, HCl to pH<2;<br>0-6°C | 14 days preserved water;<br>7 days unpreserved water |
| | | soil | E | 0-6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | GS (3x40ml) | 0-6°C | 48 hours |
| | | | GS (3x40ml) | 0-6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | GS (2 oz) | 0-6°C, methanol (high) or sodium bisulfate (low) | 14 days |
| Nitrosamines | SW8070A | water | GS (1 liter) | 0-6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Chlorinated herbicides | SW8151A/ SW8321B | water | GSA (1 liter) | 0-6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Organochlorine pesticides | SW8081B | water | GSA (1 liter) | 0-6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Polychlorinated biphenyls (PCBs) | SW8082A | water | GSA (1 liter) | 0-6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Organophosphorus pesticides | SW8141B | water | GSA (1 liter) | 0-6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |

# EXHIBIT 14-1
## Sample Containers, Preservatives, and Holding Time Requirements
(Page 3 of 5)

| Name | Analytical Methods [a] | Matrix | Sample Container Size [b,e] | Preservation [c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Volatile organic compounds[h] | SW8260C | water | G/S (3x40 ml) | 0-6°C, HCl to pH<2, Na2S2O3 (c); 0-6°C | 14 days preserved water; 7 days unpreserved water |
| | | water for acrolein and acrylo-nitrile | G/S (3 x 40 ml) | 0-6°, HCl to pH 4-5 | 7 days |
| | | soil (low) | E | 0-6°C, transfer to preserved vial within 48 hrs | 14 days |
| | | | E | 0-6°C | 48 hours |
| | | | G/S (3 x 40ml) | 0-6°C, if acid reactive analytes[g] requested | 7 days |
| | | | G/S (3 x 40ml) | 0 - 6°C, freeze to -7°C within 48 hrs, HNaO3S and 5 mL H2O to pH ≤2 | 14 days |
| | | | G/S (3 x 40ml), pre-weight with magnetic stir bar | 0 - 6°C, freeze to -7°C within 48 hrs, HNaO3S and 5 mL H2O to pH ≤2 | 14 days |
| | | soil (high) | G/S (3x40ml), pre-weighed with magnetic stir bar and preservative | 0 - 6°C, methanol | 14 days |
| | | | E | 0 - 6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | G/S (2 oz), VOC≥200µg/kg | 0 - 6°C | 48 hours |
| Semivolatile organics | SW8270D | water | GSA (1 liter) | 0-6°C in the dark, 0.008% Na2S2O3 (c) | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C in the dark | 14 days from sampling to extraction, 40 days from extraction to analysis |
| VOCs - air and soil gas | TO-14A/TO-15 | air | SUMMA® canister | none | 30 days |
| Methane, Ethane, Ethene | RSK-175 | water | G/S (2 x 40 ml) | 0-6°C, HCl to pH<2; 0-6°C | 14 days preserved water; 7 days unpreserved water |

## EXHIBIT 14-1
## Sample Containers, Preservatives, and Holding Time Requirements
(Page 4 of 5)

| Name | Analytical Methods [a] | Matrix | Sample Container Size [b,e] | Preservation [c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Ethylene dibromide (EDB) | SW8011 | water | G/S (2 x 40 ml) | 0-6°C, $Na_2S_2O_3$ (c) | 14 days |
| Explosive residues | SW8330A | water | P, G (1 liter) | 0-6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | P, G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Dioxins and furans | SW8280B/ SW8290A | water | G/S (1 liter) | 0-6°C in the dark, 0.008% Na2S2O3 (c) | 30 days from sampling to extraction, 45 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 30 days from sampling to extraction, 45 days from extraction to analysis |
| Carbon Dioxide | RSK-175 | water | G/S (2 x 40 ml) | 0-6°C | 7 days |
| Polynuclear aromatic hydrocarbons (PAHs) | SW8310/ SW8270D-SIM | water | G/S (1 liter) | 0-6°C in the dark, 0.008% Na2S2O3 (c) | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0-6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Ammonia | E350.2 | water | P, G (500 ml) | 0-6°C, $H_2SO_4$ to pH < 2 | 28 days |
| Phosphorus (Total) | E365.2 | water | P, G (500 ml) | 0-6°C, $H_2SO_4$ to pH < 2 | 28 days |
| Total Kjeldahl Nitrogen (TKN) | E351.3 | water | P, G (500 ml) | 0-6°C, $H_2SO_4$ to pH < 2 | 28 days |
| Sulfide | E376.1 | water | P, G (250 ml) | 0-6°C, Zn acetate and NaOH to pH > 9 | 7 days |
| TCLP | SW1311 | water, soil | water: G/S (1 liter); soil: G (8 oz) | 0-6°C | water and soil: VOCs - 14 days from sampling to TCLP extract, 14 days from extract to analysis; SVOCs - 14 days from sampling to TCLP extract, 7 days from extract to prep, 40 days from prep to analysis; Metals - 180 days from sampling to TCLP extract, 180 days from extract to analysis; Hg - 28 days from sampling to TCLP extract, 28 days from extract to analysis |

## EXHIBIT 14-1
## Sample Containers, Preservatives, and Holding Time Requirements
(Page 5 of 5)

| Name | Analytical Methods [a] | Matrix | Sample Container Size [b,e] | Preservation [c] | Maximum Holding Time |
|---|---|---|---|---|---|

[a] Including subsequent updates. Most recent version will be used.

[b] Polyethylene (P); glass (G); PTFE (Teflon)-lined septum seal (S); amber (A); EnCore Sampler (E).

[c] Preservation with sodium thiosulfate ($Na_2S_2O_3$) is only required when residual chlorine is present.

[d] Measurement should be performed on site.

[e] Actual sample container size will vary based on individual laboratory and method requirements.

[f] Analysis should be done as soon as possible but should not exceed hold time listed.

[g] acid reactive compounds are vinyl chloride, styrene, and 2-chloroethyl vinyl ether

[h] Most likely used sample containers, preservatives, and holding times listed. Please refer to Chapter 4 of the SW-846 Compendium for additional options and information.

[i] Plastic containers used must not contribute contaminating organics to the samples.

ml = milliliters
NA = Not applicable
oz = ounces

# STANDARD OPERATING PROCEDURE - 15

# SAMPLE IDENTIFICATION, LABELING AND PACKAGING

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the standard method for sample identification to be used on environmental investigations. This procedure outlines the required information and provides standardized forms and labels.

This procedure provides guidance for routine field operations on environmental projects. The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Field Data Records*: Field-generated documents including field log books, Exhibits and forms as supplied in the SOPs.

### 2.2 Abbreviations

| | |
|---|---|
| °C | Degrees Celsius |
| CLP | Contract Laboratory Program |
| EPA | U.S. Environmental Protection Agency |
| FDR | Field Data Record |
| IDW | Investigation Derived Waste |
| MES | Matrix Environmental Services |
| MS/MSD | Matrix Spike/Matrix Spike Duplicate |
| PM | Project Manager |
| QA/QC | Quality Assurance/Quality Control |
| QAP | Quality Assurance Plan |
| QC | Quality Control |
| SFSP | Site-Specific Field Sampling Plan |
| SOP | Standard Operating Procedure |
| SOW | Scope of Work |
| VOC | Volatile Organic Compound |

## 3.0 RESPONSIBILITIES

Field personnel (samplers) are responsible for performing the tasks outlined in this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performed and ensuring that the work is conducted in a satisfactory manner. This will be accomplished by reviewing documents (Exhibits) and data produced.

# 4.0 SAMPLE IDENTIFICATION PROCEDURES

## 4.1 Introduction

The coding system described herein will be used to identify each sample collected during the sampling program. This coding system will provide a method for tracking each sample. Proper sample identification will allow information about a particular sample to be retrieved and will enable the analytical results to be assigned to a specific location. It is imperative that each sample is labeled clearly and concisely and that a consistent and standard identification system be used as described below.

## 4.2 Method of Sample Identification

The method for identification of a sample depends on the matrix of the sample, and the type of measurement or analysis performed. On-site measurements will be recorded in field log books. The measurements may also be recorded on the Field Data Records (FDRs). Examples of on-site measurements include, but are not limited to: pH, temperature, conductivity, groundwater level, and air sampling.

Sampling during most environmental investigations will include off-site laboratory analysis of samples. Each sample is identified by a unique code, which may include, but is not limited to, the following: parcel no., location, sample type, sample no., and purpose.

Sample identification is a process that begins in the work planning stage when the planned field and Quality Assurance/Quality Control (QA/QC) samples have a unique sample number and location identifier assigned. This section of the SOP describes the sample numbering approach that will be used at McClellan. These assignments are generally summarized in a *Site-Specific Field Sampling Plan* (SFSP) or *Site-Specific Corrective Measures Implementation Plan* (CMIP). Section A8.0 of the *Quality Assurance Plan* (QAP) (Appendix A) describes data management activities including use of the project database on McClellan.

The sample numbering system to be utilized in the field has been developed to uniquely identify each sample collected at McClellan. Each sample will be assigned a sample number. The sample number will be incorporated into a sample description comprised of six elements and formatted as follows:

| SOW ID | Parcel No. | Location | Type | Sample No. | Purpose |
|---|---|---|---|---|---|
| XXXX | ###XX | XXXX## | XXXX | XXX#### | XXX |

where:

**SOW ID**. Statement of Work Identification, a two to four character alphabetical designation assigned by the work plan author that designates a particular parcel or group of parcels of a similar history or where similar work is being performed.

**Parcel No**. The unique parcel number (or lead parcel number if multiple parcels numbers are associate with the site) and the alphabetical suffixes "Q" or "QX" for specific parcels.

**Location**. The two to four character alphabetical prefix for a type of sample location:

- MW - monitoring well
- SS - screening sample
- IDWS - Investigation Derived Waste (IDW)-solid
- GP - Geoprobe (soil boring)
- SEP - seep sample
- IDWW - IDW-water
- DEP - depositional soil
- DR - drum sample
- BW - blank water
- SW/SD - surface water/sediment
- WP - wipe sample

And a two digit sequential number suffix for each type using a leading zero - "01," "02," etc.

**Type.** Two to four character alphabetical designation of the sample type (usually the same as or linked to the type of sample location used in the Location element):

- GW- groundwater (for MW locations)
- SW - surface water (for SW/SD locations)
- SS - surface soil (for GP locations)
- SD - sediment (for SW/SD locations)
- DS - deep (subsurface) soil (the rest are the same as type of sample) (for GP locations)

**Sample Number.** A two to three character alphabetical prefix that is tied to the parcel number and not repeated for any other site at McClellan (from a list maintained by the ITEMS database manager). The designation "XX" is always used for IDW samples. And a four-digit, sequential numerical suffix that is tied to the type of sample:

- "0000" to 0999" - soil matrix (including SS, DS, DEP sample types)
- "1000" to "1999" - sediment matrix
- "2000" to "2999" - surface water matrix
- "3000" to "3999" - groundwater matrix
- "4000" to "5999" - other matrices

Samples receive a unique numerical suffix including the QA/QC samples except for Matrix Spike/Matrix Spike Duplicate (MS/MSD) samples that retain the original sample number and are given a distinct sample Purpose (see below).

**Purpose.** Two to three character description of the purpose of the sample collected:

- REG - regular field sample

- ER - equipment rinsate (blank)
- FB - field blank; MS - matrix spike
- FD - field duplicate
- MB - material blank
- MSD - matrix spike duplicate
- FS - QA field split
- TB - trip blank
- GS - geotechnical sample.

The following are examples of the sample numbering system:

PPMP-200-GP02-SS-KX0007-REG
(Print Plant and Motor Pool Areas Scope of Work [SOW], Parcel 200, Geoprobe location 02, surface soil sample, number KX0007, regular field sample)

FTA-131-MW01-GW-DK3002-FD
(Fuel and Training Areas SOW, Parcel 131, monitoring well location 01, groundwater sample, number DK3002, field duplicate sample)

HR-77Q-SW/SD01-SD-HQQ1001-MSD

(Historical Ranges SOW, Parcel 77Q, surface water/sediment sample location 01, sediment sample, number HQQ1 001, matrix spike duplicate sample)

The sample number and the entire sample description will be assigned prior to the initiation of the field sampling effort. The samples to be collected at each site and their designated descriptions are presented in the SFSPs. Depth of the sample collected and other collection information is retrieved by linking the sample number to the collection data entered into the sample tracking/field module of the McClellan database. Section A8.0 of the QAP (Appendix A) discusses use of the database in more detail.

**Quality Control (QC) Sample Identification**. Field QC samples will be identified in accordance with the procedures outlined in this section; however, they will be identified as QC samples by the sample purpose field.

## 5.0 Sample Labeling Procedure

### 5.1 Sample Label

In order to prevent misidentification of samples, samples will be temporarily identified with the sample ID and analyses to be preformed on the respective bottle. This will be conducted with the use of an indelible pen, crayon or paint marker. Sample labels can be affixed to the sample jar prior to sampling, but if the label gets wet, the writing on the label may run or the label may fall off. If the sample container is to have labels affixed prior to sampling, each label must be plastic-coated (blank or preprinted) (see Exhibit 15-1). Each label must meet the following criteria:

- Waterproof;
- Will not disintegrate;
- Will retain indelible ink markings when wet; and
- Must be self-adhesive.

Complete sample labels in legibly printed text with an indelible ink pen providing the following information on:

- Field sample number.
- Project name and number.
- Analysis requested for the sample collected.
- Method of preservation/conditioning.
- Date and time of collection.
- Initials of the person collecting the sample.
- Location - Brief sample location description (This can also be the sample ID).
- Depth - Depth at which sample was collected (if applicable).
- Sample Number ID.
- Preservative - Indicate presence or absence and composition of preservative if present.
- Remarks - Pertinent remarks to help identify sample and analysis to be performed.
- Signature - Signature of sampler who actually collected the sample.

As each sample is collected, make a record of this in the field log book and the appropriate sampling form (Attachment 2), and place the sample in a labeled container. Bring coolers to the decontamination area where, if necessary, the samples can be separated for shipping to the analytical laboratories specified in the Project Plans.

### 5.2 Custody Seal

Custody Seals are required on shipping containers.

Fill out Custody Seals and sign and date each. Affix the Custody Seals such that a broken seal will indicate any opening of the shipping container or samples.

## 6.0 Sample Packing and Shipping

Pack samples for shipment following the guidelines outlined below.

### 6.1 Steps in Packing a Cooler

- Clean the inside and outside of the cooler.
- Line one layer of bubble wrap, bottom side down, in bottom of cooler and line with shredded paper to absorb shock and water.
- Line cooler with one large garbage bag.

### 6.2 Prepare Samples

- Wrap glass sample jars one time with bubble wrap making sure that there is bubble wrap coverage on the top and bottom of each sample container
- Affix bubble wrap in place and put sample in plastic bag of appropriate size as to prevent the bubble wrap from coming unwrapped.
- Volatile organic compound (VOC) vials are placed in the VOC vial sponge. This is then wrapped loosely in bubble wrap and bagged like other samples.
- Plastic sample bottles are not wrapped in bubble wrap. They are placed in a plastic zip top baggie with careful attention paid to eliminate air pockets.

### 6.3 Pack Coolers

- Care must be taken to maximize the number of sample jars placed in the cooler while not overpacking it. Sample jars should fit snugly with little or no movement if shaken lightly prior to filling open spaces with available materials. Do not place sample jars on their sides or on top of one another. Above all, glass should never be touching or capable of touching glass.
- Use available materials to fill any open space in the cooler. Tape jars together, if appropriate, to reduce movement of sample jars during shipment.
- Ice coolers with:
  a. Two to three large zip top bags with few or no air pockets, or several small bags. These bags then are double bagged to prevent any potential for leaking.
  b. Put ice inside a trash bag below a layer of shredded paper. This will help keep the sample at 4 degrees Celsius (°C). Put paper on top of the ice so it closes very tightly. There should be no inside shifting if the cooler is packed correctly.
- Affix a piece of tape on the top of the cooler with the cooler sequence number, total numbers of coolers for that respective shipment, and the laboratory destination.
- Wrap each cooler a minimum of three times around at each end with strapping or shipping tape. Tape up the drain hole.

### 6.4 Special Stickers Required On Coolers For Shipment

- Up (↑↑) labels on the ends under handles
- 8027 label (other regulated substances - environmental samples)
- Hazardous substance code (9 also indicates chilling)
- Typed label stating where shipment is to and who shipment is from
- Two custody seals placed on cooler.

### 6.5 Completing Shipment

- Use special hazardous waste (Dangerous Goods) Federal Express air bills if shipped materials are considered dangerous goods. Follow directions in Section 6.6 for completing Dangerous Goods Airbill.
- Ice and packing material is considered part of "solids."
- Insure each cooler for $5,000.

### 6.6 Instructions for Completing a Federal Express Dangerous Goods Airbill

These instructions should be used for non-radioactive environmental samples only. Do not use these instructions to ship chemicals (hexane, methanol, nitric acid, etc.) or radioactive samples. If additional questions arise call Federal Express Special Services at 1-800-238-5355. This number is preprinted at the top of each Dangerous Goods Airbill.

Complete the top portion of the Dangerous Goods Airbill as follows:

| Fed Ex Box No. | Instructions |
|---|---|
| 1 | This number should be preprinted. If it is not, then fill it in (MES Consultant Federal Express no.). |
| 2 | Laboratory name and address. If the sample custodian's name is unknown, then simply print "Sample Custodian." |
| 3 | Check box number 1 - Bill Sender. A project number is required in the box labeled "your internal billing reference information." |
| 4 | Check FedEx Priority Overnight! In the instructions box, check the box that is labeled "Dangerous goods as per attached Shipper's declaration." |
| 4 | In the case of Saturday delivery, check if appropriate. |
| 4 | To be filled in by Federal Express personnel when they weigh the coolers. |

Complete the bottom portion of the Dangerous Goods Airbill as follows:

Transport Details

Cross out the boxes that **DO NOT** apply (i.e., most environmental samples can be shipped on passenger aircraft, so cross out the "cargo aircraft only" box).

Shipment Type

Again cross out the boxes that do not apply. Cross out the "Radioactive" box. Remember that these instructions are for non-radioactive environmental samples ONLY!

Shipper's Certification for Restricted Articles/Dangerous Goods

Check the box marked "IATA/ICAO."

Proper Shipping Name

Write in "Other Regulated Substances." Directly below this, write "(Environmental Samples)."

Class or Division

Write "9."

UN or ID Number

Write "8027."

Quantity and Type of Packaging

Write in how many and what kind of coolers are being shipped, as well as the volume and weight of the enclosed media; for example, "1 plastic cooler, 4 liters liquid, 12 kg soil." Weight may be filled in at the Federal Express office after being weighed by the Federal Express personnel.

Packing Instructions

Write "906."

Authorization

Leave this blank.

The PM or an approved designee shall check shipping documents for completeness and accuracy. Any discrepancies will be noted and the Exhibits will be returned to the originator for correction.

## 7.0 REFERENCES

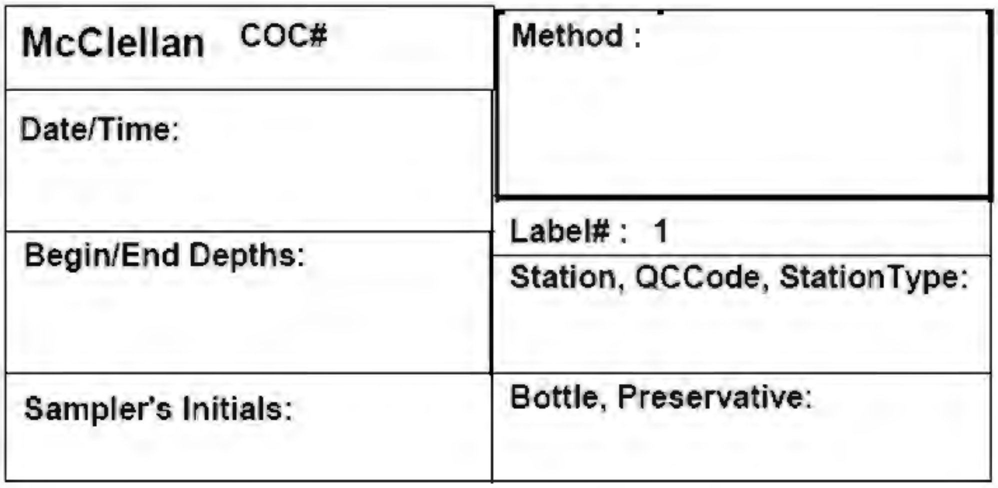
U.S. Environmental Protection Agency (EPA). 1986. "RCRA Groundwater Monitoring Technical Enforcement Guidance Document." (OSWER Directive 9950.1). September 1986.

U.S. Environmental Protection Agency (EPA). 1987. "A Compendium of Superfund Field Operations Methods." EPA/540/P-87/001. (OSWER Directive 9355.01-14). December 1987.

## 8.0 EXHIBITS

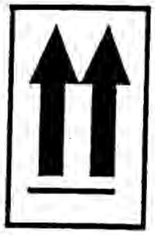
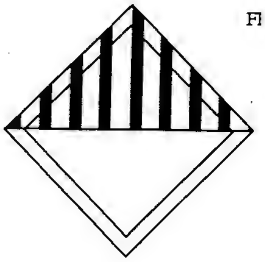
| | |
|---|---|
| Exhibit 15-1 | Sample Label |
| Exhibit 15-2 | Required Cooler Labels |
| Exhibit 15-3 | Required Cooler Label Placements |

## EXHIBIT 15-1
## Sample Label

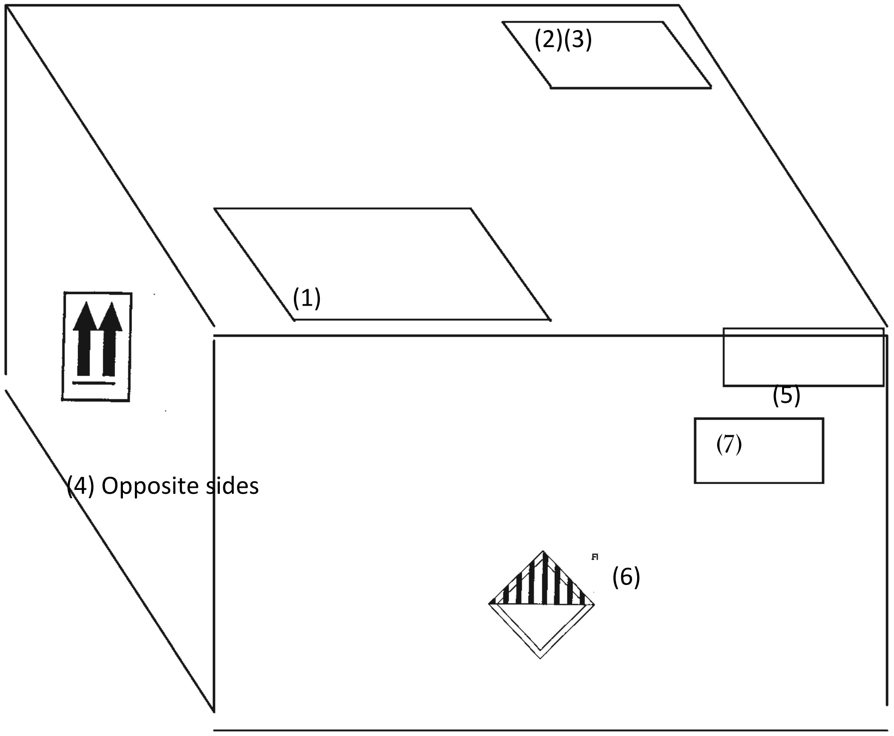


| | |
|---|---|
| McClellan COC# | Method : |
| Date/Time: | |
| Begin/End Depths: | Label# : 1 |
| | Station, QCCode, StationType: |
| Sampler's Initials: | Bottle, Preservative: |

## EXHIBIT 15-2
## Required Cooler Labels

| | |
|---|---|
| OPPOSITE SIDES<br> | TOP<br>FEDEX DANGEROUS GOODS AIRBILL |
| FRONT<br> | FRONT<br>UN ID NO.<br>PROPER SHIPPING NAME<br>NAME |
| FRONT<br>**"CONTAINS WET ICE"**<br>(IF APPLICABLE) | TOP<br>RECIPIENT ADDRESS<br>SHIPPER OR CONSIGNEE ADDRESS |

## EXHIBIT 15-3
## Required Cooler Label Placement



(1) Airbill
(2) Recipient Address
(3) Shipper or Consignee Address
(4) Orientation Arrows
(5) UN ID No. and Proper Shipping Name
(6) Label or ORM Marking
(7) Custody Seal

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# STANDARD OPERATING PROCEDURE - 16

# DRUM AND CONTAINER OPENING AND SAMPLING

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide recommended procedures for implementing safe and effective opening and sampling of drums and containers with a capacity of less than 120 gallons. Container contents are sampled and characterized for disposal, bulking, recycling, grouping, and classification purposes.

This procedure provides guidance for field operations associated with most types of drum and container opening and sampling. The Project Manager (PM) must approve deviations from the methods presented herein.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Tanks:* Any container with a capacity of 120 gallons or greater. Tanks can be aboveground, free standing, below ground, or mobile. Tanks can be constructed of plastic, steel or concrete and can include tank trucks, rail cars and even boats.

*Drums:* 55-gallon steel or plastic containers. Generally the top can be removed. Steel drums tend to corrode with use and can sometimes rupture as a result of freezing. Plastic drums tend to be corrosion resistant but are more susceptible to rupturing as a result of freezing. Drums can also be smaller than 55-gallons. Overpacks are large drums in which damaged/leaking drums are totally enclosed.

*Containers:* Any bottle, can, bag and the like with a capacity of 120 gallons or less.

*Bung:* The opening on the lid of a holding drum that is designed for liquids to enter and exit the drum.

*Chime:* The metal ring, which is bolted tightly to the top of the drum, sealing the lid to the drum.

### 2.2 Abbreviations

| | |
|---|---|
| cm | centimeter |
| COLIWASA | Composite Liquid Waste Sampler |
| FID | Flame ionization detector |
| IATA | International Air Transport Association |
| ID | inside diameter |
| IDW | Investigation Derived Waste |
| MES | Matrix Environmental Services |
| mL | milliliter |
| mm | millimeter |

| | |
|---|---|
| OSHA | Occupational Safety and Health Administration |
| PID | Photo ionization detector |
| PM | Project Manager |
| PPE | Personal Protective Equipment |
| PVC | Polyvinyl Chloride |
| SCBA | Self-Contained Breathing Apparatus |
| HASP | Health and Safety Plan |
| SOP | Standard Operating Procedure |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks in accordance with this procedure when performing work related to drum and container opening and sampling.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by the procedure. This will be accomplished by reviewing documents (Exhibits and Forms) and reviewing procedures during work performance. Activities and data collected shall be recorded in the field log book.

## 4.0 PROCEDURE

### 4.1 Drum Sampling

Prior to sampling, drums must be inventoried, staged, and opened. Inventory entails recording visual qualities of each drum and any characteristics pertinent to the contents' classification. Staging involves the organization, and sometimes consolidation of drums that have similar wastes or characteristics. Opening of closed drums can be performed manually or remotely. Remote drum opening is recommended for worker safety when the contents of the drum are unknown. The most widely used method of sampling a drum involves the use of a glass thief. This method is quick, simple, relatively inexpensive, and requires no decontamination.

#### 4.1.1 Sample Preservation, Containers, Handling, and Storage

These guidelines must be followed when taking samples from a drum:

- No preservatives shall be added to the sample;
- Read International Air Transport Association (IATA) regulations for shipping your particular sample and follow the specific requirements;
- Place each sample container in two zip top bags;
- Place each bagged container in a one-gallon covered can containing absorbent packing material. Place lid on can. (Drum samples are considered to be high concentration unless information indicates otherwise.);
- Mark the sample identification number on the outside of the can;
- Place the marked cans in a cooler and fill remaining space with absorbent packing material;

- Fill out a chain-of-custody record for each cooler, place in plastic, and affix to the inside lid of the cooler;
- Secure and custody seal the lid of the cooler; and
- Arrange for the appropriate transportation mode consistent with the type of hazardous waste involved.
- For Investigation Derived Waste (IDW) drum sampling, the samples may be treated as environmental samples. Sample Identification, Labeling, and Packaging will be in accordance with SOP-15.

### 4.2 Potential Problems

The practice of tapping drums to determine their contents is neither safe nor effective and should not be used if the drums are visually over pressurized or if shock-sensitive materials are suspected.

Drums that have been over pressurized to the extent that the head is swollen above the level of the chime should not be moved. A number of devices have been developed for venting critically swollen drums. One method that has proven to be effective is a tube and spear device. A light aluminum tube (three meters long) is positioned at the vapor space of the drum. A rigid, hooking device attached to the tube goes over the chime and holds the tube securely in place. The spear is inserted into the tube and positioned against the drum wall. A sharp blow on the end of the spear drives the sharpened tip through the drum and the gas vents along the grooves. The venting should be done from behind a wall or barricade. This device can be designed cheaply and easily and constructed where needed. Once the pressure has been relieved, the bung can be removed and the drum sampled.

### 4.3 Equipment

The following are standard materials and equipment required for sampling:

- Health and Safety Plan (HASP);
- Personal Protective Equipment (PPE);
- Wide-mouthed glass jars with Teflon® cap liner (approximately 500 milliliter (mL) volume);
- Uniquely numbered sample identification labels with corresponding data sheets;
- Chain-of-Custody sheets;
- Decontamination plan and materials;
- Glass thieving tubes or Composite Liquid Waste Sampler (COLIWASA); and
- Drum opening devices.

### 4.3.1 Bung Wrench

A common method for opening drums manually is using a universal bung wrench. These wrenches have fittings made to remove nearly all commonly encountered bungs. They are usually constructed of cast iron, brass, or a bronze-beryllium nonsparking alloy formulated to reduce the likelihood of sparks. The use of a nonsparking wrench does not completely eliminate the possibility of sparks being produced.

Manual drum opening with bung wrenches should not be performed unless the drums are structurally sound (no evidence of bulging or deformation), and their contents are known. If opening the drum with a bung wrench is deemed safe and cost-effective, then certain procedures should be implemented to minimize the hazard:

- Field personnel should be fully outfitted with protective gear;
- Drums should be positioned upright with the bung up, or, for drums with bungs on the side, laid on their sides with the bung plugs up;
- The wrenching motion should be a slow, steady pull across the drum. If the length of the bung wrench handle provides inadequate leverage for unscrewing the plug, a “cheater bar” can be attached to the handle to improve leverage.

### 4.3.2 Drum Deheader

One means by which a drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or partway off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed-head drums. Drums with removable heads must be opened by other means.

Drums are opened with a drum deheader by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off if so desired. If the top chime of a drum has been damaged or badly dented it may not be possible to cut the entire top off. Because there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built up pressure. The safest technique would be to employ a remote method prior to using the deheader.

Self-propelled drum openers, which are either electrically or pneumatically driven are available, and can be used for quicker and more efficient deheading.

### 4.3.3 Hand Pick, Pickaxe, and Hand Spike

These tools are usually constructed of brass or a nonsparking alloy with a sharpened point that can penetrate the drum lid or head when the tool is swung. The hand picks or pickaxes that are most commonly used are commercially available, whereas the spikes are generally uniquely fabricated four-foot-long poles with a pointed end.

When a drum must be opened and neither a bung wrench nor a drum deheader is suitable, then it can be opened for sampling by using a hand pick, pickaxe, or hand spike. Often the drum lid or head must be hit with a great deal of force in order to penetrate it. Because of this, the potential for splash or spraying is greater than with other opening methods; therefore, this method of drum opening is not recommended, particularly when opening drums containing liquids. Some spikes have been modified by the addition of a circular splash plate near the penetrating end. This plate acts as a shield and reduces the amount of splash in the direction of the person using the spike. Even with this shield, good splash gear is essential.

Since drums, some of which may be under pressure, cannot be opened slowly with these tools, spray from drums is common and appropriate safety measures must be taken. The pick or spike should be decontaminated after each drum is opened to avoid cross-contamination and adverse chemical reaction from incompatible materials.

#### 4.3.4 Backhoe Spike

The most common means used to open drums remotely for sampling is the use of a metal spike attached or welded to a backhoe bucket. In addition to being very efficient, this method can greatly reduce the likelihood of personnel exposure.

Drums should be “staged” or placed in rows with adequate aisle space to allow ease in backhoe maneuvering. Once staged, the drums can be quickly opened by punching a hole in the drum head or lid with a spike.

The spike should be decontaminated after each drum is opened to prevent cross-contamination. Even though some splash or spray may occur when this method is used, the operator of the backhoe can be protected by mounting a large shatter-resistant shield in front of the operator's cage. This combined with the normal personal protection gear should be sufficient to protect the operator. Additional respiratory protection can be afforded by providing the operator with supplied air.

#### 4.3.5 Hydraulic Drum Opener

Recently, hydraulic devices have been fabricated to open drums remotely. One such device uses hydraulic pressure to pierce through the wall of a drum. The device consists of a manually operated pump which pressurizes oil through a length of hydraulic line. The pressurized oil advances a piercing device through the drum to allow an access point for subsequent sampling.

#### 4.3.6 Pneumatic Devices

A pneumatic bung remover consists of a compressed air supply that is controlled by a heavy-duty, two-staged regulator. A high-pressure air line of desired length delivers compressed air to a pneumatic drill, which is adapted to turn a bung fitting selected to fit the bung to be removed. An adjustable bracketing system has been designed to position and align the pneumatic drill over the bung. This bracketing system must be attached to the drum before the drill can be operated. Once the bung has been loosened, the bracketing system must be removed before the drum can be sampled. This remote bung opener does not permit the slow venting of the container, and therefore, appropriate precautions must be taken. It also requires the container to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

## 4.4 Decontamination

Sampling equipment and the exterior of the sample jars will be decontaminated as described in the following section.

These decontamination procedures will be used on equipment to maintain sample integrity and eliminate the cross-contamination of samples.

### 4.4.1 Decontamination of Sampling Equipment

Sampling equipment, jars, and containers will be decontaminated after each sample has been obtained. The decontamination procedure will follow the procedures listed in SOP-13, Equipment Decontamination.

### 4.4.3 Decontamination of Field Personnel

On-site personnel will wear PPE as described in the Matrix Environmental Services (MES) HASP. Personnel decontamination procedures are also described in the HASP and will be implemented at each sampling location.

## 4.5 Methods

### 4.5.1 Drum Staging

Prior to sampling, the drums should be staged to allow easy access. Ideally, the staging area should be located just far enough from the drum opening area to prevent a chain reaction if one drum should explode or catch fire when opened.

During staging, the drums should be physically separated (if potential contents are known from drum type or existing labels) into the following categories: Those containing solids, those containing liquid, and those which are empty. This is done because the strategy for sampling and handling drums or containers in these categories will be different. Separation may be achieved by:

- Visual inspection of the drum and its labels, codes, etc. Solids and sludges are typically disposed of in open-top drums. Closed-head drums with a bung opening generally contain liquid; and

- Visual inspection of the contents of the drum during sampling, followed by restaging, if needed.

Once a drum has been staged and sampled, and any immediate hazard has been eliminated by overpacking or transferring the drum's contents, the drum is affixed with a numbered tag and/or transferred to a secondary staging area, if necessary. Color-coded tags, labels, or bands should be used to mark similar waste types. Considering that such labels can be lost, it may be appropriate to paint-number each container. A description of each drum, its condition, any unusual markings, and the location where it was buried or stored are recorded on a drum data sheet. This data sheet becomes the principal record-keeping tool for tracking the drum on site.

Where there is good reason to suspect that drums containing radioactive, explosive, and shock-sensitive materials are present, these materials should be staged in a separate, isolated area. Placement of explosives and shock-sensitive materials in diked and fenced areas will minimize the hazard and the adverse effects of any premature detonation of explosives.

Where space allows, the drum opening area should be physically separated from the drum removal and drum staging operations. Drums are moved from the staging area to the drum opening area one at a time using forklift trucks equipped with drum grapplers or barrel grappler. In a large-scale drum handling operation, drums may be conveyed to the drum opening area using a roller conveyor.

### 4.5.2 Drum Opening

There are three basic techniques available for opening drums at hazardous waste sites:

- Manual opening with nonsparking bung wrenches;
- Drum deheading; and
- Remote drum puncturing or bung removal.

The choice of drum opening techniques and accessories depends on the number of drums to be opened, their waste contents, and physical condition. Remote drum opening equipment should always be considered in order to protect worker safety. Under Occupational Safety and Health Administration (OSHA) 1910.120, manual drum opening with bung wrenches or deheaders may be performed ONLY when drums are structurally sound, drum contents are known, and the contents are NOT shock sensitive, reactive, explosive, or flammable in nature.

## 4.6 Drum Sampling

After the drum has been opened, preliminary monitoring of headspace gases should be performed using an explosimeter and flame ionization detector (FID) or photo ionization detector (PID).

In most cases, it is impossible to observe the contents of sealed or partially sealed vessels. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the vessel.

When sampling a previously sealed vessel, check for the presence of bottom sludges. This is easily accomplished by measuring the depth to the apparent bottom then comparing this value to the interior depth.

### 4.6.1 Glass Thief Sampler

The most widely used implement for sampling a drum or similar vessel is a glass tube (glass thief, 6 to 16 millimeter (mm) inside diameter (ID) x 48-inch length). This tool is simple, cost effective, quick, and collects a sample without having to be decontaminated.

The standard operating procedure for using a drum thief is as follows:

- Remove cover from sample container;
- Insert glass tubing almost to the bottom of the drum or until a solid layer is encountered. About one foot of tubing should extend above the drum;
- Allow the waste in the drum to reach its natural level in the tube;
- Cap the top of the sampling tube with a tapered stopper or gloved thumb, ensuring liquid does not come into contact with the stopper;
- Carefully remove the capped tube from the drum and insert the uncapped end of the tube into the sample container;
- Release the stopper and allow the glass thief to drain completely into the sample container. Fill the container to about 2/3 capacity;
- Remove the tube from the sample container, break it into pieces and place the pieces in the drum;
- Cap the sample container tightly and place the prelabeled sample container into the carrier;
- Replace the bung or place plastic over the drum; and
- Transport the sample to the decontamination area for preparation for transport to the analytical laboratory.

In many instances, a drum containing waste material will have a sludge layer on the bottom. Slow insertion of the sample tube down into this layer and then gradual withdrawal will allow the sludge to act as a bottom plug to maintain the fluid in the tube. The plug can be gently removed and placed into the sample container by using a stainless steel lab spoon.

It should be noted that in some instances, disposal of the tube by breaking it into the drum may interfere with eventual plans for the removal of the contents. The use of this technique, or other disposal techniques evaluated, should be cleared with the PM for compatibility with planned disposal techniques.

### 4.6.2 COLIWASA

Designs exist for equipment that will collect a sample from the full depth of a drum and maintain it in the transfer tube until delivery to the sample bottle. These designs include primarily the COLIWASA and modifications thereof. The COLIWASA is a much cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. One configuration consists of a 152 centimeter (cm) by 4 cm ID section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper.

- Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block;
- Slowly lower the sampler into the liquid waste;
- When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.
- Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the discharge end of the sampler is positioned in a sample container.
- Cap the sample container with a Teflon®-lined cap; attach label; seal; and record on the sample data sheet; and
- Unscrew the T-handle of the sampler and disengage the locking block. Decontaminate the sampler.

## 4.7 Health and Safety

The opening of closed containers is one of the most hazardous site activities. Maximum effort should be made to ensure the safety of the sampling team.

Proper protective equipment and general awareness of the possible dangers will minimize the risk inherent to sampling operations. Employing proper drum opening techniques and equipment will also safeguard personnel. The use of remote sampling equipment whenever feasible is highly recommended.

Most drum sampling activities are performed in Level B PPE with additional splash protection, including the following:

- Protective coverall (saranex, Tyvek, polyvinyl chloride (PVC), acid suit, etc.);

- Hard hat;
- Self-Contained Breathing Apparatus (SCBA);
- Steel toe, steel shank boot (or booties covering steel toe work boots);
- Surgical gloves;
- Solvent and acid resistant gloves;
- Splash apron; and
- Face splash shield.

## 5.0 REFERENCES

National Institute for Occupational Safety and Health (NIOSH), U.S. Coast Guard, and U.S. Environmental Protection Agency (EPA). 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. U.S. Government Printing Office, Washington, D.C.

U.S. Environmental Protection Agency (EPA). 1985. (OSWER Directive 9380.0-3.) "Guidance Document for Cleanup of Surface Tank and Drum Sites." U.S. Environmental Protection Agency. Washington, DC.

EPA. 1987. "A Compendium of Superfund Field Operations Methods." EPA/540/P-87/001, U.S. Environmental Protection Agency. Washington, DC.

Matrix Environmental Services LLC (MES), 2011. "Final Master Health and Safety Plan". August.

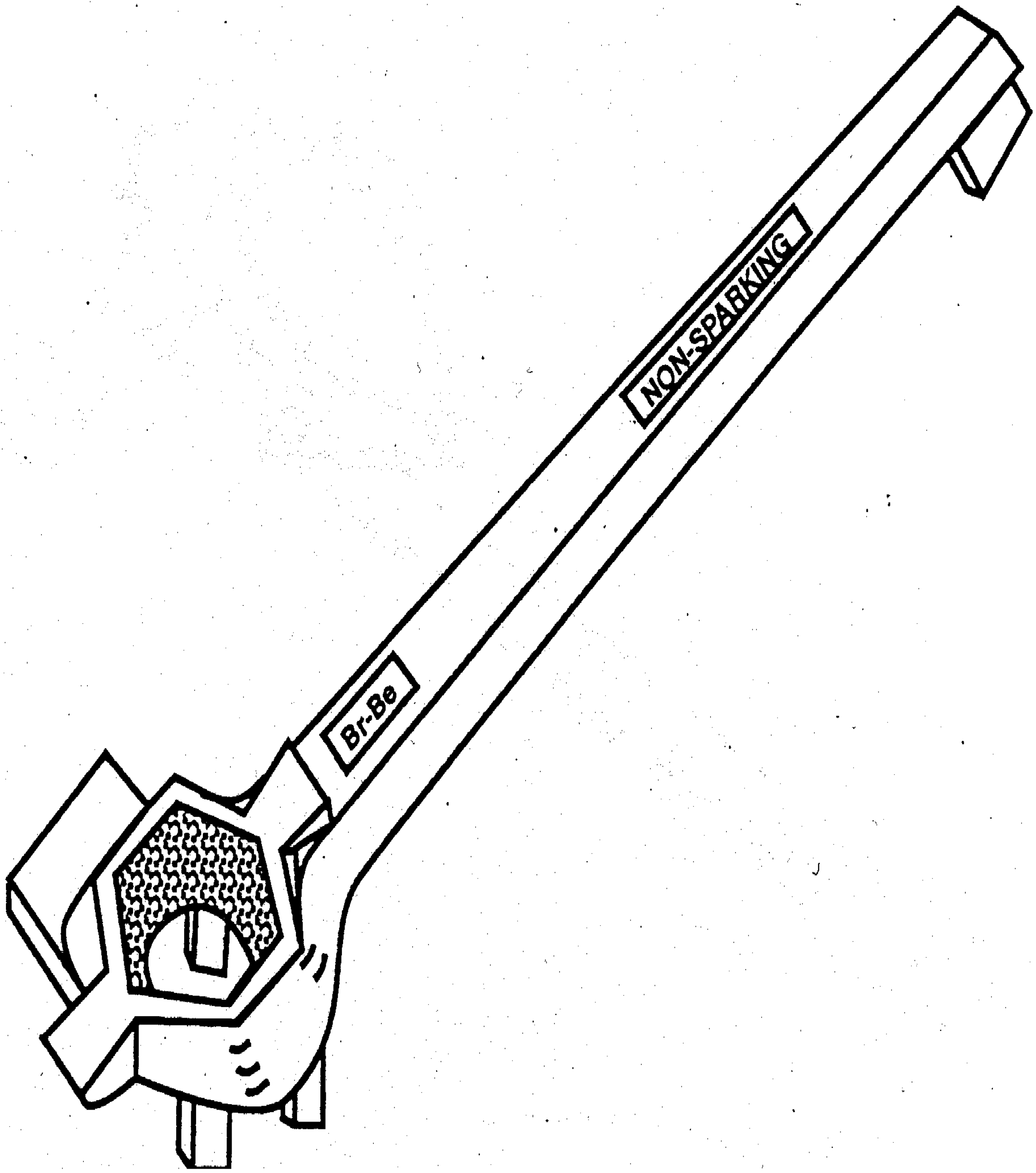
MES, 2013. "Standard Operating Procedure 13, Equipment Decontamination", SAP Attachment 3.

MES, 2013. "Standard Operating Procedure 15, Sample Identification, Labeling, and Packaging", SAP Attachment 3.

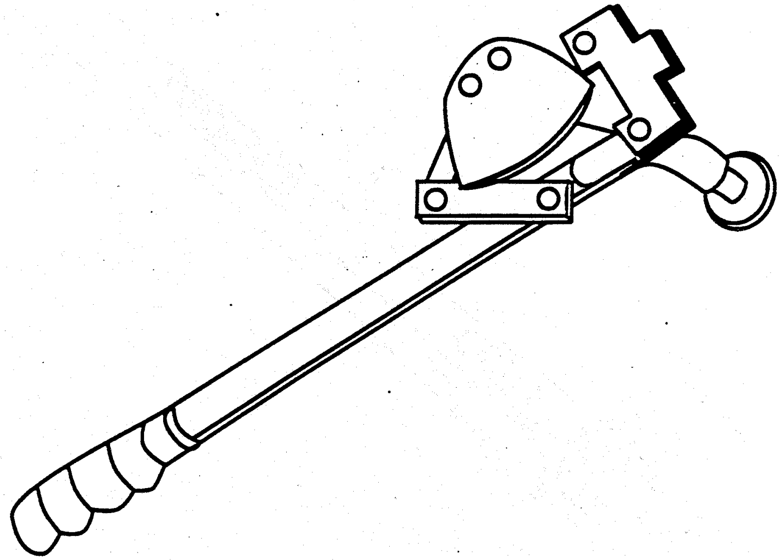
## 6.0 EXHIBITS

| | |
|---|---|
| Exhibit 16-1 | Universal Bung Wrench |
| Exhibit 16-2 | Drum Deheader |
| Exhibit 16-3 | Hand Pick, Pickaxe, and Hand Spike |
| Exhibit 16-4 | Backhoe Spike |
| Exhibit 16-5 | Hydraulic Drum Opener |
| Exhibit 16-6 | Pneumatic Bung Remover |
| Exhibit 16-7 | COLIWASA Sampler |

## Exhibit 16-1
## Universal Bung Wrench



## Exhibit 16-2
## Drum Deheader



## Exhibit 16-3
## Hand Pick, Pickaxe, and Hand Spike

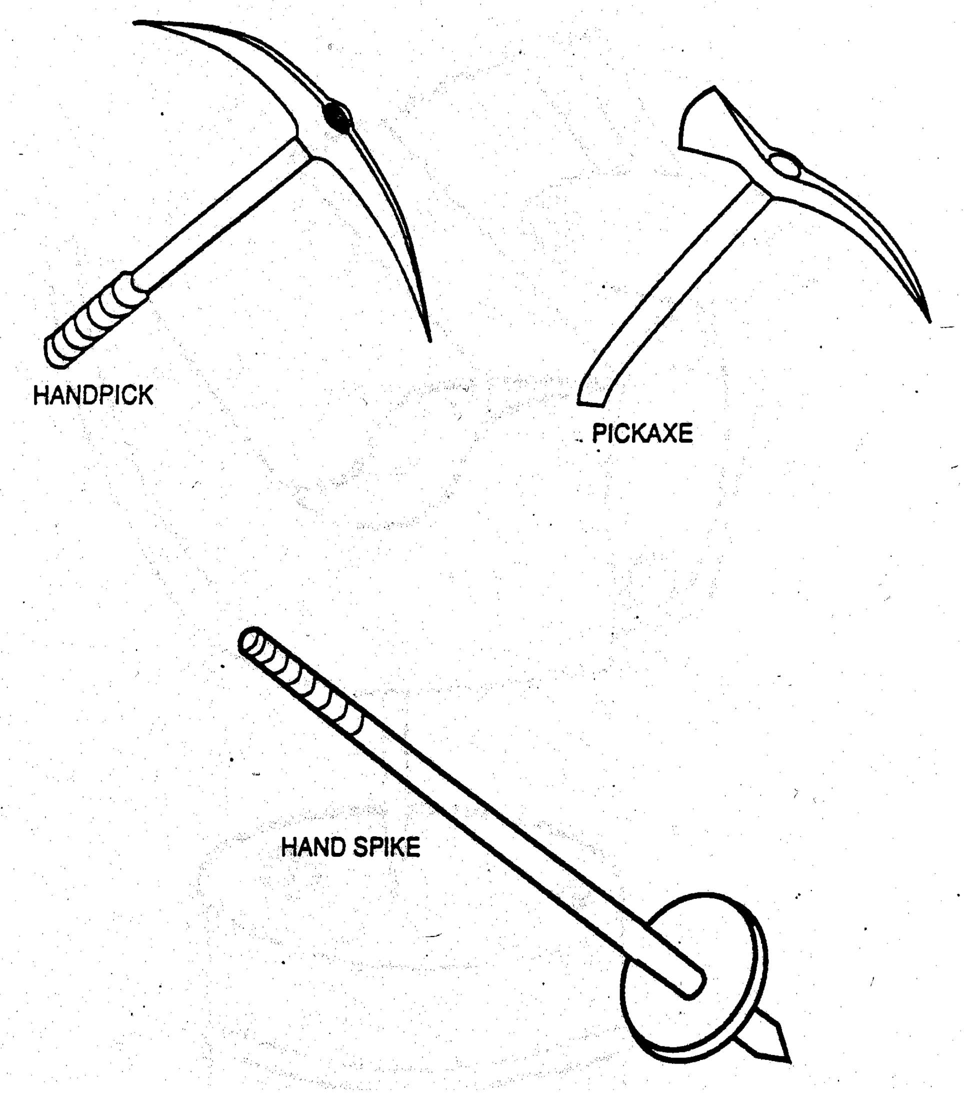


**Exhibit 16-4**
**Backhoe Spike**

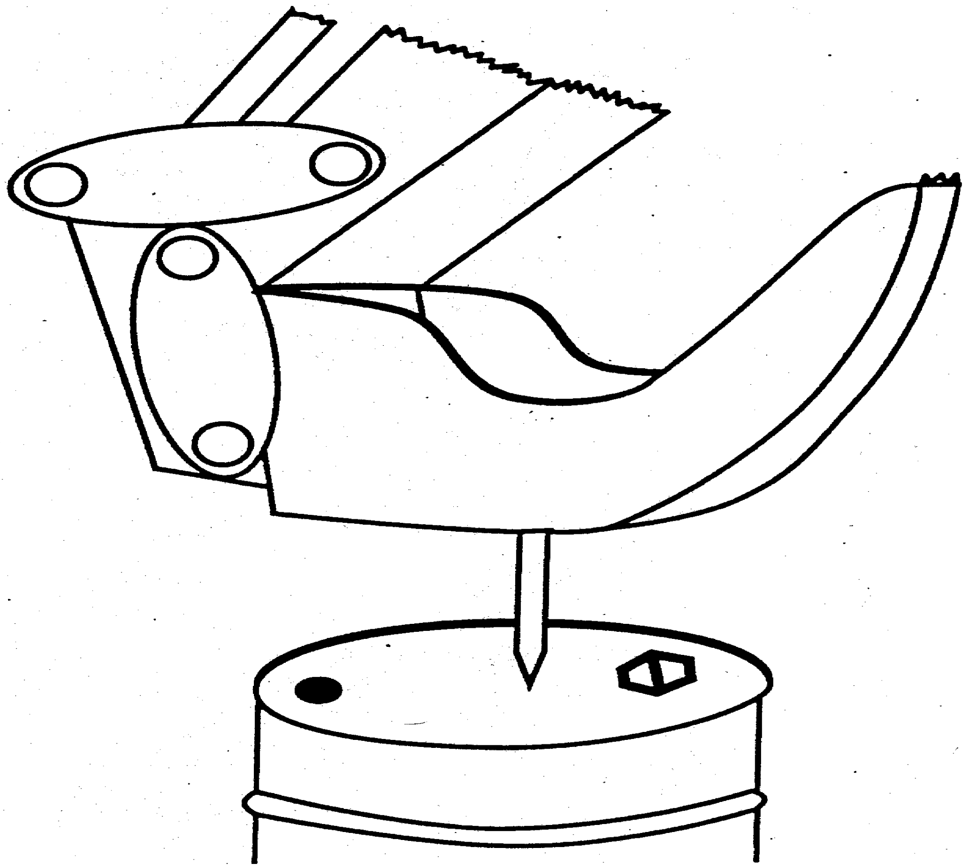
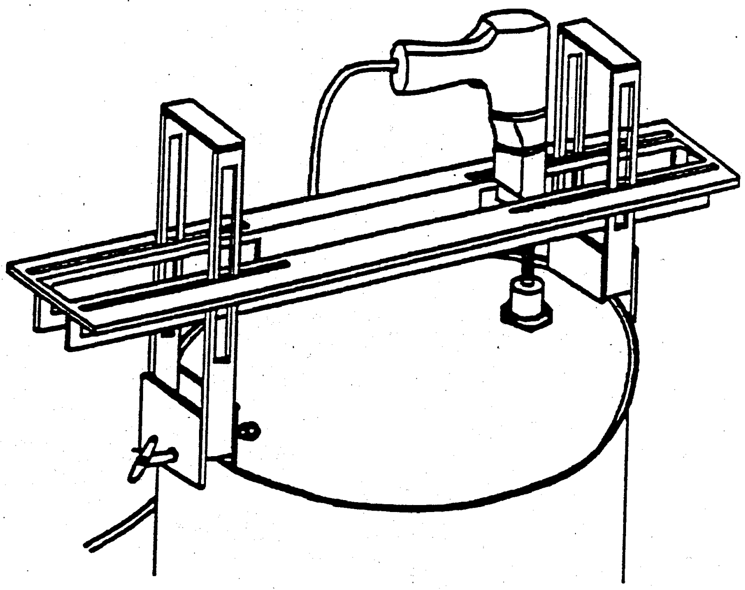
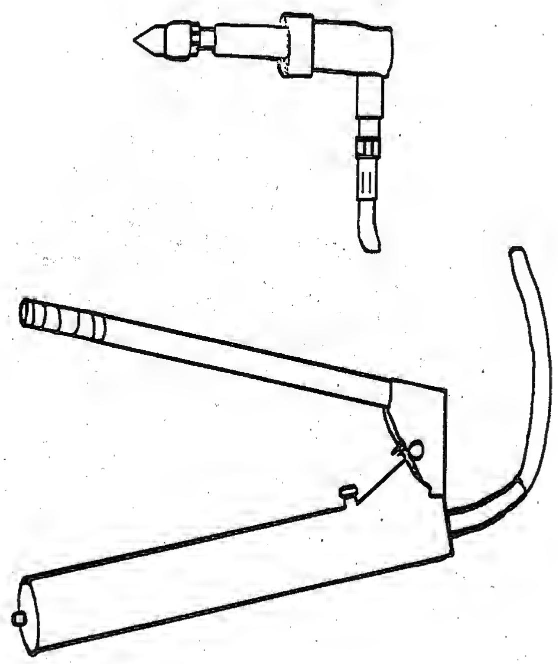


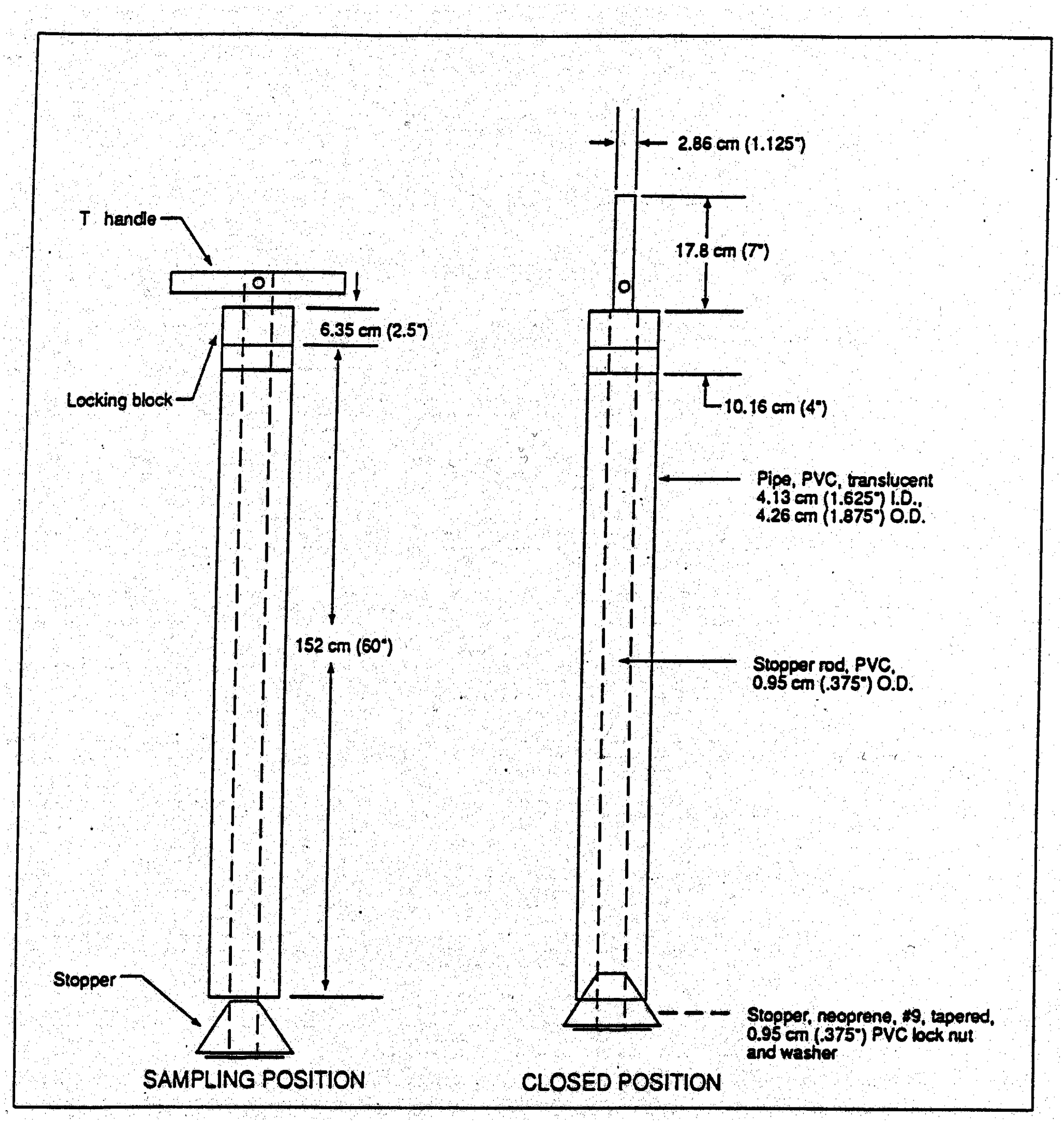
**Exhibit 16-5**
**Hydraulic Drum Opener**



## Exhibit 16-6
## Pneumatic Bung Remover



## Exhibit 16-7
## COLIWASA Sampler



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# STANDARD OPERATING PROCEDURE - 17

# FLOW MEASUREMENT

## 1.0 PURPOSE

This Standard Operating Procedure (SOP) provides general guidance for the planning, method selection, and implementation of surface flow measurements for environmental field investigations that require information on flow for streams, rivers, or surface impoundments.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Flow (or Volumetric Flow Rate)*: The volume of water that passes through a cross-sectional plane of a channel in some unit of time.

*Flow Measurement*: The act or process of quantifying a flow rate.

### 2.2 Abbreviations

| | |
|---|---|
| cfs | cubic feet per second |
| gpm | gallons per minute |
| PM | Project Manager |
| SOP | Standard Operating Procedure |
| USGS | U.S. Geological Survey |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The Project Manager (PM) or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents (Exhibits) and procedures.

## 4.0 PROCEDURES

### 4.1 General Considerations

The planning and implementation of flow measurements requires consideration of the data collection requirements. The accuracy and precision required of the flow measurement will determine the methodology employed in the field. Local site conditions, i.e., site access, streambed geometry and apparent flow rate, will determine how field procedures must be modified to obtain accurate and precise data.

The two major variables that are determined during flow measurements are:

- The geometry of the cross-sectional plane through which the fluid passes; and
- The velocity at which the fluid is moving through a particular cross section.

These variables are discussed in Section 4.2, General Methods and Applications.

The two major factors that cause variance in flow measurements are:

- The variations in technical procedures introduced by the operator; and
- The variations in fluid flow introduced by turbulence.

The variations in technical procedures introduced by the operator can be minimized by carefully following the procedures outlined in this SOP.

The variance in flow measurement caused by fluid turbulence can be reduced by applying the following procedures. The more turbulent the flow the less accurate and reproducible the flow results.

- Do not stand upstream or beside the flow measuring device and stand far enough downstream of the device so that no turbulence affects the device.
- Avoid areas just downstream of a waterfall, rapids, weir, sluice, dam, or any other structure that creates flow turbulence.
- Avoid areas of the stream that have rocky bottoms, stepping stones, wetlands vegetation in the stream bed or braided channels caused by sandbars.

The more turbulent the flow the less accurate and reproducible the flow results. The ideal location has easy access, with uniform stream banks that are not obstructed by vegetation or debris and a uniform stream bed that is that is also free of vegetation and debris.

Health and safety considerations are also important factors to be considered in planning and execution of flow measurements. Some of these considerations are:

- Accessibility of the site, i.e., bank steepness or obstacles;
- Depth of the fluid to be measured;
- Apparent flow rate of the fluid to be measured;
- Condition of the steam bed, i.e., slipperiness, obstructions, debris, vegetation, etc.; and
- Proximity of downstream structures such as dams, weirs, sluices, rapids and waterfalls.

### 4.2 General Methods and Applications

Selection and implementation of flow measurement practices require that consideration be given to the following issue, which are common to surface flow measurements at or near environmental sites:

- Preventing the spread of contamination;
- Minimizing the risk to health and safety;
- Maintaining a high level of accuracy in measuring flows;
- Causing the least possible disruption to on-site activities; and
- Reducing, where possible, any additional long- and short-term impacts.

Flow measurements are made in open channels that consist of a bed, two banks or sides, and a free or open water surface.

Most flow measurements are based on determining two key variables cited in Subsection 4.1: cross-sectional area and velocity across that area. For open channels, especially smaller ones, the cross section is often best measured directly using a tape. Care must be taken to find a location where the dimensions are constant during the time period in which flow measurements will be taken. Width and depth are expressed in terms of meters or feet, and the cross-sectional area is expressed as square meters or square feet.

Velocity is determined using one of the methods that follows, either directly or by calculation. Units are commonly given in meters per second or feet per second for most flow velocities. When cross-sectional area and flow velocity are multiplied, their product is the volumetric flow rate expressed as cubic meters per second or cubic feet per second (cfs) for large flows, and as liters per second or gallons per minute (gpm) for small flows.

### 4.3 Direct Measurement

At times, the flow in a small stream can be caught in a collector of known volume, such as a 5-gallon can or 55-gallon drum. By clocking the amount of time needed to fill the vessel, one may obtain a direct measurement of volumetric flow rate without resorting to cross-sectional area and velocity measurements. A minimum of 10 seconds to fill the container is recommended. Several fill-ups should be timed, and the results should be averaged to improve the quality of this measurement. Other means of flow measurement will be used more often than this direct estimate, which is valid only for flows between 0.06 liter per second (one gpm) and about 6.3 liters per second (100 gpm).

### 4.4 Current Meter

A current meter can be a mechanical device with a rotating element that, when submerged in a flowing stream, rotates at a speed proportional to the velocity of the flow at that point below the surface. The rotating element may be either a vertical shaft or a horizontal shaft. Meter manufacturers usually provide the user with calibration tables to translate rotation into linear speed in meters per second or feet per second.

Current meters can also be electromagnetic sensors where the passage of fluids between two electrodes in a bulb-shaped probe causes a disturbance of the electromagnetic field surrounding the electrodes. This disturbance generates a small voltage that can be made proportional to fluid velocity by internal electronic circuitry. A direct readout of velocity in meters per second or feet per second is provided for the user (Marsh-McBirney undated).

### 4.4.1 Applicability

Vertical axis meters are more commonly used because they are simpler, more rugged, and easier to maintain than horizontal shaft meters. They also have a lower threshold velocity of 0.03 meters/second (0.1 feet/second). The electromagnetic current meters can be used in making measurements in situations where mechanical meters cannot function, such as weedy streams where mechanical rotating elements would foul. However, the electromagnetic meters must always be carefully aligned to be normal to the stream cross section, since the meter measures only one velocity vector (the one parallel to the probe's longitudinal axis). Current meters will operate at depths ranging from 0.1 meter (0.3 foot) to any depth where the meter can be held rigidly in place using cables or extension poles. For most environmental investigations, depths rarely exceed two or three meters (6.5 to 10 feet). Since current meters provide readings at a single point, the mean velocity must be based on multiple readings along a vertical line, or on a single reading that can be converted to an estimated mean velocity using standard coefficients.

In many areas, the flow of waterways is monitored by local agencies. An effort should be made to incorporate flow readings from established gauge stations. At many locations, readings will be accurate and easy to obtain.

Methods for estimating mean velocity include the following:

- Six-tenths Depth Method - Uses the observed velocity at a point 0.6 of the total depth below the surface as the mean velocity for the vertical. Flow is calculated for each subsection defined by the verticals and is the product of the depth times the mean velocity for that subsection. Total discharge flow is the sum of individual subsection flows, while the average stream velocity is that sum (total discharge) divided by the total cross-sectional area. The number of readings to be taken to increase accuracy will depend on the width of the stream, from 2 or 3 readings for streams less than 5 feet across to 15 to 25 readings for streams wider than 50 feet across. Ideally, the stream should be partitioned into sections small enough so that less than 10 percent of the total stream flow passes through each section. In this manner, individual measurements that may be in error will have less impact on the overall average velocity determination. However, practical consideration, such as a rapidly changing stage or limited time available to conduct measurements, often may preclude the use of the ideal number of partial sections. Users must recognize the potential impact on the overall accuracy of velocity measurements from an inadequate number of verticals within a given cross section. This method works best at depths between 0.09 and 0.16 meters (0.3 to 2.5 feet) and is the method of choice when measurements must be made quickly.

- Two-point Method - Measures velocities at 0.2 and 0.8 of the total depth below the surface. The average of the two readings is considered to be the average for the vertical. Several different verticals are averaged across the cross section. This method is more accurate than the six-tenths depth method, but it cannot be used at depths less than 0.76 meters (2.5 feet) because the observation points would be too near the surface and the streambed.

- Three-point Method - Measures velocities at 0.2, 0.6, and 0.8 of the total depth below the surface. Readings at 0.2 and 0.8 are averaged; then that result is averaged with the reading at 0.6. This method provides a better mean value when velocities in the vertical are abnormally distributed, but it should not be used at depths less than 0.76 meters (2.5 feet).

- Vertical-velocity Method - Primarily for deep channels, this method measures velocities at 0.1 depth increments between 0.1 and 0.9 of the total depth for several verticals. Because of the multiplicity of readings, this method is rarely used.

### 4.4.2 Current Meter Methods

A step-by-step summary of a typical flow or discharge measurement is as follows:

- Assemble current meter and test for proper operation in accordance with the manufacturer's instructions. Collect data form or notebook, pencil, stopwatch, 50-foot tape, etc.
- Partition stream into sections (with tag line or bridge railing), visually observing the velocity and general flow of the stream. An adequate number of stations should be established to prevent more than 10 percent of the total discharge from passing through any individual partial section. Note that the partial section in question is not the same as the interval between two successive stations. Mark stations appropriately. A check of measurements may indicate the need for readjustment of the partitioned sections to upgrade the quality of the readings.
- Record stream stage as indicated by one of the staff gauges, and record this value on the water level recorder chart at the point of pen contact.
- Record the following items and other data as appropriate in the field log book and on Exhibit 17-1, Surface Water Flow Measurement:
    - Project;
    - Site;
    - Date;
    - Time at start of measurements;
    - Strem stage at start of measurements;

  - Approximate wind direction and speed;
  - General stream condition (e.g., turbid, clear, low level, floating debris, water temperature, type of streambed material, etc.);
  - Other factors having a bearing on discharge measurements;
  - Location of initial point;
  - Total width of stream to be measured;
  - Type of current meter and conversion factor, if applicable; and
  - Name of investigator taking the readings.

- Determine the depth and mean velocity at the first station or “initial point,” if appropriate, and record this information.
- Measure depth at the second station from initial point and record. Determine whether the velocity should be measured at the 0.6 depth from the surface (six-tenths depth method), at the 0.2 and 0.8 depths (two-point method), or by either of the other methods available. Calculate respective depths from the surface, measure the velocity at each point, and record these values.
- Follow the same method at each successive station and proceed as quickly as possible.
- Determine the depth and mean velocity at the last station, or endpoint, and record in the field log book and on Exhibit 17-1, Surface Water Flow Measurement.
- Record in the field log book and on Exhibit 17-1, Surface Water Flow Measurement, the ending time of this series of measurements and the stage, since the stage may have been changing during the measurements.
- Enter the ending stage value on the recorder chart at the point of pen contact. This information will illustrate the interval of time and stage variations during the cross-sectional measurements. Also enter the date in the field log book and on Exhibit 17-1, Surface Water Flow Measurement, and indicate that a calibration has taken place over this interval.
- Remove the tag line (if used); rinse the current meter in clean water, if necessary; allow the current meter to dry; then pack it in its carrying case.

Other issues of concern regarding stream discharge calibrations include:

- Where practical, make the measurements with the investigator standing behind (downstream) and well to the side of the meter;
- Avoid disturbing or standing along the streambed beneath the cross-sectional measuring points. This location is part of the control area and should remain constant, if possible, from calibration to calibration of the stream. This step is especially important if soft, mucky sediment is encountered somewhere along the cross section;

- Where possible, attempt to use the same cross section (location) throughout the study period and during stream calibrations. However, the number and position of stations within the cross section may be changed, if necessary, to accommodate changing flow conditions;
- Hold the wading rod vertically if it becomes necessary to switch meters during a calibration, and ascertain how $V_{NORM}$ is determined with each of the various types of meters;
- Repeat the stream calibration at regular intervals throughout the study period to account for seasonal changes in stream bank vegetation and streambed alterations that may affect measurements.

Once the mean velocity for each stream subsection is determined, that value is multiplied by the area of the subsection; the product is the volumetric flow through the subsection per unit of time. The total discharge rate is the sum of the volumetric flows for each subsection across the entire cross section of the stream. Refer to U.S. Geological Survey (USGS) Water Supply Paper 2175 for additional information (USGS 1982). Customary units are cfs for large flows and liters per second (gallons per minute) for small flows.

### 4.5 Current Meters and Stage Gauges

Where repeated measurements of a volumetric flow rate at a certain cross-sectional area are required, install a permanent stage gauge along the stream's back or side wall to facilitate measurement of the depth. The gauge will be a rigid rod or board, precisely graduated and firmly mounted with the streambed serving as a possible reference point. Where stream characteristics are such that significant bed erosion from scouring may be expected, it is best not to set the streambed as a zero point. This could lead to confusion from generation of negative numbers for gauge height readings. An arbitrary datum plume should be selected that is below the elevation of zero flow expected for the stream site. Gauges may be mounted vertically (perpendicular to the stream surface) or may incline along the slope of the stream bank. Vertical gauges are simpler to construct and calibrate, while inclined gauges provide more accurate readings and are less likely to be damaged by material floating by. The gauge provides one of the measurements needed to estimate area. Width is fixed for channels with vertical sides and are readily determined for other configurations. Velocity is determined using a current meter as described above.

Discharge rating curves are used to define the relationship between stage and stream discharge, and to allow conversion of stage hydrographs to discharge hydrographs. The discharge calibration points are hand or machine plotted onto a log-log paper graph of stage versus stream discharge. Stream stage is plotted on the vertical Y axis, and stream discharge is plotted on the horizontal X axis. Ideally, adequate calibrations are conducted over the full range of stage variations to allow a smooth curve to be hand drawn through these points on the graph.

The slope and rate of change of slope may vary significantly over the length of this curve. At certain gauging stations, the slope of this curve may break sharply, or the distribution of points may require the construction of two partial curves rather than one continuous curve. These latter two situations apply to more complex stage discharge relationships. It is the task of the investigator to derive a mathematical relationship that describes this curve as closely as possible (i.e., an equation). The development of an equation allows calculation of discharge flow by simply plugging in the stream elevation. This equation allows computerization of the process of converting stage records into discharge and eventually allows conversion to volume by noting the time interval on the recorder chart at which this rate of flow applies.

More complicated rating relationships may be required at a particular gauging station. Discharge may be not only a function of stage but also a function of slope, rate of change of stage, or other variables specific to each site. Additionally, stage-discharge relationships are rarely permanent, and discharge calibrations are carried out at periodic intervals to define the effects of various factors including the following:

- Scouring and deposition of sediment;
- Alteration of streambed roughness as a result of the creation and dissemination of dunes, anti-dunes, ripples, and standing-wave features in sandy bottoms; the deposition of leaves and other debris during different seasons; and the seasonal variation in the growth of macrophytes;
- Ice effects that may cause additional resistance to flow (if monitoring is carried out during the colder months, a complete ice-over and additional freeze will tend to constrict the stream channel with time and may increase the stage, when in fact the flow may not be increasing at all); and
- Human-related activities, such as upstream construction, recreation, etc.

### 4.5.1 Applicability

This method applies to sites where many flow measurements will be made over a long period of time. Care must be taken to maintain a known zero reference point elevation. The point does not have to be the stream's bottom. Where bed erosion over the course of flow measurements may become a problem, provisions must be made to recalibrate the gauge at regular intervals (e.g., weekly). The gauge is lowered or raised as necessary to conform with changing bed conditions. Calculation of flow rate is the same as in the preceding subsection for current meters alone.

## 4.6 Review

The PM or an approved designee shall check Exhibit 17-1, Surface Water Flow Measurement, and/or the logbook, for completeness and accuracy. Any discrepancies in the data will be noted and the Exhibits will be returned to the originator for correction. The reviewer will acknowledge that review comments have been incorporated by signing and dating the “Checked By” and “Date” blanks on Exhibit 17-1, Surface Water Flow Measurement.

## 5.0 REFERENCES

Marsh-McBirney, Inc. “Instruction Manual, Model 201 Portable Water Current Meter.” Gaithersburg, Maryland: Marsh-McBirney, Inc. Undated.

U.S. Department of Interior. “Measurement and Computations of Streamflow:” Volumes 1 and 2. Geological Survey Water Supply Paper 2175. Washington, DC: USDA. 1982.

U.S. Environmental Protection Agency (EPA). 1987. “A Compendium of Superfund Field Operations Methods.” EPA/540/P-87/001. (OSWER Directive 9355.0-14.) December 1987.

U.S. Geological Survey (USGS). 1982. Water Supply Paper 2175.

## 6.0 EXHIBITS

| | |
|---|---|
| Exhibit 17-1 | Surface Water Flow Measurement |

## EXHIBIT 17-1
## Surface Water Flow Measurement

### Surface Water
### Flow Measurement

Project Number: ________ | Project Name: ____________________ | Page ___ of _____

Site: ______________________________

Location of Initial Point: ______________________________

General Stream Condition (e.g., turbid, clear, low level, floating debris, water temperature, type of streambed material, etc.):
______________________________
______________________________

Other Factors Having a Bearing on Discharge Measurements: ______________________________
______________________________

Approx. Wind Direction and Speed: ______________

Total Width of Stream to be Measured: ______________

Time at Start of Measurements: ______________

Stream Stage at Start of Measurements: ______________

Time at End of Measurements: ______________

Stream Stage at End of Measurements: ______________

Type of Current Meter: ______________

Conversion Factor: ______________

| Point | Depth | Mean Velocity | Point | Depth | Mean Velocity |
|---|---|---|---|---|---|
| Initial Point | | | 14 | | |
| 2 | | | 15 | | |
| 3 | | | 16 | | |
| 4 | | | 17 | | |
| 5 | | | 18 | | |
| 6 | | | 19 | | |
| 7 | | | 20 | | |
| 8 | | | 21 | | |
| 9 | | | 22 | | |
| 10 | | | 23 | | |
| 11 | | | 24 | | |
| 12 | | | Final Point | | |
| 13 | | | | | |

Remarks:

| | | | |
|---|---|---|---|
| Recorded By: | Date: | Checked By: | Date: |

# STANDARD OPERATING PROCEDURE - 18

# AIR SAMPLING

## 1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the equipment and protocols for collecting air samples. This procedure outlines the method for collecting grab air samples using SUMMA® canisters.

This procedure provides guidance for field operations on environmental projects. The Project Manager (PM) must approve site-specific deviations from the methods presented herein.

Note: The procedure for integrated air sampling (i.e., taken over an extended period) is not covered in this SOP.

## 2.0 DEFINITIONS AND ABBREVIATIONS

### 2.1 Definitions

*Field Duplicate*: A duplicate sample collected simultaneously with the primary sample.
*Grab Samples*: Samples that are collected at one particular point over a short time interval.

### 2.2 Abbreviations

| | |
|---|---|
| COC | Chain-of-Custody |
| Hg | Mercury |
| ID | Identification |
| OD | Outer diameter |
| PM | Project Manager |
| SOP | Standard Operating Procedure |
| SVE | soil vapor extraction |

## 3.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks and procedures outlined herein when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents and data produced during work performance.

## 4.0 PROCEDURES

Air sampling will be conducted using SUMMA® canisters. SUMMA® canisters will be cleaned and placed under a vacuum in the laboratory and sent to the field in a sealed unit for use in taking grab samples. A small valve controlling the rate of sample collection will be used to collect the grab sample.

## 4.1 Sampling Equipment

The equipment used for collecting air samples consists of a SUMMA® canister (one or six liter) and the following hardware:

- valve
- brass cap
- particulate filter
- vacuum gauge

The SUMMA® canister and hardware will be provided by the laboratory. Consumable items, including Swagelock® compression fitting (nut), ferrules and ¼" OD teflon tubing, may be provided by the laboratory or may be purchased elsewhere by the samplers. A tag will be attached to each canister that describes the canister ID and initial canister pressure. Laboratory-specific Chain-of-Custody (COC) forms will also be provided with the equipment.

## 4.2 Sampling Procedures

1) Inspect each canister for integrity upon arrival. Verify each canister arrived with a tag showing the canister ID and initial pressure.

2) Upon receipt of the canister and associated hardware, verify the initial vacuum of each canister using the accompanied vacuum gauge, as follows:
    - Confirm the valve is closed (knob should already be tightened clockwise).
    - Remove brass cap (using a 9/16" wrench), attach gauge, and attach brass cap to side of gauge tee fitting.
    - Open and close valve quickly.
    - Read vacuum on the gauge. The initial vacuum pressure should be at least 25 in. Hg. If the canister vacuum is less than 25 in. Hg, do not use it.
    - Record the "Initial Vacuum" reading and the canister ID in the appropriate columns on the laboratory-provided COC.
    - Verify the canister valve is closed, remove gauge, and replace brass cap.

3) Read the laboratory sampling guide before conducting sampling. Prior to initiating sampling, check canister for leakage (i.e., check pressure against lab-recorded pressure). Conduct sampling as follows:
    - Confirm the valve is closed (knob should already be tightened clockwise).
    - Remove brass cap.
    - Attach particulate filter to canister.
    - The following additional instructions are for collecting air samples from a soil vapor extraction (SVE) system:
        - Slide Swagelock® nut, back ferrule, then front ferrule onto teflon tubing
        - Insert tubing into canister inlet and slide ferrules into the fitting and secure with nut. Do the same on the other end of the tubing into the SVE inlet.
    - Open valve to collect sample.
    - Close valve by hand tightening knob clockwise.
    - Disassemble the components in reverse order of the above assembly instructions.

- Using the accompanied vacuum gauge, verify and record the final canister vacuum in the appropriate column on the COC.
- Replace brass cap.
- Fill out attached canister sample tag (make sure sample ID and collection date on the tag matches what is recorded on the COC).

4) Complete the COC by populating the required fields. For air samples, this includes recording the sample ID, canister ID, initial and final vacuum pressures in addition to standard COC fields, e.g., date and time of sample collection, and requested analyses are recorded. See Section 4.3 for more information.

5) Return the SUMMA® canisters, associated hardware (valve, brass cap, gauge, and filter), and completed COC to the laboratory in the original shipping containers within two days (preferably the same day) as sample collection. Note: Unused equipment (i.e., SUMMA® canister and associated hardware) shall be returned to the laboratory within 14 days.

6) Collect field duplicate sample simultaneously with the primary sample using a field duplicate sampling T provided by the laboratory.

### 4.3 Chain-of-Custody

Samples shall be accompanied by an appropriate COC form at the time of shipping. The procedures for completing a COC, transporting samples, and transferring custody of samples are outlined in Section 5.1.7.2 of the Sampling and Analysis Plan. The canister ID and canister pressures (before and after sample collection) shall also be recorded on the COC.

### 4.4 Sample Labeling

Label samples according to the methods outlined in SOP-15, Sample Identification, Labeling, and Packaging, or as instructed by the PM.

## 5.0 REFERENCES

Matrix Environmental Services LLC (MES), 2013. “Standard Operating Procedure 15, Sample Identification, Labeling, and Packaging”, SAP Attachment 3.

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# STANDARD OPERATING PROCEDURE - 19

# PASSIVE DIFFUSION BAG SAMPLING

## 1. PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide general procedures for conducting Passive Diffusion Bag (PDB) sampling. This SOP is designed to be used in conjunction with the Sampling and Analysis Plan (SAP) and the McClellan Final Master Health and Safety Plan (HASP).

## 2. SCOPE

The following procedures will be used to deploy and collect samples for volatile organic compounds analysis from PDBs.

## 3. RESPONSIBILITIES

Sampling personnel are responsible for performing the applicable tasks in accordance with this procedure when conducting work related to environmental projects.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This is accomplished by reviewing documents and data produced during work performance. Activities and data collected shall be recorded in the field log book.

## 4. DESCRIPTION OF SYSTEM

The PDBs are prefilled polyethylene passive diffusion bags. Each PDB is 1.5 inches in diameter, 24 inches long, and holds 500 ml of deionized water. Each PDB is covered in a protective mesh sleeve.

Tethers are stainless steel cables that come preassembled. Each tether has a black, vinyl, snap connector clip at the top, followed immediately by a well ID tag. Two half-inch diameter stainless steel rings are located on the tethers and are used to attach the PDBs in the proper sampling interval. Cable-ties are used to fasten the PDBs to the tethers. The ends of the tethers have one last stainless steel split ring, to which a stainless steel weight is attached.

The snap connector clip will arrive clipped to the cardboard spool that was used for purposes of shipping the tether. The cardboard spool will be labeled with the appropriate well ID. The snap connector will clip to the stainless steel split ring located on the interior or the corresponding well cap to complete the system.

Discharge tubes are bulk packaged separately, one for each sampler.

## 5. TRAINING

Refer to the McClellan Final Master HASP.

## 6. PERSONAL PROTECTIVE EQUIPMENT

Refer to the McClellan Final Master HASP.

## 7. PROCEDURES

- Read and follow the specific Manufacturer's Operating Instructions before using any equipment.
- The hardware for each well in the sampling program will be custom-made by the PDB manufacturer prior to the initiation of the field program.
- Prior to initiating sampling of a groundwater well, check that equipment to be used is in good operating condition.

### 7.1. Sampler Deployment

- PPE shall be donned in accordance with the McClellan Final Master HASP. Nitrile gloves will be used to avoid contamination of the sampling equipment.
- Each hardware kit is labeled for each well, and should closely match the dimensions submitted to the manufacturer. A label indicating the well ID for which the corresponding tether was made will be located on each cardboard spool. A well ID tag will be permanently attached to each tether beneath the snap connector clip near the top of the tether.
- Upon initial deployment, check that each tether meets the specifications given to the manufacturer for each well.
- For initial deployment, if required by site-specific conditions, monitor headspace of well with a photo ionization detector (PID), a flame ionization detector (FID), or other appropriate monitoring instrument and record in the logbook, according to the procedures outlined in SOP-3, Use and Maintenance of Field Log Books.
- Open the appropriate hardware kit and carefully unwrap the first few feet of stainless steel tether from the spool to expose the 1/2 inch diameter stainless steel rings that have been permanently attached to the tether line. The rings will be separated by approximately 2/3 the length of the PDB sampler. Use a cable-tie through the lower stainless steel ring on the tether, and the handle of the PDB (as shown in Figures 1 and 2). Use a second cable-tie through the upper of two adjacent rings and through a section of mesh below the fill nozzle in the softer part of the filled sampler. Tighten the cable ties and snip off excess.
- Check that stainless steel weight is attached firmly to the end of the tether with a stainless steel split ring.
- Attach the black vinyl snap connector clip to the stainless steel split ring on cap. **Note: This step should only be taken upon initial deployment. The tether is to remain attached to the well cap at all times for the duration of the remaining sampling events.**

- Lower the tether, weight first, into the well. Ensure the PDB sampler is fully submerged in the screened interval of the well. Allow the weight to rest on the bottom of the well, if possible.
- Confirm that the line is slightly taught when the well cap is in place. Adjust as necessary to ensure that the tether does not sag when well cap is closed.
- Secure the well. Documentation should be included in a field notebook or other appropriate log. The log should show the monitoring well location as well as the date and time that the PDB sampler was placed in the monitoring well.
- For initial deployment, leave sampler in place for a time suitable for equilibration; a minimum of two (2) weeks is required for equilibration. Otherwise, leave sampler in place until the next sampling round. Samplers do not degrade, and can remain in wells almost indefinitely.

### 7.2. Sampler Recovery

- Don PPE in accordance with McClellan Final Master HASP.
- Sampling should begin, if possible, at the monitoring well with the least contamination, and then proceed systematically to the monitoring wells with the most contaminated groundwater.
- Check and record the condition of the monitoring well for damage or evidence of tampering. Lay out polyethylene sheeting around the well to minimize the likelihood of contamination of sampling equipment from the soil, if required by site-specific conditions.
- Record location, time, date, and appropriate information in designated field logbook and the Groundwater Sampling Log (See SOP-10). A Trimble Unit may also be used to record the appropriate information.
- If required by site-specific conditions, monitor headspace of well with a PID, FID, or other appropriate monitoring instrument, and record in the logbook according to the procedures outlined in SOP-3, Use and Maintenance of Field Log Books.
- Field personnel must include a depth for each PDB sampler on the chain-of-custody form and documented on the field logs.
- Note the time, and carefully reel in the tether by winding it around a clean cardboard spool.
- The condition of the PDB sampler must be recorded in the field logbook, including the presence of any headspace within the sampler. If the headspace is greater than 6 mm (i.e. “pea-size”) in the PDB sampler, contact the Project Chemist before proceeding.
- The contents of each PDB must be transferred to the VOA vials immediately to avoid loss of volatile compounds.
- To discharge, select a point on the sampler near the end of the PDB. Press the pointed end of a new, disposable discharge tube firmly into the PDB at a downward angle until it pierces the clear membrane. Discharge a small amount of water to waste in order to purge the discharge tube. This may require field personnel to gently squeeze the PDB to force the water to discharge.
- Carefully discharge contents of sampler into VOA vials, filling vials completely and leaving no headspace. Fill carefully and in a manner that will minimize agitation and aeration. Holding the VOA vial at a 45 degree angle may reduce the possibility of aeration of the sample.

- Label and store all samples in accordance with SOP-15, Sample Identification, Labeling, and Packaging. Samples should be immediately placed in a cool place out of direct sunlight, such as a cooler. The cooler should be kept at 4°C ± 2°C for preservation requirements for the applicable analyses.
- Immediately after the sample is collected, record applicable information in the field log book and the Groundwater Sampling Log (See SOP-10). A Trimble Unit may also be used to record the appropriate information.
- After collecting the sample, wait one day to measure the water level in the well before deploying the new PDB.
- Prior to deploying the new PDB, collect the water level and total well depth data in accordance with SOP-8. Decontaminate the water level meter in accordance with SOP-13, Equipment Decontamination.
- Change gloves and deploy new PDB as described in section 7.1, Sampler Deployment.
- Dispose of all PDB samplers and components appropriately.
- Decontaminate all reusable equipment in accordance with SOP-13, Equipment Decontamination

### 7.2.1 Field Blank

A field blank will be provided by the manufacturer with the other PDBs. The field blank will be a prefilled PDB containing 100 ml of deionized water. The purpose of the field blank is to assess if possible contamination occurred from manufacturer to shipment. The field blank should be sampled last.

## 7.3. Sample Containers

The proper sample containers to be used for specific analysis and sample preservation are outlined in Table A4-1 of the Quality Assurance Plan (QAP) (Appendix A).

## 7.4. Sample Preservation

Proper sample preservation procedures are outlined in SOP-14, Sample Containers, Preservation, and Maximum Holding Times.

## 7.5. Chain-of-Custody

Samples shall be accompanied by an appropriate Chain-of-Custody form at the time of transfer. The procedures for filling out a Chain-of-Custody form, transporting samples, and transferring custody of samples are outlined in the SAP.

## 7.6. Review

The reviewer shall check Field Log Books and the Groundwater Sampling Logs for completeness and accuracy. Any discrepancies will be noted and the logs will be returned to the originator for correction.

The reviewer will acknowledge that the review comments have been incorporated by signing and dating the “checked by” and “date” blanks on the Groundwater Sampling Log (see SOP-10), or by initialing and dating the Field Log Book.

## 8. REFERENCES

U.S. Environmental Protection Agency (EPA). 1991. “A Compendium of ERT Groundwater Sampling Procedures.” OSWER Directive 9360.4-06, January 1991. U.S. Environmental Protection Agency.

Matrix Environmental Services LLC (MES), 2011. “Final Master Health and Safety Plan”. August.

MES, 2013. “Sampling and Analysis Plan.”

MES, 2013. “Standard Operating Procedure 3, Use and Maintenance of Field Log Books”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 8, Water Level Measurement”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 10, Groundwater Sampling”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 13, Equipment Decontamination”, SAP Attachment 3.

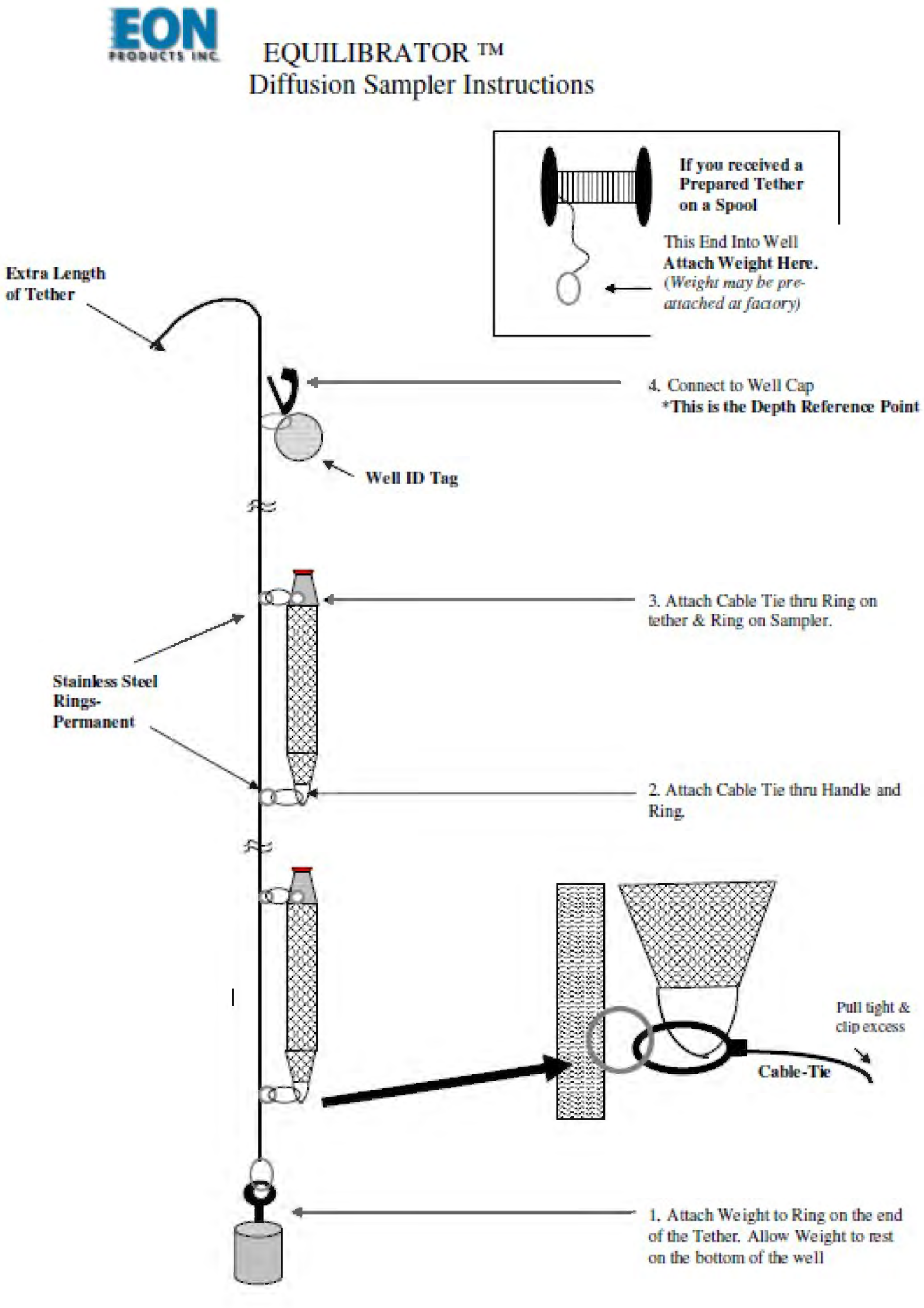
MES, 2013. “Standard Operating Procedure 14, Sample Containers, Preservation, and Maximum Holding Times”, SAP Attachment 3.

MES, 2013. “Standard Operating Procedure 15, Sample Identification, Labeling, and Packaging”, SAP Attachment 3.

## 9. EXHIBITS

| | |
|---|---|
| Exhibit 19-1 | PDB Sampler - Diagram 1 |
| Exhibit 19-2 | PDB Sampler - Diagram 2 |

## Exhibit 19-1
## PDB Sampler - Diagram 1



EON PRODUCTS INC. EQUILIBRATOR ™ Diffusion Sampler Instructions

**If you received a Prepared Tether on a Spool**

This End Into Well **Attach Weight Here.** *(Weight may be pre-attached at factory)*

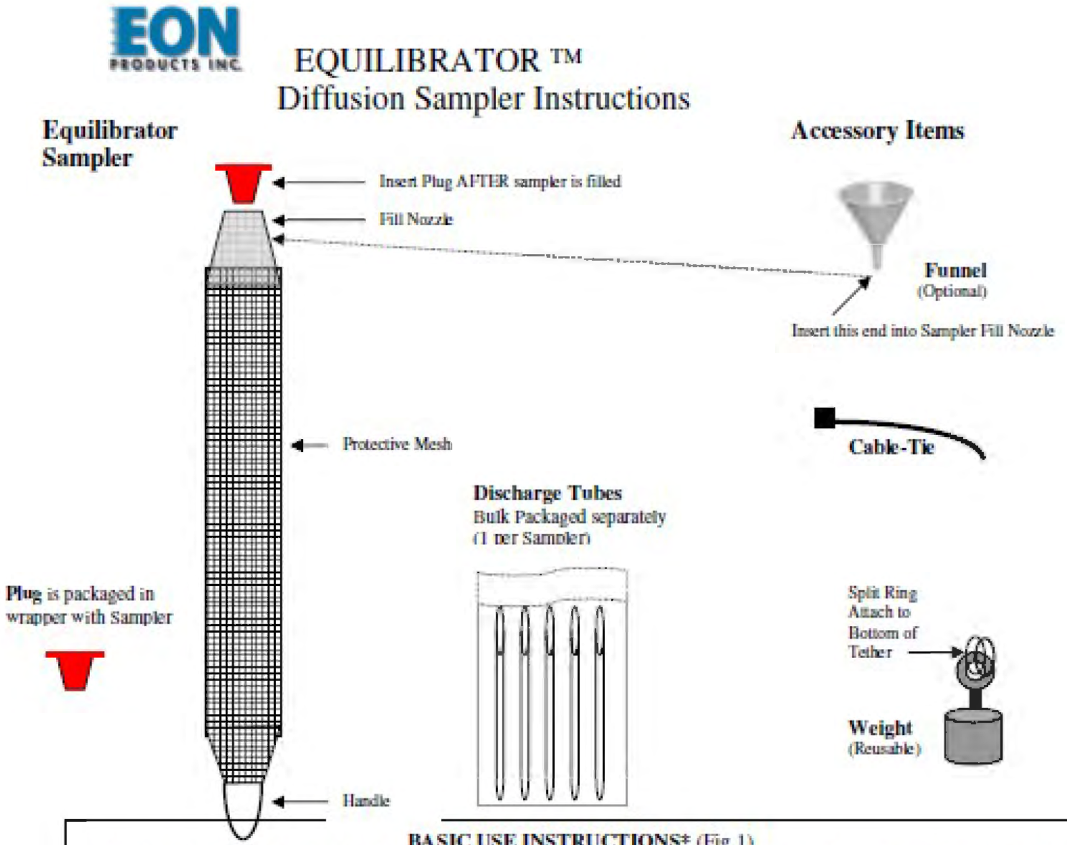
4. Connect to Well Cap ***This is the Depth Reference Point**

3. Attach Cable Tie thru Ring on tether & Ring on Sampler.

2. Attach Cable Tie thru Handle and Ring.

1. Attach Weight to Ring on the end of the Tether. Allow Weight to rest on the bottom of the well

## Exhibit 19-2
## PDB Sampler - Diagram 2



**BASIC USE INSTRUCTIONS*** (Fig 1)

1. **Fill the Sampler with deionized water** until the entire assembly is completely full of water. To use the funnel, insert the tip into the Sampler and pour deionized water into the tube. Fill the Sampler until water rises and stands at least two inches up the funnel to expand the Sampler to its maximum capacity. ***Gently squeeze and add more water to expand the membrane and remove air pockets. Repeat as needed until completely full.*** *Disclosure Statement – When filling the Sampler, we recommend that you hold the Sampler firmly at the top as close to nozzle tip as possible to prevent unnecessary stress on inside poly bag which could cause a leak to develop.*
2. **Insert the Plug firmly into the Sampler,** until the rim of the plug is as close to the nozzle as possible.
3. **Attach a Weight to the bottom of the Tether or Hanger.**
4. **Attach the Equilibrator(s) to the Tether line.** If installing on a factory prepared tether, locate the small (1/2" diameter) stainless steel rings that are attached to the Tether line. The rings will be separated by approximately 2/3 the length of the sampler. Use a Cable-Tie through the lower of two adjacent rings and through handle. Use a second Cable-Tie through upper of two adjacent rings and through a section of mesh below the fill nozzle in the softer part of the filled sampler. Tighten the Cable-Ties and snip off excess. Continue with each Sampler. If the factory did not prepare the Tether, then securely attach the Sampler(s) to the tether using cable ties at the intended location(s).
5. **Lower the Tether with Sampler(s) attached into the well.** Locate Sampler(s) below the water surface, in the screen flow zone of the well. Attach the top of the suspension cord to a well cap or other secure location at the top of the well. Leave Sampler in place for a time suitable for equilibration, a minimum of 2 weeks required.
6. **Upon retrieval: Discharge sample immediately** to avoid loss of volatile compounds. Select a point on the Sampler near the handle/bottom of sampler. Press one end of the Discharge Tube firmly into the clear polyethylene membrane at a downward angle until it pierces the membrane. ***Discharge small amount to waste to purge discharge tube.***

***Contact EON for detailed installation information and for factory prepared Tethers.**

**800-474-2490**

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## STANDARD OPERATING PROCEDURE - 20

## MONITORING WELL ABANDONMENT

### 1.0 PURPOSE

This Standard Operating Procedure (SOP) addresses the supplies and equipment to be used, and establishes guidelines and procedures for field personnel to use in the supervision of groundwater monitoring well abandonment activities.

The details within this SOP should be used in conjunction with the Installation-Wide Sampling and Analysis plan (SAP).

The objectives of monitoring well abandonment are to:

- Prevent vertical migration of fluids within the monitoring well being abandoned.
- Prevent intermixing of waters from different water-bearing zones
- Eliminate physical hazards (e.g., open boreholes)
- Prevent groundwater contamination
- Preserve aquifer properties.

### 2.0 DEFINITIONS

**Grout** - sealing material that is composed of cement, bentonite, or a cement-bentonite mixture.

**Tremie Pipe** - a pipe that is inserted into a well or borehole to transport grout or other well materials from the ground surface to a specified depth. A side discharging tremie pipe has a fitting on the end that causes the material being pumped through the tremie pipe to discharge in a lateral direction.

**Plugging** - The process of placing a material in the well or borehole that has a lower hydraulic conductivity than the surrounding geologic formation.

**Well Abandonment** - For the purposes of this SOP "well abandonment" will refer to the abandonment of groundwater monitoring wells only. Well abandonment is the process of formally destroying the well such that it may never be used again.

**Site Manager** is responsible for ensuring that all abandonment activities are conducted and documented in accordance with this SOP and any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field personnel assigned to borehole and well abandonment activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from the procedures to the Site Manager.

The Quality Control Manager (QCM) is responsible for periodic review of field generated documentation associated with this SOP. The QCM is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of work plans and SOPs, variances to the abandonment requirements, issuing nonconformances, etc.) if problems occur. The QCM may perform other duties such as coordinating drilling activities.

## 3.0 SUPPLIES AND EQUIPMENT

The following is a list of the supplies and equipment needed to implement this SOP in the field.

### 3.1 Records and Forms

1. Field logbook
2. Well log(s) of well(s) to be abandoned
3. Site-Specific Field Sampling Plan
4. Well Abandonment Logs (see Attachment 2 of SAP)
5. Site Specific Health and Safety Plan
6. Installation-Wide Safety and Health Plan
7. Appropriate SOPs

### 3.2 Materials, Equipment, and Supplies

1. Indelible black-ink pens and markers
2. Latex gloves
3. Weighted tape
4. Decontamination equipment and supplies
5. Personal protective clothing
6. Drill Rig with appropriate drill rods, bits, and tools
7. Grout Mixing Equipment
8. Grout Pumping Equipment
9. Tremie Pipe equipped with a side-discharging tip
10. Bentonite
11. Portland Cement

## 4.0 RESPONSIBILITIES

Field personnel are responsible for performing the applicable tasks outlined in this procedure when conducting work related to environmental projects. Appropriate measures should be taken to protect the health and safety of individuals when abandoning a well or borehole.

The PM or an approved designee is responsible for checking work performance and verifying that the work satisfies the applicable tasks required by this procedure. This will be accomplished by reviewing documents and data produced during work performance.

## 5.0 PROCEDURES

This section contains procedures and requirements for well abandonment. Abandonment procedures to be used at a particular site must incorporate project specific regulatory requirements.

### 5.1 Pre-Abandonment Activities

The following information should be reviewed prior to well abandonment activities:

- The subsurface lithology/soil types in the immediate vicinity of the well, as derived from the boring, soil core, and/or borehole geophysical logs compiled from the particular well.
- The well condition information based upon historical or operations records (including sample collection forms) and previous inspection activities (e.g., tape soundings, video camera logging, borehole geophysical logging, etc.).
- The well construction information, including type, depth, diameter, and length of casing and well screen; and composition and thicknesses of sand packs, bentonite seals and cement seals.
- Past analytical results of groundwater samples collected from the well.

### 5.2 Well Abandonment Activities

Well abandonment activities will be performed in accordance with *ADEM Land Division Hazardous Waste Program Division 14* regulations. The MDA will inform ADEM of proposed field activities prior to the abandonment of monitoring wells.

- Upon initiation of abandonment activities, all downhole sampling (e.g., dedicated purge pumps, sample pumps, etc.) and monitoring equipment must be removed from the well.
- Using a weighted tape (or equivalent measuring device), obtain a measurement of the total depth of the well and compare to the existing well construction information. Record this information on the well abandonment log (Attachment 2) and in the field logbook.
- Completely remove the well casing and screen from the borehole. This may be accomplished by augering with a hollow stem auger over the well casing down to the bottom of the borehole, and removing the casing, screen, grout and filter pack materials from the hole with the drill rig or other equipment. Alternatively, the borehole may be cleaned out by using a drag bit or roller cone bit to grind the casing into small cuttings and flushed out of the hole or using a solid stem auger. Regardless of the method used to remove the casing and screen materials from the borehole, the borehole shall be cleaned and then backfilled with grout by pressure grouting from bottom to top and the top two feet poured with concrete. At the discretion of the Site Manager, a 2 foot x 2 foot x 2 foot concrete surface pad may be placed over the abandoned well in high traffic areas.
- Complete, accurate records of the abandonment procedure should be kept for each well abandoned. The record of abandonment should include, at a minimum, the depth of each layer of all sealing and backfill material, the quantity of sealing

materials used, measurements of static water levels and depths, and any changes made in the well during the plugging or sealing. Record this information on the well abandonment log (Attachment 2) and in the field logbook.

### 5.3 Disposition of Spent Well Materials

Spent well materials and any other solid waste generated during well abandonment activities will be treated as nonhazardous solid waste. This waste will be managed and disposed as outlined in the SOPs in Attachment 3 of the SAP. Water displaced from the well during the grouting process will be containerized and properly managed.

## 6.0 REFERENCES

Alabama Department of Environmental Management. 2005. “Alabama Environmental Investigation and Remediation Guidance”. September.

# STANDARD OPERATING PROCEDURE - 21

# SCREENING LEVEL METALS ANALYSIS USING PORTABLE X-RAY FLUORESCENCE INSTRUMENT

## 1.0 SCOPE AND APPLICATION

The purpose of this Standard Operating Procedure (SOP) is to describe the steps required to use a Niton XL3t Model 600 or equivalent X-ray Fluorescence (XRF) instrument for the screening level analysis of metals in soils and sediments by Matrix Environmental Services (MES) Authorized User(s) personnel. This SOP is prepared specifically for the Niton XL3t XRF instrument. The general approach described in the procedure is also applicable to other x-ray tube-based instruments with modification for their particular equipment specifications and requirements. The instrument manufacturer's directions and instructions must be followed. Use of this SOP should be restricted to personnel trained and knowledgeable in the operation of an XRF instrument. This type of XRF instrument uses state-of-the art x-ray tube technology instead of radioactive sources to generate the radiation needed to cause metals fluorescence. It is the responsibility of the Authorized User(s) to know and follow all applicable Federal, State, and Local laws and regulations regarding the use of the radiation producing equipment as well as the local requirements concerning the radiation monitoring of occupational workers.

The SOP is applicable to in-situ (direct analysis) and ex-situ (analysis of samples) detection and quantification of XRF target metals in soil and sediment matrices. Data from XRF analysis using this SOP is considered to be "screening level" only and is useful for initial screening and contaminant delineation. "Screening level" data generated by the XRF should not be used for risk assessments or waste disposal. Matrix effects, lack of sample preparation, and interferences may affect comparability with fixed analytical laboratory methods. Niton XLt3 analyzers measure the eight Resource Conservation and Recovery Act (RCRA) metals, twelve Priority Pollutants, and nineteen USEPA Target Analytes.

The detection limits achieved with the XRF are dependent on the analyte of interest, the type of detector, the strength of the source, count times, matrix affects, and interferences. Table 1 summarizes the detection limits that are typically achievable in "blank" soil matrices (i.e., silica sand). Actual detection limits in site soils may be higher.

**Table 1 - Typical Limits of Detection in Silica Sand Blank**
**RCRA and Other Metals Detected by Niton XL3t Model 600 XRF**

| *Metal* | *Average LOD (ppm)* | *Metal* | *Average LOD (ppm)* | *Metal* | *Average LOD (ppm)* |
|---|---|---|---|---|---|
| Antimony | 30 | Iron | 75 | Selenium | 6 |
| Arsenic | 9 | Lead | 8 | Silver | 10 |
| Barium | 90 | Manganese | 55 | Tin | 20 |
| Cadmium | 10 | Mercury | 7 | Titanium | 100 |
| Chromium | 65 | Nickel | 50 | Zinc | 15 |
| Copper | 25 | | | | |

**Notes:**

LOD = Limit of Detection
ppm = parts per million

## 2.0 METHOD SUMMARY

### 2.1 Principles of Operation

XRF is a nondestructive qualitative and quantitative analytical technique used to determine the metal components of samples. The Niton XL3t XRF uses a high-energy, x-ray tube to produce the radiation necessary to irradiate samples. The metal atoms in the sample either absorb or reflect the x-rays. When an atom absorbs the source x-rays, a shifting of electrons occurs between electron shells. The rearrangement of electrons results in the emission of x-rays or fluorescence and each element present emits a characteristic x-ray line spectrum. The element may be identified by the energy of the wavelength. Fluorescent and reflected (backscattered) x-rays enter through a detector window where their energies are converted to electric pulses. The number of counts at a given energy per unit of time is representative of the analyte concentration. An onboard data processor converts the detector signals into useable information elements present, their concentrations in parts-per-million, and the standard deviation (error) of the measurement.

### 2.2 Instrument Description

The Niton XL3t XRF instrument is a new design that incorporates new technology into XRF field instrumentation including: the use of a high energy x-ray tube instead of sealed radioactive sources, integrated USB and Bluetooth™ communications providing direct data transfer to a PC or networked storage device, eliminating cumbersome data syncing procedures required by PDA-based XRF analyzers, and improved detector and electronics that help increase instrument sensitivity and shorten the instrument time required to perform the analysis. The Niton XL3t XRF also has an integrated test stand to aid in sample presentation and analysis. This XRF model has a design similar to a portable power drill, allowing one-handed operation by the analyst. Niton XL3t has included a handle-mounted battery pack and an instrument trigger. The x-ray tube assembly is mounted above the handle, sending the x-rays along the instrument barrel towards the Kapton film window which directly interfaces with the sample to be analyzed at the end of XRF.

The instrument instruction manual should be thoroughly reviewed for first time users and referred to by the analyst for project-specific instrument set up. This SOP summarizes typical setup and operation only.

### 2.3 Sample Preparation Procedures

Sample preparation is dependent on the mode of analysis. For samples collected and analyzed in the field, rock and vegetative matter will be removed as the sample is homogenized. If any metal debris (such as bullets or bullet fragments) is present in the sample, they will be identified by the analyst and removed by hand. The amount and type of metal debris observed will be recorded on the XRF Soil Sample Collection Log (see Attachment A to this SOP).

***Direct "In-Situ" Analysis.*** For samples analyzed in situ, all large or non-representative debris, such as rocks, pebbles, leaves, vegetation, roots, and concrete from the soil surface will be removed before analysis. The soil should be leveled to create a smooth surface to ensure the probe window makes good contact with the soil. This should be accomplished by using a stainless-steel trowel or like equipment. Prior to soil analysis, the soil should also be tamped to increase soil density and compactness. Soils completely saturated with water or under water will not be analyzed via the in-situ method.

***Onsite Laboratory Preparation.*** For samples analyzed in a laboratory environment: (a) rock, vegetative matter, and metal debris will be removed as the sample is homogenized; (b) an aliquot of sample will be placed in a disposable, oven-safe container and dried; (c) after cooling, the sample will be crushed with a ceramic pestle if necessary, and passed through a ASTM No. 10 (2-mm) wire mesh sieve and onto a piece of wax paper. After sieving, samples may be transferred to a ziptop bag for analysis or placed into plastic XRF cups and sealed using Mylar film supplied by the instrument manufacturer.

### 2.4 Sample Analysis

Sample analysis begins by exposing the sample to primary radiation from the source. The Niton XL3t has two options for sample presentation to the instrument – direct analysis or the integrated test stand.

***Direct Analysis.*** If direct analysis with the Niton XL3t is performed, the analyst will ensure the instrument window is in direct, stable contact with the soil or ground surface so that the instrument window and the sample surface are properly aligned. If contact analyzing with contact to the ground surface, clear debris, place a thin Mylar® film on the measurement location to protect the analysis window from damage. The analyst will initiate the analysis by depressing (and releasing) the XRF trigger mechanism as the instrument is held down against the film, sample bag or cup. The instrument will perform an initial “safety check” and then open the shutter allowing the analysis to begin. The analyst must hold the instrument upright and maintain a steady contact with the sample while the instrument is in the "on" position, for a nominal (programmed) sixty seconds. The XRF has a flashing red strobe light mounted on the top of the instrument and a small LCD display on the rear of the instrument. While taking a direct reading, the light will flash and the LCD display will show a counter of the total seconds elapsed. The analyst must not move the instrument during direct analysis until the sequence is complete and the shutter closes automatically. Significantly moving the instrument or sample during direct analysis will invalidate the run and potentially expose the user to x-rays. The safety lock of the Niton XL3t should immediately engage and stop the run when the instrument stops detecting sample fluorescence (i.e., the sample has been removed). It is key that the analyst lock the instrument trigger prior to moving the instrument if the distances between sample locations is great. In this manner the XRF can be safely transported without having to power down the instrument between readings.

***Test Stand Analysis.*** If the integrated test stand is utilized, the instrument is mounted in a cradle and the instrument window fits into a slot beneath the test platform so the XRF window faces “up.” The analyst places the bagged or cupped soil on the test platform directly over the XRF window of the unit, the test stand’s protective cover is closed over the analysis area, and the analysis is started. The test stand includes a red light mounted on top of the stand that will flash when analysis is underway. When analyzing the sample, the test stand cover must remain closed to reduce radiation risk to the analyst. Analysis should be performed for a nominal (programmed) sixty seconds. Once the analysis run is complete, the display changes and the red light returns to steady.

During either analysis, the instrument will constantly update to show the elapsed count time of the run, the concentration and standard deviation of the metals detected, and the detection limit of the metals which are not detected. The analyst should monitor this display, but operating in the default, standard mode, Niton XL3t programming will discontinue the analysis run when 90 seconds has elapsed. In approximately 90 seconds, the Niton XL3t has reached the lower reporting limits routinely achievable. If required, the XRF run time can be extended via analytical programming to marginally lower the reporting limits further. Check the instrument manual for instructions. The needs of the project and the objective of the XRF measurement will be taken into account by the analyst to determine the length of analysis.

## 3.0 INTERFERENCES

### 3.1 Physical Matrix Effects

Physical matrix effects may result from variations in moisture, particle size, uniformity, homogeneity, and sample position.

### 3.1.1 Moisture Content

Overall error from moisture is minimal for soil with moisture contents of 5% to 20%. Drying in a commercial toaster or laboratory oven can minimize error. No sample will be analyzed in-situ if it contains greater than 20% moisture (i.e., the soil is visually wet or contains any free water). In-the-field measurements can be performed on soil that is dried by squeezing the material through paper towels or coffee filters to remove water from the samples prior to analysis. Alternatively, the sample can be collected in the field and brought into the onsite laboratory for oven drying. If necessary, the samples will be dried for 4 to 8 hours at 120 degrees Celsius (or as needed) to remove moisture.

### 3.1.2 Particle Size, Uniformity, and Homogeneity

To minimize the analytical error attributable to particle size, uniformity and homogeneity laboratory prepared samples will be crushed, sieved and homogenized as part of the sample preparation process. Crushing will be performed using a ceramic pestle (or soil grinder, if needed). Crushed material will be passed through an ASTM No. 10 (2-mm pore size) standard sieve to remove small rock and debris. Finer size sieves may be used also depending on the project objectives. Once crushed and sieved, the material that passes through the sieve is piled onto a sheet of wax paper where it is homogenized and blended by using a rolling action. Prepared samples can be covered with a sheet of Mylar film for direct analysis or placed into ziptop bag.

### 3.1.3 Sample Position

Inconsistent positioning of samples is a potential source of error. The x-ray signal decreases as the distance from the source increases. The window of the XRF should be in direct contact with the soil bag, cup window, or sampled surface. The analyst must make sure that if performing direct analysis, the instrument window stays in constant, even contact with the sample analysis surface.

### 3.2 Chemical Matrix Effects

Concentrations of certain elements interfere with others. The effects may occur as peak overlaps, x-ray absorption, or x-ray enhancement. The Niton XL3t has advanced programming present to minimize these effects; however they cannot be eliminated entirely.

Common matrix effects include: a high lead concentration elevates the detection limit of arsenic or biases the result high; iron may interfere with the quantification of copper and cobalt, and the presence of vanadium may affect chromium quantification. Consult the instrument manual if these conditions exist at the site.

## 4.0 SAFETY

When in the field, the instrument will be operated in compliance with the manufacturer's recommended procedures found in the instrument manual**. Under no circumstances will the XRF instrument case be opened or serviced by the analyst.** If the instrument malfunctions, the MES SHSM or HSC and the manufacturer will be contacted for further instructions.

The safety procedures found in the instrument manual will be explicitly followed. These include:

- Trigger/shutter lockout will be engaged (via the control panel) when the instrument is not in use. If not in use for longer than 1-2 hours, the analyst should power down the instrument to reduce heat buildup and save battery power. If the XRF is not mounted in the test stand, it should be secured and stored inside the case.
- The analyst will always be aware of the position and angle of the x-rays.
- The analyst will operate the instrument only on a stable, flat surface when performing a measurement. If the test stand is used, the test stand should be placed on stable surface (field table, truck tailgate, e.g.).
- The analysis area will be separate from other work areas and dedicated to sample preparation and analysis.
- Leak detection testing within the last six months shall be performed on the XRF and certificates of analysis included in the shipping container. Required licensing documentation and storage requirements shall be enforced.
- When the XRF is not in use for long time periods, it will be stored in its original shipping container.

MES's health and safety personnel have reviewed instrument safety procedures of the Niton XL3t XRF while in operation. Human exposure to radiation is typically measured in rems or in one-thousandths of a rem, called millirem (mR). The allowable limit in the U.S. for occupational exposure is 5,000 mR/year for a whole-body or 50,000 mR for shallow penetration of extremities. Exposure from a properly used Niton XL3t will be less than 200 mR per year, even if the instrument is used 2,000 hours per year. Per the Alabama Department of Public Health, Radiation and Control Division, radiation safety badges or dosimetry monitoring are not required if the procedures are followed.

## 5.0 EQUIPMENT AND SUPPLIES

- XRF analyzer - An XRF analyzer should have two major components: the integrated instrument (batteries, x-ray tube, trigger, window, detector) and the optional test stand and cables.
- Calibration verification standards (blank soil and certified standard reference materials)
- Spare battery and a charger
- Sampling and homogenizing tools (examples: steel trowel, hand rake, spoon, hand auger, disposable wooden spatulas)
- Oven-safe drying containers (disposable aluminum pans)
- Ziplock storage bags
- Wax paper
- Drying oven
- Kapton/Mylar x-ray window film, XRF cups, and glass wool
- Mortar and pestle
- Sieve and sieve brushes
- Laboratory scoopula
- Waste container (for material that does not pass sieve)
- Indelible marking pens
- Paper toweling, disposable wipes
- Gloves, safety glasses, and dust mask (if crushing and sieving fine dried soils)

## 6.0 STANDARDS

### 6.1 Standard Reference Materials

Standard reference materials (SRMs) are prepared soil samples containing certified concentrations of metals in soil or sediment. Typically SRMs are purchased from the National Institute of Standards and Technology (NIST) or commercial supplier such as Environmental Resource Associates (ERA). They are used for accuracy and performance checks of XRF analyses. Three standards containing the analytes of interest at low, medium, and high levels are recommended to verify the instrument performance. Historical concentrations at the site and the concentrations of any project-specific regulatory clean up or remedial goals or action levels of the analytes of interest will be evaluated in the selection of SRMs.

### 6.2 Blanks

A blank sample of "clean" quartz or silica dioxide sand that is free of any of the analytes of interest at the detection limits is required. Usually this material will be supplied by the instrument manufacturer.

## 7.0 QUALITY CONTROL

### 7.1 Data

All field data sheets and quality control data should be maintained for reference or inspection.

### 7.2 Calibration

Instrument calibration should follow the calibration procedures outlined in the manufacturer's operator's manual. The Niton XL3t instrument undergoes a system check during start up or when the instrument is reset. An energy calibration using the stainless steel coupon (if using the test stand) or clip (direct analysis) is required after a successful system check.

### 7.3 Calibration Verification Checks

A calibration verification is performed using SRMs to check the accuracy of the instrument and to assess the stability and analysis of analytes of interest. Check samples should be analyzed at the beginning of each working day, during active sample analyses, and at the end of each working day.The count time of the calibration check should approximate the analysis time of the field samples (i.e., 90 seconds of elapsed time is the default).

In general, the measured value for each target analyte should be less than 20% difference (%D) from the certified value. The %D is defined as the absolute difference divided by the certified value and is expressed as a percent. If the %D falls outside this range, the check should be reanalyzed. If the value is outside the acceptable range again, the analyst should note this condition on the calibration log form (see Attachment A). At very low concentrations near in the detection limit, exceedances of the 20% criterion are not uncommon. Depending on the objective of the XRF measurements, the analyst should consider increasing the count time of the verification check (and also the field samples) to determine if the XRF measurement accuracy would improve with increased exposure.

### 7.4 Blanks

There are two types of blank samples that will be analyzed, instrument blanks and method blanks.

#### 7.4.1 Instrument Blanks

An instrument blank can be silicon dioxide, a polytetrafluroethylene (PTFE) block, a quartz block, “clean” sand, or lithium carbonate. Instrument blanks are used to verify no contamination exists in the spectrometer or on the probe window. The instrument blank should be analyzed at the beginning and end of each day and once per every twenty samples. An instrument blank should also be analyzed whenever contamination is suspected by the analyst.

### 7.4.2 Method Blank

A method blank can be “clean” silica sand or lithium carbonate that undergoes the same preparation procedure as the sample. Method blanks are used to monitor for laboratory-induced contaminants or interferences. The method blank is analyzed once per day to determine if contamination is entering the analytical procedure.

### 7.5 Detection Limits

The lower limits of detection will be based on spike recoveries in the matrix of concern or from recoveries on a certified reference material of the appropriate matrix and within the appropriate calibration range for the application. Concentrations should take into consideration the site screening levels.

## 8.0 PROCEDURE

Before operating any XRF instrument, consult the manufacturer's manual.

### 8.1 Instrument Warm-up and Operating Environment

After installing a newly charged battery, turn the instrument on and allow it to warm-up for at least fifteen minutes. The instrument performs best in a dry, temperature-controlled environment. The Niton XL3t can be operated in light to moderate rain (as long as the instrument and sample remain dry) and in relatively high ambient temperatures. If the internal temperature of the XRF exceeds operating specifications, the instrument will show a warning message on the display screen and shut down. If this occurs, the analyst should leave the instrument off and remove the XRF to a lower temperature environment (interior of an air conditioned building or car) for 15 to 30 minutes and then restarted.

### 8.2 Internal Calibration

Check the XRF clock date/time before beginning analysis. Adjust the time for the local time zone if needed. Either assemble and mount the XRF in the test stand or if the instrument will be used to collect direct measurements, immediately begin the automated internal calibration/equipment check sequence of the XRF. Use the stainless steel coupon (disk) in test stand mode or use the “clip on” attachment for direct analysis when prompted to do the energy calibration. Document that the instrument passes the energy calibration check.

### 8.3 Blank Analysis

After completing a successful internal/energy calibration sequence, two types of blank samples should be analyzed, the instrument blank and the method blank. . If the XRF is mounted in the test stand, the polyethylene sample cup is placed directly over the instrument window with the cup’s Mylar film facing down. Close the test stand cover and initiate analysis using the touch screen. In direct analysis mode, position the cup with the film window facing up and align the XRF window over the cup. Hold the instrument in place and depress (and release) the trigger to start analysis.

The XRF will open the shutter and test for the presence of the sample. If the sample is in place and fluorescence is detected, the instrument will begin analysis. The instrument-mounted or test stand-mounted red light will flash to indicate the analysis is underway. After a count time of at least 60 seconds (or 90 seconds of actual elapsed clock time), the analysis will be automatically terminated. Generally speaking, once the run has started, it must be completed before disengaging the XRF from the sample. If the cup is moved or the test stand cover is opened during a run, the XRF will stop the run and report an error message on the control panel. This is not recommended, as radiation exposure potentially exists. A menu-based control button can also terminate the run early if required.

When the run is complete, the touch screen will display the final XRF results of the run and allow the text entry into data fields designed to identify the run. For the calibration blank and standards, use the touch screen to type the identifying information into these fields for data log storage. Record results on calibration form (Attachment A) or a project-specific form may be used instead.

### 8.4 Calibration Check Verification

After successful analysis of a blank, analysis of a series three concentration level SRMs is recommended (low, medium and high level) depending on project objectives and the availability of SRMs. The sample cup containing the SRM is analyzed in the same manner as the blank. After a count time of at least 60 seconds (90 seconds of elapsed time), the analysis will be automatically terminated unless this is reset manually. Record identifying sample information with the touch screen and on the Calibration Form (Attachment A). A project-specific form may be used instead.

### 8.5 Precision Measurement

A minimum of one precision sample will be analyzed per day. The precision sample will be analyzed seven times in replicate.

### 8.6 Sample Analysis

After successful verification of calibration, sample analysis can begin. Follow the procedures described in Sections 2.3 and 2.4. After a count time of at least 60 seconds (90 seconds elapsed time), the analysis will be automatically terminated unless this is reset manually. Record identifying sample information with the touch screen and on a data form (Attachment A). Ensure that the sample depth of take is recorded in one of the fields to help identify the sample as well. A project-specific form may be used instead (see Attachment 2 of the SAP).

Immediately after analysis, the collected and prepared sample will be placed in a jar, labeled, and archived for possible confirmation analysis in accordance with SW6200. Samples will be archived for up to 6 months at room temperature. A minimum of 10% of XRF samples will be sent to a laboratory for confirmation if the data are to be used for characterization or decision-making purposes. The samples will be selected in a range to capture low, mid, and high ranges of screening results. It is recommended that the sample be secured in a ziptop storage bag and placed in a cooler for storage for archive. If the sample is to be sent for fixed analytical laboratory analysis, then no further processing is necessary. The sample can be transferred into the appropriate sample container for labeling and shipping off site.

Following sample preparation and analysis, all disposable materials that have come in contact with the soil will be discarded appropriately. Materials that are reusable will be decontaminated using brushes, disposable wipes, paper toweling, and air drying.

### 8.7 Post-Sample Analysis Calibration Check Verification

After analysis of project samples, the calibration should be verified at the end of the analysis cycle to document instrument stability. Repeat step 8.3 in total or use a blank and the low or mid-level SRM. The necessity of this check depends on the project objectives.

## 9.0 DATA ANALYSIS

***Forms.*** All data from the XRF is manually captured and reported by the analyst using project-specific forms or logbook. Forms will be used to record the sample collection, preparation, and analysis and XRF instrument calibration. Attachment A contains example forms.

***Electronic Data.*** The XRF is capable of storing results and spectra for thousands of samples. Data is stored by analysis date. The Niton XL3t can be wirelessly connected to a Bluetooth™-equipped GPS receiver to store coordinate data along with each individual reading for site contamination mapping. Downloads will occur according to project-specific requirements.

## 10.0 WASTE MANAGEMENT

No liquid waste should be generated from the analysis of soils by XRF. All sample debris, personal protective equipment, and laboratory waste will be collected and disposed in compliance with project-specific waste management practices. Archived soil samples can be held for up to 6 months at room temperature without preservation before disposal.

## 11.0 REFERENCES

U. S. Environmental Protection Agency (EPA) Science and Ecosystems Division, 2015, *Field X-Ray Fluorescence Measurement, SESDPROC-107-R3*, December 2015.

# XRF Calibration Form

Site: Fort McClellan Project: Baby Bains Gap Road Ranges

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## I. Initial Calibration Data

Niton XL3t 600, S/N: _________________

Check Date/Time on XRF:

Date: _________ Time: _______

Is XRF Clock correct? **Yes** **No**

Is XRF warm-up >15 minutes? **Yes** **No**

Internal calibration complete? **Yes** **No**

Energy Resolution (eV): ________

Comments:

## II. Start-of Day Calibration

| **Blank - $SiO_2$, Count: ______ sec** | | | |
|---|---|---|---|
| Element | Concentration (ppm) | | <RL Accept? Y/N |
| | Certified | Detected | |
| As | <5 | | |
| Pb | <8 | | |
| Cu | <20 | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

| **Moderate Lead-NIST 2711, Count: ____sec.** | | | |
|---|---|---|---|
| Element | Concentration (ppm) | | % D Accept? Y/N |
| | Certified | Detected | |
| As | 105 | | |
| Pb | 1162 | | |
| Cu | 114 | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

| **Low Lead-NIST 2711, Count: ____sec.** | | | |
|---|---|---|---|
| Element | Concentration (ppm) | | % D Accept? Y/N |
| | Certified | Detected | |
| As | 18.9 | | |
| Pb | 432 | | |
| Cu | 81* | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

| **High Lead-NIST 2711, Count: ____sec.** | | | |
|---|---|---|---|
| Element | Concentration (ppm) | | % D Accept? Y/N |
| | Certified | Detected | |
| As | 626 | | |
| Pb | 5532 | | |
| Cu | 2950 | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

*Comments: *-Not a NIST certified value.%D-difference of certified and measured values, divided by certified value.*

## IIIa. Continuing Calibration Data

Date: _________ Time: _______

Is XRF Clock correct? **Yes** **No**

Is XRF warm-up >15 minutes? **Yes** **No**

Internal calibration complete? **Yes** **No**

Energy Resolution (eV): ________

Comments:

## IIIb. Continuing Calibration Data

Date: _________ Time: _______

Is XRF Clock correct? **Yes** **No**

Is XRF warm-up >15 minutes? **Yes** **No**

Internal calibration complete? **Yes** **No**

Energy Resolution (eV): ________

Comments:

# XRF Calibration Form

Site: Fort McClellan Project: Baby Bains Gap Road Ranges

**IV. End-of Day Calibration** Niton XL3t 600, S/N: _________________

Check Date/Time on XRF:

Date: _________ Time: _______ Is XRF Clock correct? **Yes** **No**

Is XRF warm-up >15 minutes? **Yes** **No**

Internal calibration complete? **Yes** **No**

Energy Resolution (kV): ________

Comments:

**Blank - $SiO_2$, Count: ______ sec**

| Element | Concentration (ppm) | | <RL Accept? Y/N |
|---|---|---|---|
| | Certified | Detected | |
| As | <5 | | |
| Pb | <8 | | |
| Cu | <20 | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

**Moderate Lead-NIST 2711, Count: ____sec.**

| Element | Concentration (ppm) | | % D Accept? Y/N |
|---|---|---|---|
| | Certified | Detected | |
| As | 105 | | |
| Pb | 1162 | | |
| Cu | 114 | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

**Low Lead-NIST 2711, Count: ____sec.**

| Element | Concentration (ppm) | | % D Accept? Y/N |
|---|---|---|---|
| | Certified | Detected | |
| As | 18.9 | | |
| Pb | 432 | | |
| Cu | 81* | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

**High Lead-NIST 2711, Count: ____sec.**

| Element | Concentration (ppm) | | % D Accept? Y/N |
|---|---|---|---|
| | Certified | Detected | |
| As | 626 | | |
| Pb | 5532 | | |
| Cu | 2950 | | |

*Other metals: Zn (<10)______, Ni (<40)______*
*Hg (<10) ______, Cr (<80)________*

*Comments:*
**-Not a NIST certified value.*
*%D-difference of certified and measured values, divided by certified value*

**Form Completed By:**

Name Signature Date

# XRF Laboratory Sample Form

Site: Fort McClellan Project: Baby Bains Gap Road Ranges

## I. General Sample Location and Identification

(circle) **Floor** **Sidewall** **Other**

Sample location/description: (if "other" describe):

to

(location) (type) (excavation depth, ft)

Comments: Date: Time:

Sample Number:

Associated QC:

## II. Sample Preparation

(check all that apply)

| Insitu | Drying | Crushing | Coarse Sieve |
|---|---|---|---|
| | | | |
| (pan prep) | (Temp:___C for ___hrs) | | (#10, 2 mm) |

Sample Prep Comments/Tar Observed?

## III. Analytical Results: (in ppm)

Measurement No:

Measurement Date:

Count Time: sec

Time:

Elapsed Time: sec

| | Original Analysis | | Dup Analysis* | | | |
|---|---|---|---|---|---|---|
| | Conc | Std Dev | Conc | Std Dev | RPD % | Comments |
| As | | | | | | |
| Pb | | | | | | |
| Cu | | | | | | |
| Zn | | | | | | |

* if performed

Other metals (Ni, Hg, Cr):

Comments:

## IV. Analytical Team

Form Completed by:

Signature Date

# XRF Soil Sample Collection Log
# Fort McClellan, Baby Bains Gap Road Ranges

| Location ID | | Sampling Data | | Prep | | | XRF Data | | Concentration (ppm) | | | | | Split to Lab | Other Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | No. | Date | Time | Pan | Lab | Frag? | Read No. | Count (sec) | As | Std | Pb | Std | Other Metals | | |
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# APPENDICES

# Appendix A
# Quality Assurance Plan, Revision B.1
# McClellan, Anniston, Alabama

**Prepared for:**

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**April 2017**

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## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| %D | Percent Difference |
| %R | Percent Recovery |
| °C | Degrees Celsius |
| AB | Ambient Blank |
| ADEM | Alabama Department of Environmental Management |
| AOC | Area of Concern |
| Army | United States Department of the Army |
| ASTM | American Society for Testing and Materials |
| BFB | Bromofluorobenzene |
| BIRTC | Branch Immaterial Replacement Training Center |
| CA | Cleanup Agreement |
| CBR | Chemical Biological and Radiological |
| CCV | Continuing Calibration Verification |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COC | Chain of Custody |
| D&I | Detection and Identification |
| DFTPP | Decafluorotriphenylphosphine |
| DI | Deionized Water |
| DMP | Data Management Plan |
| DQO | Data Quality Objective |
| DQS | Data Quality Summary |
| EB | Equipment Blank |
| EDD | Electronic Data Deliverable |
| EPA | U.S. Environmental Protection Agency |
| ESCA | Environmental Services Cooperative Agreement |
| ESE | Environmental Science and Engineering |
| FD | Field Duplicate |
| FS | Feasibility Study |
| GC | Gas Chromatography |
| GeoTech | GeoTech Computer Systems, Inc. |
| GIS | Geographic Information System |
| HASP | Health and Safety Plan |
| HDD | Hard Copy Data Deliverable |
| HPLC | High Performance Liquid Chromatography |
| ICP | Inductively Coupled Plasma |
| IDL | Instrument Detection Limit |
| IS | Internal Standard |
| IT | IT Corporation |
| LC | Liquid Chromatography |
| LCS | Laboratory Control Sample |
| LCSD | Laboratory Control Sample Duplicate |
| MB | Method Blank |

| | |
|---|---|
| McClellan | Former Fort McClellan |
| MCL | Maximum Contaminant Level |
| MD | Matrix Duplicate |
| MDA | McClellan Development Authority |
| MDL | Method Detection Limit |
| MEC | Munitions and Explosives of Concern |
| MES | Matrix Environmental Services, LLC |
| MQL | Method Quantitation Limit |
| MRL | Method Reporting Limit |
| MS Access | Microsoft Access |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| NIST | National Institute of Standards and Technology |
| PA | Preliminary Assessment |
| PARCCS | Precision, accuracy, representativeness, comparability, completeness, sensitivity |
| PBMS | Performance Based Measurement System |
| PCB | Polychlorinated Biphenyl |
| PCDD | Polychlorinated dibenzo-p-dioxins |
| PCDF | Polychlorinated dibenzofurans |
| PM | Project Manager |
| POC | Point of Contact |
| QA | Quality Assurance |
| QAO | Quality Assurance Officer |
| QAP | Quality Assurance Plan |
| QC | Quality Control |
| RA | Remedial Action |
| RCRA | Resource Conservation and Recovery Act |
| RD | Remedial Design |
| RI | Remedial Investigation |
| RPD | Relative Percent Difference |
| RSD | Relative Standard Deviation |
| RTC | Recruiting Training Center |
| SAIC | Science Applications International Corporation |
| SAP | Sampling and Analysis Plan |
| SDG | Sample Delivery Group |
| SFSP | Site-Specific Field Sampling Plan |
| SHSM | Site Health and Safety Manager |
| SI | Site Investigation |
| SOP | Standard Operating Procedure |
| SRM | Standard Reference Material |
| SVOC | Semivolatile Organic Compound |
| SWMU | Solid Waste Management Unit |
| TB | Trip Blank |
| U.S. | United States |
| USACE | U.S. Army Corps of Engineers |

| | |
|---|---|
| USAEHA | U.S. Army Environmental Hygiene Agency |
| USATHAMA | U.S. Army Toxic and Hazardous Materials Agency |
| USGS | U.S. Geological Survey |
| UST | Underground Storage Tank |
| VOC | Volatile Organic Compound |
| WAC | Women’s Army Corps |
| WWII | World War II |

# A 1.0 INTRODUCTION

This Quality Assurance Plan (QAP) has been prepared by Matrix Environmental Services, LLC (MES) on behalf of the McClellan Development Authority (MDA). The MDA has assumed from the United States (U.S.) Department of the Army (Army) the responsibility for environmental closure of certain sites at McClellan (formerly known as Fort McClellan). The basis for the continuing effort at these sites is an Environmental Services Cooperative Agreement (ESCA) between the MDA and the Army. In addition, the MDA negotiated a Cleanup Agreement (CA) with the Alabama Department of Environmental Management (ADEM) that describes the responsibilities for completing the investigation and remediation of potentially impacted sites at McClellan. Figure A1-1 shows the location of McClellan.

## A 1.1 Purpose and Objectives of the Quality Assurance Plan

The purpose of this QAP is to provide a consistent and detailed framework of policies, procedures, functional activities, and organization to be used during the execution of work at McClellan. The QAP outlines the quality assurance (QA) program and quality control (QC) activities that will be used to verify and maintain a level of performance required to meet the project objectives. In addition, the QAP provides specific descriptions of how the QA program will be implemented at the laboratory. The objectives of the QAP are as follows:

- Provide a consistent framework for generating analytical data of known and acceptable quality consistent with data quality objectives (DQOs).
- Address the quality of analytical systems used to perform data collection.
- Set forth procedures that demonstrate that the analytical systems are in control.
- Set forth procedures that limit the effect of non-laboratory activities on analytical data.
- Set forth record-keeping procedures commensurate with project data uses.

## A 1.2 Quality Assurance Project Plan Preparation Guidance

This QAP is an adaptation of the *Quality Assurance Plan, Fort McClellan, Calhoun County, Alabama* prepared for the Army, Mobile District, Corps of Engineers by IT Corporation (IT, 2002). The QAP is substantially consistent with, *Requirements for Quality Assurance Project Plans* (United States Environmental Protection Agency [EPA], 2001), and with the *Alabama Environmental Investigation and Remediation Guidanc*e (ADEM, 2002), to the extent practicable.

## A 1.3 Project Description

The MDA is continuing the environmental restoration activities at McClellan. The activities are being managed by the MDA through a Program Management Team made up of MDA representatives and a contracted environmental consulting firm (Consultant) selected to support the MDA in managing this program. Work managed by the MDA could potentially involve all facets of environmental restoration activities, including site investigations (SI), remedial investigations (RI), feasibility studies (FS), remedial design (RD), remedial actions (RA), and short- and long-term monitoring programs. All environmental restoration activities conducted by MDA are in support of the ESCA between the MDA and the Army and the CA between the MDA and ADEM.

This installation-wide QAP together with the installation-wide sample and analysis plan (SAP) have been prepared for the activities to be executed in support of the environmental restoration program at McClellan. The QAP presents policies, organization, function and the specific QA and QC activities that are associated with analytical data generation, assessment and reporting. The SAP presents, in specific terms, the requirements and procedures for conducting field operations and investigations. The information presented in both documents is intended to support all sampling and analysis programs and other activities that involve data-gathering at McClellan by providing data quality objectives and other guidelines for the collecting, evaluating and reporting of quality data. Site-specific field sampling plans (SFSPs) will be prepared that supplement the project's QAP and SAP, to address individual project sampling and analysis requirements. A sampling method will be specified in the FSP, however the other options are still allowable if field conditions, available equipment, or other variables require a changed to the method proposed.

The QAP is intended to be a dynamic document that is subject to change as new laboratory technology, techniques and data are developed. Advances in instrumentation and improvements in method performance shall be incorporated as updates to the QAP, as warranted. Revisions to the QAP will be submitted by the Consultant, as necessary.

### A 1.4 Facility Description

McClellan is located in Calhoun County in the foothills of the Appalachian Mountains in northeast Alabama. The City of Anniston is located to the south and east, and the city of Weaver to the north west of the Main Post installation. Pelham Range is approximately 5 miles due west of the Main Post installation and adjoins Anniston Army Depot along its northern boundary. Adjoining the Main Post installation to the east is the Choccolocco Corridor, which provides an access corridor connecting McClellan to the Talladega National Forest (Environmental Science and Engineering, Inc. [ESE], 1998; United States Army Corps of Engineers [USACE], 1997). European immigrant farmers in the mid-1800s established the McClellan area. McClellan includes 45,679 acres of government-owned and leased land and includes the Main Post and Pelham Range. The Main Post consists of 18,946 acres and was purchased by the federal government in March 1917 for the construction of a cantonment camp for the training of the National Guard Division. In 1918, the Field Artillery Brigade Firing Center was established for training artillery organizations. By February 1919, 1,660 buildings had been constructed, and a railway spur from the nearby Southern Railway tracks was completed. During this period, pistol and rifle ranges were established north of the camp, automatic rifle and machine gun ranges were established southwest of the camp, and artillery firing ranges were established southeast of the camp toward the Choccolocco Mountains. In 1919, after the Armistice, Camp McClellan was used as a demobilization center. Later in 1920, the camp was used for a reserve office Training Corps encampment for the 4th Corps.

In 1929 Camp McClellan became a regular Army Post, designated as Fort McClellan, to accommodate one permanent regiment of infantry and a summer camp for 6,400 trainees. These changes required construction of officer's quarters, infantry barracks, mess halls, hospitals, and warehouses. The depression relief programs were mainly responsible for the continued construction of more housing, recreational, and other community-related facilities throughout the 1930s. Beginning in 1939, an intensive training of the 5th Division, which included a modified course with firing of organic weapons including mortars, anti-tank guns and artillery pieces, was initiated.

McClellan experienced continued growth in the 1940s because of the onset of World War II (WWII). The installation was established as the headquarters for the 27th Division. The installation was expanded to the east and west to provide the training requirements for the 27th Division. In 1940, the 22,245 acres of Pelham Range, west of the Main Post, was purchased for artillery, tank, and heavy mortar firing. In 1941, the Alabama Legislature leased to the federal government approximately 4,488 additional acres to the east of the Main Post to connect the Main Post to the Talladega National Forest.

In May 1942, the 27th Division was transferred out of McClellan, and the Branch Immaterial Replacement Training Center (BIRTC) was established. The BIRTC was replaced with the Infantry Replacement Training in 1943, which was later replaced by the Recruiting Training Center (RTC) in 1946. In 1947, the RTC was moved and McClellan was placed in custodial basis in preparation for the intended inactive status.

The post-war period initially brought a decline in operations at McClellan. The decrease in military spending placed the installation on inactive status; however, in 1950 the installation was reinstated to active status with the eruption of the Korean Conflict. The Chemical Corps School was moved to McClellan in 1951; the large outdoor training area allowed for specialized chemical training involving chemical warfare protection, decontamination procedures, flame throwers, and the operation of smoke generators. A new rocket launcher range was established. The Base hospital was renovated to specialize in chest diseases. The home of the first permanent Women's Army Corps (WAC) training facility was established in 1955, although detachments of the WAC were established during the 1940s at the installation. Female volunteers were trained in administrative services, motor pool activities, and supply and food service activities.

Radiological training was conducted in the Pelham Range in the mid-1950s. Starting in 1950, McClellan was used for National Guard annual training, and by 1955 more than 50 non-divisional medical, ordnance, and transport service units had trained at McClellan.

The mission of the installation was changed in 1966 and it became the U.S. Army School/Training Center. An advanced individual Training Infantry Brigade was activated in 1966 to meet requirements for the Vietnam War. The Brigade was deactivated in 1970 due to continued force reduction in Vietnam.

In 1973, the Chemical Corps School closed, along with the U.S. Army Combat Developments Command Chemical/Biological Radiological Agency. Five years later, in 1978, the WAC was disestablished and the WAC school closed.

In 1979, the Military Police School was moved to McClellan. In the same year, the U.S. Army Chemical Corps school was re-established along with a training Brigade for Basic Training. U.S. Army Forces Command units, such as D Company, 46th Engineers, were also garrisoned at the post during the 70s and 80s.

### A 1.5 Previous Environmental Studies

This section provides a summary of the previous installation restoration activities reports at McClellan. A number of technical studies have been conducted at McClellan. The status and historical use of chemical, biological, and radiological (CBR) training areas were investigated and documented by the U.S. Army Environmental Hygiene Agency (USAEHA, 1986) in 1975. Based on a limited records review and interview, USAEHA identified 12 areas at McClellan and Pelham Range that were possibly contaminated. Restricted access and inclusion in future land restoration and recovery programs were recommended for these areas (Science Applications International Corporation [SAIC], 1995).

A second installation assessment consisting of records reviews, personnel interviews, and field inspections was conducted in 1977 (United States Army Toxic and Hazardous Material Agency [USATHAMA], 1977). During this assessment, burial grounds and training areas were identified within the facility in which chemical or radiological contamination existed or was suspected. In addition, records indicated that munitions and explosives of concern (MEC) may be present in several training areas. This study also concluded that CBR contamination had not been detected in surface water at McClellan and that a potential may exist for groundwater contamination from documented landfill operations.

Based on an extensive literature review of the fate and transport of chemical agents, decontaminants, agent decontaminant byproducts, and past on-site CBR training practices, a 1983 study identified the most probable groundwater and soil contaminants that might persist at McClellan and Pelham Range. The study investigated the persistence and potential exposure pathways for various chemical breakdown scenarios.

The 1977 installation assessment conducted by USATHAMA was re-evaluated and integrated with updated data by ESE in 1984. This study was limited to chemical agents and restricted compounds and resulted in 21 site-specific contamination assessments (SAIC, 1993).

Various U.S. Army agencies, including the McClellan Chemical School and USAEHA, conducted limited surface soil sampling and screening operations at the following sites between 1972 and 1980: Area T-5, Detection and Identification (D&I) Area, Range K, Area T-38, Area T-24A, Range J, Range L, and Landfill No. 3 (ESE, 1984). Field testing for chemical agents was negative in all known sampling and the areas were cleared for surface use (SAIC, 1995).

USAEHA conducted an investigation at McClellan in 1986 to identify all solid waste management units (SWMUs) on Base. USAEHA (1986) formally identified 41 SWMUs on McClellan and Pelham Range. Each SWMU was located, described, and evaluated to the extent possible. Five monitoring wells were installed by the agency at Landfill No. 3 as part of the investigation (SAIC, 1995).

An enhanced preliminary assessment (PA) was conducted by Roy F. Weston, Inc. in 1990 (Weston, 1990) to evaluate the status of inactive Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites and active non-CERCLA sites potentially impacting the Army's planned closure of McClellan. The PA identified a total of 62 active and inactive sites on the Main Post and Pelham Range (SAIC, 1995).

The USACE, Mobile District, conducted an investigation in 1991 to evaluate soil and groundwater in the vicinity of five existing or excavated underground storage tank (UST) sites in the northwestern portion of the Main Post. The investigation focused on USTs used for storing petroleum products, including gasoline, diesel, and diesel-based fuel oil. Twenty monitoring wells were installed at these sites during this investigation. Petroleum contamination of groundwater and/or soil was documented at four of the five UST sites (Ecology and Environment, Inc., 1991).

USACE initiated a SI in 1991 at 17 sites on the Main Post and Pelham Range identified in the PA. Based on limited sampling of groundwater, surface water, and soil miniature chemical agent monitors screening, potential environmental concerns were identified at 12 of the SI sites.

A hydrogeological evaluation of the former McClellan sanitary landfill site (Landfill No. 4) was conducted by ADEM (1993) as a component of the overall permit review process. Leachate seeps were observed at the toe of the landfill and along manmade drainage ditches near the site boundary. A program of quarterly groundwater monitoring was implemented by McClellan in 1994 for five monitoring wells near former Landfill No. 4. Elevated lead, arsenic, chloride, and total organic halogen levels were detected in the wells in 1994 (SAIC, 1995).

SAIC (1995) conducted RIs at eight areas of concern (AOC) on the Main Post installation, including Area F4, Area T-5, Area T-24A, Area T-38, D&I Area, Landfills No. 1, 2, and 3, and four AOCs at Pelham Range (Ranges J, K, and L, and the Old Water Hole). Investigation activities included installation of 36 groundwater-monitoring wells, collection of subsurface soil, groundwater, sediment, and surface water samples, and a geophysical survey. Results of the investigation identified groundwater contamination at four of the 12 sites. Sites where groundwater contamination was identified included Area T-38, Range J, Landfill No. 3, and Area T-24A. Volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were detected in groundwater at these sites. Metals were also detected in groundwater, soil, sediment, and surface water at McClellan. Metals of concern included lead, mercury, thallium, vanadium, beryllium, manganese, and iron.  Based on the data obtained during the RI, it was recommended that eight of the sites required no further investigations; however, four of the sites, including Area T-38, Range J, Range K, and 6 Area T-24A, required additional investigation.

# A 2.0 PROJECT MANAGEMENT

The following subsections identify and describe the responsibilities of key project positions related to data acquisition and data management and contain detailed project organization plans and subcontractor relationships. All project personnel, including field, laboratory, and subcontractor personnel are subject to the requirements of this QAP. The key positions are described in the following subsections. An organization chart is shown in Figure A2-1.

## A 2.1 MDA Project Manager

The MDA Project Manager (PM) will facilitate the project from beginning to end, providing the necessary contact with the regulatory agencies and Consultant PM. The MDA PM will also be responsible for the following:

- Scheduling of the project activities.
- Seeking the appropriate regulatory authorizations.
- Seeking the required permits or certification necessary to complete site activities.
- Providing the necessary interface with the regulatory agencies as required.
- Obtaining the authorization to proceed with the activities at the site.
- Reviewing of work plans.
- Ultimately, meeting the project's objectives.

## A 2.2 Consultant Project Manager

The Consultant PM will serve as the central point of contact (POC) for government agencies, subcontractors, and other concerned parties. The Consultant PM will be responsible for management of the field activities, ensuring compliance with the statement of work, QAP, Health and Safety Plan (HASP), and SFSP. Specifically, the duties of the Consultant PM will be as follows:

- Receiving and complying with work orders from the client.
- Primary point of contact with the client.
- Assigning duties to the project staff and orienting the staff to the needs and requirements of the project.
- Obtaining required approvals for proposed variances to the installation-wide SAP, QAP, and HASP.
- Supervising the performance of the project staff.
- Evaluating training needs of the project staff.
- Providing budget and schedule control.
- Reviewing subcontractor work and approving subcontractor invoices.
- Establishing a project record system.
- Ensuring that major project deliverables are reviewed for technical accuracy and completeness, including data validity before their release.
- Ensuring that the requirements of the QAP are satisfied.

- Regularly communicating the project status, progress, and any problems to the MDA Project Manager.
- Stopping work if unsafe working conditions are present.

### A 2.3 Program Quality Assurance Officer

The Program Quality Assurance Officer (QAO) will be an independent representative reporting to the MDA PM and/or the Consultant corporate QA/QC officer, responsible for ensuring compliance with the QAP and other work-related documents. The specific duties of the QAO are as follows:

- Administering the overall QAP.
- Performing independent QA audits of field and laboratory operations.
- Serving as the official contact for all project quality matters.
- Identifying and responding to QA/QC needs, resolving problems, and answering requests for assistance or guidance.
- Reviewing, evaluating, and approving quality related changes to the QAP, SAP, or HASP.
- Preparing and submitting QA/QC reports to the MDA PM and Consultant PM.
- Verifying that appropriate corrective actions are taken for all nonconformances and that all audit findings are addressed in a timely manner.
- Tracking the progress of quality tasks in this QAP and consulting periodically with the MDA PM.
- Monitoring on-site and off-site subcontractors.
- Evaluating effectiveness of the project QAP.
- Monitoring sampling activities.
- Stopping work if unsafe working conditions are present.
- Stopping work if field procedures are detrimental to the QA/QC of the project.
- Other duties and responsibilities as assigned by the MDA and Consultant PM.

### A 2.4 Health and Safety Manager

The Site Health and Safety Manager (SHSM) will ensure that site activities comply with the requirements of the HASP. The Consultant SHSM will have the authority to stop work, if necessary, and to implement corrective actions if HASP requirements are not satisfied.

### A 2.5 Project Chemist

The Consultant Project Chemist is the chemistry and data management task leader whose primary responsibilities include the following:

- Defining sampling, analytical, data management and reporting requirements that meet SFSPs DQOs.
- Securing analytical laboratory subcontractors.
- Coordinating McClellan project activities with the subcontracted laboratory.

- Identifying any problems with field samples or their corresponding analyses.
- Verifying data deliverables received by the subcontracted laboratory are complete and accurate.
- Ensuring laboratory activities are conducted according to the SAP.
- Verifying project DQOs have been met.
- Verifying data outputs generated from the McClellan project database are complete and accurate.
- Generating quality assurance reports to management outlining any data issues which impact project DQOs.

### A 2.6 Data Manager

The Consultant data manager is responsible for loading electronic data deliverables (EDDs) submitted by all subcontracted laboratories into the McClellan project database, as well as generating various reports in support of the McClellan project. Activities include, but are not limited to:

- Providing specifications for inputting field and laboratory data into database.
- Communicating with Project Chemist and laboratory regarding EDDs.
- Implementing client-specific databases.
- Generating chain-of-custody (COC) forms.

### A 2.7 Sample Coordinator

The Consultant sample coordinator is responsible for overseeing the successful collection, documentation, and shipment of all environmental samples and related QA/QC parameters while initiating all data gathering activities and capturing pertinent information through sample tracking procedures for inclusion into the McClellan project database.

### A 2.8 Laboratory Services QA/QC Director

The subcontracted analytical service provider will assign a QA/QC director whose responsibilities include the following:

- Ensuring that all work is performed in accordance with the laboratory QA/QC plan.
- Performing audits of the laboratory to verify compliance with QAP.
- Verifying completion of correction actions cited in previous audits.
- Acting as the POC for proposed changes in the laboratory QA/QC plan and initiating changes in the program.
- Discussing with the laboratory project manager and section leaders any unresolved non-conformances.
- Providing orientation and necessary training to laboratory personnel on the requirements of this QAP.
- Maintaining documentation of calibration records for all laboratory equipment including balances, ovens, and all standard reference materials (SRMs).

- Measuring temperatures of all standard and sample storage areas daily.
- Ensuring that internal sample custody is maintained throughout the analytical process.

### A 2.9 Laboratory Project Manager

The subcontracted analytical service provider will assign a PM whose responsibilities include the following:

- Providing orientation and necessary training to laboratory personnel on the requirements of the QAP.
- Assisting the project staff in implementing sampling and testing programs.
- Serving as liaison between laboratory staff, the Consultant PM, task managers, and other project personnel.
- Serving as the POC for laboratory staff reporting nonconformances and changes in laboratory activities.
- Notifying the laboratory, QA personnel, the Consultant PM, and affected task managers of specific laboratory nonconformances and changes.
- Maintaining laboratory data and checkprints while sampling is in progress.
- Preparing and submitting QA/QC reports to the laboratory manager.
- Releasing test data and results.
- Storing and controlling samples submitted for analysis or archiving.

### A 2.10 Subcontractor Activities

The selection of qualified subcontractors will be in accordance with the Consultant's procurement and QA procedures. Subcontractors such as drillers, geophysical specialists, laboratories, surveyors, and environmental monitoring specialists must meet predetermined qualifications developed by the Consultant PM that are defined in the procurement bid packages. Each subcontractor bid submittal is reviewed by technical personnel, purchasing, and QA personnel to verify that the bidders are qualified and can satisfy bid requirements. Before starting work, the Consultant will perform a quality check to determine if the subcontractor has fulfilled the procurement requirements necessary to begin activities. Subcontractors involved in environmental measurements will be monitored by the field coordinator to verify the use of calibrated equipment and qualified operators.

All subcontractors will be required to follow the procedures of the QAP. Ongoing observation and monitoring of subcontractor performance during the field investigation will be the responsibility of the Consultant PM or the field coordinator. Periodic QC inspections of each subcontractor may be performed. The inspection will include (as appropriate):

- Type and condition of equipment.
- Standard operating procedures.
- Personnel qualifications.
- Documentation.

The subcontractor laboratory may not subcontract any portion of work for this project without prior written consent from Consultant. The subcontract laboratory will be fully responsible for ensuring that any second-tier subcontractors meet all analytical requirements, including but not limited to: certifications, method compliance, data quality, data package content and format, EDD, and all other deliverables.

### A 2.11 Qualifications and Training of Personnel

Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. In addition to education and experience, specific training may be required to qualify individuals to perform certain activities. Training will be documented on the appropriate form and placed in the project file as a record. Project personnel will receive an orientation to the SAP, the HASP, and the QAP as appropriate to their responsibilities before participation in project activities. Training of field personnel will be provided by the Consultant site coordinator, the QAO, or by a qualified designee. This orientation will be documented.

# A 3.0 DATA QUALITY OBJECTIVES

DQOs are defined as quantitative statements derived from a process that clarifies technical and quality objectives, defines the appropriate type of data, and specifies tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of needed data. This process has been adopted and modified specifically for CERCLA; however, this same approach to establishing DQOs applies to any environmental data collection effort including those governed under the Resource Conservation and Recovery Act (RCRA).

DQOs are applicable to all data collection activities, and the level of detail and data quality needed will vary based on the intended uses of the data. The DQO process helps define the purpose for which environmental data will be used and sets guidelines for designing a data collection program that will meet regulatory objectives. The process also provides a logical, objective, and quantitative framework for determining the time and resources that will be used to generate data of the desired level of quality. The DQO definition process will be performed on each project task and described in site-specific work plans and in accordance with the following guidelines.

## A 3.1 DQO Seven-Stage Process

The DQO process presented here has been developed following EPA guidelines (EPA, 2006). EPA guidelines specify that DQOs be presented in the form of output statements and design parameters describing various aspects of the project. The following is a brief description of the seven-step DQO process specified by the EPA.

### A 3.1.1 State the Problem (*Step 1*)

This step requires that the contamination problem that will require new or additional environmental data be summarized. The resources available to resolve the contamination problem must be specified. Key activities associated with this step include:

- Identifying members of the scoping team.
- Developing or refining the conceptual site model.
- Defining the exposure pathways and exposure scenarios.
- Specifying available resources.
- Writing a brief summary of the contamination problem.

The main output of this step is a complete description of the contamination problem including the regulatory and programmatic context of the problem. This description typically consists of:

- A list of the known and suspected contaminants in each environmental medium and estimates of their concentration, variability, distribution, and location.
- The conceptual site model and exposure pathways.

- A summary of the outcome and status of any previous response(s) at the site, such as early actions or previous data collection activities.
- The site's physical and chemical characteristics that influence migration and associated human, environmental, and physical target(s).
- An estimate of the budget, schedule, and available personnel necessary to implement the appropriate response for the site.

### A 3.1.2 Identify the Decision/Objective (*Step 2*)

This step requires identification of the decision/objective that requires new or additional environmental data. For example, an early assessment decision is to determine whether a chemical release poses a potential threat to human health or the environment. Key activities associated with this step include:

- Identifying the key objective for the current phase or stage of the project.
- Identifying alternative actions that may be taken based on the findings of the field investigation.
- Identifying relationships between this objective and any other current or subsequent objectives.

The output from this step should include the following:

- A statement of the objectives that will use environmental data.
- A list of the actions that will be taken toward remediation or removal of the potential contamination problem based on the outcome of the field investigation.

### A 3.1.3 Identify Inputs to the Decision/Objective (*Step 3*)

The purpose of this step is to identify the information needed to support the objective, and specify which inputs require new environmental measurements. Key activities associated with this step include:

- Identifying the informational inputs needed to resolve the objective.
- Identifying sources for each informational input, and listing those inputs that are obtained through environmental measurements.
- Defining the basis for establishing contaminant-specific action levels.
- Identifying potential sampling approaches and appropriate analytical methods.

The outputs that will result from this step include a list of informational inputs needed to make the decision, and a list of environmental variables or characteristics that will be measured. The outputs from this step are actually the inputs that will be used to support the objective, sometimes referred to as the "decision."

### A 3.1.4 Define the Study Boundaries (*Step 4*)

This step requires definition of the spatial and temporal aspects of the environmental media that the data must represent to support the objective. Key activities associated with this step include:

- Defining the geographic areas of the field investigation.
- Defining each environmental medium of concern.
- Dividing each medium into strata having relatively homogeneous characteristics.
- Defining the scale of decision-making (this is the smallest area, volume, or timeframe of the medium) in which the scoping team wishes to control decision errors.
- Determining the time frame to which the objective applies.
- Determining when to take samples.
- Identifying practical constraints that may hinder sample collection (reconsider previous steps as necessary).

Outputs from this step may include:

- A detailed description and physical representation (map) of the geographic limits (boundaries) of each environmental medium (soil, water, air, etc.) within which the decision(s) will be made.
- A detailed description of the characteristics that define the population of interest.
- Definition of the time period during which samples will be collected and to which DQOs will apply.
- The most appropriate scale of decision-making for each medium of concern.
- A description of practical constraints that may impede sampling.

### A 3.1.5 Develop a Decision Rule (*Step 5*)

The purpose of this step is to integrate the output from the previous steps of the DQO process into a statement that defines the conditions that would cause the decision-maker to choose among alternative actions. Key activities associated with this step include:

- Specifying the parameter of interest (such as mean, median, maximum or proportion).
- Specifying the action level for the decision.
- Combining the output of the previous DQO steps into an "if...then..." decision rule that includes the parameter of interest, the action level, and the alternative actions.

The output from this step is an "if...then..." statement that defines the conditions that would cause the decision-maker to choose among alternative courses of action. It should include the decision, the actions, the parameter of interest, the action level, and the scale (magnitude of impact) of decision-making.

### A 3.1.6 Specify Limits on Decision Errors (*Step 6*)

The purpose of this step is to specify the acceptable decision error rates based on a consideration of the consequences of making an incorrect decision. These limits will be used in Step 7 of the process. Key activities associated with Step 6 include the following:

- Determining the possible range of the parameter of interest.
- Defining both types of decision errors and identifying the potential consequences of each.
- Specifying a range of possible parameter values where the consequences of decision errors are relatively minor (gray region), whenever possible.
- Assigning probability values to points above and below the action level that reflect the acceptable probability for the occurrence of decision errors, when necessary.
- Checking the limits on decision errors to ensure that they accurately reflect the decision-maker's concern about the relative consequences for each type of decision error.

The outputs from this step are the acceptable decision error rates based on a consideration of the consequences of making an incorrect decision. These limits on decision errors can be expressed in a decision error limits table, or in a design goal diagram.

### A 3.1.7 Optimize the Design for Obtaining Data (*Step 7*)

The purpose of this step is to identify the most resource-effective sampling design that generates data that satisfy the DQOs specified in the preceding steps. To develop the optimal design for this study, it may be necessary to work through this step more than once after revisiting the previous six steps of the DQO process.

### A 3.2 Project Data Quality Objectives

The project DQO process identifies the overall objectives of the project, defined by the individual site investigation requirements. The project DQO selection follows the same seven-step process. However, project DQOs are site-related and site-specific, whereas the DQOs described in this QAP are to ensure the overall analytical quality and to ensure that the integrity of the data collected is not compromised. Therefore, a more detailed discussion of the project DQOs is not part of the QAP. Project DQOs will be described in SFSPs as appropriate.

### A 3.3 Data Quality Indicators

Part of the review to determine whether DQOs were met will be to evaluate a series of data quality indicators that include measurements of the precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS). How each of these measurements is to be performed and assessed is discussed in this section. The target acceptance criteria for the results have been developed for a wide variety of anticipated analyses on soil/sediment, surface water, and groundwater matrix samples and are presented in Section A 6.0. Other data quality indicators will be developed as needed for other sampling media and other analysis programs and presented in the SFSPs.

For a given investigation task, a specific list of target constituents will be formulated, and if they cannot be quantified by the methods summarized in this QAP, then they will be addressed in SFSPs. Applicable analyses will meet the recommended method guidance found in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods,* SW-846 (EPA, 1986) and its subsequent updates, as supplemented by the information presented in Section A 6.0 of this QAP. The most recent version of the SW-846 method will be used. Other requested analyses must conform to their specified method. These may include the *Annual Book of ASTM Standards* (American Society for Testing and Materials [ASTM], 1994), *Methods for Chemical Analysis of Water and Wastes* (EPA, 1983), and similar sources.

### A 3.3.1 Precision

Precision is a measure of the reproducibility of a set of duplicate analytical results, usually under "prescribed similar conditions". Precision is expressed in terms of the relative percent difference (RPD) between duplicate determinations, or in terms of the relative standard deviation (RSD) when three or more determinations are made. Various measures of precision exist depending on the prescribed similar conditions.

Overall sampling and analysis precision will be assessed using RPDs for duplicate environmental samples and matrix spike (MS)/ matrix spike duplicates (MSDs). The RPD for laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) sample results will be used to assess laboratory spike and recovery precision. RPD is defined as the difference between two measurements divided by their mean and expressed as a percent as shown in the following equation:

$$\text{RPD} = 100 \times (D1-D2)/((D1+D2)/2)$$

where:

D1 = result from the original measurement
D2 = result from a duplicate measurement.

To evaluate precision, the RPDs for LCS/LCSDs or MS/ MSD can be compared to laboratory historical limits.

The RSD is the standard deviation of a set of values divided by the average value expressed as a percent as shown in the following equation:

$$\text{RSD} = 100S/\overline{X}$$

where:

S = The sample standard deviation of the sample data
$\overline{X}$ = The arithmetic mean of the sample data.

RSDs can be used to evaluate initial calibration results.

### A 3.3.2 Accuracy

Accuracy is a measure of the agreement of a measurement X (or an average of measurements of the same parameter), against an accepted reference or true value, K. Accuracy is typically expressed as a percent recovery (%R) calculated by the ratio of the measurement and accepted true value as shown in the following equation:

$$\%R = ((Xs - Xu) / K) \times 100\%$$

where:

$X_S$ = Measured value of the spiked sample
Xu = Measured value of the unspiked sample
K = Known amount of the spike in the sample.

Analytical accuracy is assessed through the analysis of spikes such as surrogates, MS/MSDs and LCS, performance evaluation samples, standard reference materials and calibration check samples. With the surrogates and MS/MSDs that are spiked onto the actual sample matrix and analyzed, these accuracy indicators must take into account the nature of the matrix in question and the native concentration of the analyte spiked. Matrix variability or interferences from high concentrations of native compounds may adversely affect spike recovery and yield less than conclusive data. Accuracy checks that focus on analytical method and consist of compounds spiked in a "blank" or non-interfering matrix (e.g., LCSs, SRMs, or calibration check samples) address the accuracy of the method and/or instrumentation at detecting the target analyte(s) at a certain quantification level and are not considered to be subject to matrix effects.

Measuring the accuracy of the overall sampling program is also difficult, especially with respect to collection of samples for analysis for VOCs. These organic compounds can be volatilized and lost from collected samples and result in a negative bias, or the sample can become contaminated with foreign compounds during sample collection, handling, and preparation, and result in a positive bias. Using proven sample collection methods that incorporate steps to minimize sample disturbance during collection, provide for the isolation of samples from known sources of contamination, and incorporate the immediate preservation of samples on ice should reduce the potential for bias. Accuracy of the sampling system, emphasizing cross-contamination with volatile compounds, can be assessed by evaluating analytical results for field QC samples, including field-prepared field blanks, laboratory-prepared trip blanks (TB), equipment rinsate blanks (EB), and laboratory storage blanks and analytical method blanks (MB).

### A 3.3.3 Representativeness

Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix conditions. For example, in conducting groundwater monitoring, representativeness requires proper location of wells and the collection of samples under consistent, documented procedures. Wells are located based upon the results of the hydrogeologic study in progress and are designed to provide maximum coverage of the flow conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness can also be monitored by reviewing field documentation and by performing field QA audits.

Other sampling approaches where representativeness is a concern is in building composite samples and using an unbiased grid sampling system. In compositing, individual subsamples are collected and combined to represent a greater physical area or cover a particular time period. Often to characterize a large unknown surface area, a grid sampling pattern is established and then samples are collected at random node locations where horizontal and vertical traverse lines intersect.

Considerations such as number of samples required and their spatial relationship will affect how representative the unbiased grid sample results are. In such cases, the sampling objective must be well defined and the intended purpose for the sample data generated must be reviewed to establish the DQOs for representativeness through statistical analysis. Parameters such as the number of subsamples composited, the number of samples submitted for analysis, and the sampling interval can then be specified to increase the degree of confidence and improve representativeness when warranted by the performance objective.

### A 3.3.4 Completeness

Data completeness represents the percentage of valid data collected from a sampling/analytical program or measurement system compared to the amount expected to be obtained under optimal conditions. The completeness goal for critical samples (i.e., field samples requiring chemical or geotechnical analysis) is 95 percent. Task-specific completeness goals may also be defined in SFSPs.

### A 3.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability for sampling and analysis tasks is achieved by:

- Specifying well-recognized techniques and accepted standard methods for sampling and analysis, and using well-trained sampling and analysis technicians to execute the prescribed methods consistently.
- Requiring that all sampling and analysis personnel produce adequate documentation to record how the prescribed methods were actually executed.
- Noting non conformances and corrective measures taken.

Specifying standardized laboratory methods helps to ensure that the data generated for an event are comparable to past and future activities. Periodic field and laboratory audits as approved by project management and/or the QAO to assess consistency of method implementation for these prescribed procedures are also critical in determining comparability.

### A 3.3.6 Sensitivity and Detection Limits

The term sensitivity is used broadly here to describe the method detection/quantitation/reporting limits established to meet project-specific DQOs; and not limited to the definition, which describes the capability of a method or instrument to discriminate between measurement responses. Several limits have been established to describe sensitivity requirements. Reported instrument detection limits (IDLs) and method detection limits (MDLs) are typically based upon a reagent water matrix or purified solid and ignore sample matrix interferences and the resulting effects on the limits. For this reason, published MDLs or IDLs are presumably not achievable for environmental samples. To promote the generation of comparable data, the definitions described in the following subsections shall be used if not superseded by project-specific requirements.

#### A 3.3.6.1 Method Detection Limit

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero as determined from analysis of a sample in a given matrix containing the analyte. The subcontractor laboratory shall at a minimum, perform MDL studies during the initial method setups, whenever the basic chemistry of the procedures is changed and annually. Since it is not practical to establish an MDL for each specific matrix received at any given laboratory, MDLs shall be determined for all target analytes in an interference-free matrix, typically reagent water for aqueous samples, and a purified solid matrix (e.g., sand) for soil/sediment samples. The subcontractor laboratory may determine MDLs using procedures presented in 40 Code of Federal Regulations (CFR), Part 136, Appendix B, or equivalent statistical approaches. The validity of the MDL study is verified per CFR, Part 136, Appendix B requirements by comparing the mean value of the measured MDL spikes to the calculated MDL. The MDLs shall be representative of the specific sample preparation method identified for an analytical method, and include any clean-up methods used.

#### A 3.3.6.2 Method Quantitation Limit

There is significant error (approximately 100 percent) associated with results calculated at the MDL and the MDL may not be attainable within project matrices. The method quantitation limit (MQL) is established at a factor of five to ten times the MDL for the majority of target analytes, but not lower than two times the MDL for any target analyte. The statistical error (20 to 30 percent) associated with this area of the calibration curve is notably reduced from the MDL. The appropriate factor applied to the MDL to establish the MQL is based on the amount of error the data user is willing to accept for the data generated. Ideally, this MQL should have an associated error comparable to the method-prescribed continuing calibration verification (CCV) acceptance limits. However, this may not be feasible due to the lower concentration range of interest. It is recommended that the allowable error at the MQL not exceed the CCV acceptance criterion by more than 5 to 15 percent. In the absence of project-specific requirements to the contrary, the MQL is set at the lowest standard used for the initial calibration curve (or low level calibration verification standard) or higher for each target analyte. The lowest standard or low-level calibration verification standard must be at least three times the MDL. A target analyte detected and reported below the MQL must be flagged as an estimated quantity.

### A 3.3.6.3 Method Reporting Limit

The method reporting limit (MRL) is a threshold value below which the laboratory reports a result as not detected. It may be based upon project-specific concentrations of concern, regulatory action levels, or the sensitivity of the method and instrument. MRLs are adjusted based on the sample matrix and any necessary sample dilution. The lowest value that can be reported by the laboratory as a nondetect shall be no lower than the MDL check sample (about two times the MDL). Target analyte values detected and reported below the MRL but above the MDL must be flagged as an estimated quantity (i.e., J flag).

### A 3.3.6.4 Project MRL's Relation to Action Levels

When establishing contract requirements for sensitivity as defined by the MRL, the following issues should be considered. The MRL must be based upon the data needs of the data user, the size of the error associated with the low-level detection data that the user is willing to accept, and the sensitivity of the method. The data needs may be associated with compliance issues as a maximum contaminant level (MCL), MCL goal, media cleanup standard, or other applicable relevant and appropriate requirements. Other data users (e.g., risk assessor, design engineer) may require a sample quantitation limit, a toxicity reference concentration, a preliminary remediation goal, or other concentration of interest. As a general rule, where analytically achievable, MRLs will be established at approximately one-half the expressed project action levels. The project-specific MRLs may be established anywhere in the range from the MDL check sample concentration (2 times the MDL) up to one-half of the project action level. A comparison of the project-specific MRL to the laboratory MQL is done to verify whether the concentration may be estimated, or are attainable by the method/instrument.

When the project-specific MRLs are below the laboratory MQLs for that method, the sample results reported below the MQL will be qualified as estimated. If very low levels of quantitation are required (e.g., data used for a risk assessment or compliance issue), to avoid estimation of data based upon the above requirement, the following is recommended. Analyze a low-level check sample (taken through the appropriate preparatory procedures) at the MRL level to assess the accuracy at this concentration. An appropriate performance criterion should be defined based upon this assessment.

If the project MRLs (and associated action limits) are lower than the MDLs generated by the laboratory, or proposed within the methods, it is unlikely they will be attainable for an environmental matrix without imposing method variations. Discussions with laboratory personnel may be needed to identify options available to lower the MDL proposed within the method (i.e., increase initial sample volumes processed, decrease final extract volumes, etc.), or selection of an alternative method. If the recommended factors cannot be accommodated, the data user is informed of this predicament, and a compromise must be reached. Compromise may entail accepting a higher degree of error associated with the data reported near action levels, or the acceptance of a higher potential for false negatives (Type II error) near the MDL.

### A 3.4 Data Quality Levels

The DQO process provides a logical basis for linking QA/QC procedures to the intended use of the data. Data quality levels were developed to assist in the interpretation of the data. The data quality levels that have been created and will be used in the activities conducted at McClellan are screening level data and definitive level data.

These two data quality levels are associated with specific QA and QC elements, and may be generated using a wide range of analytical methods. The particular type of data to be generated depends on the qualitative and quantitative DQOs developed during application of the DQO process.

#### A 3.4.1 Screening Level Data

Screening level data are subject to minimal QC requirements. Results are often not compound-specific and not quantitative, but results are available in real time. Obtaining screening level data is less costly than obtaining definitive level data, but the results are less defensible because of the greater potential for error and the inherent precision and accuracy limitations. This level is normally used for field investigation health and safety screening, but can also be used to identify media or samples for consideration for further analyses. Field pH, conductivity, temperature, turbidity, dissolved oxygen, and oxidation/reduction potential measurements are examples of screening level data.

#### A 3.4.2 Definitive Level Data

Analyses performed using established analytical procedures and strict QC procedures produce definitive level data. Applicable EPA test methods (EPA, 1983 and 1986) or other accepted methods can be used to collect definitive level data. Analytical results produced were analyte-specific with confirmation of analyte identity and concentration. Definitive level data meeting quality criteria are suitable for site assessments, risk assessments, remedial design, and remediation efforts.

### A 3.5 Quality Assurance Objectives for Analytical Data

QC procedures are operations employed during sample collection and chemical analysis to support and document the attainment of established QA objectives. QA objectives are the detailed specifications for precision, accuracy, representativeness, comparability, completeness and sensitivity (collectively referenced as PARCCS). The QA objectives established in this QAP should be also used for sampling and analysis plan development and data quality review. In regards to measurement data quality, the QA/QC program shall include the following QA objectives:

- Provide a mechanism for the ongoing control and evaluation of measurement data quality.

- Provide measures of data quality in terms of PARCCS to assess whether the data meet the project objectives and can be used for their intended purpose.

The primary objective of the chemical measurement data is to generate sufficient information to determine the presence or absence of chemical contamination within the sites' media and to determine the nature and extent of any contamination present. The chemical measurement data are then used to evaluate potential remedial activities. Data acquired during the sample collection phase must be technically defensible with respect to the attributes of data quality and which are relevant to the decision-making process. The quality objectives for the chemical measurement data specify the "quality" of the data needed to enable project personnel to make decisions (e.g., a decision to pick one remediation technique over another). As such, the DQOs determine the type and quantity of data needed to make a decision, as well as the measurement objectives (precision, accuracy) for each type of measurement data collected. The objectives previously listed will be accomplished by ensuring that the following analytical objectives are met:

- Collect and analyze samples under controlled situations using standard methods.
- Obtain usable analytical results of verifiable data quality.

The representativeness of the measurement data is a function of the sampling strategy and will be achieved by following the procedures discussed in the SAP and SFSP. The quality of the analytical results is a function of the analytical system and will be achieved by using standard EPA test methods (EPA, 1983 and 1986) or other accepted methods and the QC systems discussed in this section.

## A 4.0 SAMPLE RECEIPT, STORAGE, AND HOLDING TIME REQUIREMENTS

This section identifies the requirements for sample receipt condition verification, sample storage and handling requirements, intra-laboratory custody requirements, analytical parameter holding times, and corrective action documentation.

### A 4.1 Sample Receipt

The receiving laboratory's procedure for monitoring COCs, storing samples, and dispersing samples for analysis shall be documented in a laboratory standard operating procedure (SOP). For their safety, laboratory personnel shall open coolers under a hood to minimize potential exposure to volatile constituents. The laboratory shall inspect each cooler to verify sample condition, including proper sample containers, volumes, preservation, etc., and shall use individual cooler receipt forms to document any problems observed. The laboratory shall report sample receipt anomalies to the Consultant’s Project Chemist within one working day of the sample’s receipt. Corrective action will be required for any deficiencies identified. The COC forms, shipping documents, completed cooler receipt forms, telephone conversation record forms, electronic transmittals (e.g., e-mail, facsimile), and corrective action forms will be maintained by the laboratory for each shipment and included in the reporting package when results are submitted. Table A4-1 summarizes the requirement for sample containers, preservation, volumes, and holding times for commonly requested McClellan analyses.

### A 4.2 Sample Handling

The laboratory shall provide an adequate, contamination-free, and well-ventilated workspace for the receipt of samples. Samples and their associated extracts shall be stored under contaminant-free conditions that will ensure their integrity and preservation. Sufficient restricted access refrigerator space shall be provided for the proper storage of samples and their associated extracts. Samples submitted for VOC analyses shall be stored in dedicated refrigerators. Samples shall not be stored with standards. Samples and their associated extracts shall be stored for a minimum of 60 days after receipt of the final data report for those samples by the Consultant. The laboratory will be responsible for the disposal of the samples and their associated extracts in compliance with federal, state, and local regulations.

### A 4.3 Sample Holding Times

Extract and digestate holding times shall be measured from the date and time of sample collection in the field to the date and time when the sample is first exposed to the extraction or digestion solvent. Analysis holding times shall be measured from the date and time of sample extraction to the date and time of sample analysis. The laboratory shall maintain proper documentation that clearly shows the dates (and times when applicable) for all sample handling/manipulation procedures. Sufficient time should be allowed for the re-preparation or re-analysis of samples within holding times should calibration, method, or QC failures occur.

# A 5.0 ANALYTICAL PROCEDURES

The analytical objective for this program is to provide data that accurately reflect the constituents present at each sample location. This objective will be met through the selection of appropriate sample collection techniques, sample preparation procedures, and analytical methods. The process of selecting the proper analytical methods and procedures is based on the sample matrix and composition, available sample volume, and analytes or compounds of interest.

## A 5.1 Chemical Analysis Program

Samples will be prepared and analyzed using the applicable EPA methods (EPA, 1983 and 1986) or other approved methods. SFSPs will specify required modifications to methods or the rationale for selecting alternate methods. The QAO and Project Chemist must approve deviations from approved methods prior to analyses of samples. All laboratories performing analyses on McClellan environmental samples will maintain written, approved, and detailed SOPs. Overall, these SOPs shall be based on the guidance published by the EPA. Format for laboratory SOPs shall be a written narrative, providing stepwise descriptions of laboratory operating procedures. The SOPs shall accurately describe the equipment and the actual analytical procedures used in the laboratory. Copies of the SOPs shall be readily available to the appropriate laboratory personnel. Calculations that are performed external to an instrument or in its automation software shall be documented in the SOPs. Laboratory SOPs shall be given unique identification numbers. These SOPs shall be controlled documents that are reviewed annually, updated as necessary whenever procedure or method changes are made, and assigned new version numbers. Retired SOPs shall be maintained on file by the laboratory in case data quality questions arise at a later date. The laboratory will be responsible for documenting personnel training and having these records available for review during audits.

The laboratories participating in the analytical program will be equipped with the proper analytical instrumentation necessary to complete the desired sample analyses, and to meet the project DQOs. The analysts performing the sample preparation and analysis shall be familiar with the methods selected for sample preparation and analysis, proper instrument operation, instrument calibration, QC requirements, and instrument preventive maintenance. The laboratories utilized will provide a well-documented analytical data package that meets or exceeds the project-required deliverables.

Each instrument used to analyze samples for this project will be set up, calibrated according to the procedures specified, and operated according to the selected analytical methods. Instrument setup, calibration, and operation will be documented in the instrument run log. Any deviations from these procedures will be documented in the laboratory case narrative that accompanies the analytical data package for every sample delivery group (SDG). QC sample analyses will be performed according to the type and frequencies specified by each method in order to verify instrument performance periodically during routine analyses.

### A 5.2 Geotechnical Analysis Program

Selected soil samples may be analyzed for geotechnical properties, which may include one or more of the following: Atterberg limits (ASTM D4318), moisture content (ASTM D2216), grain size (ASTM D422), and U.S. Geological Survey (USGS) classification (ASTM D2487). Soil and sediment samples collected will undergo moisture content analysis as part of the chemical analyses in accordance with standard chemical analysis laboratory procedures.

### A 5.3 Analytical Procedure References

The McClellan Environmental Restoration Program analytical and reporting methods are drawn from the following reference documents:

- *Test Methods for the Evaluation of Solid Waste, Physical/Chemical Methods, SW-846* (EPA, 1986) for VOCs, SVOCs, pesticides, herbicides, polychlorinated biphenyls (PCB), polychlorinated dibenzo-p-dioxins/polychlorinated dibenzofurans (PCDD/PCDF) compounds, and metals. Most recent method will be used.
- *Annual Book of ASTM Standards* (ASTM, 1994) for geotechnical and physical/chemical characteristics (wet chemistry).
- *Methods for Chemical Analysis of Water and Wastes* (EPA, 1983) for electrochemical, titration, and gravimetric analysis methods (wet chemistry).

### A 5.4 Laboratory Method Reporting Limits

Laboratory MRLs for the analytical procedures discussed in the QAP are provided in Tables A5-1 through A5-16. Actual laboratory MRLs will vary between laboratories performing the analyses. Deviations from these laboratory MRLs and their ability to meet the DQOs will be addressed in the SFSPs. In addition, laboratory MRLs reported for samples vary due to the sample matrix and the concentration of compounds present. Sample results that exceed the range of the highest calibration standard must be diluted and reanalyzed. The sample analyte values reported below these elevated laboratory MRLs must be flagged as estimated quantities. Dilutions must be applied to the sample results and reported accordingly. The laboratory shall report data from the original and diluted analyses. Solid samples are to be determined on a dry-weight basis. Sample target analyte values should be reported to three significant figures for inorganic analyses and two significant figures for organic analyses. Reported laboratory MRLs will be reviewed during the data evaluation/assessment to determine if the objectives of the project are met. If project objectives are not met, the Consultant PM will be notified and a project variance initiated. The appropriate corrective action will be determined by reviewing the reason for the variance and evaluating corrective action options. Possible corrective actions include reanalysis by the original method, the addition of sample cleanup steps prior to analysis, re-sampling and analysis, or analysis by an alternative method.

## A 5.5 Standard and Non-Standard (Performance Based Measurement Systems) Methods

Generally, laboratories providing analytical services for the McClellan program will be required to adhere to the methods and performance criteria specified in this QAP. Based on the guidance provided by the EPA (1986), USACE (2001), and other published guidance, analytical methods must meet the following general requirements:

- For each method performed, the laboratory shall maintain documentation that demonstrates each analyst's ability to perform the method within the sensitivity and precision limits as stated in the published method, and any requirements outlined within the project SAP. These procedures will be repeated when there is significant change in the method, instrumentation, or personnel.
- The laboratory shall develop a detailed SOP for each method.
- The laboratory shall evaluate method sensitivity by performing an initial MDL study for each applicable matrix. Due to the difficulty in obtaining a solid interference-free matrix for metals determinations, the laboratory shall process spiked reagent water for both the aqueous and solid digestion methods to estimate aqueous and solid MDLs for inductively coupled plasma (ICP) analyses.
- The laboratory shall determine an appropriate MQL and MRL for each compound and matrix based upon the calculated MDL and the guidance presented in Section A 3.0 of this QAP.
- The laboratory shall perform an initial demonstration for the method, noting all key employees' (i.e. technicians and analysts) ability to perform the method within the precision limits as stated in the published method. A minimum of four laboratory control samples shall be carried through the method at the same time, or over a period of consecutive days. This control sample shall be obtained from an outside source, if available, or from a lot independent of the calibration standards. The concentration of each target analyte shall be approximately 10 times the MDL. Using the four results, calculate the mean recovery and standard deviation for each parameter or target analyte of interest. Compare the method precision of the laboratory to the method performance summary presented within the published reference method. If any target analytes exceed the acceptance range, the performance is unacceptable. For unacceptable target analytes or parameters, corrective actions shall be taken to locate the source of the problem, and the test should be repeated. The laboratory must maintain documentation for each analyst performing the applicable analysis.
- Analyst shall be required to demonstrate their continuing capability to perform a given method by ensuring all applicable SOPs are kept current and represent the implementation of the method by the laboratory accurately. Sensitivity of each method is demonstrated quarterly by analyzing the MDL check sample or annually by an MDL study. Any adjustments to the MQL based upon noted changes in method sensitivity are made. A minimum of one blind performance evaluation sample is analyzed successfully on an annual basis. The precision of the method are demonstrated by analyzing the LCSs and other QC check samples with each batch of samples processed, and monitored by review of method control charts.

It is possible that sometime during the course of the program, it may be necessary to employ non-standard or Performance Based Measurement System (PBMS) versions of methods defined in this QAP. This situation will most likely arise due to the following:

- Project requirements necessitate that non-standard or modified methods be performed.
- Laboratory must perform a modified method due to sample matrix or level of contamination.

PBMS are acceptable so long as they meet the requirements specified above and are approved by the QAO and Project Chemist prior to implementation.

# A 6.0 QUALITY CONTROL PROCEDURES

This section presents QC requirements relevant to analysis of environmental samples that shall be followed during all analytical activities for fixed-base, mobile, and field laboratories producing definitive data. Tables A6-1 through A6-19 summarize calibration procedures and QC requirements relevant to analysis of environmental samples associated with the McClellan project.

## A 6.1 Calibration Procedures and Frequencies

The calibration of instruments, support equipment and materials is required to ensure that the analytical system is operating correctly and functioning at optimal conditions. The responsibility for control, calibration, and maintenance of the laboratory analysis equipment and supplies will rest with each laboratory section manager and the laboratory QA/QC director.

### A 6.1.1 Analytical Standards Preparation and Traceability

The laboratory shall have, in-house, the appropriate standards for target analytes. These standards can either be prepared from neat, high purity, bulk materials or purchased as certified solutions. Primary reference standards and standard solutions used by the laboratory shall be obtained from reliable commercial sources (i.e., National Institute of Standards and Technology [NIST], EPA, etc.) to ensure the highest purity possible. Certificates shall be made available upon request that verify the purity or concentration of each standard. The use of correction factors for all standards that are not at least 99.9 percent pure for inorganics and 96 percent for organics will be required. The laboratory shall continuously monitor the purity or quality of reagents and standard solutions through a series of well-documented procedures. Stock and working standards shall be checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or changes in concentration.

Reagents and standards used shall be clearly identified with lot numbers on their respective containers and appropriate laboratory preparation log sheets. The reagent and standard containers and preparation logs must include the following information:

- Unique identification standard lot number.
- Source (e.g., manufacturer and lot number for commercial stock solutions).
- Composition (final concentration of all target analytes, type and purity).
- Reagents and solvents added to standards (including source and lot numbers).
- Preparation date and expiration date.
- Name of preparer.

### A 6.1.2 Analytical Balances

The calibration of analytical balances shall be verified on first daily use at a mass (or masses) that are representative of the measurements routinely performed at that balance. The quality of the weights used for this calibration verification shall be documented and shall be in accordance with the quality requirements established within ASTM D5522. Balance calibration verifications shall be documented in appropriate logbooks. Acceptance criteria shall be clearly defined. Refer to ASTM D5522, ASTM E319, and ASTM E898 for additional details.

### A 6.1.3 Refrigerators/Freezers

All refrigerators and freezers shall be monitored for proper temperature by measuring and recording internal temperatures on a daily basis. The calibration of all thermometers used for these measurements shall be verified at least annually against NIST-certified or NIST-traceable thermometers. Electronic thermometers shall be calibrated at least quarterly. Temperatures shall be recorded in appropriate logbooks. Refrigerators shall be maintained at 4 degrees Celsius (°C) ±2°C, and freezers at -10°C to -20°C. Refer to ASTM E77 for additional details.

### A 6.1.4 Pipettes and Other Volumetric Laboratory Equipment

All volumetric devices, glassware, or labware shall be initially inspected, and all cracked or damaged items removed from use. The calibration of variable-volume Eppendorf-type pipettes shall be verified at the volume of use, or at two volumes that bracket the range of use on the day of use, or at a minimum of weekly. The calibration of all fixed-volume Eppendorf-type pipette shall be verified monthly. In addition, the accuracy of all non-standard labware (K-D tubes, Zymark tubes, plastic cups, centrifuge tubes, etc.) used to measure the initial sample volume or final volume of sample extracts or digestates must be verified. Accuracy must be verified to within 3 percent. If the check reveals error greater than 3 percent, steps should be taken to improve the accuracy of these measurements, or use alternative procedures or equipment that meet this requirement. Each calibration check shall consist of at least three measurements, and the average calculated and recorded in appropriate logbooks. Refer to ASTM E542 and ASTM E969 for additional details.

### A 6.1.5 Water Supply System

The laboratory shall maintain an appropriate water supply system that can furnish high-purity water capable of meeting the needs of the various analytical sections (organic, inorganic, wet chemistry). The water supply system should be monitored on a regular basis by conductivity readouts or measurement of general chemistry parameters. Appropriate general chemistry parameters should be based upon the analyses performed by the laboratory. Refer to ASTM 1193 for additional details.

### A 6.1.6 Analytical Support Equipment

Other support equipment used to maintain appropriate temperatures as prescribed within the analytical methods, such as hotplates and water baths, shall be monitored for compliance with the method-specified ranges. Critical times or temperatures shall be documented within laboratory logbooks.

### A 6.1.7 Method Calibration and Calibration Verification

The frequencies of calibration and calibration verification for each method are presented in Tables A6-1 through A6-19. Tables A6-1 through A6-19 highlight key information on calibration procedures and acceptance limits for each method summarized.

A second source standard shall be used to independently confirm initial calibration. A second source standard is defined as a standard purchased from a different vendor than the vendor supplying the material used in the initial calibration standards. Two different lot numbers from the same vendor does not constitute a second source.

## A 6.2 Laboratory Internal Quality Control Checks

Laboratory overall method performance shall be monitored by the inclusion of various internal QC checks that allow an evaluation of method control or batch QC, and the effect of the sample matrix on the data being generated (matrix-specific QC). Batch QC is based on the analysis of an LCS to generate accuracy data and a method blank (MB) to assess the potential for cross-contamination. Matrix-specific QC shall be based on the use of an actual environmental sample for precision and bias determination from the analysis of MS, MSD, matrix duplicates (MDs), and surrogate spikes. The overall quality objectives are to implement procedures for laboratory analysis and reporting of data that meet quality criteria consistent with their intended use.

### A 6.2.1 Sample Preparation Batch

The sample preparation batch shall be defined as samples of the same or similar matrix that are prepared together by the same person or group of people. A sample preparation batch shall be prepared within the same time period, following the same method, using the same type of equipment and same lots of reagents. The laboratory shall have sufficient quantities of extraction and digestion laboratory equipment to meet these requirements. Sample preparation batch size shall be limited to 20 field samples of a similar matrix. Each preparation batch shall contain the requisite number and type of calibration solutions, blanks, QC samples and regular analytical samples defined by the analytical method. These requirements are summarized in Tables A6-1 through A6-19. Field and batch QC samples within the batch shall be subjected to the same preparation and clean-up procedures employed for the field samples.

Every effort shall be made by the laboratory to analyze all samples within a sample preparation batch on a single instrument.

### A 6.2.2 Analysis Batch

The analysis batch or instrument run sequence shall be defined as samples that are analyzed together within the same time period or in continuous time periods on one instrument under the control of one CCV sample. Analysis sequences are bracketed by the appropriate calibration solutions, CCV standards, and other QC samples as summarized in Tables A6-1 through A6-18.

For samples that are purged and then analyzed immediately, the preparation batch and analysis sequences are combined. To ensure ambient environmental conditions throughout the loading process, a MB shall be analyzed every 4 hours, or twice a day when samples are loaded throughout the day.

### A 6.2.3 Method Blank

MBs are analyzed to assess background interference or contamination that exists in the analytical system that might lead to the reporting of elevated concentration levels or false positive data. A MB is defined as an interference-free blank matrix similar to the sample matrix to which all method reagents are added in the same volumes or proportions as the regular samples. The MB is carried through the complete sample preparation, cleanup, and analysis procedures. The results of the MB analysis are evaluated in conjunction with other QC information to determine the acceptability of the data generated for that batch of samples. Sample results shall not be corrected for MB contamination.

For a MB to be acceptable, the greatest of three criteria must be met. The concentration of all target analytes shall be below one-half of their respective reporting limit, or less than 5 percent of the regulatory limit associated with that analyte, or less than 5 percent of the sample result for the sample analyte. When the applicable criterion is exceeded, corrective action shall be taken to find and eliminate the source of contamination in the MB. If the source of MB contamination cannot be eliminated, corrective action may be limited to qualification of the sample result for blank contamination.

### A 6.2.4 Laboratory Control Sample

The LCS is analyzed to assess general method performance based on the ability of the laboratory to successfully recover target analytes from a control matrix. The LCS is similar in composition to the MB. The LCS is spiked with the full list of single component target analytes for a particular method before it is carried through the preparation, cleanup, and analysis procedures. The results of the LCS analysis are evaluated in conjunction with other QC information to determine the acceptability of the data generated for that batch of samples. The laboratory shall maintain control charts for LCSs to monitor bias for each method.

If the results for the LCS are outside the established control limits, the analyses shall be terminated, the problem corrected, and the samples associated with that LCS shall be re-prepared and re-analyzed with the appropriate new QC. If similar results are acquired with the re-analysis, sample results reported within the affected batch shall be flagged accordingly and a discussion of the impact included within the SDG's case narrative.

### A 6.2.5 Matrix Spike/Matrix Spike Duplicate

The MS and MSD samples are used to assess the performance of the method as applied to a particular project matrix. MS/MSDs are environmental samples to which known concentrations of the full list of single component target analytes for a particular method have been added before they're carried through the preparation, cleanup, and analysis procedures. Results of the MS and MSD are evaluated in conjunction with other QC information to determine the effect of the matrix on the accuracy of the analysis. The MS/MSD RPD values shall be reviewed to assess the effect of the matrix on the precision of the analysis.

### A 6.2.6 Laboratory Duplicate

A laboratory duplicate is used to assess method precision as applied to a particular matrix and to provide information on the homogeneity of the matrix. A laboratory duplicate is an environmental sample that is divided into two separate aliquots by the laboratory. The laboratory duplicate is carried through the complete sample preparation, cleanup, and analysis procedures. Results from a laboratory duplicate are evaluated in conjunction with other QC information to determine the effect of the matrix on the precision of the analysis.

### A 6.2.7 Surrogates

Surrogates are analyzed to assess the ability of the method to successfully recover these specific non-target analytes from an actual matrix. Surrogates are organic compounds that are similar to the analytes of interest in chemical structure and behavior but are not normally found in the environment. The surrogates to be used are specified within the published analytical methods. Other compounds may serve as surrogates, depending on the analysis requirements, if they are representative of the compounds being analyzed, they cover the chromatographic range of interest, documentation exists for their use as a surrogate, and approval for their use has been obtained from the Project Chemist and QAO. The laboratory SOP shall state specifically which surrogate compounds will be used for a particular method. These compounds should be spiked into the environmental samples and accompanying QC samples requiring gas chromatography (GC), liquid chromatography (LC), or GC/mass spectroscopy analysis prior to any sample manipulation. The results of the surrogates are evaluated in conjunction with other QC information to determine the effect of the matrix on the individual sample determinations.

### A 6.2.8 Internal Standards

Internal standards (IS) are measured amounts of certain compounds added after preparation or extraction of a sample. They are used in an internal calibration method to correct sample results affected by column injection loss, purging loss, or viscosity effects.

ISs shall be added to environmental samples, controls, and blanks, in accordance with method requirements or laboratory SOPs.

When the IS results are recovered outside acceptance limits, corrective actions shall be performed. After the system problems have been resolved and system control has been restored, all samples analyzed while the system was malfunctioning shall be reanalyzed. If corrective actions are ineffective, IS failures shall be documented in a non-conformance report and affected data qualified appropriately.

### A 6.2.9 Retention Time Windows

Retention time windows are used in GC and high performance liquid chromatography (HPLC) analysis for qualitative identification of analytes. They are calculated from replicate analysis of a standard on multiple days. The procedure and calculation method are provided in EPA SW-846 Method 8000C (EPA, 1986) and subsequent updates, using the most recent version.

When the retention time is outside of the acceptance criteria, corrective action shall be performed. After the system problems have been resolved and system control has been restored, reanalyze the samples that were analyzed since the last acceptable retention time check.

### A 6.2.10 Target Analyte Confirmation

Chromatography is a technique that relies upon the comparison of retention times between standards and unknown peaks for qualitative identification. Unless mass spectrometry is used as the detector, tentative identification is based solely on the retention time of an unknown peak eluting within the prescribed retention time window of a known standard.

To minimize the possibility of incorrect identification (or false positives), confirmation shall be required for all chromatographic methods involving the analysis of single-component target analytes. Confirmation techniques shall involve the use of another analytical technique (i.e., GC/mass spectroscopy), or a second dissimilar column. A different type of detector may be used for confirmation if approval by the McClellan project chemist has been granted.

When the second dissimilar column is used, it shall be calibrated in the same manner as the primary column. After the target analyte has been identified, compare the primary and confirmatory results for agreement. If the calculated RPD between the two results is greater than 40 percent with no overlapping peaks or other anomalies noted, the higher of the two results shall be reported. A narrative shall be issued with the submitted data to advise the McClellan project chemist of the disparity between the results on the two columns.

Analytical results shall be reported from the primary column unless interferences were noted. If quantitative results are reported from the confirmation column, the documentation from the analysis of all appropriate QC samples on the confirmation column shall also be required within the data package.

### A 6.2.11 Mass Spectrometer Instrument Performance Check

GC/mass spectrometer instrument performance checks are performed to ensure mass resolution, identification, and to some degree, sensitivity. The instrument performance check solution must be analyzed at the beginning of the analytical shift/sequence and every 12 hours of continuous analysis. The 12-hour clock starts at the time of injection of the instrument performance check solution. The instrument performance check for VOCs is 4-bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP) for SVOCs. The instrument performance check must meet the ion abundance acceptance criteria listed in the laboratory SOP or reference analytical method.

If the instrument performance check fails, corrective action shall be performed (e.g., clean the mass spectrometer source), and the performance check solution re-injected into the instrument. The laboratory shall not proceed with analysis until the instrument performance check is acceptable.

### A 6.2.12 Post-Digestion Spikes

Post-digestion spikes apply to metals analysis and are prepared by the addition of a primary source standard to an aliquot of the digestate for the same metals and at approximately the same concentration as that used for the MS/MSD.

Post-digestion spikes shall be performed at a frequency of one sample per analytical batch for the ICP metals and mercury methods.

### A 6.2.13 Serial Dilutions

A serial dilution analysis is performed to verify whether physical or chemical interferences exist due to sample matrix. Serial dilutions shall be performed at a frequency of one per analytical batch containing samples with a similar matrix type for the ICP metals and mercury methods. An environmental sample is diluted five fold (1:5) and analyzed. For analyte concentrations that are sufficiently high (the concentration in the original environmental sample is greater than 10 times the MDL), the serial dilution analysis shall agree within a 10 percent difference (%D) of the original environmental sample. If the %D is greater than 10, a chemical or physical interferences effect should be suspected and further confirmation, such as a post-digestion spike analysis, may be necessary.

### A 6.2.14 MDL Check Sample

MDL check samples are analyzed by the laboratory to ensure that valid MDL values were determined through the process defined in Section A 3.3.6.1. The laboratory shall analyze an MDL check sample by spiking an interference-free matrix with target analytes at approximately two times the calculated MDL. The MDL check sample shall be taken through all the preparation and analysis steps used to establish the calculated MDL values, to verify a response is detected. If any of the target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detectable. The detectable target analyte concentrations shall then be used in lieu of the calculated MDL values to establish the lowest detected concentration for samples taken through all appropriate method procedures. The laboratory may then demonstrate continued method detection capability by analyzing the MDL check sample on a quarterly basis, in lieu of the annual MDL study.

When multiple instruments or confirmation columns are used for the same method, separate MDL studies may be replaced by the analysis of an MDL check sample on all instruments and columns. The MDL check sample shall be analyzed after major instrument maintenance or changes in instrumentation or instrument conditions to verify the sensitivity of the method.

### A 6.3 Field Quality Control Checks

Field QC samples are collected and analyzed to evaluate field sampling activities. The types of field QC samples are summarized in the following subsections.

#### A 6.3.1 Ambient Blank

An ambient blank (AB) consists of ASTM Type II reagent grade water poured into a VOC sample vial at the sampling site (in the same vicinity as the associated samples). ABs are handled like a regular analytical sample and transported to the laboratory for analysis. ABs are prepared only when aqueous VOC samples are scheduled to be collected and analyzed. ABs are used to assess the potential introduction of contaminants to the samples during sample collection from ambient sources (e.g., active runways, engine test cells, gasoline motors in operation, etc.). The frequency of AB collection shall be specified in the SFSP.

#### A 6.3.2 Equipment Blank

An EB is a sample of ASTM Type II reagent grade water poured into, over, or pumped through a sampling device. EBs are collected in a sample container and transported to the laboratory for analysis. EBs are used to assess the effectiveness of equipment decontamination procedures. EBs shall be analyzed for the same laboratory analyses requested for the environmental samples collected at the site. The frequency of EB sample collection shall be specified in the SFSP.

#### A 6.3.3 Source Water or Material Blank

A source water or material blank sample is defined as a sample of a "clean" reagent source such as deionized (DI) water, a chemical reagent source, or a sampling medium such as air filter or sorbent cartridge considered to be "analyte-free" or "background-free" of contamination. If these blanks show elevated concentrations of target analytes, the corresponding data set may be considered biased. Corrective action shall be implemented to eliminate the source of contamination. A source water sample will be collected at the beginning of each sampling event from the on-site potable water source. This water will be used for the initial rinse during the decontamination procedures. Material blanks (also called “Source Water”) will be collected on a weekly basis to monitor the final rinse water provided by the contractor for potential contaminants. The frequency of source water or material blank collection shall be specified in the SFSP.

### A 6.3.4 Trip Blank

TBs are used to assess the potential introduction of contaminants from sample containers or during the sampling, transportation, and storage procedures. A TB consists of VOC sample vials filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. TBs are not opened in the field and are only prepared when aqueous VOC samples are scheduled to be collected and analyzed by the laboratory.

### A 6.3.5 Field Duplicate

Field duplicate (FD) samples are independent samples collected simultaneously or in immediate succession with the original investigative samples such that they are expected to be equally representative of the medium at the time of sampling. FD samples are collected using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. FD samples provide precision information for the entire measurement system, including sample collection, handling, shipping, storage, preparation, and analysis. The sample containers will be assigned an identification number in the field such that laboratory personnel performing the analysis cannot identify them as a duplicate sample. The frequency of FD sample collection shall be specified in the SFSP.

### A 6.3.6 Field Splits

A field split is a single sample divided into two equal parts and sent to two different laboratories for analysis. Field split samples are used to assess sampling precision and comparability. The frequency of field split sample collection shall be specified in the SFSP.

# A 7.0 DATA REVIEW AND VALIDATION

Data quality is assessed through two review processes. The contracted analytical laboratory performs the first data review to assess compliance with the analytical methods approved by this QAP and with laboratory SOPs. The Consultant performs the second data review to assess compliance with the QA objectives, and to assess hard copy and electronic deliverable consistency and integrity.

## A 7.1 Laboratory Data Quality Assessment

The laboratory verifies receipt of the samples with the Project Chemist. Any sample integrity problems or discrepancies with the COCs are addressed at this time. Any problems encountered by the laboratory during the sample analysis program are immediately brought to the attention of the Project Chemist.

The laboratory data quality assessment includes an analytical data review to ensure accurate and complete data reporting and compliance with the analytical method specifications. The laboratory will flag analytical results, when necessary, to indicate potential impacts to data usability and to alert the user to special analytical conditions. More than one qualifier may be used to indicate multiple conditions or situations that apply to an individual result. Table A7-1 presents a summary of data qualifier flags typically applied during laboratory review of analytical results.

At the completion of sample analyses and the laboratory data quality assessment, the contract laboratory will provide results in two formats: analytical data packages (hardcopy data deliverables [HDDs]) and EDDs. Upon receipt of the HDD and the associated EDD, the Project Chemist will verify that the HDD is complete. If the HDD is incomplete or appears to have gross errors, the Project Chemist will coordinate with the laboratory to ensure that the corrected HDD and EDD are submitted.

## A 7.2 Consultant Data Quality and Usability Assessment

The following sections describe the procedures that the Consultant will follow to assess the quality and usability of the data. Data assessment is complete when 100 percent of the information have been collected and reviewed. Based on the results of the review process, data are categorized as fully usable, usable as qualified, or rejected.

### A 7.2.1 Data Review and Validation

The Consultant shall review the analytical data in accordance with the analytical methods (EPA, 1983 and 1986), and *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (EPA, 2017 and 2017). The data review process will include reviewing and evaluating 100 percent of the hard copy data for (1) extraction and analysis holding times, (2) surrogate recoveries, (3) blank detections, (4) LCS/LCSD recoveries and RPDs, (5) MS/MSD recoveries and RPDs, (6) FD RPDs, (7) laboratory duplicate RPDs, if applicable, (8) initial and continuing calibrations, (9) instrument tuning and performance, (10) reporting limits, and (11) completeness of the COC forms. Data transcription checks will be performed on hard copy data only on an as needed basis.

Hard copy data packages will be checked to verify that the following items are included:

- Case narrative.
- Data summary sheets.
- Initial and continuing calibrations.
- Method or preparation blanks (at least one per QC batch).
- MS/MSD (5 percent of client samples).
- LCS/LCSD (one per QC batch).
- Duplicate analyses (laboratory duplicate sample, LCS/LCSD, MS/MSD, as applicable).
- Holding times.
- Retention time window calculation (if applicable).
- Standard preparation sheets.
- Linear range calculations (correlation coefficients).

### A 7.2.2 MDA Qualification of Data

Based on the data review, the Consultant will assign final qualifiers to analytical results. Table A7-2 presents a summary of qualifier flags applied during data validation by the Consultant.

Validation deliverable requirements (e.g., Data Quality Summary [DQS] report) will be dependent on the use of the data.

# A 8.0 DATA MANAGEMENT PLAN

The goal of a data management plan (DMP) is to provide a systematic approach for tracking laboratory data and for utilizing project data for end users. The DMP will be implemented from sample collection to disposal, and includes a paper trail as well as a database system. The DMP is designed to maintain an audit trail and database integrity, as well as verify that data are complete and of a known quality before release to the end user.

Data management procedures include the following:

- Sample analysis and data tracking (chemical and geological).
- EDD and HDD management and verification.
- Final reports.

## A 8.1 Database Software

Microsoft Access (MS Access) will be utilized for the electronic storage of field investigation data including laboratory analytical data and important data regarding sampling sites and media. The Enviro Data software application by GeoTech Computer Systems, Inc (GeoTech) will be used as the database management application. Enviro Data facilitates loading, validating, and reporting data, and provides a high level of quality assurance for the project data.

### A 8.1.1 Database Model

The database model is designed to store and relate site characterization data. GeoTech developed the database model used in the Enviro Data database. It was developed primarily for groundwater, surface water, sediment and soil data, although it is not limited to those data types. It is also possible to store media characterization data such as physical characteristics and geologic units.

The design of the tables and relationships is intended to be Fifth Normal Form; i.e., data of like types are stored together, and redundant data are separated out, with parent-child (and even grandchild) relationships and lookup tables used as appropriate. This design provides good performance, a minimum of wasted space, and maximum control over data quality.

#### A 8.1.1.1 Conventions

The database model used for the Enviro Data database was created for MS Access, so field types are listed as Access data types. SQL Server and Oracle databases have similar data types facilitating flexibility for the user. For coordinate locations and dates, suffixes are included in their respective field names, so that other computer programs reading the tables can identify the field types. These conventions are useful for spatial data retrieval by geographic information system (GIS), contouring and geostatistics software applications. Specifically, coordinate values end in _CX or _CY to identify them as Cartesian X and Y coordinates or _LX or _LY to identify them as Longitude and Latitude, and date fields end in _D to indicate that the date portion of the Access combined date and time field is to be used, if another system stores date and time in separate fields.

Analytical data shall be imported in digital form from files supplied by the contract laboratory. Field personnel or other consultants may provide additional data for import into the Enviro Data database. Other historical project data can be imported from other database systems or manually entered as needed to fulfill project requirements. These data consist of site identification data, data about each well, and a small amount of data for lookup codes.

The largest volume of the data to be input initially by database users is for the Stations table, including location data and elevation data. Data administrators using a semi-automated approach, based on an Excel table, can perform this data entry as appropriate. Proper quality assurance guidelines must be followed for this data entry, including double entry procedures or an independent check of a percentage of entries against original data.

### A 8.1.1.2 Database Tables

The Enviro Data database model is divided into the following four table types:

- Primary tables
- Lookup tables
- Reference tables
- Utility tables

Primary tables contain data imported from the contract laboratory or entered by data administrators. Lookup tables contain expansions of abbreviations and other information that are not stored in the primary tables and are keys to the data in the primary tables. Some of the lookups (*e.g.* Parameters and Units) are formally linked to the primary tables through relationships. Others (AnalyticFlags, AnalyticProblems and ValidationFlags) are not tied with relationships. This is because multiple flags can be entered into the field, so these tables are for reference only. Utility tables provide other functions in the database, but are not related to primary or lookup tables.

The Enviro Data system contains data in six files. Unlike some other database management applications (such as dBase and Paradox), Access and SQLServer store multiple tables, queries, and forms in one file. The Enviro Data files include an “application” database called EnvDProg, a “data” database called EnvDData, and a settings database called Settings. Two additional files, BlankDB.mdb and ExportDB.mdb are used for creating subsets or Access exports. The application code, forms, reports, etc., are stored in the program database in Microsoft Access format. The primary tables and the lookup tables are stored in the data database. The data database can be in SQLServer or Oracle on a database server or in Access on the users’ computers. These databases are read-only (no changes allowed) for all users with two exceptions. These exceptions are data loading/editing and system maintenance. All interactions with the database are password-protected and the QAO or Database Manager will administer users and passwords.

Both the structure of the database (fields and tables) and the contents of the lookup tables can be changed as required for the project. Database administrators and the QAO can make changes to the content of the lookup tables. To the extent necessary the database will be modified to maximize the benefit to McClellan field investigations.

### A 8.2 Sample Tracking Procedures

The goal of sample tracking is to verify that all samples scheduled in SFSPs are collected during field activities and to verify that the appropriate analytical parameters were requested, performed, reported, and loaded into MS Access.

#### A 8.2.1 Sample Tracking

Attachment A1, Data Transfer Standard, shows the fields that may be reported in the EDD. For the investigations at McClellan, the minimum required fields to be reported by contract laboratories are indicated on Attachment A1.

Manual or automated data tracking will be used to assist in maintaining a record of data locations and schedule.

After samples are received at the laboratory, the Project Chemist is responsible for obtaining updates from the laboratory regarding the preparation and analytical status of the samples. This will be conducted to keep track of holding and turnaround times.

#### A 8.2.2 Electronic Data Deliverable Management

After the Project Chemist has approved the HDD (see Section 7.0), the EDD will be turned over to the Data Manager for loading into MS Access. The Data Manager will verify that the integrity of the EDD has been maintained before, during, and after the loading process. After this step has been conducted, the Chemist will conduct a final review on the loaded EDD to verify that it does match the HDD. If the EDD is missing sample results or does not match the HDD, the laboratory will be immediately notified of the discrepancy. Resolution of the problem and any changes made to the database or HDD will be documented and retained in the project files. The minimum requirement for the EDD is specified in Attachment A1.

Problems encountered in EDD management are typically due to inconsistencies, incompleteness, or errors in the format or reporting of the data. The data in the EDD will be checked electronically or manually (via printouts) before loading. The data checks will include (but are not limited to) identifying the following:

- Incorrect field sample ID numbers.
- Duplicate, redundant data sample ID numbers.

- Inconsistent or improper parameter names.
- Sample data with missing information (e.g., detection limits, units).
- Missing sample analyses.
- Incorrect sample collection information.
- Number of significant figures reported.
- Laboratory QC data properly paired with corresponding sample data.

Similar checks will be performed after loading. It is important that data problems be identified as soon as possible to allow for corrections before data use. Data received from the laboratory will be checked for the inconsistencies listed above. Ten percent of the data loaded will be checked. If significant errors or discrepancies are found, the problem will be resolved and the data will be redelivered or reloaded, or an additional 10 percent of the data will be compared. If additional errors are found, 100 percent of the entered data will be compared. Resolution of problems and any changes made to the database or HDD will be documented and retained in the project files.

### A 8.3 Data Reporting

To make efficient use of MS Access to support decisions, it is important for the end user to know the status (i.e., preliminary or final) and quality (e.g., non-validated, validated) of the data in the database. Therefore, every database-generated report will indicate the current status of the database. In addition, until the database is finalized (i.e., data is validated, reviewed, and the database QC completed) authorization for the database will be limited to the QAO and Data Manager. If there is a need for preliminary data by an end user, authorization will be obtained from the Project Manager.

For database reports generated before the database is considered to be final (e.g., non-validated data in database), database reports will include: (1) a header indicating that the data are "PRELIMINARY," and (2) a status line per sample analysis type (e.g., metals, etc.) indicating the current status of the data for that sample. The status lines will indicate the following:

- **Pre-QC Level – Data Entered But Not Checked –** Sample results have been entered into the database, but the data entry has not been proofed. This may include manual entry of validated or non-validated results, or entry of non-validated results from a data file supplied by the laboratory.
- **QC Level – Data Entry Checked –** Sample data entered manually or entered from a data file and have been proofed in accordance with the DMP.
- **Validated Level – Data Validated –** Data have been validated, qualifiers have been assigned, and the validated data have been entered and proofed.
- "**PRELIMINARY"** database reports, the reported sample results are subject to change and should be used with caution by the end user.

# A 9.0 PREVENTATIVE MAINTENANCE

The primary objective of a preventive maintenance program is to promote the timely and effective completion of a measurement effort. Preventive maintenance is designed to minimize the downtime of crucial sampling and/or analytical equipment due to component failure. In implementing a preventive maintenance program efforts are focused in three areas:

- Establish maintenance responsibilities.
- Establish maintenance schedules for major and/or critical instrumentation and apparatus.
- Establish an adequate inventory of critical spare parts and equipment.

## A 9.1 Maintenance Responsibilities

Equipment and apparatus used in environmental measurement programs fall into two general categories:

- Equipment permanently assigned to a specific laboratory.
- Field sampling equipment available for use on an as-needed basis (e.g., field meters, pumps, and vehicles).

Maintenance of laboratory instruments is the responsibility of the laboratory contracted to perform the analytical portion of this program. Generally, the laboratory manager or supervisor of a laboratory is responsible for the instruments and equipment in his or her work area. The laboratory manager will establish maintenance procedures and schedules for each major equipment item. This responsibility may be delegated to laboratory personnel, although the managers retain responsibility for ensuring adherence to prescribed protocol. The laboratories are bound by analytical contractual agreements to maintain the ability to produce data that meet the project objectives and to follow method specifications. This ensures that adequate spare parts, maintenance, schedules, and emergency repair services are available.

Maintenance responsibilities for field equipment are assigned to the consultant site manager and/or field coordinator.

## A 9.2 Maintenance Schedules

The effectiveness of any maintenance program depends to a large extent on adherence to specific maintenance schedules for each major equipment item. Other maintenance activities are conducted on an as-needed basis. Manufacturers' recommendations will provide the primary basis for the established maintenance schedules, and manufacturers' service contracts provide the primary maintenance for many major instruments (e.g., GC instruments, and analytical balances).

### A 9.3 Spare Parts

Along with a schedule for maintenance activities, an adequate inventory of spare parts is required to minimize equipment down time. The inventory includes those parts (and supplies) that:

- Are subject to frequent failure.
- Have limited useful lifetimes.
- Cannot be obtained in a timely manner should failure occur.

The consultant site manager and/or field manager and the respective laboratory managers will be responsible for maintaining an adequate inventory of spare parts. In addition to spare parts and supply inventories, a backup supply of much of the equipment and instrumentation for the field sampling will be maintained.

### A 9.4 Maintenance Records

Maintenance and repair of major field and laboratory equipment will be recorded in field or laboratory logbooks. These records will include documentation of the serial numbers of the equipment, the person performing the maintenance or repairs, the date of the repair, the procedures used during the repair, and proof of successful repair prior to the use of the equipment.

# A 10.0 SYSTEMS AND PERFORMANCE AUDITS

To verify the performance of work activities in accordance with approved work instructions and QA program requirements, a system of planned and documented surveillances, inspections, and performance evaluations will as needed be implemented. Both internal activities and the activities of subcontractors can be monitored. These assessments may include, but not be limited to, the following areas:

- Conformance to DQOs.
- Supplier capabilities and performance.
- Transmittal of information.
- Record control and retention.
- Inspection of subcontractor provided materials.

The objective of these assessments is to improve the consistency by which samples are collected, data gathered, analyses performed, and results reported.

## A 10.1 General Auditing Techniques

Auditing techniques include surveillance, inspections and performance evaluations as described below.

### A 10.1.1 Surveillance

Surveillance, or the witnessing of quality-related activity execution, provides a means to review project activities with less formality than inspections. Surveillance may be scheduled or unscheduled and may involve contractor project management and technical project staff. At the discretion of these individuals, surveillance may be conducted on any project activity at any time.

### A 10.1.2 Inspections and Performance Evaluations

To verify the execution of specific activities in accordance with approved work instructions and project requirements, a system of inspections and performance evaluations may be utilized. Inspections are primarily visual examinations, but possibly may include recording measurements and tests of materials and equipment being used, techniques employed, and final product. Each inspection will be planned to provide the inspector(s) with the opportunity to observe all phases of the subject activity that may affect the end result, to minimize delays in the work activity, and to provide early detection of plan nonconformances. Examinations, measurements, or tests will be performed as necessary and documented to verify the desired performance. Documentation will generally be on a field activity daily log and/or an inspection checklist.

Results, descriptions of findings, and recommended corrective actions for auditing activities will be presented in a memorandum or formal inspection report. The memorandum report will be issued within 30 calendar days of audit completion and sent to the Consultant PM (if this individual did not participate in the inspection), and the individual contractor or subcontractor directly supervising the activity inspected. A written response from the contractor project staff or subcontractor will be required to indicate the corrective actions taken to resolve any issues noted and QA personnel will then verify the corrective actions as part of future follow-up audit activities.

### A 10.2 Field Auditing Procedure

Auditing of field procedures by both surveillance and inspection will be conducted as needed. The scope of these audits will be highly dependent on the type of field activity that is being audited. Activities as diverse as sample collection, well installation, soil boring, excavation, construction, and remediation may be included. The auditor must have sufficient knowledge of the site activity to accurately observe, comment, and ask appropriate questions of the participating contractor staff. A checklist of typical field auditing concerns is included in Attachment A2. The auditor may modify this checklist to key on task-specific QA issues relevant to the audit.

The field audits that are conducted periodically may generate, as a final deliverable, an audit assessment report that evaluates the current state of implementation of project technical and QA plans. These reports will identify areas of potential concern as audit findings, and document what the observed conditions or procedures were at the time of the audit, what they should have been, and the corrective action steps required to formulate a systematic change. Follow-up audits may then be scheduled and performed to address the findings of the previous audit and judge the progress of the audited group.

These audit reports, once compiled, should be circulated to the field and management staff for evaluation. Finalized audit reports will be retained in the project central files for future reference.

### A 10.3 Laboratory Auditing Procedure

Contract laboratories providing data to the project database shall participate in a system of organized, internal laboratory surveillance and quality systems audits conducted by its QA/QC director. The laboratory QA/QC director on an annual basis shall conduct internal audits for each analytical area to verify the following at a minimum: procedures are compliant with SOPs; documentation practices are complete and traceable to a certified source(s); data reviews are complete, well-documented, and effective; and data reporting practices, including electronic or manual data transfer and client report generation, are accurate and complete. Audit findings, corrective actions, root cause determination, etc. shall be fully documented in QA reports to management. The laboratory QA/QC director shall document that all corrective actions necessary are verified complete within a reasonable time frame. Audits performed by external agencies or accrediting authorities shall not substitute for internally conducted surveillance and laboratory audits.

Project quality system audits, performed by designated McClellan and contractor personnel, may also be scheduled. The focus of the system audit will vary depending on the type of analytical support provided by the audited laboratory. The laboratory audits that are conducted will generate, as a final deliverable, an audit assessment report that evaluates the current state of implementation of project technical and QA plans. These reports will identify areas of potential concern or deficiencies as audit findings, and document what the observed conditions or procedures were at the time of the audit. The final audit assessment will also include a formal response to findings and comments submitted by the audited laboratory management. Follow-up audits may then be scheduled and performed to address the findings of the previous audit and judge if corrective actions have been implemented and performed effectively by the audited laboratory. These audit reports, once compiled, should be circulated to the laboratory management staff for evaluation. Finalized audit reports will be retained in the project central files for future reference.

## A 11.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

If requested the consultant's PM will receive a technical report on the performance of the measurement system and the data quality for each investigative task or completed parcel. Minimally, these reports shall include:

- Assessment of measurement data quality indicators, i.e., data PARCCS.
- Results of laboratory system audits.
- Significant QA/QC problems and recommended solutions.

This evaluation of project data with regards to the QC results may also be provided in technical summary reports. This evaluation will present guidelines for data usability in terms of bias and precision.

Two types of QC results may be evaluated and reported for each event:

- Field QC activities
    - FDs.
    - EBs.
    - Field blanks.
    - TBs.
    - Field Splits (if performed).

- Analytical QC activities
    - MRLs.
    - Holding times.
    - MS/MSD results.
    - MBs.
    - LCSs.
    - Surrogate standards.

An overall comparison to the DQOs established in the project may, if requested, be performed, and the results of the data validation procedures can be incorporated into this report.

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# Table A 4-1
# Sample Containers, Preservatives, and Holding Time Requirements
# McClellan, Anniston, Alabama

| Name | Analytical Methods[a] | Matrix | Sample Container (Size)[b,e] | Preservation[c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Alkalinity | E310.1/SM2320B | water | P, G (50 ml) | 0 - 6°C | 14 days |
| Common anions | SW9056A/ E300.0/E300.1 | water | P, G (50 ml) | 0 - 6°C | 28 days for Br, F, Cl, $SO_4$;<br>48 hours for $NO_3$, $NO_2$, $PO_4$ |
| Perchlorate | E314.2 | water | P, G (50 ml) | 10°C from field to lab, 0 - 6°C until analysis | 28 days |
| Cyanide, total and amenable to chlorination | SW9010C/ SW9012B/ SM4500-CN E | water | P, G (500 ml) | 0 - 6°C, NaOH to pH > 12, 0.6 g ascorbic acid | 14 days |
| | | soil | P, G (4 oz) | 0 - 6°C | 14 days |
| Total Dissolved Solids[f] (TDS) | SM2540C/E160.1 | water | P, G (100 ml) | 0 - 6°C | 7 days |
| Total Suspended Solids[f] (TSS) | SM2540D/E160.2 | water | P, G (100 ml) | 0 - 6°C | 7 days |
| Hydrogen ion (pH) | SW9040C/ SM4500-H B | water | P, G (NA) | None | Analyze immediately[d] |
| | SW9045D | soil | P, G (NA) | None | Analyze immediately[d] |
| Nitrate+Nitrite as Nitrogen | SM4500-NO3 E/ E353.3 | water | P, G (500 ml) | 0-6°C, $H_2SO_4$ to pH < 2 | 28 days |
| Conductance | SW9050A/ E120.1 | water | P, G (NA) | 0-6°C | 28 days[d] |
| Temperature | E170.1 | water | P, G (NA) | None | Analyze immediately[d] |
| Dissolved oxygen | E360.1 | water | G (500 ml) | None | Analyze immediately[d] |
| Turbidity | E180.1 | water | P, G (NA) | 0-6°C | 48 hours |
| Total organic carbon | SM5310B/ SW9060A | water | P[i], G (500 ml) | 0 - 6°C, HCl or $H_2SO_4$ to pH < 2 | 28 days |
| Chromium VI (CrVI) | SW7196A | water | P, G (500 ml) | 0 - 6°C | 24 hours |
| | | soil | P, G (8 oz) | 0 - 6°C | 30 days to extraction, 4 days from extraction to analysis |
| Mercury (Hg) | SW7470A | water | P, G (500 ml) | $HNO_3$ to pH<2, 0 - 6°C | 28 days |
| | SW7471B | soil | P, G (8 oz) | 0 - 6°C | 28 days |

# Table A 4-1
# Sample Containers, Preservatives, and Holding Time Requirements
# McClellan, Anniston, Alabama

| Name | Analytical Methods[a] | Matrix | Sample Container (Size)[b,e] | Preservation[c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Metals (except CrVI and Hg) | SW6010D/ SW6020B | water | P, G (600 ml) | $HNO_3$ to pH<2, 0 - 6°C | 180 days |
| | | soil | P, G (8 oz) | 0 - 6°C | 180 days |
| Total volatile petroleum hydrocarbons[h] (TVPH) (i.e., GRO) | SW8015V (modified) | water | GS (2 x 40 ml) | 0 - 6°C, HCl to pH<2; 0 - 6°C | 14 days preserved water; 7 days unpreserved water |
| | | soil | E | 0 - 6°CC, freeze to -7°C within 48 hrs | 14 days |
| | | | G/S (2x40ml) | 0 - 6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | G/S (2x40ml) | 0 - 6°C | 48 hours |
| | | | G/S (2x40ml), VOC≥200µg/kg | 0 - 6°C, methanol | 14 days |
| | | | G/S (2 oz), VOC≥200µg/kg | 0 - 6°C | 48 hours |
| Total extractable petroleum hydrocarbons (TEPH) (i.e., DRO) | SW8015D (modified) | water | GA (1 liter) | 0 - 6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Aromatic and halogenated volatiles[h] | SW8021B | water | GS (2 x 40 ml) | 0-6°C, HCl to pH < 2, $Na_2S_2O_3$ (c); 0 - 6°C | 14 days preserved water; 7 days unpreserved water |
| | | soil | E | 0 - 6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | G/S (2x40ml) | 0 - 6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | G/S (2x40ml) | 0 - 6°C | 48 hours |
| | | | G/S (2x40ml), VOC≥200µg/kg | 0 - 6°C, methanol | 14 days |
| | | | G/S (2 oz), VOC≥200µg/kg | 0 - 6°C | 48 hours |

# Table A 4-1
# Sample Containers, Preservatives, and Holding Time Requirements
# McClellan, Anniston, Alabama

| Name | Analytical Methods[a] | Matrix | Sample Container (Size)[b,e] | Preservation[c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Nitrosamines | SW8070A | water | G/S (1 liter) | 0 - 6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Chlorinated herbicides | SW8151A / SW8321B | water | GSA (1 liter) | 0 - 6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Organochlorine pesticides | SW8081B | water | GSA (1 liter) | 0 - 6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Polychlorinated biphenyls (PCBs) | SW8082A | water | GSA (1 liter) | 0 - 6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Organophosphorus pesticides | SW8141B | water | GSA (1 liter) | 0 - 6°C, NaOH or H2SO4 to pH 5-8 | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Semivolatile organic compounds | SW8270D | water | GSA (1 liter) | 0 - 6°C in the dark, 0.008% $Na_2S_2O_3$ (c) | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C in the dark | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Volatile organic compounds[h] (VOCs) | SW8260C | water | G/S (3 x 40 ml) | 0 - 6°C, HCl to pH<2, $Na_2S_2O_3$ (c); 0 - 6°C | 14 days preserved water; 7 days unpreserved water |
| | | water for acrolein and acrylonitrile | G/S (3 x 40 ml) | 0 - 6°C, HCl to pH 4-5 | 7 days |

# Table A 4-1
# Sample Containers, Preservatives, and Holding Time Requirements
# McClellan, Anniston, Alabama

| Name | Analytical Methods[a] | Matrix | Sample Container (Size)[b,e] | Preservation[c] | Maximum Holding Time |
|---|---|---|---|---|---|
| VOCs[h] continued | SW8260C | soil (low) | E | 0 - 6°C, transfer to preserved vial within 48 hrs | 14 days |
| | | | E | 0 - 6°C | 48 hours |
| | | | G/S (3x40ml) | 0 - 6°C, if acid reactive analytes[g] requested | 7 days |
| | | | G/S (3x40ml) | 0 - 6°C, freeze to -7°C within 48 hrs, HNaO3S and 5 mL H2O to pH ≤2 | 14 days |
| | | | G/S (3x40ml), pre-weighed with magnetic stir bar and preservative | 0 - 6°C, freeze to -7°C within 48 hrs, HNaO3S and 5 mL H2O to pH ≤2 | 14 days |
| | | Soil (high conc) | G/S (3x40ml), pre-weighed with magnetic stir bar and preservative | 0 - 6°C, methanol | 14 days |
| | | | E | 0 - 6°C, freeze to -7°C within 48 hrs | 14 days |
| | | | G/S (2 oz), VOC≥200µg/kg | 0 - 6°C | 48 hours |
| VOCs - air and soil gas | TO-15 | air | SUMMA® canister | none | 30 days |
| Methane, Ethane, Ethene, Propane | RSK-175 | water | G/S (2 x 40 ml) | 0 - 6°C, HCl to pH<2;0 - 6°C | 14 days preserved water;<br>7 days unpreserved water |
| Carbon Dioxide | RSK-175 | water | G/S (2 x 40 ml) | 0 - 6°C | 7 days |
| Ethylene glycol, Propylene glycol | RSK-175; SW8015D (mod) | water | P (500 ml); GS (2x40ml) | 0 - 6°C | 14 days |
| | | soil | G (8 oz) | 0 - 6°C | 14 days |
| Polynuclear aromatic | SW8310/ SW8270-SIM | water | G/S (1 liter) | 0 - 6°C in the dark, 0.008% $Na_2S_2O_3$ (c) | 7 days from sampling to extraction, 40 days from extraction to analysis |

# Table A 4-1
# Sample Containers, Preservatives, and Holding Time Requirements
# McClellan, Anniston, Alabama

| Name | Analytical Methods[a] | Matrix | Sample Container (Size)[b,e] | Preservation[c] | Maximum Holding Time |
|---|---|---|---|---|---|
| hydrocarbons (PAHs) | | soil | G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Dioxins and furans | SW8280B/ SW8290A | water | G/S (1 liter) | 0 - 6°C in the dark, 0.008% $Na_2S_2O_3$ (c) | 30 days from sampling to extraction, 45 days from extraction to analysis |
| | | soil | G (8 oz) | 0 - 6°C | 30 days from sampling to extraction, 45 days from extraction to analysis |
| Explosive residues | SW8330A | water | P, G (1 liter) | 0 - 6°C | 7 days from sampling to extraction, 40 days from extraction to analysis |
| | | soil | P, G (8 oz) | 0 - 6°C | 14 days from sampling to extraction, 40 days from extraction to analysis |
| Ethylene dibromide (EDB) | SW8011 | water | G/S (2 x 40 ml) | 0 - 6°C, $Na_2S_2O_3$ (c) | 14 days |
| Ammonia | SM4500-NH3 F/ E350.2 | water | P, G (500 ml) | 0 - 6°C, $H_2SO_4$ to pH < 2 | 28 days |
| Phosphorus (Total) | SM4500-P E/ E365.2 | water | P, G (500 ml) | 0 - 6°C, $H_2SO_4$ to pH < 2 | 28 days |
| Total Kjeldahl Nitrogen (TKN) | SM4500-$N_{org}$C/ E351.3 | water | P, G (500 ml) | 0 - 6°C, $H_2SO_4$ to pH < 2 | 28 days |
| Sulfide | SM4500-$S^{2-}$ F/ E376.1 | water | P, G (250 ml) | 0 - 6°C, Zn acetate and NaOH to pH > 9 | 7 days |
| Biological Oxygen Demand (BOD) | SM5210B/ E405.1 | water | P, G (1 liter) | 0 - 6°C | 48 hours |
| Chemical Oxygen Demand (COD) | SM5220B/ E410.4 | water | P, G (500 ml) | 0 - 6°C, $H_2SO_4$ to pH < 2 | 28 days |
| TPH-Oil & Grease | E418.1/1664 | water | GSA (1 liter) | 0 - 6°C, HCl or $H_2SO_4$ to pH < 2 | 28 days |
| | | soil | G (8 oz) | 0 - 6°C | 28 days |
| Hardness | SM2340C/ E130.2 | water | P, G (500 ml) | $HNO_3$ to pH<2, 0 - 6°C | 6 months |

# Table A 4-1
# Sample Containers, Preservatives, and Holding Time Requirements
# McClellan, Anniston, Alabama

| Name | Analytical Methods[a] | Matrix | Sample Container (Size)[b,e] | Preservation[c] | Maximum Holding Time |
|---|---|---|---|---|---|
| Toxicity Characteristic Leaching Procedure (TCLP) | SW1311 | water, soil | water: G/S (1 liter);<br>soil: G (8 oz) | 0 - 6°C | water and soil: VOCs - 14 days from sampling to TCLP extract, 14 days from extract to analysis; SVOCs - 14 days from sampling to TCLP extract, 7 days from extract to prep, 40 days from prep to analysis; Metals - 180 days from sampling to TCLP extract, 180 days from extract to analysis; Hg - 28 days from sampling to TCLP extract, 28 days from extract to analysis |

**Notes:**

[a] Including subsequent method revisions/updates. Most recent revision will be used.

[b] Polyethylene (P); glass (G); PTFE (Teflon)-lined septum seal (S); amber (A); EnCore Sampler (E).

[c] Preservation with sodium thiosulfate (Na2S2O3) is only required when residual chlorine is present.

[d] Measurement should be performed on site.

[e] Actual sample container size will vary based on individual laboratory and method requirements.

[f] Analysis should be done as soon as possible but should not exceed hold time listed.

[g] acid reactive compound are vinyl chloride, styrene, and 2- chloroethyl vinyl ether

[h] Most likely used sample containers, preservatives, and holding times listed. Please refer to Chapter 4 of the SW-846 Compendium for additional options and information.

[i] Plastic containers used must not contribute contaminating organics to the samples.

ml = milliliters
NA = Not applicable
oz = ounces

DRO = Diesel Range Organics
GRO = Gasoline Range Organics
TPH = Total Petroleum Hydrocarbons

# Table A 5-1
# Wet Chemistry Parameters*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter (Method*)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| Hardness (SM2340C/E130.2) | 10 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Total Dissolved Solids (SM2540C/E160.1) | 10 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Total Suspended Solids (SM2540D/E160.2) | 10 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Alkalinity (E310.1/SM2320B) | 5 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Perchlorate (E314.2) | 2 | µg/L | 75-125 | 25 | 25 | µg/kg | 75-125 | 25 |
| Ammonia (SM4500-NH3 F/E350.2) | 0.1 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Total Kjeldhal Nitrogen (TKN) (SM4500-NorgC/E351.3) | 0.1 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Sulfide (SM4500-$S^{2-}$ F/E376.1) | 1 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Biochemical Oxygen Demand (BOD) (SM5210B/E405.1) | 2 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Chemical Oxygen Demand (COD) (SM5220B/E410.4) | 10 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| TPH-Oil & Grease (E1664/E418.1) | 5 | mg/L | 80-120 | 20 | 60 | mg/kg | 80-120 | 50 |
| Phenols (E420.1) | 0.05 | mg/L | 80-120 | 20 | -- | -- | -- | -- |
| Chromium VI (SW7196A) | 0.02 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Cyanide (SW9010C/SW9012B/SM4500-CN E) | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Total Organic Carbon (TOC) (SM5310B/SW9060A) | 1 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Ferrous Iron ($Fe^{+2}$) (SM3500) | 5 | mg/L | 80-120 | 20 | -- | -- | -- | -- |

**Notes:**

* Including subsequent method revisions. Most recent revision will be used.

| | |
|---|---|
| -- = Not applicable | µg/L = micrograms per liter |
| %R = Percent recovery | mg/L = milligrams per liter |
| MRL = Method reporting limit | µg/kg = micrograms per kilogram |
| RPD = Relative Percent Difference | mg/kg = milligrams per kilogram |
| TPH = Total Petroleum Hydrocarbons | |

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A 5-1a
# Dissolved Gases by Method RSK-175*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | |
|---|---|---|---|---|
| Parameter | MRL | Units | Accuracy (%R) | Precision (RPD) |
| Methane | 1.2 | µg/L | 50-150 | 20 |
| Ethane | 1.5 | µg/L | 50-150 | 20 |
| Ethene | 1.5 | µg/L | 50-150 | 20 |
| Propane | 3 | µg/L | 50-150 | 20 |
| Carbon dioxide | 1200 | µg/L | 50-150 | 30 |
| Ethylene glycol | 10 | mg/L | 70-130 | 30 |
| Propylene glycol | 10 | mg/L | 70-130 | 30 |

**Notes:**
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter

* Including subsequent method revisions. Most recent revision will be used.

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A 5-2
# GRO, DRO, and Glycols by Modified Method SW8015D*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| TVPH (GRO) (C6-C10) | 0.1 | mg/L | 70-130 | 30 | 1 | mg/kg | 70-130 | 50 |
| Bromofluorobenzene (surrogate) | -- | -- | 70-150 | -- | -- | -- | 70-150 | -- |
| TEPH (DRO) (C10-C28) | 0.5 | mg/L | 70-130 | 30 | 10 | mg/kg | 70-130 | 50 |
| Motor Oil | 1 | mg/L | 70-130 | 30 | 20 | mg/kg | 70-130 | 50 |
| Bromobenzene (surrogate) | -- | -- | 60-150 | -- | -- | -- | 60-150 | -- |
| Hexacosane (surrogate) | -- | -- | 60-160 | -- | -- | -- | 60-160 | -- |
| Ethylene glycol | 10 | mg/L | 70-130 | 30 | 10 | mg/kg | 70-130 | 50 |
| Propylene glycol | 10 | mg/L | 70-130 | 30 | 10 | mg/kg | 70-130 | 50 |

**Notes:**
* Including subsequent method revisions. Most recent revision will be used.
-- = Not applicable
%R = Percent recovery
DRO = Diesel Range Organics
GRO = Gasoline Range Organics
mg/L = milligrams per liter
mg/kg = milligrams per kilogram
MRL = Method reporting limit
RPD = Relative Percent Difference
TEPH = Total Extractable Petroleum Hydrocarbons
TVPH = Total Volatile Petroleum Hydrocarbons

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A 5-3
# BTEX by Method SW8021B*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| Benzene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Toluene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Ethylbenzene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Xylenes, Total | 3 | µg/L | 70-130 | 20 | 15 | µg/kg | 70-130 | 30 |
| MTBE | 2 | µg/L | 70-130 | 20 | 10 | µg/kg | 70-130 | 30 |
| **Surrogates:** | | | | | | | | |
| 1,1,1-Trifluorotoluene | -- | -- | 70-130 | -- | -- | -- | 70-130 | -- |
| Bromofluorobenzene | -- | -- | 70-130 | -- | -- | -- | 70-130 | -- |

**Notes:**
* Including subsequent method revisions.
-- = Not applicable
%R = Percent recovery
BTEX = Benzene, Toluene, Ethylbenzene, Xylenes
MRL = Method reporting limit
MTBE = Methyl tert-butyl ether
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A 5-4
# Organochlorine Pesticides by Method SW8081B*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | MRL | Units | Accuracy (%R) | Precision (RPD) | MRL | Units | Accuracy (%R) | Precision (RPD) |
| 4,4-'DDD | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| 4,4-'DDE | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| 4,4-'DDT | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| Aldrin | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| alpha-BHC | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| alpha-chlordane | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| beta-BHC | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| delta-BHC | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| Dieldrin | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| Endosulfan I | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| Endosulfan II | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| Endosulfan Sulfate | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| Endrin | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| Endrin Aldehyde | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| Endrin Ketone | 0.2 | µg/L | 70-130 | 30 | 4 | µg/kg | 70-130 | 50 |
| gamma-BHC | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| gamma-Chlordane | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| Heptachlor | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| Heptachlor Epoxide | 0.1 | µg/L | 70-130 | 30 | 2 | µg/kg | 70-130 | 50 |
| Methoxychlor | 1 | µg/L | 70-130 | 30 | 20 | µg/kg | 70-130 | 50 |
| Toxaphene | 3 | µg/L | 70-130 | 30 | 100 | µg/kg | 70-130 | 50 |
| **Surrogate:** | | | | | | | | |
| Decachlorobiphenyl | -- | -- | 40-150 | -- | -- | -- | 40-150 | -- |
| Tetrachloro-m-xylene | -- | -- | 30-130 | -- | -- | -- | 30-130 | -- |

**Notes:**

* Including subsequent method revisions. Most recent revision will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-5
# Aroclors by Method SW8082A*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| Aroclor 1016 | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Aroclor 1221 | 1 | µg/L | -- | -- | 50 | µg/kg | -- | -- |
| Aroclor 1232 | 1 | µg/L | -- | -- | 50 | µg/kg | -- | -- |
| Aroclor 1242 | 1 | µg/L | -- | -- | 50 | µg/kg | -- | -- |
| Aroclor 1248 | 1 | µg/L | -- | -- | 50 | µg/kg | -- | -- |
| Aroclor 1254 | 1 | µg/L | -- | -- | 50 | µg/kg | -- | -- |
| Aroclor 1260 | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| **Surrogate:** | | | | | | | | |
| Decachlorobiphenyl | -- | -- | 40-160 | -- | -- | -- | 40-160 | -- |
| Tetrachloro-m-xylene | -- | -- | 40-160 | -- | -- | -- | 40-160 | -- |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-6
# Organophosphorus Pesticides by Method SW8141B*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| Azinphos-methyl (guthion) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Bolstar (sulprofos) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Chlorpyrifos | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Coumaphos | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Demeton (total) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Diazinon | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Dichlorvos | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Dimethoate | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Disulfoton | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Ethoprop (ethoprofos) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Famphur | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Fensulfothion | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Fenthion | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Malathion | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Merphos | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Methyl parathion | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Mevinphos (phosdrin) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Naled | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Ethyl parathion (parathion) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Phorate | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Ronnel (fenchlorphos) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Stirophos (tetrachlorvinphos) | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Sulfotepp | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Thionazin | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Tokuthion | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Trichloronate | 1 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| **Surrogate:** | | | | | | | | |
| Triphenyl phosphate | -- | -- | 50-130 | -- | -- | -- | 50-130 | -- |
| Tributyl phosphate | -- | -- | 30-130 | -- | -- | -- | 40-130 | -- |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

# Table A5-6
# Organophosphorus Pesticides by Method SW8141B*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-7
# Herbicides by Method SW8151A/SW8321B*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | **Water** | | | | **Soil** | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| 2,4,5-T | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| 2,4,5-TP(Silvex) | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| 2,4-D | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| 2,4-DB | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| Dalapon | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| Dicamba | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| Dichloroprop | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| Dinoseb | 0.4 | µg/L | 70-130 | 30 | 10 | µg/kg | 70-130 | 50 |
| MCPA | 50 | µg/L | 70-130 | 30 | 2000 | µg/kg | 70-130 | 50 |
| MCPP | 50 | µg/L | 70-130 | 30 | 2000 | µg/kg | 70-130 | 50 |
| **Surrogate:** | | | | | | | | |
| 2,4-Dichlorophenylacetic acid | -- | -- | 40-140 | -- | -- | -- | 30-140 | -- |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-8
# Volatile Organic Compounds by Methods SW8260C* and TO-15*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| Parameter | Water (8260C*) | | | Soil (8260C*) | | | Air (TO-15*) | | |
|---|---|---|---|---|---|---|---|---|---|
| | MRL (µg/L) | Accuracy (%R) | Precision (RPD) | MRL (µg/kg) | Accuracy (%R) | Precision (RPD) | MRL (ppbv) | Accuracy (%R) | Precision (RPD) |
| 1,1,1,2-Tetrachloroethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 1,1,1-Trichloroethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,1,2,2-Tetrachloroethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,1,2-Trichloro-1,2,2-trifluoroethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,1,2-Trichloroethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,1-Dichloroethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,1-Dichloroethene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,1-Dichloropropene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 1,2,3-Trichlorobenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 1,2,3-Trichloropropane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 1,2,4-Trichlorobenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 20 | 70-130 | 25 |
| 1,2,4-Trimethylbenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,2-Dibromo-3-chloropropane | 2 | 70-130 | 20 | 10 | 70-130 | 30 | -- | -- | -- |
| 1,2-Dibromoethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,2-Dichlorobenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,2-Dichloroethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,2-Dichloropropane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,3,5-Trimethylbenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,3-Dichlorobenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 1,3-Dichloropropane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 1,4-Dichlorobenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| 2,2-Dichloropropane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 2-Butanone (MEK) | 10 | 70-130 | 20 | 20 | 70-130 | 30 | 5 | 60-140 | 25 |
| 2-Chlorotoluene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 2-Hexanone | 10 | 70-130 | 20 | 20 | 70-130 | 30 | 20 | 60-140 | 25 |
| 4-Chlorotoluene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| 4-Methyl-2-Pentanone (MIBK) | 10 | 70-130 | 20 | 20 | 70-130 | 30 | 5 | 60-140 | 25 |
| Acetone | 10 | 70-130 | 20 | 20 | 70-130 | 30 | 20 | 60-140 | 25 |
| Acrylonitrile | 10 | 70-130 | 20 | 50 | 70-130 | 30 | -- | -- | -- |
| Benzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Bromobenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| Bromochloromethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| Bromodichloromethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |
| Bromoform | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |
| Bromomethane | 2 | 70-130 | 20 | 10 | 70-130 | 30 | 5 | 70-130 | 25 |
| Carbon Disulfide | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |
| Carbon Tetrachloride | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Chlorobenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Chloroethane | 2 | 70-130 | 20 | 10 | 70-130 | 30 | 5 | 70-130 | 25 |
| Chloroform | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Chloromethane | 2 | 70-130 | 20 | 10 | 70-130 | 30 | 20 | 70-130 | 25 |
| cis-1,2-Dichloroethene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| cis-1,3-Dichloropropene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Dibromochloromethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |
| Dibromomethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| Dichlorodifluoromethane | 2 | 70-130 | 20 | 10 | 70-130 | 30 | 5 | 70-130 | 25 |
| Ethylbenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Hexachlorobutadiene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 20 | 70-130 | 25 |
| Iodomethane | 2 | 70-130 | 30 | 5 | 70-130 | 30 | -- | -- | -- |
| Isopropyl benzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |
| Methylene chloride | 2 | 70-130 | 20 | 10 | 70-130 | 30 | 5 | 70-130 | 25 |
| MTBE | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |

# Table A5-8
# Volatile Organic Compounds by Methods SW8260C* and TO-15*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| Parameter | Water (8260C*) | | | Soil (8260C*) | | | Air (TO-15*) | | |
|---|---|---|---|---|---|---|---|---|---|
| | MRL (µg/L) | Accuracy (%R) | Precision (RPD) | MRL (µg/kg) | Accuracy (%R) | Precision (RPD) | MRL (ppbv) | Accuracy (%R) | Precision (RPD) |
| Naphthalene | 2 | 70-130 | 20 | 10 | 70-130 | 30 | -- | -- | -- |
| n-Butylbenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| n-Propylbenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |
| p-Isopropyltoluene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| Sec-Butylbenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| Styrene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| tert-Butylbenzene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| Tetrachloroethene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Toluene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| trans-1,2-Dichloroethene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 60-140 | 25 |
| trans-1,3-Dichloropropene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Trans-1,4-dichloro-2-butene | 2 | 70-130 | 20 | 10 | 70-130 | 30 | -- | -- | -- |
| Trichloroethene | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Trichlorofluoromethane | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Vinyl Acetate | 2 | 70-130 | 20 | 5 | 70-130 | 30 | -- | -- | -- |
| Vinyl Chloride | 1 | 70-130 | 20 | 5 | 70-130 | 30 | 5 | 70-130 | 25 |
| Xylenes (Total) | 3 | 70-130 | 20 | 15 | 70-130 | 30 | 10 | 70-130 | 25 |
| **Surrogates:** | | | | | | | | | |
| 1,2-Dichloroethane-d4 | -- | 70-130 | -- | -- | 70-130 | -- | -- | 70-130 | -- |
| 4-Bromofluorobenzene | -- | 70-130 | -- | -- | 70-130 | -- | -- | 70-130 | -- |
| Toluene-d8 | -- | 70-130 | -- | -- | 70-130 | -- | -- | 70-130 | -- |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
ppbv = parts per billion volume
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-9
# Semivolatile Organic Compounds by Method SW8270D*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| 1,2,4-Trichlorobenzene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 1,2 -Dichlorobenzene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 1,3-Dichlorobenzene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 1,4-Dichlorobenzene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2,4,5-Trichlorophenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2,4,6-Trichlorophenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2,4-Dichlorophenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2,4-Dimethylphenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2,4-Dinitrophenol | 20 | µg/L | 70-130 | 20 | 660 | µg/kg | 70-130 | 30 |
| 2,4-Dinitrotoluene | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2,6-Dinitrotoluene | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2-Chloronaphthalene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2-Chlorophenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2-Methylnaphthalene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2-Methylphenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 2-Nitroaniline | 20 | µg/L | 70-130 | 20 | 660 | µg/kg | 70-130 | 30 |
| 2-Nitrophenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 3,3'-Dichlorobenzidine | 10 | µg/L | 70-130 | 20 | 660 | µg/kg | 70-130 | 30 |
| 3-Nitroaniline | 10 | µg/L | 70-130 | 20 | 660 | µg/kg | 70-130 | 30 |
| 4,6-Dinitro-2-methylphenol | 20 | µg/L | 70-130 | 20 | 660 | µg/kg | 70-130 | 30 |
| 4-Bromophenyl-phenylether | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 4-Chloro-3-methylphenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 4-Chloroaniline | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 4-Chlorophenyl-phenylether | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 4-Methylphenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 4-Nitroaniline | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| 4-Nitrophenol | 20 | µg/L | 70-130 | 20 | 660 | µg/kg | 70-130 | 30 |
| Acenaphthene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Acenaphthylene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Anthracene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Benzo(a)anthracene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Benzo(a)pyrene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Benzo(b)fluoranthene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Benzo(g,h,i)perylene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Benzo(k)fluranthene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Benzyl Alcohol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Bis(2-chloroethoxy)-methane | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Bis(2-chloroethyl)ether | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Bis(2-ethylhexyl)phthalate | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Butylbenzyl phthalate | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Carbazole | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Chrysene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Di-n-butyl phthalate | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Di-n-octyl phthalate | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Dibenzo(a,h)-anthracene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Dibenzofuran | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Diethyl phthalate | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |

# Table A5-9
# Semivolatile Organic Compounds by Method SW8270D*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| Dimethyl phthalate | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Fluoranthene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Fluorene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Hexachlorobenzene | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Hexachlorobutadiene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Hexachlorocyclopentadiene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Indeno(1,2,3-cd)pyrene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Isophorone | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| N-Nitroso-di-n-propylamine | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| N-Nitrosodiphenylamine | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Naphthalene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Nitrobenzene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Pentachlorophenol | 20 | µg/L | 70-130 | 20 | 660 | µg/kg | 70-130 | 30 |
| Phenanthrene | 20 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Phenol | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| Pyrene | 10 | µg/L | 70-130 | 20 | 330 | µg/kg | 70-130 | 30 |
| **Surrogate:** | | | | | | | | |
| 2,4,6-Tribromphenol | -- | -- | 40-130 | -- | -- | -- | 40-130 | -- |
| 2-Fluorobiphenyl | -- | -- | 30-130 | -- | -- | -- | 30-130 | -- |
| 2-Fluorophenol | -- | -- | 30-130 | -- | -- | -- | 30-130 | -- |
| Nitrobenzene-d5 | -- | -- | 30-130 | -- | -- | -- | 30-130 | -- |
| Phenol-d5 | -- | -- | 30-130 | -- | -- | -- | 30-130 | -- |
| Terphenyl-d14 | -- | -- | 40-130 | -- | -- | -- | 40-130 | -- |

**Notes:**

* Including subsequent method revisions. Most recent revision will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-10
# Dioxins/Furans by Method SW8280B/8290A*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| 2,3,7,8-TCDD | 10 | pg/L | 70-130 | 50 | 1 | pg/g | 70-130 | 50 |
| Total TCDD | 10 | pg/L | 70-130 | 50 | 1 | pg/g | 70-130 | 50 |
| 1,2,3,7,8-PeCDD | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| Total PeCDD | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 1,2,3,4,7,8-HxCDD | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 1,2,3,7,8,9-HxCDD | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 1,2,3,6,7,8-HxCDD | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| Total HxCDD | 150 | pg/L | 70-130 | 50 | 15 | pg/g | 70-130 | 50 |
| 1,2,3,4,6,7,8-HpCDD | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| Total HpCDD | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| OCDD | 100 | pg/L | 70-130 | 50 | 10 | pg/g | 70-130 | 50 |
| 2,3,7,8-TCDF | 10 | pg/L | 70-130 | 50 | 1 | pg/g | 70-130 | 50 |
| Total TCDF | 10 | pg/L | 70-130 | 50 | 1 | pg/g | 70-130 | 50 |
| 1,2,3,7,8-PeCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 2,3,4,7,8-PeCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| Total PeCDF | 100 | pg/L | 70-130 | 50 | 10 | pg/g | 70-130 | 50 |
| 1,2,3,4,7,8-HxCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 1,2,3,6,7,8-HxCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 2,3,4,6,7,8-HxCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 1,2,3,7,8,9-HxCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| Total HxCDF | 200 | pg/L | 70-130 | 50 | 20 | pg/g | 70-130 | 50 |
| 1,2,3,4,6,7,8-HpCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| 1,2,3,4,7,8,9-HpCDF | 50 | pg/L | 70-130 | 50 | 5 | pg/g | 70-130 | 50 |
| Total HpCDF | 100 | pg/L | 70-130 | 50 | 10 | pg/g | 70-130 | 50 |
| OCDF | 100 | pg/L | 70-130 | 50 | 10 | pg/g | 70-130 | 50 |
| **Internal Standards:** | | | | | | | | |
| $^{13}C_{12}$-2,3,7,8-TCDD | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-2,3,7,8-TCDF | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-1,2,3,7,8-PeCDD | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-1,2,3,7,8-PeCDF | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-1,2,3,6,7,8-HxCDD | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-1,2,3,7,8,9-HxCDD | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-1,2,3,4,7,8-HxCDF | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |
| $^{13}C_{12}$-OCDD | -- | -- | 40-135 | -- | -- | -- | 40-135 | -- |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
pg/g = picograms per gram
pg/L = picograms per liter

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts.

# Table A5-11
# Polynuclear Aromatic Hydrocarbons by Method SW8310/SW8270D-SIM*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | MRL | Units | Accuracy (%R) | Precision (RPD) | MRL | Units | Accuracy (%R) | Precision (RPD) |
| Acenaphthene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Acenaphthylene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Anthracene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Benzo(a)anthracene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Benzo(a)pyrene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Benzo(b)fluoranthene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Benzo(g,h,i)peryylene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Benzo(k)fluoranthene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Chrysene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Dibenzo(a,h)anthracene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Fluoranthene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Fluorene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| lndeno(1,2,3-cd)pyrene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Naphthalene | 1 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Phenanthrene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| Pyrene | 2 | µg/L | 70-130 | 20 | 5 | µg/kg | 70-130 | 30 |
| **Surrogate:**<br>Terphenyl-d14 | -- | -- | 40-130 | -- | -- | -- | 40-130 | -- |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-12
# Nitroaromatic and Nitramine Explosives by Method SW8330A*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| 1,3,5-Trinitrobenzene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 1,3-Dinitrobenzene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 2,4,6-Trinitrotoluene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 2,4-Dinitrotoluene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 2,6-Dinitrotoluene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 2-Amino-4,6-Dinitrotoluene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 2-Nitrotoluene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 3-Nitrotoluene | 0.6 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 4-Amino-2,6-Dinitrotoluene | 0.6 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| 4-Nitrotoluene | 0.6 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| HMX | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| Nitrobenzene | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| RDX | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| Tetryl | 0.4 | µg/L | 70-130 | 30 | 400 | µg/kg | 70-130 | 50 |
| **Surrogate:** | | | | | | | | |
| 3,4-Dinitroluene | -- | -- | 50-150 | -- | -- | -- | 50-150 | -- |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-13
# Chemical Warfare Degradants by Method SW8270 Modified*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| p-Chlorophenylmethylsulfone | 10 | µg/L | 70-130 | 30 | 330 | µg/kg | 70-130 | 50 |
| p-Chlorophenylmethylsulfoxide | 10 | µg/L | 70-130 | 30 | 330 | µg/kg | 70-130 | 50 |
| 1,4-Dithiane | 10 | µg/L | 70-130 | 30 | 330 | µg/kg | 70-130 | 50 |
| 1,4-Oxathiane | 10 | µg/L | 70-130 | 30 | 330 | µg/kg | 70-130 | 50 |
| **Surrogate:** | | | | | | | | |
| Nitrobenzene-d5 | -- | -- | 30-130 | -- | -- | -- | 30-130 | -- |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
-- = Not applicable
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-14
# Chemical Warfare Degradants by Method SW8321B Modified*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| Diisopropyl methyl phosphonate (DIMP) | 10 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Dimethyl methyl phosphonate (DMMP) | 10 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Ethyl methylphosphonic acid (EMPA) | 10 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |
| Isopropyl methylphosphonic acid (IMPA) | 20 | µg/L | 70-130 | 30 | 100 | µg/kg | 70-130 | 50 |
| Methylphosphonic acid (MPA) | 100 | µg/L | 70-130 | 30 | 500 | µg/kg | 70-130 | 50 |
| Thiodiglycol | 10 | µg/L | 70-130 | 30 | 50 | µg/kg | 70-130 | 50 |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
µg/L = micrograms per liter
µg/kg = micrograms per kilogram

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-15
# Metals by Methods SW6010D/SW6020B/SW7470A/SW7471B*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| **SW6010D*:** | | | | | | | | |
| Aluminum | 0.2 | mg/L | 80-120 | 20 | 20 | mg/kg | 80-120 | 20 |
| Antimony | 0.1 | mg/L | 80-120 | 20 | 10 | mg/kg | 80-120 | 20 |
| Arsenic | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Barium | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Beryllium | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Cadmium | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Calcium | 1 | mg/L | 80-120 | 20 | 100 | mg/kg | 80-120 | 20 |
| Chromium | 0.02 | mg/L | 80-120 | 20 | 2 | mg/kg | 80-120 | 20 |
| Cobalt | 0.02 | mg/L | 80-120 | 20 | 2.5 | mg/kg | 80-120 | 20 |
| Copper | 0.02 | mg/L | 80-120 | 20 | 2 | mg/kg | 80-120 | 20 |
| Iron | 1 | mg/L | 80-120 | 20 | 20 | mg/kg | 80-120 | 20 |
| Lead | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Magnesium | 1 | mg/L | 80-120 | 20 | 100 | mg/kg | 80-120 | 20 |
| Manganese | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Nickel | 0.02 | mg/L | 80-120 | 20 | 2 | mg/kg | 80-120 | 20 |
| Potassium | 5 | mg/L | 80-120 | 20 | 500 | mg/kg | 80-120 | 20 |
| Selenium | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Silver | 0.02 | mg/L | 80-120 | 20 | 2.5 | mg/kg | 80-120 | 20 |
| Sodium | 1 | mg/L | 80-120 | 20 | 100 | mg/kg | 80-120 | 20 |
| Tin | 0.1 | mg/L | 80-120 | 20 | 10 | mg/kg | 80-121 | 20 |
| Thallium | 0.01 | mg/L | 80-120 | 20 | 2 | mg/kg | 80-120 | 20 |
| Vanadium | 0.01 | mg/L | 80-120 | 20 | 2 | mg/kg | 80-120 | 20 |
| Zinc | 0.1 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| **SW6020B*:** | | | | | | | | |
| Aluminum | 0.1 | mg/L | 80-120 | 20 | 10 | mg/kg | 80-120 | 20 |
| Antimony | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Arsenic | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Barium | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Beryllium | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Cadmium | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Calcium | 0.1 | mg/L | 80-120 | 20 | 10 | mg/kg | 80-120 | 20 |
| Chromium | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Cobalt | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Copper | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Iron | 0.1 | mg/L | 80-120 | 20 | 10 | mg/kg | 80-120 | 20 |
| Lead | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Magnesium | 0.1 | mg/L | 80-120 | 20 | 10 | mg/kg | 80-120 | 20 |
| Manganese | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Nickel | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Potassium | 0.1 | mg/L | 80-120 | 20 | 20 | mg/kg | 80-120 | 20 |
| Selenium | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Silver | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Sodium | 0.1 | mg/L | 80-120 | 20 | 20 | mg/kg | 80-120 | 20 |
| Thallium | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Vanadium | 0.001 | mg/L | 80-120 | 20 | 0.5 | mg/kg | 80-120 | 20 |
| Zinc | 0.01 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |

# Table A5-15
# Metals by Methods SW6010D/SW6020B/SW7470A/SW7471B*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| **SW7470A/SW7471B*:** | | | | | | | | |
| Mercury | 0.0004 | mg/L | 80-120 | 20 | 0.1 | mg/kg | 80-120 | 20 |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A5-16
# Anions by Methods SW9056A/E300.1*
# Method Reporting Limits and QC Acceptance Criteria
# McClellan, Anniston, Alabama

| | Water | | | | Soil | | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** | **MRL** | **Units** | **Accuracy (%R)** | **Precision (RPD)** |
| Bromide | 0.5 | mg/L | 80-120 | 20 | 5 | mg/kg | 80-120 | 20 |
| Chloride | 0.2 | mg/L | 80-120 | 20 | 2 | mg/kg | 80-120 | 20 |
| Fluoride | 0.1 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Nitrate-N | 0.1 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Nitrite-N | 0.1 | mg/L | 80-120 | 20 | 1 | mg/kg | 80-120 | 20 |
| Sulfate | 0.5 | mg/L | 80-120 | 20 | 5 | mg/kg | 80-120 | 20 |
| Phosphate-P | 0.5 | mg/L | 80-120 | 20 | 5 | mg/kg | 80-120 | 20 |

**Notes:**
* Including subsequent method revisions. Most recent version will be used.
%R = Percent recovery
MRL = Method reporting limit
RPD = Relative Percent Difference
mg/kg = milligrams per kilogram
mg/L = milligrams per liter

The MRLs shown in the table are subject to change. Actual MRLs will be unique to individual laboratories and instruments and are based on method detection limit studies performed by the laboratories.

The Accuracy (%R) and Precision (%RPD) values shown in the table are interim acceptance criteria based on method recommendations and laboratory performance criteria, and are subject to change. Actual Accuracy (%R) and Precision (%RPD) values will be unique to individual laboratories and instruments and are developed by the laboratory using control charts or similar procedures.

# Table A6-1
# Summary of Calibration and QC Procedures for Wet Chemistry Methods
# McClellan, Anniston, Alabama

| Method* | Parameter* | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| Gravimetric Methods | TDS (E160.1),<br>TSS (E160.2),<br>O&G (1664/418.1) | Instrument check | Daily, prior to sample analysis | Analytical balance within ±0.1 of the certified weight value | Correct problem then repeat instrument check. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per analytical batch | RPD ≤20% | None |
| Titrimetric Methods | Hardness (E130.2),<br>Alkalinity (E310.1),<br>Sulfide (E376.1), TOC (Walkely Black) | Instrument calibration | Daily, prior to sample analysis | ±0.05 pH units | Correct problem then repeat initial calibration. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per analytical batch | RPD ≤20% | None |
| Colorimetric Methods | Ammonia (E350.2),<br>TKN (E351.3),<br>COD (E410.4),<br>Chromium VI (SW7196A) | Multipoint calibration | Initial calibration prior to sample analysis | Least-squares regression r ≥ 0.995 | Correct problem then repeat initial calibration. |
| and | | Second-source calibration verification | After initial calibration | Within ±15% of true value | Correct problem then repeat initial calibration. |
| Spectrophotometric, Infrared Methods | Phenols (E420.1),<br>TPH-O&G (E418.1),<br>$Fe^{+2}$ (SM3500) | Calibration verification | At beginning and end of analysis sequence, and every 10 samples | Within ±15% of true value (±10% for COD and $Fe^{+2}$) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per 20 project samples per matrix | RPD ≤20% | Document duplicate sample outside criteria in the SDG case narrative. |

# Table A6-1
# Summary of Calibration and QC Procedures for Wet Chemistry Methods
# McClellan, Anniston, Alabama

| Method* | Parameter* | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | MS | One per 20 project samples per matrix | 75-125% or QC acceptance criteria, Table A5-1 | Document MS outside criteria in the SDG case narrative. |
| E314.1 | Perchlorate | Multipoint calibration | Every 6 months or when IPC fails | Least-squares regression r ≥ 0.995 | Correct problem then repeat initial calibration. |
| | | Quality Control Sample (QCS) | After initial calibration | Within ±10% of true value | Correct problem then repeat initial calibration. |
| | | Instrument Performance Check (IPC) | Initially per analytical batch | 80-120% | Correct problem then repeat initial calibration. |
| | | Initial calib. Check at MRL | At beginning of analysis sequence | Within ±25% of true value | Correct problem then repeat initial calibration. |
| | | Calibration verification | Every 10 samples and at end of analysis sequence | Within ±15% of true value | |
| | | Method blank | One per analytical batch | No analytes detected ≥ ½ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per 20 project samples per matrix | RPD ≤15% | Document duplicate sample outside criteria in the SDG case narrative. |
| | | MS | One per 20 project samples per matrix | QC acceptance criteria, Table A5-1 | Document MS outside criteria in the SDG case narrative. |
| E314.1 | Perchlorate | Multipoint calibration | At least 5 stds with lowest std at or below MRL | Within ±25% of true value per calib point, except ±50% of true value for lowest point | Correct problem then repeat initial calibration. |
| | | Quality Control Sample (QCS) | After initial calibration | Within ±25% of true value | Correct problem then repeat initial calibration. |
| | | Instrument Performance Check | Initially per analytical batch | Within ±25% of true value | Correct problem then repeat initial calibration. |
| | | Initial calib. Check at MRL | At beginning of analysis sequence | Within ±50% of true value | Correct problem then repeat initial calibration. |

# Table A6-1
# Summary of Calibration and QC Procedures for Wet Chemistry Methods
# McClellan, Anniston, Alabama

| Method* | Parameter* | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Calibration verification | Every 10 samples and at end of analysis sequence | Within ±25% of true value | |
| | | Method blank | One per analytical batch | No analytes detected ≥ 1/3 MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | Within ±25% of true value | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per 20 project samples per matrix | RPD ≤50% for ≤2x MRL; RPD ≤25% for > 2x MRL | Document duplicate sample outside criteria in the SDG case narrative. |
| | | MS | One per 20 project samples per matrix | Within ±25% of true value | Document MS outside criteria in the SDG case narrative. |
| EPA 405.1 | Biological Oxygen Demand (BOD) | Instrument calibration | Prior to sample analysis | Manufacturer's instruction | Correct problem then repeat initial calibration. |
| | | Dilution water | Once per preparation batch | ≤0.2 mg/L dissolved oxygen (DO) uptake | Document outliers in the SDG case narrative. |
| | | Seed control | One per lot seed. | 50% DO Depletion | Reprep and reanalyze samples in the affected analytical batch |
| | | Seeded method blank | One per analytical batch | Between 0.6 and 1.0 mg/L DO uptake | Document outliers in the SDG case narrative. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per 20 project samples per matrix | RPD ≤20% | None. |
| SW1010 | Ignitibility | Initial calib. check | Prior to sample analysis | 90-120% | Correct problem then repeat initial calibration. |
| | | LCS | One per analytical batch | Flash at 29-30°C | Open new standard. Reanalyze the LCS. |
| | | Duplicate Sample | One per analytical batch | Difference ≤5% | Reanalyze. |
| SW9010C | Cyanide | Multipoint calibration | Initial calibration prior to sample analysis | Least-squares regression r ≥ 0.995 | Correct problem then repeat initial calibration. |

# Table A6-1
# Summary of Calibration and QC Procedures for Wet Chemistry Methods
# McClellan, Anniston, Alabama

| Method* | Parameter* | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Distillation Standards | One high and one low prior to sample analysis | Within ±10% of undistilled standards | Correct problem. Reprep and reanalyze initial calibration and associated samples, as appropriate. |
| | | Second-source calibration verification | After initial calibration | Within ±15% of true value | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, and every 10 samples | Within ±15% of true value | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per 20 project samples per matrix | RPD ≤20% | Document duplicate sample outside criteria in the SDG case narrative. |
| | | MS | One per 20 project samples per matrix | QC acceptance criteria, Table A5-1 | Document MS outside criteria in the SDG case narrative. |
| SW9040C/SW9045D | pH | Instrument calibration | Daily, prior to sample analysis | Minimum two-point, ±0.05 pH units | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence | Within ±0.1 pH units of true value | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. |
| | | Duplicate Sample | One per analytical batch | RPD ≤20% | None. |
| SW9060A | TOC | Two point (high and low) initial calibration | Prior to sample analysis | Manufacturer's instruction | Correct problem then repeat initial calibration. |
| | | Second-source calibration verification | After initial calibration | Within ±10% of true value | Correct problem then repeat initial calibration. |

# Table A6-1
# Summary of Calibration and QC Procedures for Wet Chemistry Methods
# McClellan, Anniston, Alabama

| Method* | Parameter* | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Calibration verification | Every 15 samples and at end of analysis sequence | Within ±10% of true value | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per analytical batch | RPD ≤20% | None |
| | | MS | One per 10 project samples per matrix | QC acceptance criteria, Table A5-1 | Document MS outside criteria in the SDG case narrative. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

BOD = Biological Oxygen Demand
COD = Chemical Oxygen Demand
MRL = Method Reporting Limit
O&G = Oil & Grease
TDS = Total Dissolved Solids
TKN = Total Kjeldahl Nitrogen
TPH = Total Petroleum Hydrocarbons
TOC = Total Organic Carbons
TSS = Total Suspended Solids
$Fe^{+2}$ = Ferrous iron
LCS = Laboratory Control Sample
MRL = Method Reporting Limit
MS = Matrix Spike
QC = Quality Control
r = correlation coefficient
RPD = Relative Percent Difference
SDG = sample delivery group

# Table A6-1a
# Summary of Calibration and QC Procedures for Method RSK-175
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| RSK-175* | Methane, Ethane, Ethene, Propane | Five-point initial calibration | Prior to sample analysis, then as needed. | RSD ≤ 20% | Correct problem then repeat initial calibration. |
| | | Second-source calibration verification | After initial calibration | Within ±25% of true value | Correct problem then repeat initial calibration. |
| | | Calibration verification | Bracket every 12 hours and at end of analysis sequence. | Within ±15% of true value | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-1a | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-1a | Document MS outside criteria in the sample delivery group (SDG) case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RSD = Relative Standard Deviation

# Table A6-2
# Summary of Calibration and QC Procedures for Method SW8015D
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8015D* (GC/FID) | TVPH (GRO), TEPH (DRO) | Minimum 5-point initial calibration | Prior to sample analysis. | RSD ≤ 20% for all target analytes | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±20% of true value* | Correct problem then repeat initial calibration. |
| | | Retention time (RT) window (RTW) | RT ranges for GRO and DRO are defined during the initial calibration.<br>RTWs must be established for each instrument and GC column, and when new GC column is installed.<br>RTW midpoints are established using the RTs from the calibration verification standards. | 1,2,4-trimethylbenzene and 2-methylpentane used to establish RT range for GRO; C10 and C28 alkanes used to establish range for DRO.<br>RT window = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>The RTs for target analytes and surrogates must be within established RT windows in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RT window, recalculate the RT window, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. |
| | | Calibration verification | At beginning and end of analysis sequence, and every 12 hours. | %D within ±20% ** | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-2 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-2 | Correct problem, re-extract and re-analyze affected samples. |

# Table A6-2
# Summary of Calibration and QC Procedures for Method SW8015D
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-2 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-2 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

** Per Method 8000C, this is a change from the previous versions of 8000.

%D = Percent difference
DRO = Diesel Range Organics
GRO = Gasoline Range Organics
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group
TEPH = Total Extractable Petroleum Hydrocarbons
TVPH = Total Volatile Petroleum Hydrocarbons
GC/FID = Gas Chromatography/Flame Ionization Detector

# Table A6-3
# Summary of Calibration and QC Procedures for Method 8021B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8021B* (GC) | Aromatic and Halogenated Volatile Organics | Minimum 5-point initial calibration (1) | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±20% of true value (2) | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, and every 12 hours. | %D within ±20% (2) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per analytical batch (up to 20 samples) | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-3 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-3 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |

# Table A6-3
# Summary of Calibration and QC Procedures for Method 8021B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-3 | Correct problem, re-extract and re-analyze affected samples. |
| | | Second-column confirmation | For all positive identifications | RPD ≤ 40% | Check chromatograms. If no anomalies or chromatogram problems are indicated, report the lower result.(2) If only one of the peaks shows interference, report the result from the better peak. Document column RPDs > 40% in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-3 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Method 8000C, this is a change from the previous versions of 8000.

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
ICV = Initial calibration verification
LCS = Laboratory Control Sample

MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient

RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-4
# Summary of Calibration and QC Procedures for Method SW8081B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8081B* (GC) | Organochlorine Pesticides | Minimum 5-point initial calibration(1). Single point mid-level standard for toxaphene & chlordane. | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±20% of true value (2) | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, every 12 hour shift, and every 20 samples. | %D within ±20% (2) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Endrin and DDT Breakdown Check | Before samples are analyzed and at beginning of each 12-hour shift. | Degradation ≤ 15% | Correct problem and repeat breakdown check. Ensure degradation ≤ 15% before proceeding with calibration and sample analysis. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-4 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |

# Table A6-4
# Summary of Calibration and QC Procedures for Method SW8081B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-4 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-4 | Correct problem, re-extract and re-analyze affected samples. |
| | | Second-column confirmation | For all positive identifications | RPD ≤ 40% | Check chromatograms. If no anomalies or chromatogram problems are indicated, report the lower result.(2) If only one of the peaks shows interference, report the result from the better peak. Document column RPDs > 40% in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-4 | Correct problem and repeat test for analytes that failed to meet criteria. |

# Table A6-4
# Summary of Calibration and QC Procedures for Method SW8081B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Method 8000C, this is a change from the previous versions of 8000.

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-5
# Summary of Calibration and QC Procedures for Method SW8082A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8082A* (GC) | Polychlorinated Biphenyls (PCBs) as Aroclors | Minimum 5-point initial calibration(1) for Aroclors 1016 & 1260. Single point mid-level standard for the other five Aroclors.(2) | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±20% of true value(3) | Correct problem then repeat initial calibration. |
| | | Calibration verification (1016/1260 mix) (2) | At beginning and end of analysis sequence, every 12 hour shift, and every 20 samples. | %D within ±20% (3) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and samples in the affected batch. |
| | | LCS (1016/1260 mix) | One per analytical batch | QC acceptance criteria, Table A5-5 | Correct problem. Reprep and reanalyze LCS and associated samples in the affected batch. |

# Table A6-5
# Summary of Calibration and QC Procedures for Method SW8082A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | MS/MSD (1016/1260 mix) | One per 20 project samples per matrix | QC acceptance criteria, Table A5-5 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-5 | Correct problem, re-extract and re-analyze affected samples. |
| | | Second-column confirmation | For all positive identifications | RPD ≤ 40% | Check chromatograms. If no anomalies or chromatogram problems are indicated, report the lower result.(3) If only one of the peaks shows interference, report the result from the better peak. Document column RPDs > 40% in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-5 | Correct problem and repeat test for analytes that failed to meet criteria. |

# Table A6-5
# Summary of Calibration and QC Procedures for Method SW8082A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) When only a few Aroclors are of interest, a multi-point initial calibration and calibration verification of the Aroclor(s) of interest may be used instead of the 1016/1260 mix.

(3) Per Method 8000C, this is a change from the previous versions of 8000.

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-6
# Summary of Calibration and QC Procedures for Method SW8141B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8141B* (GC) | Organophosphorus Pesticides | Minimum 5-point initial calibration(1). | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±20% of true value (2) | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, every 12 hour shift, and every 20 samples. | %D within ±20% (2) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be, corrected perform new initial calibration and reanalyze affected samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-6 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-6 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |

# Table A6-6
# Summary of Calibration and QC Procedures for Method SW8141B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-6 | Correct problem, re-extract and re-analyze affected samples. |
| | | Second-column confirmation | For all positive identifications | RPD ≤ 40% | Check chromatograms. If no anomalies or chromatogram problems are indicated, report the lower result.(2) If only one of the peaks shows interference, report the result from the better peak. Document column RPDs > 40% in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-6 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Method 8000C, this is a change from the previous versions of 8000.

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-7
# Summary of Calibration and QC Procedures for Method SW8151A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8151A* (GC) | Chlorinated Herbicides | Minimum 5-point initial calibration(1). | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±20% of true value (2) | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, every 12 hour shift, and every 10 samples. | %D within ±20% (2) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-7 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-7 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |

# Table A6-7
# Summary of Calibration and QC Procedures for Method SW8151A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-7 | Correct problem, re-extract and re-analyze affected samples. |
| | | Second-column confirmation | For all positive identifications | RPD ≤ 40% | Check chromatograms. If no anomalies or chromatogram problems are indicated, report the lower result.(2) If only one of the peaks shows interference, report the result from the better peak. Document column RPDs > 40% in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-7 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Method 8000C, this is a change from the previous versions of 8000.

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-8
# Summary of Calibration and QC Procedures for Method SW8260C
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8260C* (GC/MS) | Volatile Organic Compounds | Minimum 5-point initial calibration(1) | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | ±30% (2) (SW846 suggested criteria, alternative limits may be used as appropriate for project (3)). | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning of analysis sequence and every 12 hours | %D within ±20% | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Response Factor (RF) | All initial calibration & continuing calibration verification standards | RFs for common target analytes should meet the minimum RFs shown in Table 4 of SW8260C. (2) | Evaluate system and correct problem before proceeding with sample analysis. |
| | | BFB instrument tune check | Prior to initial calibration and each calibration verification. | Manufacturer-specified mass intensity criteria. (4) | Correct problem, repeat tune and verify prior to analysis of calibration standards and samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Relative Retention Time (RRT) | Calibration standards | RRTs for each target analyte should agree within 0.06 RRT units. | Correct problem, reanalyze calibration verification standard and affected samples. |

# Table A6-8
# Summary of Calibration and QC Procedures for Method SW8260C
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Internal Standard (IS) | Each calibration verification standard | IS RT ±10 seconds from RT of mid-point ICAL standard (2). IS area count within -50% to +100% of mid-point ICAL standard. | Inspect chromatographic system, correct problem, reanalyze affected samples. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-8 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-8 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-8 | Correct problem, re-extract and re-analyze affected samples. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |

# Table A6-8
## Summary of Calibration and QC Procedures for Method SW8260C
## McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-8 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Method 8260C, this is a change from the previous versions of 8260.

(3) EMAX criteria: ±25% for all target analytes, except ±35% for bromomethane, chloroethane, chloromethane, dichlorodifluoromethane due to erratic chromatographic behavior.

(4) If manufacturer's acceptance criteria is not available, the default criteria listed in Table 3 of SW8260C may be used, or tuning criteria from other methods (e.g. CLP or 524.2) provided method performance is not adversely affected.

%D = percent difference or percent drift
BFB = 4-bromofluorobenzene
COD = coefficient of determination
GC/MS = Gas Chromatography/Mass Spectrometry
ICAL = Initial calibration
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-9
# Summary of Calibration and QC Procedures for Method SW8270D
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8270D* (GC/MS) | Semivolatile Organic Compounds | Minimum 5-point initial calibration(1) | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | ±30% (2) (SW846 suggested criteria, alternative limits may be used as appropriate for project (3)). | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning of analysis sequence and every 12 hours | %D within ±20% | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Response Factor (RF) | All initial calibration & continuing calibration verification standards | RFs for common target analytes should meet the minimum RFs shown in Table 4 of SW8270D. (2) | Evaluate system and correct problem before proceeding with sample analysis. |
| | | DFTPP instrument tune check | Prior to initial calibration and each calibration verification. | Manufacturer-specified mass intensity criteria. (4) | Correct problem, repeat tune and verify prior to analysis of calibration standards and samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Relative Retention Time (RRT) | Calibration standards | RRTs for each target analyte should agree within 0.06 RRT units. | Correct problem, reanalyze calibration verification standard and affected samples. |

# Table A6-9
# Summary of Calibration and QC Procedures for Method SW8270D
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Internal Standard (IS) | Each calibration verification standard | IS RT ±30 seconds from RT of mid-point ICAL standard. IS area count within -50% to +100% of mid-point ICAL standard. | Inspect chromatographic system, correct problem, reanalyze affected samples. |
| | | Method blank | One per preparation batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per preparation batch | QC acceptance criteria, Table A5-9 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-9 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-9 | Correct problem, re-extract and re-analyze affected samples. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |

# Table A6-9
# Summary of Calibration and QC Procedures for Method SW8270D
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-9 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Method 8270D, this is a change from the previous versions of 8270.

(3) EMAX criteria: ±25% for all target analytes, except ±35% for benzidine, 4,6-dinitro-2-methylphenol, 4-chloroaniline, benzyl alcohol, n-nitrosodimethylamine, 4-nitrophenol, 2-nitroaniline, 3-nitroaniline, pyridine, and benzoic acid due to erratic chromatographic behavior.

(4) If manufacturer's acceptance criteria is not available, the default criteria listed in Table 3 of SW8270D may be used, or tuning criteria from other methods (e.g. CLP or 625) provided method performance is not adversely affected.

%D = percent difference or percent drift
COD = coefficient of determination
DFTPP = decafluorotriphenylphosphine
GC/MS = Gas Chromatography/Mass Spectrometry
ICAL = Initial calibration
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-10
# Summary of Calibration and QC Procedures for Method SW8290A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8290A* (HRGC/ HRMS) | Dioxins/Furans | PFK Instrument Tune and Mass Resolution Check | Perform PFK tune prior to each initial calibration; perform mass resolution check at beginning and end of each 12-hour period of operation. | Minimum resolving power of 10,000 (10% valley resolution) at m/z 304.9824 (PFK) or any other reference signal close to m/z 303.9016 (from TCDF). Verify the exact mass of m/z 380.9760 (PFK) is within 5 ppm of required value. | Correct problem, retune instrument and verify. Repeat calibration procedure and reanalyze all samples analyzed since last successful mass resolution check. |
| | | GC Column Performance Check | Prior to initial calibration and at beginning of each 12-hour period. | ≤25% valley resolution between 2,3,7,8-TCDD and other TCDD isomers or between 2,3,7,8-TCDF and other TCDF isomers | Correct problem then repeat until criteria are met. Reanalyze all samples since last successful performance check. |
| | | Retention time window | With GC column performance check, prior to initial calibration. | Refer to SW8290A, Section 7.8.4.1. | Refer to SW8290A, Section 7.8.4.1 |
| | | Five-point initial calibration | Prior to sample analysis. | RSD ≤20% for the 17 unlabeled standards; RSD ≤30% for the 9 labeled internal standards;<br>Ion abundance ratios within control limits shown in Table A6-11;<br>S/N ≥10 for GC signals in each SICP. | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning (after mass resolution and GC resolution checks) and end of each 12-hour period of operation. | %D within ± 20% of mean ICAL values for unlabeled standards; %D within ± 30% of mean ICAL values for labeled standards;<br>Ion abundance ratios within control limits shown in Table A6-11.<br>S/N ≥10 for GC signals in each SICP. | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. |
| | | Internal Standards | Every sample, spiked sample, standard, and method blank prior to extraction. | 40-135%;<br>Ion abundance ratios within control limits shown in Table A6-11. | Inspect mass spectrometer and GC system for malfunctions; correct problem and reanalyze affected samples. If problem persists and S/N for IS < 10, re-extract and reanalyze affected samples. Document internal standards outside criteria in the SDG case narrative. |

# Table A6-10
# Summary of Calibration and QC Procedures for Method SW8290A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Ion abundance ratios | For all unlabeled analytes in calibration standards, and carbon labeled analytes in internal standards and recovery standards. | Within control limits shown in Table A6-11. | Assess and correct problem. Reanalyze affected samples. |
| | | Method blank | One per preparation batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per preparation batch | QC acceptance criteria, Table A5-10 | Correct problem. Reprep and reanalyze LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC recovery acceptance criteria, Table A5-10; RPD within ±20% | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |

# Table A6-10
# Summary of Calibration and QC Procedures for Method SW8290A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-10 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

%D = percent difference
GC = Gas chromatogram
HRGC/HRMS = High Resolution Gas Chromatography/High Resolution Mass Spectrometry
ICAL = Initial calibration
IS = Internal standard
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
RPD = Relative percent difference
RSD = Relative Standard Deviation
SDG = sample delivery group
SICP = selected ion current profile
S/N = signal-to-noise ratio

# Table A6-11
# Ion Abundance Ratios Specific Control Limits for PCDDs and PCDFs
# McClellan, Anniston, Alabama

| Number of Chlorine Atoms | Ion Type | Theoretical Abundance Ratio | Control Limits |
|---|---|---|---|
| 4 | M/M+2 | 0.77 | 0.65-0.89 |
| 5 | M+2/M+4 | 1.55 | 1.32-1.78 |
| 6 | M+2/M+4 | 1.24 | 1.05-1.43 |
| 6[a] | M/M+2 | 0.51 | 0.43-0.59 |
| 7[b] | M/M+2 | 0.44 | 0.37-0.51 |
| 7 | M+2/M+4 | 1.04 | 0.88-1.20 |
| 8 | M+2/M+4 | 0.89 | 0.76-1.02 |

**Notes:**

[a] Used only for $^{13}$C-HxCDF (IS).

[b] Used for $^{13}$C-HpCDF (IS).

Source: Table 8 in SW8290A or most recent version of method.

# Table A6-12
# Summary of Calibration and QC Procedures for Method SW8310
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8310* (HPLC) | Polynuclear Aromatic Hydrocarbons (PAHs) | Minimum 5-point initial calibration (1) | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear $r \geq 0.99$, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±20% of true value (2) | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, and every 12 hours. | %D within ±20% (2) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-11 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-11 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |

# Table A6-12
# Summary of Calibration and QC Procedures for Method SW8310
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-11 | Correct problem, re-extract and re-analyze affected samples. |
| | | Second-column confirmation | For all positive identifications | RPD ≤ 40% | Check chromatograms. If no anomalies or chromatogram problems are indicated, report the lower result.(2) If only one of the peaks shows interference, report the result from the better peak. Document column RPDs > 40% in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-11 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Method 8000C, this is a change from the previous versions of 8000.

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group
HPLC = High Performance Liquid Chromatography

# Table A6-13
# Summary of Calibration and QC Procedures for Method SW8330A*
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8330A* (HPLC) | Nitroaromatics and Nitramines (Explosives) | Minimum 5-point initial calibration (1) | Prior to sample analysis. | RSD ≤ 20% (2); or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | Within ±30% of true value (2) | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, every 12 hour shift, and every 20 samples. | %D within ±20% (2) | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-12 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-12 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |

# Table A6-13
# Summary of Calibration and QC Procedures for Method SW8330A*
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-12 | Correct problem, re-extract and re-analyze affected samples. |
| | | Second-column confirmation | For all positive identifications | RPD ≤ 40% | Check chromatograms. If no anomalies or chromatogram problems are indicated, report the lower result.(2) If only one of the peaks shows interference, report the result from the better peak. Document column RPDs > 40% in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-12 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

(2) Per Methods 8330B and 8000C, this is a change from the previous versions of 8330 and 8000.

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
ICV = Initial calibration verification

MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control

RPD = Relative percent difference
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-13
# Summary of Calibration and QC Procedures for Method SW8330A*
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|

LCS = Laboratory Control Sample

r = correlation coefficient

HPLC = High Performance Liquid Chromatography

# Table A6-14
# Summary of Calibration and QC Procedures for Method SW8270 Modified - Chemical Warfare Degradents
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8270* (modified) CWM (GC/MS) | Chemical Warfare Degradents | Minimum 5-point initial calibration | Prior to sample analysis. | RSD ≤ 30% | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | ±30% | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning of analysis sequence and every 12 hours | %D within ±20% | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | DFTPP instrument tune check | Prior to initial calibration and each calibration verification. | Manufacturer-specified mass intensity criteria. ** | Correct problem, repeat tune and verify prior to analysis of calibration standards and samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Relative Retention Time (RRT) | Calibration standards | RRTs for each target analyte should agree within 0.06 RRT units. | Correct problem, reanalyze calibration verification standard and affected samples. |
| | | Internal Standard (IS) | Each calibration verification standard | IS RT ±30 seconds from RT of mid-point ICAL standard. IS area count within -50% to +100% of mid-point ICAL standard. | Inspect chromatographic system, correct problem, reanalyze affected samples. |
| | | Method blank | One per preparation batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per preparation batch | QC acceptance criteria, Table A5-13 | Correct problem. Reprep and reanalyze LCS and associated samples in the affected batch. |

# Table A6-14
# Summary of Calibration and QC Procedures for Method SW8270 Modified - Chemical Warfare Degradents
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-13 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-13 | Correct problem, re-extract and re-analyze affected samples. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-13 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

** Tuning criteria from other methods (e.g. CLP or 625) may also be used, provided method performance is not adversely affected.

%D = percent difference
CWM = Chemical weapons material
DFTPP = decafluorotriphenylphosphine
GC = Gas Chromatography
ICAL = Initial calibration
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS = Mass Spectrometry
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group

# Table A6-15
# Summary of Calibration and QC Procedures for Method SW8321 Modified - Chemical Warfare Degradents
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW8321*<br>(modified)<br>CWM<br>(HPLC) | Chemical Warfare Degradents | Minimum 5-point initial calibration ** | Prior to sample analysis. | RSD ≤ 30%; or<br>Least squares regression: linear r ≥ 0.99, non-linear $r^2$ or COD ≥ 0.99. | Correct problem then repeat initial calibration. |
| | | Second-source standard (ICV) | After initial calibration | ±30% | Correct problem then repeat initial calibration. |
| | | Calibration verification | At beginning and end of analysis sequence, every 12 hour shift, and every 20 samples. | %D within ±20% | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If problem can't be corrected, perform new initial calibration and reanalyze affected samples. |
| | | Retention time (RT) window (RTW) | RTWs must be established for each instrument and GC column, and whenever new GC column is installed.<br>RTW midpoints are established using the RTs from calibration verification standards. | RTW = ±3x SD of mean RT established during 72-hour period, or 0.03 minutes, whichever is greater.<br>RTs for target analytes and surrogates must be within established RTWs in all calibration verification standards. | If the RT for a target analyte or surrogate in the calibration verification standard falls outside the RTW, recalculate the RTW, unless instrument maintenance corrects the problem. Reanalyze calibration verification standard and affected samples. If problem cannot be corrected, redo initial calibration and reanalyze affected samples. |
| | | Method blank | One per preparation batch | No analytes detected ≥ MRL | Correct problem. Reprep and reanalyze method blank and associated samples in the affected batch. |
| | | LCS | One per preparation batch | QC acceptance criteria, Table A5-14 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | QC acceptance criteria, Table A5-14 | Identify whether out-of-control MS/MSD is due to matrix affects or analytical problems (e.g., check LCS results, chromatograms for interference, extraction & analytical procedures, etc). If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS outside criteria in the SDG case narrative. |

# Table A6-15
## Summary of Calibration and QC Procedures for Method SW8321 Modified - Chemical Warfare Degradents
## McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-14 | Correct problem, re-extract and re-analyze affected samples. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-14 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

** For non-linear calibrations: 6-point for 2nd order (quadratic), 7-point for 3rd order (polynomial).

%D = percent difference or percent drift
COD = coefficient of determination
GC = Gas Chromatography
CWM = Chemical weapons material
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit

MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
r = correlation coefficient
RSD = Relative Standard Deviation
SD = standard deviation
SDG = sample delivery group
HPLC = High Performance Liquid Chromatography

# Table A6-16
# Summary of Calibration and QC Procedures for Method SW6010C
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW6010D*<br>(ICP-AES) | ICP Metals | Initial calibration (minimum one standard and a blank) | Daily, prior to sample analysis | NA | NA |
| | | Second source mid-level ICV | Daily after initial calibration | Recovery within ±10% of true value | Correct problem then repeat initial calibration. |
| | | Low-level ICV (LLICV) | Daily after initial calibration | Recovery within ±30% of true value | Correct problem then repeat initial calibration. |
| | | CCV | After every 10 samples and at the end of analysis sequence. | Recovery within ±10% of true value | Correct problem, repeat calibration, and reanalyze all samples since last acceptable CCV. |
| | | Low-level CCV (LLCCV) | At the end of analysis sequence. (For samples with trace concentrations, every 10 samples may also be needed.) | Recovery within ±30% of true value | Correct problem, repeat LLCCV, and reanalyze all samples since last acceptable LLCCV or LLICV. |
| | | Calibration blank (ICB/CCB) | After ICV and LLICV, every 10 samples, and at end of analysis sequence. | No analytes detected ≥ MRL | Correct problem, reanalyze calibration blank and all samples since last acceptable CCB or ICB. |
| | | Interference Check Sample (ICS) | Beginning of each analytical run, prior to sample analysis | Recovery within ±20% of true value | Correct problem then repeat initial calibration. |
| | | Method blank | One per analytical batch | No analytes detected ≥ MRL | Reanalyze method blank. If reanalysis fails, correct problem, and reprep and reanalyze the method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | QC acceptance criteria, Table A5-15 | Reanalyze LCS. If reanalysis fails, correct problem, and reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | Recovery within 75-125% of known value and RPD within 20% (or laboratory-derived control limits up to a maximum of ±25% recovery and 20% RPD) | Perform additional quality control tests (i.e., post-digestion spike and serial dilution test, described below)*. If no obvious matrix effect is indicated, reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS/MSD outside criteria in the SDG case narrative. |

# Table A6-16
# Summary of Calibration and QC Procedures for Method SW6010C
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Post Digestion Spike | When MS/MSD fails * | Recovery within 80-120% of true value * | Perform serial dilution test. Document post-digestion spike outside criteria in the SDG case narrative. |
| | | Serial Dilution Test | When MS/MSD and post-digestion spike fails * | 1:5 dilution should agree within ±10% of original determination for analyte concentrations ≥ 10x MDL | Document serial dilution tests outside criteria in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-15 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

AES = Atomic Emission Spectrometry
CCB = Continuing calibration blank
CCV = Continuing calibration verification
ICP = Inductively Coupled Plasma
ICB = Initial calibration blank
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
NA = Not applicable
QC = Quality Control
RPD = Relative Percen Difference
SDG = sample delivery group

# Table A6-17
# Summary of Calibration and QC Procedures for Methods SW7470A/SW7471B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW7470A/ SW7471B* | Mercury | Initial calibration (minimum five standards and a blank) | Daily, prior to sample analysis | Correlation coefficient ≥ 0.995 for linear regression | Correct problem then repeat initial calibration. |
| | | Second source ICV | Daily after initial calibration | Recovery within ±10% of true value | Correct problem then repeat initial calibration. |
| | | LLQC ** | After establishing lower reporting limit and on as needed basis to demonstrate desired detection capability. | Recovery within ±30% of true value | Correct problem then repeat initial calibration. |
| | | CCV | After every 10 samples and at the end of analysis sequence. | Recovery within ±10% of true value ** | Correct problem, repeat calibration, and reanalyze all samples since last acceptable CCV. |
| | | Calibration blank (ICB/CCB) | After ICV, every 10 samples, and at end of analysis sequence. | No concentrations detected ≥ MRL | Correct problem, reanalyze calibration blank and all samples since last acceptable CCB or ICB. |
| | | Method blank | One per analytical batch | No concentrations detected ≥ MRL | Reanalyze method blank. If reanalysis fails, correct problem, and reprep and reanalyze the method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | Recovery within ±20% of true value, or laboratory-derived control limits (up to a maximum of ±20% recovery and 20% RPD). | Reanalyze LCS. If reanalysis fails, correct problem, and reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD | One per 20 project samples per matrix | Recovery within ±20% of true value, or laboratory-derived control limits up to a maximum of ±20% recovery and 20% RPD. | Perform additional quality control tests (i.e., post-digestion spike and serial dilution test, described below)*. If no obvious matrix effect is indicated, reanalyze MS/MSD; if MS/MSD criteria still not met, report both sets of results. Document MS/MSD outside criteria in the SDG case narrative. |

# Table A6-17
# Summary of Calibration and QC Procedures for Methods SW7470A/SW7471B
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Post Digestion Spike | When MS/MSD fails * | Recovery within 80-120% of true value * | Perform serial dilution test. Document post-digestion spike outside criteria in the SDG case narrative. |
| | | Dilution Test | When MS/MSD and post-digestion spike fails * | 1:5 dilution should agree within ±10% of original determination for analyte concentrations ≥ 10x MDL | Document serial dilution tests outside criteria in the SDG case narrative. |
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-15 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

* Per Method 7000B, this is a change from the previous versions of 7000.

CCB = Continuing calibration blank
CCV = Continuing calibration verification
ICB = Initial calibration blank
ICV = Initial calibration verification
LCS = Laboratory Control Sample
LLQC = Lower limit of quantitation check

MDL = Method Detection Limit
MRL = Method Reporting Limit
MS/MSD = Matrix Spike/Matrix Spike Duplicate
QC = Quality Control
RPD = Relative Percen Difference
SDG = sample delivery group

# Table A6-18
# Summary of Calibration and QC Procedures for Method SW9056A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| SW9056A* | Anions:<br>Bromide, Chloride, Fluoride, Nitrate, Nitrite, Phosphate, Sulfate | Initial calibration (minimum three standards and a blank) | Prior to sample analysis | Correlation coefficient ≥ 0.995 for least-squares linear regression | Correct problem then repeat initial calibration. |
| | | Second source ICV | After initial calibration | Recovery within ±10% of true value | Correct problem then repeat initial calibration. |
| | | CCV | Daily at beginning and end of analysis sequence, and after every 10 samples. | Recovery within ±10% of true value | Correct problem, repeat calibration, and reanalyze all samples since last acceptable CCV. |
| | | Retention Time Window | After initial calibration, and CCVs | ±3x SD of mean RTs for standards established during the course of the daily shift. | Correct problem, reanalyze calibration standards and associated samples in the affected batch. |
| | | Calibration blank (ICB/CCB) | After ICV and CCVs, every 10 samples, and at end of analysis sequence. | No concentrations detected ≥ MRL | Correct problem, reanalyze calibration blank and all samples since last acceptable CCB or ICB. |
| | | Method blank | One per analytical batch | No concentrations detected ≥ MRL | Reanalyze method blank. If reanalysis fails, correct problem, and reprep and reanalyze the method blank and associated samples in the affected batch. |
| | | LCS | One per analytical batch | Recovery within ±20% of true value, or laboratory-derived control limits (up to a maximum of ±20% recovery). | Reanalyze LCS. If reanalysis fails, correct problem, and reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | MS/MSD or MS/Duplicate Sample | One per 20 project samples per matrix | Recovery within 80-120% of true value; RPD ≤ 20%. | Identify whether out-of-control MS/MSD or MS/Dup is due to matrix affects or analytical problems. If no obvious matrix effect is indicated, re-extract and/or reanalyze MS/MSD or MS/Dup; if criteria still not met, report both sets of results. Document MS, MSD, and Dup outside criteria in the SDG case narrative. |

# Table A6-18
# Summary of Calibration and QC Procedures for Method SW9056A
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | MDL study | Once per 12 month period or perform quarterly MDL checks. | Detection limits established shall be ≤ their MRLs | None |
| | | MDL Check Sample | Analyzed quarterly in lieu of annual MDL study, or after major instrument maintenance. | Verify calculated MDLs | If any of target analytes are not detected, then the concentration shall be increased in another MDL check sample, and the analysis repeated until the failed target analytes are detected. The detectable target analyte concentration shall be used in lieu of the calculated MDL values. |
| | | Demonstration of Proficiency (Analysis of four replicate aliquots of reference sample) | Before each sample prep and determinative method is used, for new analysts, and after significant changes in instrumentation. | QC acceptance criteria, Table A5-16 | Correct problem and repeat test for analytes that failed to meet criteria. |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

CCB = Continuing calibration blank
CCV = Continuing calibration verification
Dup = Duplicate Sample
ICB = Initial calibration blank
ICV = Initial calibration verification
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QC = Quality Control
RT = Retention time
SD = standard deviation
RPD = Relative Percen Difference
SDG = sample delivery group

# Table A6-19
# Summary of Calibration and QC Procedures for Method TO-15
# McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| TO-15* (GC/MS) | Volatile Organic Compounds | BFB instrument performance check | Prior to initial calibration and every 24-hour period prior to calibration verification. | Ion abundance criteria listed in Table 3 of Method TO-15 (1) | Correct problem then repeat instrument performance check. |
| | | Minimum 5-point initial calibration | After instrument performance check and prior to sample analysis. | RSD ≤ 30% with at most two exceptions up to ≤ 40% | Correct problem then repeat initial calibration. |
| | | Relative Retention Time (RRT) | Initial calibration standards | RRTs for each target analyte must be within 0.06 RRT units of the mean RRT. | Correct problem then repeat initial calibration. |
| | | Calibration verification (CV) | Daily at beginning of each 24-hour period, after instrument performance check and prior to sample analysis. | %D within ±30% | Correct problem, repeat calibration verification, and reanalyze all samples since last successful calibration verification. If calibration verification still fails, perform new initial calibration and reanalyze affected samples. |
| | | Internal Standard (IS) | Calibration standards, method blank, LCS, and samples. | Area response within ±40% of mean ICAL area response. RT within ±20 seconds of mean ICAL RTs. | Inspect chromatographic system, correct problem, reanalyze affected samples. |
| | | Method blank | Each 24-hour period, after ICAL/CV and LCS, and prior to sample analysis. | No analytes detected ≥ MRL | Correct problem before proceeding with sample analysis. Reanalyze method blank and associated samples in affected batch. |
| | | LCS | Each 24-hour period, after ICAL/CV and prior to sample analysis. | QC acceptance criteria, Table A5-8 | Correct problem. Reprep and reanalyze the LCS and associated samples in the affected batch. |
| | | Duplicate Sample | One per 10 project samples per matrix | RPD ≤ 25% for detections > 5x the MRL. | Identify whether out-of-control duplicate sample is due to matrix affects or analytical problems. If no obvious matrix effect is indicated reanalyze duplicate sample, if criteria still not met, report both sets of results. Document duplicate sample outside criteria in the SDG case narrative. |

## Table A6-19
## Summary of Calibration and QC Procedures for Method TO-15
## McClellan, Anniston, Alabama

| Method | Parameter | QC Check | Minimum Frequency | Acceptance Criteria | Corrective Action |
|---|---|---|---|---|---|
| | | Surrogate spike | Every sample, spiked sample, standard, and method blank | QC acceptance criteria, Table A5-8 | Correct problem, re-extract and re-analyze affected samples. |
| | | MDL | Follow 40 CFR 136 Appendix B. (2) | Detection limits established shall be ≤ their MRLs | None |

**Notes:**

* Including subsequent method revisions. Most recent version will be used.

(1) U.S. Environmental Protection Agency (EPA). 1999. *Compendium of Methods for the Determination of Toxic Organice Compunds in Ambient Air*. January.

(2) Code of Federal Regulations 40 CFR 136 (*Guidelines Establishing Test Procedures for the Analysis of Pollutants*), Appendix B: *Definition and Procedure for the Determination of the Method Detection Limit*

%D = percent difference
BFB = 4-bromofluorobenzene
CV = Calibration verification
GC/MS = Gas Chromatography/Mass Spectrometry
ICAL = Initial calibration
IS = Internal Standard
LCS = Laboratory Control Sample
MDL = Method Detection Limit
MRL = Method Reporting Limit
QC = Quality Control
RPD = Relative percent difference
RSD = Relative Standard Deviation
RRT = Relative Retention Time
RT = Retention Time
SDG = sample delivery group

# Table A7-1
# Data Qualifier Flags Applied by the Laboratory
# McClellan, Anniston, Alabama

| Flag | Definition |
|---|---|
| B | Analyte was detected in the sample and associated method blank at a concentration greater than the QC level. |
| E | Analyte concentration is above the maximum calibration range. |
| J | Estimated value. The analyte is positively identified and the concentration is less than the reporting limit (RL) but greater than the method detection limit (MDL). |
| P | Confirmation uncertain. Results from primary and secondary GC columns differ by greater than 40 percent. |
| U | Not detected at the method reporting limit for the analysis. |

# Table A7-2
## Qualifier Flags[a] Applied During Data Validation
## McClellan, Anniston, Alabama

| Validation Qualifiers | |
|---|---|
| **Flag** | **Definition** |
| J | Estimated detection. The associated numerical value is the approximate concentration of the analyte in the sample. |
| UJ | Analyte was analyzed for, but was not detected. The reported quantitation limit is estimated. |
| U | Result was qualified as not detected above the reporting limit or reported sample quantitation limit. |
| N | Tentatively identified, associated numerical value represents its approximate concentration. |
| R | The data are unusable. Results were rejected due to serious deficiencies in meeting QC criteria. The analyte may or may not be present in the sample. |
| **Sub-Qualifiers** | |
| **Flag** | **Definition** |
| A | Internal standard area was outside method-specific control limits. |
| B | Result was qualified based on method blank, continuing calibration blank, or trip blank contamination. |
| C | Continuing calibration was outside method-specific control limits. |
| G | ICS outside method criteria. |
| H | Holding time exceeded method criteria. |
| I | Initial calibration was outside method-specific control limits. |
| L | The LCS and LCSD recoveries were outside laboratory historical control limits. |
| M | The MS and MSD recoveries were outside laboratory historical control limits. |
| P | Sample was not preserved properly. |
| S | Surrogate recovery was outside laboratory historical control limits. |
| T | Temperature outside acceptance criteria. |
| X | Result exceeded the calibration range of the instrument. |
| Q | Result was qualified based on reviewer judgment. |
| Z | Duplicates relative percent difference (RPD)/relative standard deviation (RSD) exceed the method-specific control limits/laboratory historical control limtis. |

**Notes:**

[a] U.S. Environmental Protection Agency (EPA) Contract Laboratory Program National Functional Guidelines for Organic Data Review (June 2008), Inorganic Data Review (January 2010), and Chlorinated Dioxin/Furan Data Review (September 2011); and subsequent updates.

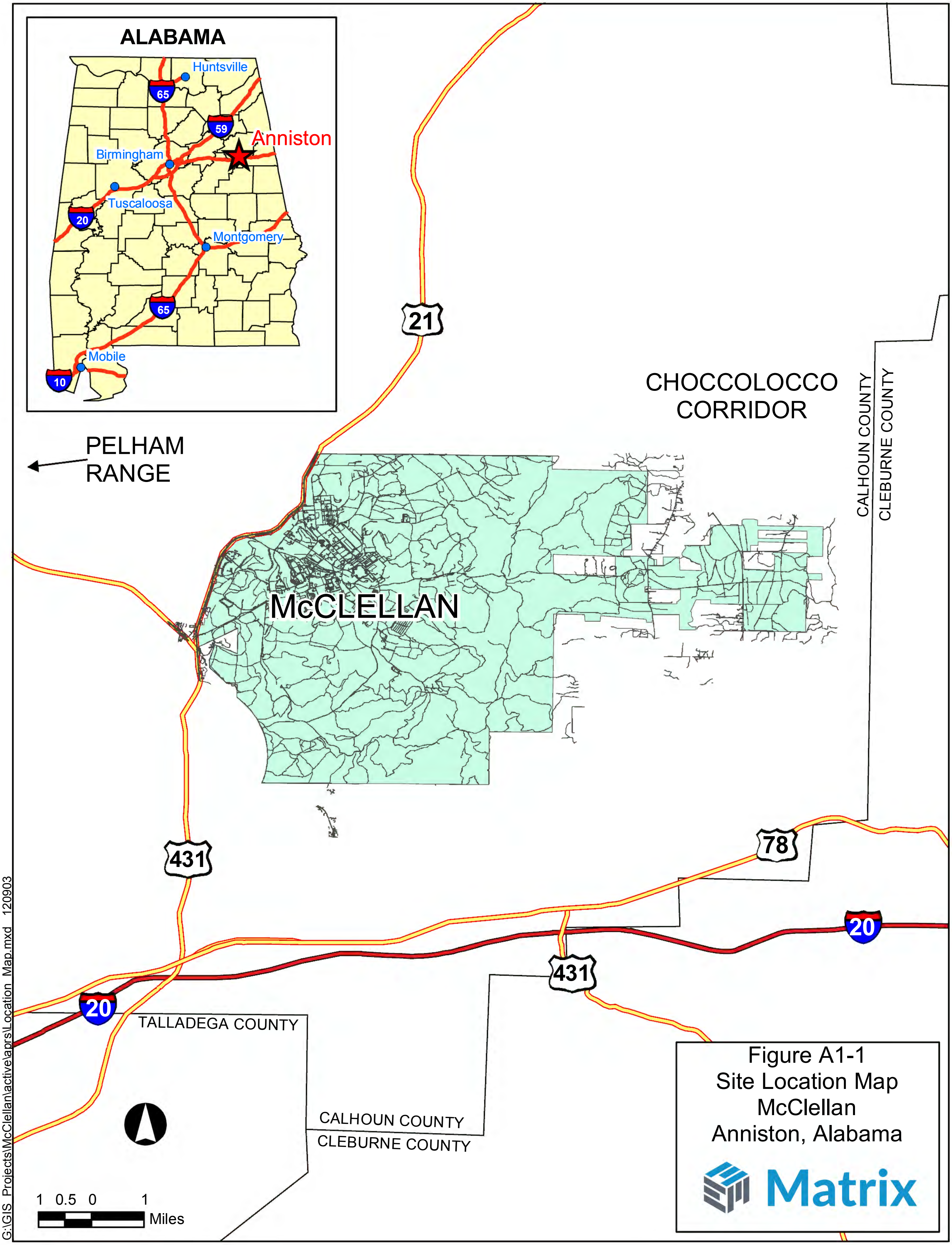
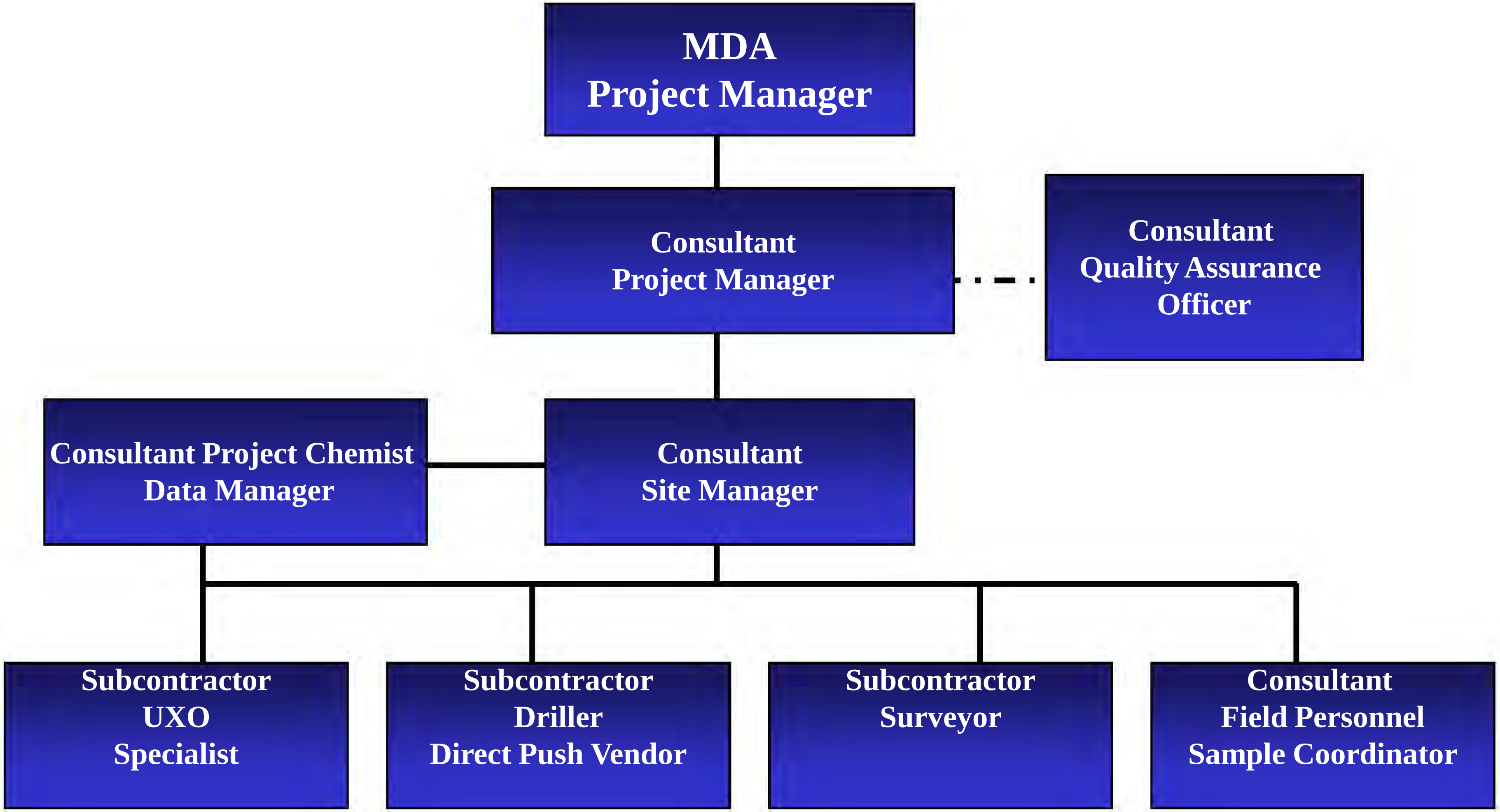


Figure A1-1
Site Location Map
McClellan
Anniston, Alabama

Matrix

G:\GIS_Projects\McClellan\active\aprs\Location_Map.mxd 120903



Matrix ENVIRONMENTAL

Figure A 2-1 (Revision 1): Organization Chart, McClellan Development Authority Environmental Investigations

# Attachment A1, Revision 1
# Data Transfer Standard

This Data Transfer Standard (DTS) has been developed to allow import of many relevant data fields especially those required for data validation. It is based on the DTS developed by GeoTech for the EnviroData database management system.

## PURPOSE

Investigations and remediation efforts generate a large amount of analytical and other data much of which is obtained through laboratories and subcontractors. In order to import, store, and use this project data, the data must be received in a consistent format that allows easy import into the database system. The purpose of this DTS is to provide a description of the standard format that laboratories will be required to use when submitting data to be included in the project database.

It is not the intention of this DTS to limit the types of data used in projects. Rather, the DTS is intended to facilitate the transfer of data by providing a well-defined format for data delivery. This format is intended to be flexible enough to accommodate the majority of the analytical and other technical evaluation and monitoring data for the project. There may be data that will not fit into this standard and the organization supplying that data should contact the Client's Data Manager to discuss how data transfer can be accommodated.

Creators of digital data use a wide variety of tools in the process of generating their data files. It is not intended to dictate the tools to be used by the data creator. However, data must be transferred in the standard format outlined in this document to simplify the data transfer.

## DATABASE BACKGROUND INFORMATION

This DTS addresses data generated as part of a remedial investigation or corrective measures. Data of concern for this standard includes Sites (facilities or projects), Stations (observation points), Samples (individual observation events), and Analyses (specific individual values from an event).

## DATA CONTENT

This section covers the content of the data being transmitted. The following section covers the format of that data. In the following sections the content is organized by the target table in the database. In the spreadsheet format all of the content is in one structure. In the following descriptions, fields are described as "Required" or "Optional". These denote database application requirements and laboratories will be instructed if any of the "Optional" fields are required for this project.

### Sites and Stations-

*SiteName* – This is required data and represents the name of the site (project, facility, etc.) from which the samples were taken. This field is required, and must match the site listed on the chain-of-custody (COC) and subsequently the database. This will be converted to a site identification number in the Stations table during the import.

A Station is a location of observation. Examples of stations include soil borings, monitoring wells, surface water monitoring stations, soil and stream sediment sample locations, air monitoring stations, and weather stations. A station can be a location that is persistent, such as a monitoring well which is sampled regularly, or can be the location of a single sampling event. For stations that are sampled at different elevations (such as a soil boring), the location of the station is the surface location for the boring, and the elevation or depth component is part of the sampling event.

*StationName* – This is a required field that contains the name of the well, boring, etc. from which the sample was taken. The entry must match a station name listed on the COC and subsequently the database for the site name provided. It is also converted to an identification number on import.

## Samples

A Sample is a unique sampling event for a station. Each station can be sampled at various depths (such as with a soil boring), at various dates (such as with a monitoring well), or both.

*SampleDate_D* – This is a required field that contains the date on which the sample was taken. Information for this field will be included on the COC.

*SampleTypeCode* – This is a required field used to identify the type of sample collected (e.g., grab, composite). The information for this field can be found on the COC.

*SampleMatrix* – This is a required field that identifies the primary material composition of the sample. The full Sample Matrix name, such as “Water” must be provided.

*SampleTop* and *SampleBottom* – These are required fields containing soil sample depths or elevations, as instructed by the client. The fields should contain only numeric values. If these fields are not applicable or are unknown to the laboratory, then they should be populated with zeros, for compatibility with ODBC databases. Information for these fields will be included on the COC.

*DepthUnits* – This is a required field containing the associated units for sample top and sample bottom. This field is linked to the ReportingUnits lookup table. If this information is unavailable to the lab, “Unknown” should be reported. These units can be entered into the import file using information on the COC.

*DuplicateSample* – This is a required field that should be populated with a zero.

*FieldSampleID* – This is an optional field that may contain the client-assigned field ID number for each sample.

*LabSampleID* – This is an optional field for EnviroData, but is required for this project. This field shows the sample identification number used internally by the laboratory.

*AltSampleID* – This is an optional field that may contain another sample identification number if needed.

*CoolerID* – This is an optional field that may contain a number to identify the cooler in which primary samples and QC samples were shipped. This field should be populated if information is provided on the COC.

*Sampler* – This is an optional field that may contain the name of the person taking the sample.

*Description* – This is an optional field that may contain a description of the sample, such as its condition.

*SampleMethodCode* – This is a required field used to describe the means of collecting the sample (e.g., bailer, spoon). This information will be provided on the COC.

*COCNumber* – This is an optional field for EnviroData, but is required for this project. This field contains the Chain-of-Custody tracking number that can be found on the COC.

*DeliveryGroup* – This is an optional field for EnviroData, but is required for this project. This field contains the sample delivery group number supplied by the laboratory.

*AmbientBlankLot, EquipmentBlankLot,* and *TripBlankLot* – These are optional fields for EnviroData that shows the relations of field samples to field QC samples. This field should be populated if it’s applicable and information is provided on the COC.

*FilteredSample* – This is a required field that contains filter information at the sample level. Entries are compared to the Filtered look-up table in the database. The laboratory will populate the field with the Filter description, as appropriate (e.g., Total, Dissolved, Unknown).

*QCSequenceID* – This is an optional field that may contain a QC sequence identifier. This field is another laboratory tracking field, used to relate field samples to laboratory samples.

*QCSampleCode* – This is a required field containing a code to identify QC samples. It ties to the QCCodes table, which contains codes for both the sample and analysis levels. The laboratory should supply the code shown on the COC for field samples. If this information is not available to the laboratory, the project chemist should be notified immediately for resolution. Note: Surrogates are not identified in this field.

*TaskNumber* – This is an optional field that may contain the administrative task number under which sampling is done.

*SampleResult* – This is an optional field that may contain a result of the sampling process, such as “successful”, “dry”, “no access”. Its primary use is to indicate that obtaining a sample was attempted unsuccessfully. Because it will not be available to the laboratory, this field will be entered into the import table by the Client’s Data Manager.

## Analyses

An Analysis, as used in this attachment and in the database system, is the observed value of a parameter related to a sample. Analyses information will be primarily provided by the laboratory.

This term is intended to be interpreted broadly, and not to be limited to chemical analyses. For example, field parameters such as pH, temperature, and turbidity also are considered analyses.

*ParameterName, CASNumber, AltParamNumber* – Various combinations of these fields are used to identify the Parameter Name. ParameterName should always be provided. The system compares the Parameter name to the entries in the Parameters and ParameterAlias lookup tables. CASNumber and AltParamNumber are not required for EnviroData, but should be provided whenever possible to help ensure the correct parameter name assignment. If the ParameterName does not match a lookup entry, the system compares either the CASNumber, or the AltParamNumber (frequently used for Storet codes), to Parameter table entries.

*Superseded* – This is a required field that should be populated with a zero.

*AnalyticMethod* – This field is optional for EnviroData, but is required for this project. This field contains the method used to perform the analysis. The AnalyticMethod requested by the client will be included on the COC.

*Value* – This field is optional for EnviroData, but is required for this project. This field contains the measured result or concentration of the parameter. For surrogates, laboratory control spike and matrix spike samples, the results should be reported in percent recovery, with the units in percent (%). Moisture content should be reported as a separate analytical record, with the units in %. They should be entered on a “by weight” basis, based on total weight. If the parameter was not detected, the reporting limit will be entered into this field and supported by the *FlagCode* and *DetectedResult* fields to indicate non-detection.

R*eportingUnits* – This is a required field containing the units of the analysis. The entry provided should be the full abbreviation, such as “mg/l”. Entries must match an entry in the ReportingUnits lookup table in the database. Detection limits and radiologic error must be reported in the same units as the value.

*FlagCode* – This is a required field storing one to four coded entries for the analytical flag describing the analysis. Each character in the field must match an entry in the AnalyticFlags lookup table in the database. If the analysis is considered a usable value and only one flag would apply, this field should contain the code “V” (detected value), J (estimated detected value), U (non-detected value) or S (surrogate). Multiple flags may be used to describe a sample condition. For example, if “B” (detected in blank) and “J” (estimated value) both applied to the sample result, then “BJ” (estimated value, detected in blank) can be entered as an analytic flag.

*ProblemCode* – This is a required field that holds a code that identifies any analytical problems. Analytic problems are usually described in the narrative, and not included in the electronic format. If this field data is not provided, the field should contain a “z” for unknown. If the laboratory chooses to supply problems in the electronic file, then the codes must match entries in the AnalyticProblems table. As with the FlagCode field, the entry can consist of from one to four approved codes.

*ValidationCode* – This is a required field containing one to four flags associated with validation of analyses. The laboratory will populate this field with a “z” for Unknown. The client will validate the data and update the ValidationCode as necessary.

*DetectedResult* – This is an optional field for EnviroData, but is required for this project. This field should contain either "Y" for yes, the analyte was detected, or "N" for no, the analyte was not detected. This field overlaps slightly with FlagCode. The purpose of this field is to separate the non-detect flag from other laboratory qualifiers, such as "J" or "B", for statistical, evaluation and validation purposes.

*Detect* – This is an optional field for EnviroData, but is required for this project. This field contains the method detection limit (MDL) (or instrument detection limit [IDL]) associated with the parameter. The MDL/IDL must be reported in the same units as the value, and reflect any dilutions associated with the reported value. This field also contains the lower control limit (LCL) for surrogates, MS/MSDs, and LCS/LCSDs in units of percent (%).

*LimitType* – This is an optional field for EnviroData, but is required for this project. This field identifies the type of limit contained in the Detect field, MDL (or IDL) or LCL.

*Detect2* – This is an optional field for EnviroData, but is required for this project. This field contains the reporting limit (RL) or practical quantitation limit (PQL) used by the laboratory. The RL/PQL must be reported in the same units as the value, and reflect any dilutions associated with the reported value. This field also contains the upper control limit (UCL) for surrogates, MS/MSDs, and LCS/LCSDs in units of percent (%).

*LimitType2* – This is an optional field for EnviroData, but is required for this project. This field identifies the type of limit contained in the Detect2 field, RL or PQL, or UCL.

*Detect3* – This is an optional field for EnviroData, but is required for this project. This field is used to report the RPD limit associated with MS/MSDs, LCS/LCSDs, and sample/laboratory duplicates, in units of percent (%).

*LimitType3* – This is an optional field for EnviroData, but is required for this project. This field identifies the type of limit contained in the Detect3 field, RPD.

*Error* – An optional field containing the standard error for radioactivity measurements.

*DilutionFactor* – This is an optional field for EnviroData, but is required for this project. This field contains the amount that the sample was diluted prior to analysis.

*Basis* – This is a required field for storing whether a sample is analyzed wet or dry. Should be "W" for wet or "D" for dry. Can also report "N" for not applicable, or "Z" for unknown.

*FilteredAnalysis* –This is a required field containing filter or measure basis information at the analysis level. Entries are compared to the Filtered look-up table in the database. The laboratory should populate the field with the filter code, as appropriate (e.g., TOT, DIS, Z).

*LeachMethod* – A required field storing the method used to leach a particular sample. Entries are compared to the Leach Method lookup table to maintain consistency. Laboratory should supply the full name of the method, eg: TCLP. If the analysis was not leached, "None" should be reported.

*PrepMethod* – This is an optional field for EnviroData, but is required for this project. This field is used for storing the method used to prepare the sample, separate from leaching or analytical method specific preparation.

*PreparationLot* – A required field for this project used to document the batch of samples prepared together.

*ReportableResults* – This is an optional field for EnviroData, but is required for this project. This field contains a flag that indicates whether the result is to be used in reports, i.e., “Y” for yes or “N” for no. The laboratory should use “Y” as the default flag. The Client’s Data Manager will update the field as necessary.

*AnalDate_D* – This is an optional field for EnviroData, but is required for this project. This field contains the date on which the analysis was performed.

*ExtractDate_D* – This is an optional field for EnviroData, but is required for this project. This field contains the date on which the material was extracted for analysis. The laboratory should populate this field as applicable.

*LabReportDate_D* – An optional field used to store the date on which the lab reported the analysis. The laboratory may populate this field as applicable.

*Lab* – This is an optional field for EnviroData, but is required for this project. This field contains the name of the laboratory performing the analysis.

*LabComments* – An optional field used for laboratory comments about the analysis. The laboratory may populate this field as applicable.

*AnalysisLabID* – An optional field used for the laboratory identification number at the analysis level. LabSampleID tracks the laboratory analyses at the sample level. This field is used for identification numbers at the analysis level. The laboratory may populate this field if the information is easily captured by the LIMS.

*AnalyticalBatch* – This is an optional field for EnviroData, but is required for this project. This field contains the laboratory batch identification number. The laboratory should populate this field with information associating samples to the correct analytical run.

*ValueCode* – A required field containing the parameter value classification. This field identifies the analytical trial, and supplies the reason for a superseded analysis. It is a coded entry enforced by a lookup table. The lab should report the code, such as “O” for original analysis, “DL” for dilution, “RE” for re-extracted, or “RA” for re-analysis.

*RunCode* – A required field used for storing the confirmation run identification (e.g., dual-column methods). This is a coded entry enforced by a lookup table. The lab should supply the code, such as “PR” for primary run, “N” for not applicable, or “Z” for Unknown.

*QCAnalysisCode* – A required field used to define surrogates and tentatively identified compounds (TICs). If the parameter is not a surrogate or TIC, the field will be populated with “Z” for unknown.

## Spreadsheet Format

The database spreadsheet format contains the data in the format of a spreadsheet program. The spreadsheet selected for this standard is Microsoft Excel for Office. Other brands of spreadsheet programs can save their files in Excel format. The spreadsheet file should contain all of the data on the first sheet. Each row should represent one observation (such as the value of a chemical analysis) and each column a data item for that observation. The first row of the file must contain the field names as listed in the following table. The spreadsheet file must contain the following columns in the order shown, and the fields marked as required (bold text) must be populated for this project-specific database. A spreadsheet is provided to contracted laboratories and can be used as a template. A Valid Values List (VVL) which shows the codes, field size, etc., allowed by EnviroData, and an instructions/explanation sheet for the EnviroData EDD are also provided to contracted laboratories.

### Spreadsheet File Format

| Field Name | Data Type | Record Size | Description | Table |
|---|---|---|---|---|
| **SiteName** | Text | 50 | Site Name | Sites |
| **StationName** | Text | 25 | Station name or identifier | Stations |
| **SampleDate_D** | Date/Time | 8 | Date sample was taken | Samples |
| **SampleTypeCode** | Text | 5 | Sample collection code | Samples |
| **SampleMatrix** | Text | 15 | Sample matrix | Samples |
| **SampleTop** | Number | (Sg) | Sample top | Samples |
| **SampleBottom** | Number | (Sg) | Sample bottom | Samples |
| **DepthUnits** | Text | 15 | Units for sample top/sample bottom | Samples |
| **DuplicateSample** | Number | (Int) | Duplicate samples | Samples |
| FieldSampleID | Text | 20 | Client assigned field sample ID | Samples |
| **LabSampleID** | Text | 20 | Lab sample ID | Samples |
| AltSampleID | Text | 20 | Alternate sample identification | Samples |
| CoolerID | Text | 20 | Cooler ID number - for QA/QC | Samples |
| Sampler | Text | 50 | Name of person taking sample | Samples |
| Description | Text | 50 | Sample description | Samples |
| **SampleMethodCode** | Text | 4 | Sampling method used | Samples |
| **COCNumber** | Text | 20 | Chain-of-custody number | Samples |
| **DeliveryGroup** | Text | 10 | Sample delivery group | Samples |
| **AmbientBlank Lot** | Text | 40 | Ambient blank lot number | Samples |
| **EquipmentBlank Lot** | Text | 40 | Equipment blank lot number | Samples |
| **TripBlank Lot** | Text | 40 | Trip blank lot number | Samples |
| **FilteredSample** | Text | 20 | Filter description | Samples |
| QCSequenceID | Text | 15 | QC sequence identifier | Samples |
| **QCSampleCode** | Text | 4 | QC code for this sample | Samples |
| TaskNumber | Text | 20 | Task number for sampling event | Samples |
| SampleResult | Text | 255 | Result of attempted sampling | Analyses |
| **ParameterName** | Text | 60 | Parameter name | Analyses |
| **CASNumber** | Text | 20 | CAS number of parameter | Analyses |
| AltParamNumber | Text | 20 | Alternative number for parameter | Analyses |
| **Superseded** | Number | (Int) | Analysis superseded by re-analysis? | Analyses |
| **AnalyticMethod** | Text | 25 | Method used to perform analysis | Analyses |

| Field Name | Data Type | Record Size | Description | Table |
|---|---|---|---|---|
| **Value** | Number | (Sg) | Value measured during analysis | Analyses |
| **ReportingUnits** | Text | 15 | Units of the analysis | Analyses |
| **FlagCode** | Text | 4 | Data qualifier | Analyses |
| **ProblemCode** | Text | 4 | Problems encountered during analysis | Analyses |
| **ValidationCode** | Text | 4 | Code from data validation | Analyses |
| **DetectedResult** | Text | 1 | Was analyte detected | Analyses |
| **Detect** | Number | (Sg) | MDL/IDL or LCL | Analyses |
| **LimitType** | Text | 4 | Type of limit in Detect | Analyses |
| **Detect2** | Number | (Sg) | RL/PQL or UCL | Analyses |
| **LimitType2** | Text | 4 | Type of limit in Detect2 | Analyses |
| **Detect3** | Number | (Sg) | RPD for QC samples | Analyses |
| **LimitType3** | Text | 4 | Type of limit in Detect3 | Analyses |
| Error | Number | (Sg) | Error range for this analysis | Analyses |
| **DilutionFactor** | Number | (Sg) | Dilution factor | Analyses |
| **Basis** | Text | 1 | Analyzed wet or dry | Analyses |
| **FilteredAnalysis** | Text | 20 | Filter/measure basis at analytical level | Analyses |
| **LeachMethod** | Text | 20 | Leaching method | Analyses |
| **PrepMethod** | Text | 20 | Lab preparation method | Analyses |
| **PreparationLot** | Text | 40 | Sample batch | Analyses |
| **ReportableResult** | Text | 1 | Designates analysis as reportable result | Analyses |
| **AnalDate_D** | Date/Time | 8 | Date the analysis was performed | Analyses |
| **ExtractDate_D** | Date/Time | 8 | Date the extraction was performed | Analyses |
| LabReportDate_D | Date/Time | 8 | Lab analysis reporting date | Analyses |
| **Lab** | Text | 10 | Name of lab conducting analysis | Analyses |
| LabComments | Text | 50 | Lab comments about this analysis | Analyses |
| AnalysisLabID | Text | 20 | Lab identification number for analysis | Analyses |
| **AnalyticalBatch** | Text | 40 | Lab batch ID number | Analyses |
| **ValueCode** | Text | 6 | Differentiates between different results | Analyses |
| **RunCode** | Text | 5 | Run code for GC analyses | Analyses |
| **QCAnalysisCode** | Text | 4 | QC code for this analysis | Analyses |

[1] Field names in **bold** are required fields. The others may be blank.
[2] SampleTop and SampleBottom are required. Numbers for depth or elevation should be entered for soil analyses, they should be zero if not applicable.
[3] (Sg) A fundamental data type that holds single-precision floating point numbers in IEEE format. A Single variable is stored as a 32-bit (4-byte) number that can be reported with up to 7 significant figures.
[4] (Int) A two-byte whole number ranging from –32,768 to 32,767.
[5] (Lg) A fundamental data type. Stores numbers from –2,147,483,648 to 2,147,483,647 (no fractions).
[6] Character width for text fields. Does not apply directly to numbers.
[7] Numbered values for duplicate samples, with 0 for preferred sample, increasing by one for each additional value. Must fill in all duplicates or none.
[8] Numbered values for superseded analyses, with 0 for current analysis, increasing by one for each older value.
[9] Database table to receive data, either directly or after converting using a lookup table.

# Field Auditing Checklist

## I. Field Audit General Information:

Audit Start Date:

Time Started:

Audit Finish Date:

Time Completed:

Auditor:

Organization:

Auditee:

Organization:

Field Activity Audited:

Type of Audit: Initial or Follow-up

Internal or External

Purpose of the Audit:

## II. Activity-Specific Audited Items:

| **A. Site Preparation and Organization** | Yes | No | Comment |
|---|---|---|---|
| 1. Clean / Contaminated / Contamination Reduction zones established, marked, and in use? Are field personnel aware ? | | | |
| 2. Is field supervisor or task manager on-site to direct field activities? Are appropriate personnel in the field? | | | |
| 3. Have work plans been prepared? Are they approved? Available on-site? Are the personnel familiar with the documents? | | | |
| 4. Is decontaminated equipment staged properly until use? | | | |
| 5. Contaminated equipment and supplies recovered from the area when activity is completed? | | | |
| 6. Are site areas secure and access limited to authorized personnel only? | | | |
| 7. Are proper health and safety measures incorporated into the activity? Is proper PPE worn? Is air monitoring appropriate? H&S inspections performed regularly? | | | |

| B. General Site Issues | Yes | No | Comment |
|---|---|---|---|
| 1. Are status meetings routinely held to notify field crews of changes in site activities, plans, and procedures? | | | |
| 2. If subcontractors are used, are they adequately trained? Do they know the task objectives? Are they familiar with the project/task plans? | | | |
| 3. Is the necessary equipment on-site to perform the tasks adequately? Are the personnel trained to operate equipment? | | | |
| 4. Are investigation derived wastes properly stored, handled, disposed? | | | |
| 5. Are on-site records complete? Field logbooks up to date? Equipment calibration logs current? Any copies of var/noncon forms? | | | |
| 6. Any chemical reagents/solvents on-site? Stored properly? Labeled w/dates? Flammables segregated from acids? MSDSs available? | | | |
| 7. Sample storage/prep area clean and adequate? Temp documentation/custody in place if stored >24 hr on-site? | | | |
| 8. On-site DI water supply system functioning? Regularly maintained? Maintenance logbook? Test results? | | | |
| 9. Field instruments stored in good condition? Maintenance / calibr records on-site? Calibration standards stored properly? Expired? Probes stored correctly? In good condition? | | | |

| C. Sample Collection Activities | Yes | No | Comment |
|---|---|---|---|
| 1. Have the sample locations been properly identified before collection? Is sample location/ IDs assigned unique? | | | |
| 2. Is the sampling method/equipment selected appropriate to collect the most representative sample from the matrix? | | | |
| 3. Is the sampling equipment properly cleaned, calibrated, and prepared for field use? | | | |
| 4. Is the sample documentation adequate, timely, and does it provide an accurate record of the details of the collection activity? | | | |
| 5. Are appropriate procedures used to reduce the possibility of field contamination or analyte loss? | | | |
| 6. Are the associated field QC samples collected to meet the requirements of the QAP or WP? Are they documented correctly? | | | |
| 7. Are the sample preservation techniques employed as specified in the QAP or WP? Is preservation documented on label and COC? | | | |
| 8. Are samples appropriately stored, packaged, and shipped to the analysis laboratory? | | | |
| 9. Is the laboratory made aware of incoming sample shipment contents? Is the sample coordinator contacted and doc. relayed? | | | |
| 10. Is a contingency plan in place for handling nonconformances with sample receipt? Is POC designated on the COC? | | | |

**General Notes:**

| D-1. Task-Specific Activities: | Yes | No | Comment |
|---|---|---|---|
| 1. Sample-specific forms used? Appropriate? | | | |
| 2. Were methods specified implemented as planned? Were methods adequate? | | | |
| 3. Were field instruments used appropriately? Were field data accurately measured and recorded? | | | |
| 4. Adequate health and safety precautions taken? Was IDW handled to avoid spread of contamination? | | | |
| 5. Field equipment decontaminated and stored correctly? | | | |
| 6. Equipment used was adequate for task? | | | |
| 7. Field samples collected and documented according to procedures? Stored and shipped properly? | | | |

**General Notes:**

| D-2. Task-Specific Activities: | Yes | No | Comment |
|---|---|---|---|
| 1. Sample-specific forms used? Appropriate? | | | |
| 2. Were methods specified implemented as planned? Were methods adequate? | | | |
| 3. Adequate health and safety precautions taken? Was IDW handled to avoid spread of contamination? | | | |
| 4. Field equipment decontaminated and stored correctly? | | | |
| 5. Equipment used was adequate for task? | | | |
| 6. Field samples collected and documented according to procedures? Stored and shipped properly? | | | |

**General Notes:**

# Appendix B
# Monitoring Well Installation Plan, Revision 4.0
# McClellan, Anniston, Alabama

**Prepared for:**

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**Anniston, Alabama**

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**August 2023**

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## LIST OF FIGURES

# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ADEM | Alabama Deparment of Environmental Management |
| ARMY | United States Department Of The Army |
| ASTM | American Society For Testing And Materials |
| BCT | Base Realignment and Closure Cleanup Team |
| CMIP | Corrective Measures Implementation Plan |
| FTMC | Fort McClellan |
| HTRW | Hazardous toxic radioactive waste |
| ID | Inside diameter |
| IDWMP | Investigation Derived Waste Management Plan |
| IPS | Improved Plow Steel |
| IT | IT corporation |
| MDA | McClellan Development Authority |
| MES | Matrix Environmental Services L.L.C |
| MWIP | Monitoring Well Installation Plan |
| NSF | National Sanitation Foundation |
| NTU | Nephelometric turbidity units |
| PQ | Drill bit standard size (nominal 5-inch outside diameter) |
| PVC | Polyvinyl chloride |
| QA | Quality Assurance |
| QC | Quality Control |
| QCM | Quality Control Manager |
| SAP | Sampling and analysis plan |
| SFSP | Site-specific field sampling plan |
| SOP | Standard operating procedure |
| SOPQAM | Standard Operating Procedure and Quality Assurance Manual |
| SQ | Drill bit standard size (nominal 4-inch outside diameter) |
| USACE | United States Army Corps Of Engineers |
| UXO | Unexploded ordnance |

# B 1.0 INTRODUCTION

This installation-wide sampling and analysis plan (SAP) for McClellan, Anniston, Alabama, has been prepared by Matrix Environmental Services (MES) on behalf of the McClellan Development Authority (MDA). The MDA has assumed from the United States (U.S.) Department of the Army (Army) responsibility for investigation and ongoing monitoring at several of the Hazardous Toxic and Radioactive Waste (HTRW) sites throughout McClellan (formerly referred to as Fort McClellan). The basis for this transfer of property and responsibility is the Environmental Services Cooperative Agreement (ESCA) between the MDA and the Army. In addition the MDA has negotiated a Cleanup Agreement (CA) with the Alabama Department of Environmental Management (ADEM) that describes the responsibilities of both parties in completing the investigation and remediation of the HTRW sites at McClellan.

## B 1.1 Objectives of the MWIP

This monitoring well installation plan (MWIP) was prepared to meet the following objectives:

- Provide general well specifications
- Specify types of drilling equipment and materials required
- Describe drilling techniques and procedures to be followed
- Present monitoring well development and redevelopment requirements and procedures.

## B 1.2 Monitoring Well Installation Plan Preparation Guidance

This MWIP is an adaptation of the Draft Monitoring Well Installation Plan, Fort McClellan, Calhoun County, Alabama prepared for the U.S. Department of the Army, Mobile District, Corps of Engineers, Mobile, Alabama by IT Corporation (IT, 2002). This MWIP was prepared in accordance with the following guidance documents:

- Army Engineering Manual EM-1110-1-4000, Engineering and Design - Monitoring Well Design, Installation, and Documentation at Hazardous Toxic, and Radioactive Waste Sites (U.S. Army Corps of Engineers [USACE] 1998)
- ***Field Branches Quality System and Technical Procedures (FBQSTP, EPA, Most Recent Version)***
- Installation-Wide Work Plan, and Installation-Wide Sampling and Analysis Plan (SAP) for McClellan, Anniston, Alabama (MES Most Recent Version).
- Alabama Environmental Investigation and Remediation Guidance (ADEM, 2005)
- Well installation and specification requirements that are different from the general requirements will be provided in site-specific field sampling plans (SFSPs) or corrective measures implemenation plans (CMIPs).

## B 2.0 MONITORING WELL PLACEMENT AND DEPTH

Proposed monitoring well locations and supporting rationale will be described in the applicable SFSPs, and are not discussed in this document. Only generally applicable information regarding the selection of well locations is provided in this document. Monitoring wells will be installed in the residuum, transition zone and bedrock aquifers. The drilling rig(s) to be used will be capable of drilling to depths of approximately 100 feet with hollow-stem augers for residuum and transition monitoring wells, and to 400 feet with air rotary, air percussion, coring, or sonic tools, for bedrock wells. When field conditions require access to off-road locations, extensive grading and gravel placement may be required or a drilling rig mounted on an all-terrain carrier or all-wheel-drive truck may be used.

### B 2.1 Utility Clearance

Utility clearance will be performed at all locations where monitoring wells or extraction wells are to be installed. The on-Site project manager and safety staff will be responsible for determining whether untilties “reasonably may be expected to be encountered.” Known utilities will be identified and marked prior to performing any intrusive actvities. Utility locate activities will be coordinated by the on-Site project manager and safety staff in conjunction with local utility locate businesses. At McClellan, the Alabama Line Location Center (800-292-8525) shall be contacted a minimum of 48 hours prior to performing any scheduled intrusive activities. Upon completion of the buried utility clearance, the project manager or designee shall document the utility companies contacted in the project daily log.

### B 2.2 Unexploded Ordnance Survey

Unexploded ordnance (UXO) surface and downhole UXO surveys for drilling of monitoring wells will be required at some sites. The SFSPs or CMIPs and the SAP provide details on the rationale and techniques to be used to sweep surface areas and survey downhole locations prior to the installation of wells.

### B 2.3 Monitoring Wells

The SFSPs or CMIPs will address the total depth of each monitoring well and the lithologic unit where each well will be completed. Monitoring wells may be installed where: (1) there is evidence that a known contaminant plume has moved beyond an array of existing wells (2) its horizontal and/or vertical extent is no longer known or (3) where groundwater contamination is suspected and no existing wells are located. If contamination is suspected at a site, but the horizontal and vertical extent of contamination is unknown, an exploratory investigation may be conducted prior to installation of permanent wells. Permanent monitoring well locations will be selected based on the results of exploratory investigations (as applicable) in order to monitor plume migration; otherwise, monitoringwell locations will be based on historical data. There are several types of monitoring wells that may be installed at the Site depending on the type of geology and investigation requirements. These include Type I Temporary Monitoring Wells/Piezometers, Permanent Type II Monitoring Wells, Permanent Type III (Double-Cased) Monitoring Wells, Permanent Bedrock Wells, and Nested or Cluster Wells. Single cased wells will be installed in residuum, transition and bedrock groundwater bearing zones where there is no known residuum or transition zone contaminant source. Double cased wells will be installed in residuum, transition and bedrock groundwater bearing zones where there is a known or suspected contaminant source and the intent is to place the well screen beneath the known contaminant source. Double cased or temporary double cased wells may also be installed in locations where differential bedrock weathering is encountered and the potential for formation collapse on the drilling tools exists. In some isolated instances, triple cased bedrock wells may be installed in locations where differential weathering exists and bedrock formations are not consistent.

Monitoring well depths will be based on the character of the known contaminants and the objectives of the investigation. Monitoring wells will generally be installed as single wells, but may, when necessary, be placed in clusters or pairs to determine the vertical extent of contamination and the vertical hydraulic gradient.

# B 3.0 DRILLING AND LITHOLOGIC SAMPLING PROCEDURES

The following subsections provide a brief overview of drilling methods appropriate for McClellan. Generally, monitoring well drilling techniques fall into one of two broad categories: percussion and rotary. There are several specific methods within each of these categories.

## B 3.1 Drilling Methods

Various drilling methods may be employed to achieve the objective of the investigation program. Generally, hollow stem auger drilling will be used to install residuum and transition wells, and air rotary/air percussion drilling will be used to install bedrock wells. Sonic drilling and rock coring may also be used to install wells at locations where continuous lithologic information is required. In some instances, based on the local geology and the investigation goals, a combination of two or more drilling methods may be employed to install an individual well.

### B 3.1.1 Hollow-Stem Auger

This type of auger consists of a hollow, steel stem or shaft with continuous, spiraled steel flights, welded onto the stem exterior. When rotated, the auger flights transport cuttings to the surface. This method is best suited in soils that have a tendency to collapse when disturbed. A monitoring well can be installed through hollow-stem augers with little or no concern for the caving potential of the soils and/or water table. However, retracting augers in caving sand conditions while installing monitoring wells can be extremely difficult or impossible, especially since the augers have to be extracted without being rotated. If caving sands exist during monitoring well installations, a drill rig must be used that has enough power to extract the augers from the borehole without having to rotate them.

A bottom plug, trap door, or pilot bit assembly can be fastened onto the bottom of the augers to prevent most soils from clogging the bottom of the augers during drilling. Potable water (analyzed for contaminants of concern) may be poured into the augers (where applicable) to equalize pressure so that the inflow of formation soil and water will be minimized when the bottom plug is released. Water-tight center plugs are not acceptable because they create suction when extracted from the augers. This suction forces or pulls cuttings and formation materials into the augers and defeats the purpose of the center plug.

Augering without a center plug or pilot bit assembly is permitted, provided that the soil plug, formed in the bottom of the augers during drilling, is removed before sampling or installing well casings.

Removing the soil plug from the augers can be accomplished by washing out the soil plug using a side discharge rotary bit, or augering out the plug with a solid-stem auger bit sized to fit inside the hollow-stem auger. The type of bottom plug, trap door, or pilot bit assembly proposed for the drilling activity should be approved by a senior field geologist prior to drilling operations.

Hollow stem auger drilling is generally used to drill boreholes to depths of 100 feet or less 6 (depending on the auger size).

Augers are constructed in varying diameters. Two-inch residuum or transition monitoring wells generally will be installed using 4 1/4-inch inside-diameter (ID) hollow-stem augers while 4-inch residuum monitoring wells will be installed with 6 5/8-inch ID hollow-stem augers.

### B 3.1.2 Solid-Stem Auger

This type of auger consists of a solid stem or shaft with a continuous spiraled steel flight welded to the outer side of the stem. This stem is connected to the auger bit, and when rotated transports cuttings to the surface. This auger is best used in cohesive and semi-cohesive soils that do not have a tendency to collapse when disturbed.

### B 3.1.3 Rotary Methods

Rotary methods typically consist of a drill pipe or hollow drill stem coupled to a drilling bit that rotates and cuts through residuum and bedrock. The drilling fluids generally consist of water or air. These fluids are pumped down through the drill pipe and out through the bottom of the drilling bit and exit to the surface in the annular space between the borehole wall and the drill pipe. Drill cuttings are carried out of the borehole through the annular space with the drilling fluids. The drilling fluids not only carry the cuttings to the surface, but also keep the drilling bit cool.

When considering rotary methods, it is important to evaluate the potential for contamination when fluids and/or air are introduced into the borehole. If the rotary method is selected as one of the drilling methods, water rotary is the preferred method, followed by air rotary.

### B 3.1.4 Rotosonic Drilling

This method combines high frequency vibrations, downward pressure, and relatively slow rotations to advance a dual string of drill pipe. This combination of forces advances the drill pipe through soil and rock without the use of drilling fluids. The dual string of drill pipe is used to sample and advance the hole and consists of an inner core barrel sampler and an outer pipe casing. The core barrel is driven to the required depth, the outer casing is then driven down over the core barrel. The outer casing prevents the hole from collapsing when the core barrel is extracted for sample retrieval. Drilling can be completed without the use of fluids, but potable water is commonly used during the driving of the outer casing to flush material from the annular space between the core barrel and the pipe casing.

### B 3.1.5 Other Methods

Other methods such as the cable-tool method, the jetting method, the boring method, and direct push technologies (e.g. GeoProbe®) are available. If these and/or other methods are proposed for installing monitoring wells, specific details with respect to the equipment and drilling fluids that are used and activities that will be performed will be included in the SFSP or CMIP.

### B 3.2 Drill Spoils Management

Drill spoils and fluids generated during investigations will be containerized and handled in accordance with the Investiative Derived Waste Management Plan (IDWMP) prepared for McClellan and presented in Appendix C of the SAP.

### B 3.3 Water Usage and Control

Water may not be available at all drilling locations for grout mixing and drilling. Potable water will be transported to the location, if required, in a clean water truck or a truck-mounted tank. The source of the water will be from the potable water supply located at the facility. A sample of the potable water will be submitted for analysis of the same parameters analyzed for each investigation.

### B 3.4 Prevention of Cross Contamination

Drilling and sampling equipment decontamination will be performed to maintain integrity of the groundwater, soil, and sediment sample collected. Decontamination shall be performed either at a central decontamination station, or at remote drilling locations. At remote drilling locations, a temporary decontamination pad will be built on site. The station will be lined with three layers of at least 6-milliliter-thick Visqueen® and will be bermed on all sides to contain the decontamination fluids. Decontamination fluids managed at both temporary pads and central stations will be containerized and analyzed for proper disposal.

### B 3.5 Lithologic Sampling Methods

Lithologic sampling may be performed concurrently when advancing borings for monitoring well construction. Lithologic sampling may be performed continuously or at intervals specified in the SFSP. Generally, continuous sampling will be performed in residuum from ground surface to 12 feet below ground surface. From 12 feet below ground surface to the bottom of the borehole, samples will be collected at 5-foot intervals. At bedrock well locations where primary and secondary structures are suspected that may influence groundwater and contaminant movement, continuous bedrock sampling may be performed.

Lithologic samples will be collected and described on a boring lithologic log (see Attachment 2 of the SAP). The residuum and transition zone samples collected will be logged in accordance with American Society for Testing and Materials (ASTM) Method D2488 (ASTM, 2001a) using the Unified Soil Classification System and screened in the field using a calibrated organic vapor meter with a photoionization detector and/or flame ionization detector. Bedrock cores will be described in accordance with methods outlined in USACE South Atlantic Division Manual DM 1110-1-4000 (November, 1998).

### B 3.5.1 Residuum and Transition Zone Sampling

A split spoon sampler will be used in conjunction with hollow stem auger drilling methods and advanced beneath the auger to obtain undisturbed residuum or transition zone samples. Samples will be collected using a 24-inch-long, 2-inch or-larger- diameter, carbon steel or stainless steel, split-spoon sampler following the methodology outlined in ASTM D1586 (ASTM, 2001b). In some instances a 3-inch diameter split spoon may be used. The sampler consists of two halves of a cylinder held together by a sub and shoe that thread onto the top and bottom of the cylinder, respectively. The sampler is threaded to the bottom of steel rod equipped with an anvil at the surface. The sampler shall be driven into undisturbed residuum by the force of a 140-lb hammer dropped from approximately 30 inches above the anvil. Hydraulic driven (preferred) or manually pulled hammers may also be used. When sonic drilling methods are employed, lithologic samples will be collected continuously from ground surface to top of bedrock. Residuum and transition zone samples will be collected in a 4-inch ID, 10foot long, core barrel as the core barrel is advanced. The samples will be brought to the surface and placed in clear plastic sleeves. Additional information concerning soil sampling is provided in the SOPs (Attachment 3 of SAP).

### B 3.5.2 Bedrock Sampling

Lithologic samples may be collected continuously in competent bedrock using a PQ or equivalent (nominal 5-inch outside diameter) or SQ (nominal 4-inch outside diameter) wireline triple-tube core barrel with a 5-foot, longitudinally split inner tube. Bedrock samples may also be collected continuously during sonic drilling using a double-cased system with a 3-inch diameter inner core barrel and 5-inch diameter override casing (3” x 5” sonic) or in some cases a 4-inch diameter core barrel and 6-inch diameter override casing (4” x 6” sonic). The core barrel will be equipped with a bit appropriate for the known formation (i.e., carbide-tipped bits used for soft formations such as siltstones, mudstones, and shales, and diamond-tipped bits for harder formations such as carbonates and sandstones). Bedrock coring may be accomplished using air or water as a drilling lubricant and to cool the drill bit. Bedrock coring will require that the overlying residuum and transition zone material be either temporarily or permanently cased off to ensure that the borehole does not collapse in on the drilling tools. Rock coring with a PQ core barrel will create a borehole with a diameter of approximately 6 inches. Boreholes drilled with a PQ core barrel will generally require reaming to enlarge the borehole diameter to an appropriate size for installing a 4-inch diameter monitoring well. Bedrock reaming will be accomplished with rotary drilling methods. If broken rock zones, washouts, and/or lost circulation are encountered during coring, this may inhibit the advancement of the core barrel and core recovery. If this occurs, coring will be discontinued, the borehole reamed, and temporary steel casing will be advanced to the broken rock zone. Continuous coring will then be resumed with the core barrel. Rock cores will be placed in core boxes to be provided by the subcontractor.

### B 3.6 Lithologic Logs

Suitable logs detailing lithologic characteristics will be completed and maintained for inclusion in the applicable report. The logs (Attachment 2 of the SAP) will be prepared by the field geologist, who will be present during all drilling operations.

# B 4.0 WELL CONSTRUCTION MATERIALS

Monitoring well materials shall be free of foreign materials prior to use. Factory-wrapped well materials may be used directly from the original wrapping if the wrapping seal has not been broken, however casing and screen materials exposed to the environment should be cleaned following decontamination procedures outlined in Section 5.5 of the SAP prior to use. If a lubricant is necessary when connecting joints of the drilling and sampling equipment, a nonreactive lubricant will be used to avoid possible contamination of groundwater samples.

## B 4.1 Borehole Construction

The size of the drill bit shall be selected so that the target borehole diameters will be at least four inches greater than the intended casing diameter. This will allow access for well construction and sufficient thickness of the filter pack. The borehole shall be plumb and in alignment to allow proper well construction and free access of pumps, bailers and other sampling/testing devices that may be used in the well.

## B 4.2 Well Construction Materials

After completion of drilling, the well will be completed to optimize well yeld. Completion requires decisions about both constuction materials and well design. Materials include casing, well screen annular fill and seals.

### B 4.2.1 Casing and Screen Material

Well casing will generally consist of new, threaded, flush joint, polyvinyl chloride (PVC) pipe of an adequate size with a minimum 2-inch annular space between the borehole wall and casing. However, where conditions dictate, monitoring wells installed in highly contaminated areas shall be constructed of 304 or 316 stainless steel well casing and screen. All well casing will, as a minimum, conform to the requirements of ASTM D1785 (ASTM, 2001c) for Schedule 40 or Schedule 80 pipe. The PVC casing will be National Sanitation Foundation (NSF) potable water grade. Schedule 40 PVC will be used for monitoring wells that have a total depth less than 100 feet. For monitoring wells with a total depth greater than 100 feet, schedule 80 PVC will be used. The SFSPs will provide details on the well construction materials to be used.

The well screen will generally be constructed of 10- to 20-foot sections of 0.010-inch continuous wrap PVC, however, the slot size and screen length may differ based on site conditions. The schedule of the well screen will match the schedule of the well casing. The well screen will comply with the same requirements as the well casing regarding ASTM and NSF standards. Solvent PVC glue will not be used at any time during the construction of the wells. The bottom of the deepest screen or casing will be sealed with a threaded PVC cap or plug, however if a threaded cap cannot be used, a PVC friction cap may be attached to the bottom of the screen using stainless steel screws. At the discretion of the Site Manager, a sump may be installed below the screen to serve as a sediment trap for wells installed in silty or clayey formations.

### B 4.2.2 Filter Pack Material

Filter pack material will be placed in the annular space between the well screen and the borehole wall. It shall extend a minimum of 2 feet above the top of the screen. The filter pack shall consist of 20/40 silica sand. In wells installed at depths greater than 20 feet, the filter pack material shall be placed using a tremie pipe. In wells installed to a total depth of 20 feet or less, filter pack material may be poured (gravity feed) into the annular space between the well screen and borehole wall.

In situations where the screen is installed to intersect a solution feature or void in bedrock, the installation of a filter pack is not recommended because of the uncertainty of the volume of filter pack material need to fill the annular space. In this situation, a pre-packed, or double screen sand pack may be used. The pre-packed screen shall consist of an inner screen, graded silica filter pack material (generally 20/40 silica sand), and an outer well screen as one integral unit. The screen material shall generally be constructed of schedule 40 PVC. The installation of pre-packed screens shall only be performed after consultation with the MDA.

### B 4.2.3 Well Seal Material

A seal shall be placed in the annular space on top of the filter pack. The seal shall consist of bentonite pellets and shall be a minimum of 2 feet thick. The bentonite pellets shall be tremied into place at depths greater than 50 feet below ground surface. At shallower depths, the bentonite seal shall be installed by gravity feed.

At depths greater than 100 feet below ground surface, the seal shall be constructed by first tremieing approximately 5 feet of very fine quartz sand (30/70 silica sand) above the filter pack. Bentonite pellets shall then be tremied 5 feet above the very fine quartz sand seal. In certain situations where bedrock fracturing is prevalent, the seal may be extended above the bentonite pellets with bentonite chips to inhibit the potential of cement bleeding into the formation. For deep wells in excess of 100 feet, a "bentonite slurry" mix may be used to minimize potential bridging. In double cased wells, the bentonite seal shall be extended to a minimum of 5 feet into the bottom of the outer casing.

Once the bentonite is installed, it shall be allowed to hydrate a minimum eight hours or according to the manufacturer's recommended hydration time, whichever is longer, prior to completion of the well. At locations where the bentonite seal is installed above the groundwater table, the bentonite shall be hydrated with potable water.

In monitoring wells installed with a pre-packed screen, a grout catcher shall first be attached to the well casing above the pre-packed screen as the screen and casing are lowered into the borehole. The bentonite seal shall then be installed as previously described.

### B 4.2.4 Grouting the Annular Space

The annular space above the bentonite seal shall be filled with bentonite-cement grout. The grout shall be mixed in proportion of 6.5 to 7 gallons of potable water per one 94-lb bag of Type I Portland cement and approximately 5 to 10 percent (by weight) powdered bentonite. Type II Portland cement may be substituted at the discretion of the Field Manager. The grout mixture shall be added to the annular space to within 2 feet of the ground surface or below the frost line, whichever is greater. At zones where the grout mixture is observed bleeding into the formation due to fractures and voids, coarse silica gravel shall be added to the annular space to bridge the zone. The remaining length of the annular space shall then be grouted using the bentonite-cement grout mixture.

Prior to grouting, the bentonite seal will be measured using a weighted type or equivalent to ensure that the "seal" has not dropped in the borehole or within the casing. Should this occur, additional bentonite or bentonite slurry will be added and allowed to hydrate prior to commencing grouting of the annular space.

## B 5.0 MONITORING WELL INSTALLATION

Monitoring well constuction shall be performed under the supervision of a qualified geologist licensed in the State of Alabama and by licensed drillers following procedures provided in the following subsections.

### B 5.1 Construction of Single-Cased Monitoring Wells

Well casing and screens for monitoring wells will be plumb in the borehole, and will be installed through the augers/drill casing to prevent cave-in of the borehole; therefore, centralizers may not be required. Permanent wells will have a maximum screened interval of 10 ft of 0.010-inch continuous wrap PVC, however, the slot size and screen length may differ based on site conditions. At the discretion of the Site Manager, a sump up to 5 feet in length, composed of new, threaded, flush joint, PVC pipe may be attached to the bottom of the well screen.

Filter materials will be placed into the annulus through the augers/drill casing, and the augers/drill casing will be removed from the hole as the filter pack is installed. The filter pack will be placed to maintain approximately 1 foot of filter materials in the augers or casing as the augers/casing is withdrawn. The filter pack will be installed a minimum of 2 to 4 feet above the top of the screen. Once the filter pack has been installed, a 2- to 5-foot-thick bentonite seal will be formed using bentonite pellets. In wells where the bentonite seal is above the water table, placement of bentonite pellets will be done in 6-inch lifts, and each lift will be hydrated 15 minutes per lift. After the seal is in place, additional potable water will be added and the bentonite pellets will be allowed to fully hydrate. In wells where the bentonite seal is placed below the water table, the bentonite pellets will be tremied into place in one 2- to 5-foot lift to prevent bridging and allowed enough time to hydrate (minimum of 8 hours or the manufacturer's recommendation, whichever is longer) using the formation water. The remaining annular space will be tremie-grouted with cement-bentonite grout. All filter pack materials, grout, and installation techniques will follow SOPQAM specifications. A typical single-cased monitoring well and extraction well installation is shown in Figure B-2.

### B 5.2 Construction of Double-Cased Monitoring Wells

Monitoring wells to be installed through the residuum aquifer into the bedrock aquifer will require IPS mild carbon steel outer protective casing, which will be installed and grouted a minimum 5 feet into bedrock. The outer casing will be constructed by welding or threading together sections of casing. Borehole drilling for the surface casing may be performed using a variety of drilling techniques including hollow-stem auger drilling, air rotary drilling, or sonic drilling. Regardless of the drilling method used, the diameter of the borehole will be sufficient to allow a minimum of 2 inches between the borehole wall and the outer casing. Once the target depth has been reached, the drill stem will be removed and the casing will be installed. On doubled-cased wells where bedrock is encountered less than 20 feet from the surface, the outer casing will be grouted by means of a tremie pipe suspended in the annulus outside of the casing (borehole conditions permitting). The bottom of the outer casing will be sealed with a drillable Teflon® or natural untreated wood plug. During grouting, the bottom of the tremie pipe should always be submerged a few feet beneath the grout level. As the grout level rises, the tremie pipe should be withdrawn at the same rate until the annulus is full. The grout will be allowed to cure for a minimum of 48 hours before additional drilling takes place. The casing method of grouting may be used as an alternative method for grouting the casing if borehole conditions dictate. The casing method involves the outer casing to be set at the proper depth, and the volume of the annulus to be calculated. Typically, the batch volume will be increased by 10 to 20 percent to account for voids in the formation. Next, a steel plate with an air pressure connection head will be welded to the top of the casing. The calculated amount of grout will be mixed and pumped into the casing through the welded plate until the casing is full. The casing will then be pressurized. If the calculated amount of grout does not fill the casing, then potable water will be pumped into the casing through the steel plate until the casing is full and pressurized. Once the casing is full and pressurized the pressure release valve on the steel plate will be closed. This will push the grout down through the casing and up into the annular space around the protective steel casing. The pressure release valve on the steel plate will be left closed until the grout has cured. The grout will be allowed to cure for a minimum of 24 hours before additional drilling takes place.

Well casing and screens for the doubled-cased wells will be installed plumb in the borehole; stainless-steel centralizers may be used if necessary to achieve a plumb well. Filter materials will be tremied into place between the borehole wall and well screen. The filter pack will be brought 2 to 4 feet above the top of the screen. A bentonite seal will be placed above the filter pack and will extend to approximately 5 feet above the bottom of the outer casing. In wells where the bentonite seal is above the water table, bentonite pellets will be placed in 6-inch lifts, and each lift will be hydrated for 15 minutes. After the seal is in place, additional potable water will be added and the bentonite pellets will be allowed to fully hydrate. In wells where the bentonite seal is placed below the water table, the bentonite pellets will be tremied into place in 2- to 5-foot lifts to prevent bridging and allowed to hydrate using the formation water. After the bentonite seal has been installed and hydrated (minimum 8 hours or the manufacturer’s recommendation, whichever is longer), the remaining annular space will be tremie-grouted with a cement-bentonite grout. All filter pack materials, grout, and installation techniques will follow SOPQAM specifications. A typical double-cased monitoring well installation is shown in Figure B-1.

### B 5.3 Monitoring Well Completion and Protection

Monitoring wells will be completed with either a stickup surface completion or a flush-mounted surface completion. The stickup surface completion will be constructed in most situations, however, a flush-mount well completion will be used in traffic areas and on private property. After completion, monitoring wells will be surveyed for latitude/longitude coordinates and elevation.

### B 5.3.1 Stickup Surface Completion

For aboveground monitoring well completions, a 5-foot length of protective steel casing with a locking cap will be installed over the well pipe to a depth of approximately 2.5 feet bgs. A minimum 2-by-2-foot square concrete pad will be constructed around the well. The concrete pad will be approximately 6 in thick, with 4 inches above the ground surface.. The concrete pad will surface shall be angled such that water flows away from the monitoring well. An internal drainage hole will be drilled through the steel casing approximately 6 inches above the well pad. The monitoring well will be identified by a stenciled number painted on the protective steel casing.

Bumper guards will be placed around the concrete pad in a configuration that provides maximum protection to the well. These bumper guards shall extend above the ground surface a minimum of 3 ft and have a total minimim length of 5 ft. Additionally, the guard posts will be filled with concrete and will be painted to be highly visible, for example, fluorescent yellow. In UXO areas borings drilled for the installation of guard posts shall first be surveyed for UXO anomalies.

### B 5.3.2 Flush Mounted Surface Completion

Flush-mount monitoring wells will be completed using an 8- or 12-inch steel flush-mount, bolt-down, traffic-bearing monitoring well cover. The flush-mount cover will be installed in a minimum 3-by-3-foot-square, 4-inch-thick concrete pa, as far above grade as practical to minimize standing water and promote runoff. The pad will be sloped away from the well and will be flush with the ground surface at the edges. The monitoring well will be identified by a brass monument installed in the northern portion of the well pad.

### B 5.4 Well Construction Logs

Suitable logs detailing construction practices will be completed and maintained for inclusion in the applicable report. The logs will be prepared by the field geologist, who will be present during all drilling operations. Construction information shall be recorded on the appropriate well construction logs (Attachment 2 of the SAP) for single cased and double cased wells.

## B 6.0 WELL DEVELOPMENT/REDEVELOPMENT

The following subsections describe the development of newly installed wells. Development is performed to clean out particulate matter that may have been incorporated during emplacment of the filter pack and to close up the contacet between the aquifer, the annular material , and the screen. This may be accomplished in one of several ways that forces water in and out of the screen, filter pack, and aquifer.

### B 6.1 Well Development

After each well has been constructed, but no sooner than 24 hours after the surface pad and outer protective casing are installed, each well will be developed. Wells will be developed by pumping or bailing and surging without using acids, flocculents, disinfectants, or dispersing agents. Compressed air shall not be used. All purged water will be contained at the well site. During development, the pump inlet will be moved through the entire screened interval or the bailer will be lifted from different depths in the well. (During well development, the minimum volume of water removed from the borehole shall be equivalent to that which was lost in the borehole during drilling.) The development procedure will continue until the following conditions are met:

- Water is clear to the unaided eye (less than 20 nephelometric turbidity units [NTU]), free of sand, and free of drilling fluids.
- Thickness of the accumulated sediment in the well is less than 1 percent of the length of the well screen (sediment will be measured with a weighted tape-water level indicator).
- Field parameters (Temperature, pH, turbidity, and specific conductance values) stabilize for at least three consecutive readings.
- A volume of water equal to five times standing water in the well casing and screen assuming 30 percent porosity, has been removed and the volume of water introduced into the borehole during drilling has been removed.

Water shall not be added to the well once the well has been grouted and sealed. If the well is purged dry during the development prior to stabilization of field parameters, the water level shall be allowed to equilibrate to static conditions prior to additional development efforts. If the well is purged dry after three consecutive attempts to develop, no further attempts to develop the well will be conducted.

### B 6.2 Well Redevelopment

If one of the following conditions are found to be exhibited at a well to be sampled, the well may be redeveloped according to the same procedures set forth in Section B6.1:

- Sediment accumulation in the well covers more than 1 percent of the total length of the well screen.
- Recharge has declined through time; slow recharge is defined as a condition where upon removal of fluids from a well, the water level has not returned to the static level within 24 hours.

### B 6.3 Development Records

The following records will be kept on a well development log (see Attachment 2 of SAP):

- Project name and location
- Well designation and location
- Date and time of well development
- Static water level from top of well casing before well development
- Depth from top of well casing to top of sediment inside well, before and after development
- Field measurement of pH, conductivity, turbidity, and temperature before, after each well volume, and after development
- Water quality testing equipment used
- Development Method (i.e. bailer, make/model of pump)
- Depth from top of well casing to bottom of well
- Type and size/capacity of pump and/or bailer used
- Description of surge technique
- Measured height of well casing above ground surface at time of development
- Typical pumping/purge rate
- Quantity of water/fluid removed during development, both incremental and total.
- Physical character of removed water, including changes in clarity, color, particulate, and odor
- Quantity of potable water used during well installation and/or rock coring.

# B.7.0 WELL REPLACEMENT OR ABANDONMENT

## B 7.1 Classification of a Well as Nonfunctional

Monitoring wells may be found to be nonfunctional during groundwater sampling for the following reasons:

- Two episodes of redevelopment have been conducted and the well still does not meet the requirements set forth in Section B6.1.
- The casing has been damaged to the point that the integrity of the sample may be compromised, and the damage cannot be repaired at the surface.

Nonfunctional wells are required to be abandoned following procedures provided in the following subsection.

## B 7.2 Well Abandonment

Monitoring well abandonment will follow procedures outlined in the Monitoring Well Abandonment Standard Operating Procedure (SOP 20) in Attachment 3 of the SAP.

If a well is located at a required monitoring point for the long-term monitoring program and cannot be replaced by another existing well, it will be recommended that a replacement well be installed at that location. Replacement well installation procedures will follow the drilling and monitoring well installation procedures outlined in Chapters B 4.0 and B 5.0.

# B 8.0 FIELD DOCUMENTATION

Field documentation forms to be used at McClellan, including Field log books, Sample Collection Logs, Boring Lithologic Logs, Well Construction and Development Logs, are discussed in the SAP. Example logs are proved in Attachment 2 of the SAP.

## B 9.0 REFERENCES

American Society of Testing and Materials (ASTM), 2001 a, ***Practice D2488-00 Standard Practice for Description and Identification*** *of* ***Soils (Visual-Manual Procedure),*** Annual Book of ASTM Standards - 2001.

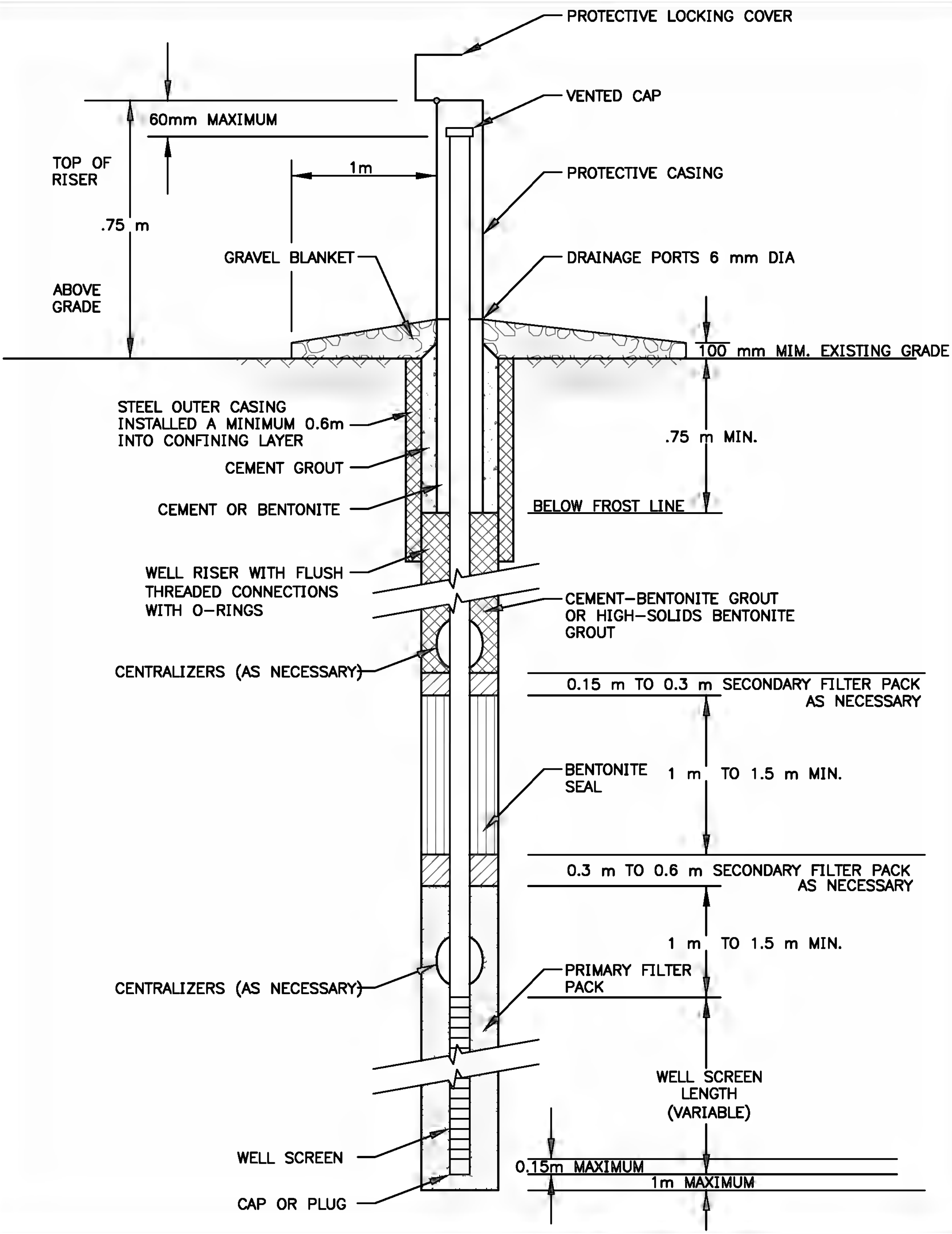
American Society of Testing and Materials (ASTM), 2001b, Test Method D1586-99 Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils, Annual Book of ASTM Standards - 2001.

American Society of Testing and Materials (ASTM), 2001c, ***Specification D1785-99 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and*** *120,* Annual Book of ASTM Standards - 2001.

IT Corporation, 2002, ***Draft Monitoring Well Installation Plan, Fort McClellan, Calhoun County, Alabama*** prepared for the U.S. Department of the Army, Mobile District, Corps of Engineers, Mobile, Alabama

U.S. Environmental Protection Agency (EPA), Most Recent Version, ***Region 4 Field Branches Quality System and Technical Procedures,***.

U.S. Army Corps of Engineers (USACE), 1998, EM-110-1-1, ***Monitoring Well Installation and Documentation at Hazardous and/or Toxic Waste Sites,*** Engineering Manual, August.



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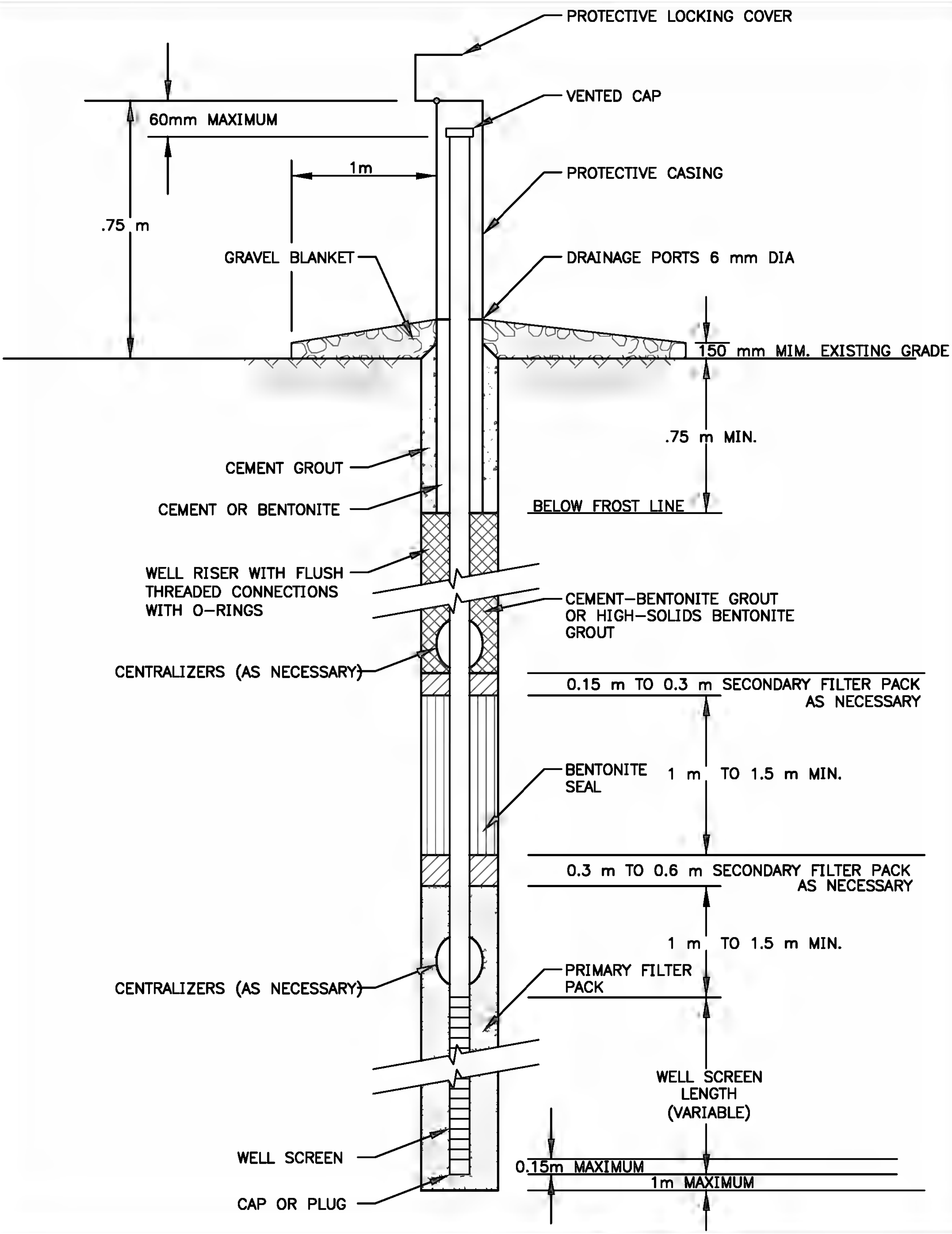
**McClellan, Anniston, Alabama**

**STANDARDS**

**MONITORING WELL CONSTRUCTION FORM (MULTI-CASED)**

| | | | |
|---|---|---|---|
| DESIGNED BY: [illegible]<br>DRAWN BY: [illegible]<br>CHECKED BY: [illegible] | SCALE | DATE ISSUED<br>JANUARY, 2004 | B– 1 |



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**STANDARDS**

**MONITORING WELL CONSTRUCTION FORM (SINGLE-CASED)**

| | | | |
|---|---|---|---|
| DESIGNED BY: [illegible]<br>DRAWN BY: [illegible]<br>CHECKED BY: [illegible] | SCALE | DATE ISSUED<br>JANUARY, 2004 | **B-2** |

# Appendix C
# Installation-Wide Investigation-Derived Waste Management Plan, Revision 3.0
# McClellan, Anniston, Alabama

**Prepared for:**

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DEVELOPMENT AUTHORITY

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**August 2023**

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# LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ADEM | Alabama Department of Environmental Management |
| AOC | Area of Concern |
| Army | United States Department of the Army |
| BIRTC | Branch Immaterial Replacement Training Center |
| CBR | Chemical, Biological, And Radiological |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| D&I | Detection and Identification |
| EPA | United States Environmental Protection Agency |
| ESE | Environmental Science and Engineering |
| FOMRA | Former Ordnance Motor Repair Area |
| HTRW | Hazardous, Toxic, and Radioactive Waste |
| IDW | Investigation Derived Waste |
| IDWMP | Investigation Derived Waste Management Plan |
| IT | IT Corporation |
| JPA | Joint Powers Authority |
| MEC | Munitions and Explosives of Concern |
| McClellan | Fort McClellan |
| MDA | McClellan Development Authority |
| MES | Matrix Environmental Services, L.L.C. |
| MINICAMS | Miniature Chemical Agent Monitors |
| No. | Number |
| NSA | New South Associates |
| PA | Preliminary Assessment |
| PPE | Personal Protective Equipment |
| RI | Remedial Investigation |
| RTC | Recruiting Training Center |
| SAIC | Science Applications International Corporation |
| SAP | Sample Analysis Plan |
| SI | Site Investigation |
| SWMU | Solid Waste Management Unit |
| TCLP | Toxicity Characteristic Leaching Procedure |
| USACE | United States Army Corps of Engineers |
| USAEHA | United States Army Environmental Hygiene Agency |
| USATHAMA | United States Army Toxic and Hazardous Material Agency |
| UST | Underground Storage Tank |
| UXO | Unexploded Ordnance |
| WAC | Women's Army Corps |
| WWII | World War II |

# C 1.0 INTRODUCTION

This Installation-Wide Investigation-Derived Waste Management Plan (IDWMP) has been prepared by Matrix Environmental Services L.L.C. (MES), for the Fort McClellan (McClellan) Development Authority (MDA), Fort McClellan, Alabama in support of continuing environmental sampling and analysis programs associated with the transfer of Army property to the local redevelopment authority.

The MDA has assumed from the United States (U.S.) Department of the Army (Army) responsibility for investigation and ongoing monitoring at several of the Hazardous, Toxic, and Radioactive (HTRW) sites throughout McClellan. The basis for this transfer of property and responsibility is the Environmental Services Cooperative Agreement (ESCA) between the MDA and the Army. In addition, the MDA has negotiated a Cleanup Agreement (CA) with the Alabama Department of Environmental Management (ADEM) that describes the responsibilities of both parties in completing the investigation and remediation of HTRW sites at McClellan.

## C 1.1 Purpose and Scope of the Installation-Wide IDWMP

The purpose of this IDWMP is to provide guidance to effectively control investigation derived waste (IDW) disposition at McClellan for work performed for the MDA. The scope of this effort is designed to (1) manage IDW in a manner protective of human health and the environment and (2) comply with ADEM and applicable Federal and local requirements in the disposal of IDW.

## C 1.2 IDWMP Development

This IDWMP is an adaptation of the *Investigative Derived Waste Management Plan,* Fort McClellan, Calhoun County, Alabama Prepared for the Army, Mobile District, Corps of Engineers by IT Corporation (IT 2002). The IDWMP is substantially consistent with, the Alabama Environmental Investigation and Remediation Guidance (AEIRG [ADEM 2002, Revised 2005]), to the extent practicable.

## C 1.3 Project Description

The MDA is continuing the environmental restoration activities at McClellan. The activities are being managed by the MDA through a Program Management Team made up of MDA representatives and a contracted environmental consulting firm (Consultant) selected to support the MDA in managing this program. Work managed by the MDA could potentially involve all facets of environmental restoration activities, including site investigations, remedial investigations (RI), feasibility studies, remedial design, remedial actions, and short- and long-term monitoring programs. All environmental restoration activities conducted by MDA are in support of the ESCA between the MDA and the Army and the CA between the MDA and ADEM.

This IDWMP, together with the Installation-Wide Sampling and Analysis Plan (SAP) (MES 2004, revised 2013), has been prepared for the activities to be executed in support of the environment restoration program at McClellan. The IDWMP presents policies, organization, function and the specific activities that are associated with proper management of materials and environmental media that are produced as a result of environmental investigations at McClellan. The SAP presents, in specific terms, the requirements and procedures for conducting field operations and investigations. The information presented in both documents is intended to support all sampling and analysis programs and other activities that involve environmental investigation activities at McClellan. Site-specific field sampling plans (SFSPs) or Corrective Measures Implementation Plans (CMIPs) will be prepared that supplement the project's IDWMP and SAP, to address individual project sampling and analysis requirements, as necessary.

## C 1.4 Facility Description and Background

McClellan was a U. S. Army facility (Fort McClellan) formerly under the control of the U. S. Army Training and Doctrine Command (TRADOC) that was closed under the Base Realignment and Closure (BRAC) program in September 1999. McClellan is located in northeast Alabama, and a portion of McClellan was annexed by the City of Anniston. While active, McClellan consisted of three portions of land: Main Post, Choccolocco Corridor, and Pelham Range. This IDWMP pertains only to portions of the Main Post transferred to the MDA.

The majority of past development at McClellan occurred in the northwest area of the Main Post. The main post is within the eastern and northern edge of the City of Anniston. Adjoining the Main Post to the east are the Choccolocco Mountains of the Talladega National Forest. The Main Post, consisting of 18,929 acres, was purchased by the federal government in March 1917 for the construction of a National Guard camp (Camp McClellan). Pistol and rifle ranges were established north of the camp, automatic rifle and machine gun ranges were established southwest of the camp, and artillery-firing ranges were established southeast of the camp toward the Choccolocco Mountains (New South Associates, Inc. [NSA], 1993). Camp McClellan expanded throughout the 1920s and 1930s. The advent of World War II in the 1940s brought continued growth for the installation. Most notably, the 22,245 acres of Pelham Range were purchased to the west of the Main Post in early 1940 for artillery, tank, and heavy mortar firing. Approximately 4,488 additional acres to the east of the Main Post (Choccolocco Corridor) were leased from the state to connect the Main Post to the Talladega National Forest (CH2M Hill, 1994). Historically, Choccolocco Corridor was also used for various range training activities. The lease was terminated in May 1998.

The post-war period initially brought a decline in operations at McClellan. The decrease in military spending placed the installation on inactive status. However, in 1950 the installation was reinstated to active status because of the Korean Conflict. The U.S. Army Chemical School was established at McClellan in 1951; the large outdoor training areas allowed for specialized chemical training involving chemical warfare protection, decontamination procedures, flamethrowers, and the operation of smoke generators. The Base hospital was renovated to specialize in chest diseases. The first permanent Women's Army Corps (WAC) training facility was established in 1955, although two WAC detachments had been established during the 1940s at the installation. Radiological training was conducted in the mid-1950s at Iron Mountain, Alpha Field, and Bromine Field, all located on the Main Post, as well as at Rideout Field on Pelham Range (NSA, 1993).

The mission of the installation was changed in 1966 and it became the U.S. Army School/Training Center. An Advanced Individual Training Infantry Brigade was activated in 1966 to meet requirements for the Vietnam War. The brigade was deactivated in 1970 due to continued force reduction in Vietnam.

In 1973, the Chemical Corps School closed, along with the U.S. Army Combat Developments Command Chemical/Biological Radiological Agency. Five years later, in 1978, the WAC was disbanded and the WAC school closed.

In 1979, the Military Police School was moved to McClellan. In the same year, the U.S. Army Chemical Corps school was re-established, along with a Brigade for Basic Training. U.S. Army Forces Command units, such as D Company, 46" Engineers, were also garrisoned at the post during the 1970s and 1980s.

The mid-1980s brought additional operations to Pelham Range, which is located approximately 2 miles northwest of The City of Anniston. This area was used for maneuver training and a wide range of activities from small-arms training to tank and artillery training. Pelham Range has also been used for chemical decontamination training and radiological training.

McClellan operations were deactivated and missions completed with the installation closure on September 30, 1999.

## C 1.5 Previous Environmental Studies

This section provides a summary of the previous installation restoration activities reports at McClellan. A number of technical studies have been conducted at McClellan. The status and historical use of chemical, biological, and radiological (CBR) training areas were investigated and documented by the U.S. Army Environmental Hygiene Agency (USAEHA) in 1975. Based on a limited records review and interview, USAEHA identified 12 areas at McClellan and Pelham Range that were possibly contaminated. Restricted access and inclusion in future land restoration and recovery programs were recommended for these areas (Science Applications International Corporation [SAIC] 1995).

A second installation assessment consisting of records reviews, personnel interviews, and field inspections was conducted in 1977 (United States Army Toxic and Hazardous Material Agency

[USATHAMA] 1977). During this assessment, burial grounds and training areas were identified within the facility in which chemical or radiological contamination existed or was suspected. In addition, records indicated that Munitions and Explosives of Concern (MEC) might be present in several training areas. This study also concluded that CBR contamination had not been detected in surface water at McClellan and that a potential may exist for groundwater contamination from documented landfill operations.

Based on an extensive literature review of the fate and transport of chemical agents, decontaminants, agent decontaminant byproducts, and past on-site CBR training practices, a 1983 study identified the most probable groundwater and soil contaminants that might persist at McClellan and Pelham Range. The study investigated the persistence and potential exposure pathways for various chemical breakdown scenarios.

The 1977 installation assessment conducted by USATHAMA was re-evaluated and integrated with updated data by ESE in 1984. This study was limited to chemical agents and restricted compounds and resulted in 21 site-specific contamination assessments (SAIC 1993).

Various U.S. Army agencies, including the McClellan Chemical School and USAEHA, conducted limited surface soil sampling and screening operations at the following sites between 1972 and 1980: Area T-5, Detection and Identification (D&I) Area, Range K, Area T-38, Area T-24A, Range J, Range L, and Landfill No. 3 (ESE 1984). Field-testing for chemical agents was negative in all known sampling locations and the areas were cleared for surface usage (SAIC, 1995).

USAEHA conducted an investigation at McClellan in 1986 to identify all solid waste management units (SWMU) on Base. USAEHA (1986) formally identified 41 SWMUs on McClellan and Pelham Range. Each SWMU was located, described, and evaluated to the extent possible. Five monitoring wells were installed by the agency at Landfill No. 3 as part of the investigation (SAIC 1995).

An enhanced preliminary assessment (PA) was conducted by Roy F. Weston, Inc. in 1990 (Weston, 1990) to evaluate the status of active non- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites and inactive CERCLA sites potentially impacting the Army's planned closure of McClellan. The PA identified 62 active and inactive sites on the Main Post and Pelham Range (SAIC 1995).

The USACE, Mobile District, conducted an investigation in 1991 to evaluate soil and groundwater in the vicinity of five existing or excavated underground storage tank (UST) sites in the northwestern portion of the Main Post. The investigation focused on USTs used for storing petroleum products, including gasoline, diesel, and diesel-based fuel oil. Twenty monitoring wells were installed at these sites during this investigation. Petroleum contamination of groundwater and/or soil was documented at four of the five UST sites (Ecology and Environment, Inc. 1991).

USACE initiated a site investigation (SI) in 1991 at 17 sites on the Main Post and Pelham Range identified in the PA. Based on limited sampling of groundwater, surface water, and soil miniature chemical agent monitors (MINICAMS) screening, potential environmental concerns were identified at 12 of the SI sites.

A hydrogeological evaluation of the former McClellan sanitary landfill site (Landfill No. 4) was conducted by the ADEM (1993) as a component of the overall permit review process. Leachate seeps were observed at the toe of the landfill and along manmade drainage ditches near the site boundary. A program of quarterly groundwater monitoring was implemented by McClellan in 1994 for five monitoring wells near former Landfill No. 4. Elevated lead, arsenic, chloride, and total organic halogen levels were detected in the wells in 1994 (SAIC, 1995).

SAIC (1995) conducted RIs at eight areas of concern (AOC) on the Main Post installation, including Area F4, Area T-5, Area T-24A, Area T-38, D&I Area, Landfills No. 1, 2, and 3, and four AOCs at Pelham Range (Ranges J, K, and L, and the Old Water Hole). Investigation activities included installation of 36 groundwater monitoring wells, collection of subsurface soil, groundwater, sediment, and surface water samples, and a geophysical survey. Results of the investigation identified groundwater contamination at four of the 12 sites. Sites where groundwater contamination was identified included Area T-38, Range J, Landfill No. 3, and Area T-24A. Volatile organic compounds and semivolatile organic compounds were detected in groundwater at these sites. Metals were also detected in groundwater, soil, sediment, and surface water at McClellan. Metals of concern included lead, mercury, thallium, vanadium, beryllium, manganese, and iron. Based on the data obtained during the RI, it was recommended that eight of the sites required no further investigations; however, four of the sites, including Area T-38, Range J, Range K, and 6 Area T-24A, required additional investigation.

## C 1.6 Plan Organization

The following sections describe specific management practices for the in-process handling and subsequent disposition of IDW. These waste management practices will serve to consolidate regulatory guidance, and will provide McClellan with the necessary protocols and procedures to ensure adequate protection of human health and the environment.

- Section 2.0 presents a summary of practices for placing IDW in containers pending characterization.
- Section 3.0 discusses chemical characterization of IDW.
- Section 4.0 discusses disposition options for the IDW based on results of chemical characterization.
- Section 5.0 provides a list of references while attachments provide miscellaneous reference material.

# C 2.0 Management of IDW

IDW is generated as a result of various operations that take place at McClellan during site investigative and remedial activities. The IDW typically consists of drill cuttings, groundwater monitoring well purge and development water, spent personal protective equipment (PPE), and other inert materials (i.e., plastic, rope, tape, paper, etc.), generated as a result of site activities. The following paragraphs detail the planned methods for managing IDW generated during site activities.

## C 2.1 IDW Containment Requirements

IDW will be managed to minimize exposure to human health and the environment. In general, IDW will be generated as a result of two major activities: (1) drilling soil-test borings and (2) constructing and sampling groundwater monitoring wells. In instances where soil test borings are advanced, either for the sole purpose of retrieving soil samples or to allow for the retrieval of a groundwater sample via installation of a monitoring well, the following handling protocols for IDW soil will be used:

### C 2.1.1 Soil and Solid IDW

Soil cuttings will be placed in a roll-off box or 55-gallon drum staged at the site of generation. Roll-off boxes will be lined with polyethylene sheeting prior to filling. Containers holding soil cuttings will be covered daily or during rainfall events to prevent contact with moisture. Soil cuttings will not be used to backfill the borehole. Solids may be bulked into larger approved containers situated within a central staging area. Typically, solids at each parcel will be consolidated in 55 gallon drums.

### C 2.1.2 Aqueous and Liquid IDW

Aqueous waste, drilling mud and purge liquids will be collected and placed into separate containers located at each site.

Decontamination of such items as PPE and drilling equipment will be performed at designated decontamination areas. If this decontamination area is on-site, plastic sheeting or other appropriate measures will be taken to protect the area from contamination. Material from the decontamination area will contain mostly water with some soil washed from equipment. These solids and liquids will either be stored in portable drums or tanks or decontamination fluids will be pumped from the decontamination area and stored in a Baker tank.

Water purged from monitoring wells during development and sampling will be collected in portable drums or tanks located at a central waste management location. If drums are used, they will be stored according to the requirements of the relevant sampling plan approved by

ADEM (either at the central waste management area or at the site under investigation). The monitoring well numbers and the approximate volume of water added to the tank or drums from each well will be recorded on container inventory sheets.

Liquids generated from treatability studies will be handled in the same manner as water purged from monitoring wells unless specified in documentation prepared for the treatability study.

Liquids will be collected at the site in one of several types of containers including 55-gallon lined drums, 250-gallon polyethylene tanks, 4,000-gallon tank trucks, or 21,000-gallon frac tanks. Liquid for large investigations may be bulked in 21,000-gallon frac tanks at the generation site or the staging area. Drums are stockpiled at the Ammunition Storage Point (ASP). Solids and liquids will be separated prior to disposal. Any free liquid will be siphoned off collected solids (drill cuttings, etc.) and combined with other liquids generated at the site.

### C 2.1.3 PPE IDW

PPE will be bagged at the generation site and staged in roll-off boxes or suitable waste container specific for PPE. PPE will be kept segregated from other IDW until characterization of the PPE has been completed. Unless the site specific field sampling plan or Corrective Measures Implementation Plan specifies differently, PPE will generally be disposed of as municipal solid waste.

## C 2.2 Documentation of IDW Collection

After each container (i.e., drum, roll-off box, etc.) has been filled, the container and lid, if appropriate, will be labeled indicating a description of the IDW (solids, water, or PPE), date the IDW was placed in the container, site identification (i.e., parcel number), and any other pertinent information. A record of the containers and their contents will be established at the generation site and will be included in the project file. At the end of each day and/or field activity, all containers will be closed or covered to prevent the introduction of rainwater or surface run-off. For each container the following information should be recorded and tracked:

- Source or origin of IDW
- Medium
- Date of IDW generation
- Date sampled for chemical/physical characterization
- Responsible organization
- Contact telephone number

# C 3.0 Characterization of IDW

IDW will be characterized as described in the following subsections to help define final disposal options. IDW will be characterized using analytical data obtained from samples collected from the storage container (frac tank, roll-off, tank truck, etc.) after the container has been filled. Analytical data from investigation soil samples and ground water samples will be used as a reference for analytical testing suites for IDW. Water obtained from monitoring wells (i.e., purge and development water) will be characterized from samples collected directly from storage containers (frac tanks, polyethylene tanks, etc). Solids such as spent PPE, plastic sheeting, rope, unused monitor well construction materials, and other IDW will be characterized for disposal based on generator knowledge or analytical results of actual samples collected from the IDW.

## C 3.1 Chemical Analysis of IDW

The suite of analytical parameters will be based on suspected contaminants and prior available analytical data. History of the site and generator knowledge may be used to expand or minimize the volume of analytical testing required to adequately characterize the media. MDA will compare the IDW analytical results to the appropriate screening values on a site-specific basis.

### C 3.1.1 Soil and Solid IDW

Hazardous versus non-hazardous determinations for soil and solid IDW will be made utilizing those parameters outlined in ADEM Administrative Code R. 335-14-3-.08, *Special Requirements for Generators of Waste Destined for Disposal at Commercial Hazardous Waste Disposal Facilities Located in the State of Alabama* (ADEM, 2017) and ADEM Administrative Code R. 335-14-2-.02 (1), and 335-14-2-.03 (ADEM, 2015). Where listed wastes are expected or where the potential exists for listed wastes, specific analytes will be compared to appropriate screening levels on a site-specific basis and in accordance with the approved Correct Measures Implementation Plan (CMIP). All sampling and analytical testing protocols will be consistent with those procedures presented in the Quality Assurance Plan (Appendix A) in accordance with ADEM and United States Environmental Protection Agency (EPA) requirements and methodologies.

### C 3.1.2 Aqueous or Liquid IDW

Hazardous versus non-hazardous determinations for aqueous and liquid IDW will be made utilizing guidelines provided in ADEM Administrative Code R. 335-14-3-.08, *Special Requirements for Generators of Waste Destined for Disposal at Commerical Hazardous Waste Disposal Facilities Located in the State of Alabama* (ADEM, 2017) and or most recent version) and ADEM Administrative Code R. 335-14-2-.02 (1), and 335-14-2-.03 (ADEM, 2015, or most recent version).

Disposal options for aqueous or liquid IDW will also be based on concentrations of chemical constituents present in the IDW and comparison to the appropriate screening levels on a site-specific basis and in accordance with the approved CMIP.  Disposal will be in accordance with the approved corrective measures implantation plan, if applicable.

# C 4.0 DISPOSITION OF IDW

Once characterized, the containers of IDW will be properly labeled with U.S. Department of Transportation approved labels when transportation outside of McClellan boundaries is required or anticipated. The IDW may also be bulked on site (within the staging area at the ASP) with like waste streams possessing compatible non-reactive characteristics. Hazardous and nonhazardous materials will be segregated and all liquids and solids will be separated. The current staging area is located at the ASP. However, the staging area may be moved based on the requirements of McClellan or the needs of ongoing investigation and removal activities. Full containers generated for a given parcel that must be removed from the generation site before final disposition of the IDW can be determined will be placed in the central staging location. In the event that conditions indicate the potential for reactive wastes, special handling and storage precautions will be used. The integrity of containers moved to the staging area will be monitored for leaks or other potential problems. Waste may be transported between parcels when required or in preparation of disposal activities without specific regulatory concurrence (i.e., McClellan is not required to obtain regulatory approval to transport wastes within the installation boundaries).  Other specific management requirements are as follows.  Figure 4-1 shows a flow diagram providing general guidance on management of IDW.

## C 4.1 Soil and Solid IDW

For management and disposition purposes, the soil and solid IDW will be separated into two major categories: hazardous and non-hazardous for which separate disposal options exist for each category.

### C 4.1.1 Non-hazardous Soil and Solid IDW

Soil and solid IDW characterized as non-hazardous will be staged in the storage area located at the ASP.

Non-hazardous solid IDW may be disposed of into a permitted solid waste facility or off site permitted disposal facility as long as the following conditions are met:

The MDA will obtain ADEM’s approval before disposing of any non-hazardous soil and solid IDW to an off-site permitted disposal facility.

Approval has been received from the permitted disposal facility based on the submission of results for a suite of analysis specified by the disposal facility or contaminant levels are below analytical reporting limits.

A MDA representative signs the non-hazardous waste manifest as the generator's representative.

Non-hazardous PPE IDW, plastic sheeting, rope, unused monitor well construction materials, and other IDW generated during field activities that have been determined to be nonhazardous through generator knowledge or sampling and analysis will be consolidated into 55-gallon drums, dumpsters, roll-off boxes or other appropriate container for disposal at a permitted solid waste disposal facility by the same steps as listed in above.

### C 4.1.2 Hazardous Soil and Solid IDW

The disposition of solids possessing hazardous characteristics will be determined on a case-by-case basis depending on specific contaminants, concentrations, and parcel conditions. With ADEM approval, the solids may be returned (i.e., in secure storage containers) to the parcel from which they were generated and the remediation of the site, if required, will be addressed, at which time a remedial plan is prepared for other contaminated soil at the site. Prior to returning the waste to the parcel where generated, MDA will submit in writing a request detailing the planned handling and placement procedures with a site sketch indicating the temporary storage location.

In the event that hazardous solids are not allowed to be returned to the parcel and on site treatment is not available, the IDW will be disposed of off-site in accordance with state and federal requirements in a permitted hazardous waste disposal facility through a licensed hazardous waste transporter, as required. Hazardous soil and solid IDW will be transported to a permitted hazardous waste disposal facility by a licensed hazardous waste transporter. A MDA representative will sign all hazardous waste manifests as the generator's representative. The MDA will obtain ADEM’s approval before the disposal of hazardous soil and solid IDW.

#### C 4.1.2.1 Temporary Storage of Hazardous Soil and Solid IDW

Soil or Solid IDW exhibiting hazardous characteristics (ADEM Administrative Code R. 335 14-2-.03) (ADEM 2012) or that contain a listed hazardous waste (ADEM Administrative 3 Code R 335-14-2-.04) (ADEM 2011) may be stored upon generation near the point of generation within the parcel of origin or bulked at the central staging area in anticipation of disposal activities. Hazardous soil or solid IDW will be containerized, transported/treated/disposed in a manner that is in compliance with Resource Conservation and Recovery Act Subtitle C or superseding ADEM Administrative Codes including storage for not more than 90 days. Where available information prior to beginning a site investigation does not suggest that hazardous wastes or materials are expected, it will be assumed, in accordance with the Office of Emergency and Remedial Response Directive 9345.3-10 02 (USEPA 1991), that IDW soils that do not exhibit hazardous characteristics also do not contain listed wastes and will be assumed to be non-hazardous. Non-hazardous and assumed non-hazardous IDW soils will be managed using best management practices as presented in above sections.

## C 4.2 Aqueous and Liquid IDW

In general, wastewater generated during site activities will likely be disposed of in one of three methods: (1) if the wastewater is non-hazardous and no contaminants were detected above site-specific screening levels it may be disposed of on site by, for example, release to the ground; (2) if the wastewater is non-hazardous, but contains contaminants above standards it may be disposed of on site directly into a permitted wastewater treatment facility after approval of the wastewater treatment facility; and (3) if the wastewater is hazardous, it will transported off site by a licensed hazardous waste transporter to a permitted hazardous waste treatment facility. Details of these approaches are discussed below.

### C 4.2.1 Non-hazardous Aqueous or Liquid IDW

Aqueous or liquid IDW generated during site activities and for which analytical tests show no level of contamination above approved method reporting limits will be considered nonregulated. The disposal means and methods of non-regulated wastewater may be discharged at the site of generation and do not require regulatory consultation or concurrence. Results of the IDW sample analysis of the aqueous or liquid IDW will be placed in the project file.

Aqueous or liquid IDW determined to be non-hazardous per ADEM Administrative Code R. 335-14-2-.02 (ADEM 2011) or Title 40 Code of Federal Regulations (CFR) Part 261, but possessing concentrations less than water quality control criteria, may be disposed directly into the sanitary sewerage system where it will ultimately be treated at the Anniston Water and Sewage Department wastewater treatment facility. The non-hazardous wastewater may be released at discharge point at the ASP if appropriate approvals are granted by the Anniston Water and Sanitary Sewer district.. The wastewater will not be disposed of into the sanitary sewerage system without specific prior authorization of the Anniston Water and Sewage Department. Authorization to dispose of the IDW wastewater in the sanitary sewer will be recorded in the project file.

Discharges to the publicly owned treatment works will be in accordance with provisions outlined in Division, Water Quality Program, of the ADEM Administrative Code (ADEM 2011). More specifically, the discharge will not be greater than 5 percent of the average dry weather capacity of the wastewater treatment plant, greater than 5 percent of the design capacity of the wastewater treatment plant, or subject to Section 403.6 of the Federal Water Pollution Control Act. A disposal permit is not required as long as the wastewater is discharged in quantities of less than 25,000 gallons per day and is non-hazardous (40 CFR 261).

Documentation of all discharges (regulated and non-regulated) will be placed in the project file. The documentation will contain pertinent information regarding the discharge including, date, time, volumes, analytical data (if available), site, action, etc.

### C 4.2.2 Hazardous Aqueous or Liquid IDW

Hazardous wastewater will be transported, when required, and treated at a permitted wastewater treatment facility when the following conditions are met:

1. The treatment facility meets the definition of a wastewater treatment unit as defined by the ADEM Administrative Code R. 335-14-1-.02 (ADEM, 2011).

2. The treatment facility is capable of (a) rendering characteristically hazardous wastes (defined in ADEM Administrative Code R. 335-14-2-.03) (ADEM, 2011) non-hazardous or (b) removing listed wastes (defined in ADEM Administrative Code R. 335-14-2-.04) from the contaminated media so that the media no longer contains the listed waste for which the media was originally considered hazardous. If after treatment, analytical tests show the listed waste is not present above laboratory detection limits, then the contaminated media will be considered to no longer contain the listed waste and will no longer be considered hazardous.

3. The wastewater treatment facility(s) has been constructed at McClellan in conjunction with a removal, interim remedial action, or remedial action, at a parcel.

Wastewater identified as hazardous may be transported between parcels and within McClellan boundaries for treatment/disposition in accordance with the previously outlined provisions without specific regulatory concurrence.

MDA will submit documentation of discharges of hazardous wastewater to ADEM. The documentation will contain pertinent information regarding the discharge including date, time, volumes, analytical (if available), site, action, etc. The MDA will obtain a National Pollutant Discharge Elimination System (NPDES) permit issued by ADEM before discharging hazardous wastewater.

All discharges to the sanitary sewer system will be approved by and coordinated with Anniston Water and Sewage Department prior to any discharge. The MDA will consult with ADEM to obtain approval and/or to determine if a State Indirect Discharge (SID) permit is required before wastewater is discharged into the sanitary sewer system.

In the event that McClellan does not have a facility on-line capable of treating the hazardous wastewater at or approximately at the time of generation, the storage of hazardous wastewater will not exceed 90 days and the water will be stored in an area with an adequate secondary containment system until an approved treatment system is on-line.

Unless specifically mandated by ADEM and the EPA, hazardous and non-hazardous wastewater will be treated and disposed as previously described. Wastewater will be treated and disposed in a timely manner to expedite site activities and to ensure the protection of human health and the environment.  Any discharge of hazardous aqueous or liquid IDW will not occur without ADEM's approval.

# C 5.0 REFERENCES

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