

Table 2-1. Personnel Qualifications

Name	Title	Organizational Affiliation	Responsibility	Education and Experience Qualification
Walter Migdal	USACE Project Manager	USACE	<ul style="list-style-type: none"> • Manages governmental oversight of the project • Manages project funding and scope 	NA
Michael D'Auben	USACE QA Manager	USACE	<ul style="list-style-type: none"> • Provides governmental oversight of the Shaw QA Program • Provides quality-related directives through Contracting Officer's Technical Representative • Provides technical and administrative oversight of Shaw surveillance audit activities • Acts as point-of-contact on all matters concerning QA and the client's laboratory QA program • Authorized to suspend project execution if QA requirements are not adequately followed 	BS, Environmental Chemistry 22+ years of experience
Mark Phaneuf	USACE Technical Lead	USACE	<ul style="list-style-type: none"> • Provides technical oversight of groundwater monitoring activities • Point of contact for technical matters 	NA
Tom Cooper	Project Manager	Shaw	<ul style="list-style-type: none"> • Manages oversight of the project for Shaw • Ensures that all requirements of project contract are attained in a manner consistent with project plans • Manages project budgets and schedules 	MS, Geology 11+ years of experience
Craig Givens	QA Officer	Shaw	<ul style="list-style-type: none"> • Independent oversight of all project implementation in accordance with the project-specific QAPJP 	BS, Geological Engineering 23 + years of experience
Pamela Moss	Field Team Manager – Chemistry	Shaw	<ul style="list-style-type: none"> • Reviews and approves the QAPJP • Guides the selection of subcontract analytical laboratories • Serves as a point-of-contact for the USACE QA Manager • Develops corrective action as required • Serves as a technical advisor to the project 	BS, Chemistry 32+ years of experience
Dale Flores	Field Team Manager - Geoscience	Shaw	<ul style="list-style-type: none"> • Develops work plans to address project scope of work • Prepares work plan variances, if necessary • Manages technical project elements • Reports to Project Manager 	BS, Geology 16+ years of experience

Table 2-1. Personnel Qualifications (concluded)

Name	Title	Organizational Affiliation	Responsibility	Education and Experience Qualification
Gary Hecox	Field Team Manager – Remediation	Shaw	<ul style="list-style-type: none"> • Develops work plans to address project scope of work • Prepares work plan variances, if necessary • Manages technical project elements • Reports to Project Manager 	PhD, Geology 32+ years of experience
Terry Rulon	Site Supervisor	Shaw	<ul style="list-style-type: none"> • Advises field personnel on any technical issues that arise during work execution • Reviews field and laboratory data • Authors Quarterly Monitoring Reports and makes recommendations 	AS, Construction Management 20 years of experience

Notes:

AS = Associate's of Science degree

BS = Bachelor's of Science degree

MS = Master's of Science degree

NA = not applicable

PhD = Doctor of Philosophy

QA = quality assurance

QAO = Quality Assurance Officer

QAPjP = BFF Spill Quality Assurance Project Plan

USACE = U.S. Army Corps of Engineers

Table 3-1. Sample Requirements for Analytical Testing

Low-Concentration Samples					
Matrix	Parameter ¹	Container ^{2,3}	Preservation	Maximum Holding Times ⁴	
				Extraction	Analysis
Water	Volatiles	2 x 40-mL ⁵ G, Septa Vial	Ice to 4°C 4 drops conc. HCl or sodium bisulfate (NaHSO ₄) to pH<2	---	14 days
Water	SVOCs	2 x 1-L ^{5,6} amber G	Ice to 4°C	7 days	40 days
Water	Metals ⁶	1 x 1-L P	Nitric acid (HNO ₃) to pH<2		6 months ⁷
Water	TPH –gasoline TPH – diesel	2 x 40-mL ⁵ G, Septa Vial 2 x 1-L G	Ice to 4°C		14 days
Water	Common parameters	1 x 1-L ⁸ G	Ice to 4°C		28 days ⁸
Soils/Sediments	Volatiles	3 – 5 gram Terra Core	Ice to 4°C Sodium bisulfate		48 hr, 14 days frozen
Soils/Sediments	SVOCs, PCBs, pesticides	1 x 8-oz G	Ice to 4°C	14 days	40 days
Soils/Sediments	Metals, cyanide, TPH	1 x 8-oz G 5-gram Terra Core for TPH- gasoline	Ice to 4°C		6 months, ⁷ 14 days, 48 hr, 14 days frozen
Vapor	VOCs/TPH gasoline/ APH	1 x 1-L Bottle Vac	None	N/A	30 days
Vapor	Fixed gases	1 x 1-L Tedlar bag	None	N/A	30 days
Medium-Concentration Samples					
Water/Liquid	Volatiles	2 x 40-mL G	Ice to 4°C ⁵		14 day
Water/Liquid	SVOCs ⁵	2 x 32-oz wide- mouth jars, G	Ice to 4°C ⁵	7 days	40 days
Water/Liquid	PCBs ⁵ , pesticides	2 x 32-oz wide- mouth jar G	Ice to 4°C ⁵	7 days	40 days
Water/Liquid	Metals	1 x 16-oz wide- mouth jar, G	HNO ₃ to pH<2		6 months ⁷
Water/Liquid	Explosives	2 x 1-L amber G	Ice to 4°C	7 days	40 days
Water/Liquid	Cyanide	1 x 1- L P	Sodium hydroxide (NaOH) to pH>12 Ice to 4°C		14 days
Soils/Sediments	Volatiles	3- 5 gram Encore	Ice to 4°C		48 hr, 14 days frozen
Soils/Sediments	SVOCs, PCBs, pesticides	1 x 8-oz wide- mouth jar, G	Ice to 4°C	14 days	40 days

Table 3-1. Sample Requirements for Analytical Testing (concluded)

Medium-Concentration Samples (continued)					
Matrix	Parameter ¹	Container ^{2,3}	Preservation	Maximum Holding Times ⁴	
				Extraction	Analysis
Soils/Sediments	Metals, cyanide, TPH	1 x 8-oz wide-mouth jar, G 5-gram Terra Core for TPH-gasoline	Ice to 4°C		6 months, ⁷ 14 days, 48 hr, 14 days frozen
Liquid	All organic and inorganic analyses	1 x 8-oz wide-mouth jar, G		See comment 9	
Solids	All organic and inorganic analyses	2 x 8-oz wide-mouth jars, G		See comment 9	

- 1 APH = air-phase petroleum hydrocarbon; PCB = polychlorinated biphenyl; SVOC = semivolatle organic compound; TPH = total petroleum hydrocarbon; and VOC = volatile organic compound.
- 2 All containers must have Teflon-lined seals (Teflon-lined septa for volatile organic analysis [VOA] vials).
- 3 G = glass; L = liter; mL = milliliter; and P = high-density polyethylene. Sample preservation will be done in the field immediately upon sample collection. If water samples are filtered in the field, differential pressure methods using 45-micron filters will be used, and preservatives added after filtration. VOA samples should never be filtered.
- 4 When only one holding time is given, it implies total holding time from sampling until analysis.
- 5 Samples with residual chlorine present will be dechlorinated with sodium thiosulfate as specified in SW-846 (third edition).
- 6 Three bottles are required on at least 5 to 10 percent (but at least one) sample so that the laboratory can perform all method quality control checks for SW-846 method.
- 7 Total recoverable metals for water samples. Holding time for mercury is 28 days in glass; for hexavalent chromium is 24 hours.
- 8 Chlorine, bromine, fluorine, nitrate, nitrite, phosphate, sulfate; 1 L for each method; orthophosphate requires filtration. Holding time for extraction is 48 hours for nitrate, nitrite, and phosphate if not preserved with sulfuric acid to pH<2.
- 9 Holding times for medium-concentration samples are the same as those specified for low-concentration samples.

Table 3-2: Analytical Method, Preservation, and Holding Time Requirements – Groundwater Monitoring

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Water	VOCs – EPA 8260B	Preparation: EPA 5030B Analysis: EPA 8260B	40 mL	3 X 40 mL VOA with Teflon® septa	HCL to pH <2 Cool at 0-6°C	14 days for analysis
Water	EDB – EPA 8011	Preparation: EPA 8011 Analysis: EPA 8011	40 mL	3 X 40 mL VOA with Teflon® septa	Cool at 0-6°C	14 days for analysis
Water	TPH gasoline – EPA 8015B	Preparation: EPA 5030B Analysis: EPA 8015B	40 mL	3 X 40 mL VOA with Teflon® septa	HCL Cool at 0-6°C	14 days for analysis
Water	TPH diesel – EPA 8015B	Preparation: EPA 3510C and silica gel cleanup Analysis: EPA 8015B	1 L	1 X 1 L Amber	Cool at 0-6°C	7 days for extraction 40 days for analysis
Water	VPH – MA DEP	Preparation: Method MA DEP Analysis: Method MA DEP	40 mL	3 X 40 mL VOA with Teflon® septa	HCL to pH <2 Cool at 0-6°C	14 days for analysis
Water	EPH – MA DEP	Preparation: Method MA DEP and silica gel cleanup Analysis: Method MA DEP	1 L	1 X 1 L Amber	Cool at 0-6°C	7 days for extraction 40 days for analysis
Water	SVOCs – EPA 8270C	Preparation: EPA 3510C Analysis: EPA 8270D	1 L	1 X 1 L Amber	Cool at 0-6°C	7 days for extraction 40 days for analysis
Water	Dissolved Iron and Manganese – EPA 6010C	Preparation: EPA 3005A/3010A Analysis: EPA 6010C	100 mL	1 X 250 mL polyethylene (field filtered with 0.45 micrometers filter)	HNO ₃ to pH <2 Cool at 0-6°C	180 days for analysis
Water	Total Cations and Lead– EPA 6010C	Preparation: EPA 3005A/3010A Analysis: EPA 6010C	100 mL	1 X 250 mL polyethylene	HNO ₃ to pH <2 Cool at 0-6°C	180 days for analysis
Water	Anions – EPA 300.0	Preparation: EPA 300.0 Analysis: EPA 300.0	100 mL	1 X 250 mL polyethylene	Cool at 0-6°C	48 hours for nitrate and 28 days for all other anions

Table 3-2: Analytical Method, Preservation, and Holding Time Requirements – Groundwater Monitoring (concluded)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Water	Alkalinity – SM 2320B	Preparation: SM 2320B Analysis: SM 2320B	100 mL	1 X 250 mL polyethylene	Cool at 0-6°C	14 days for analysis
Water	Ammonia – SM 4500B, D	Preparation: EPA 4500B, D Analysis: EPA 4500B, D	100 mL	1 X 250 mL polyethylene	H ₂ SO ₄ to pH<2 Cool at 0-6°C	28 days for analysis
Water	O-Phosphate – SM 4500 PE	Preparation: SM 4500 PE Analysis: SM 4500 PE	100 mL	1 X 250 mL polyethylene	H ₂ SO ₄ to pH<2 Cool at 0-6°C	28 days for analysis
Water	Sulfide – SM 4500 S-2CF	Preparation: EPA 4500 S-2CF Analysis: EPA 4500 S-2CF	100 mL	1 X 250 mL polyethylene	Zinc Acetate and Sodium Hydroxide to pH>9 Cool at 0-6°C	7 days for analysis
Water	Dissolved Gases – RSK 175	Preparation: RSK 175 Analysis: RSK 175	40 mL	3 x 40 mL VOA with Teflon septa	Cool at 0-6°C	7 days for analysis
Water	Stable Carbon Isotope – Laboratory SOP AM 24	Preparation: Lab SOP AM 24 Analysis: Lab SOP AM 24	40 mL	9x40 mL VOA	HCL to pH<2 Cool at 0-6°C	14 days for initial VOC analysis NA for isotope analysis
Water	Stable Hydrogen Isotope Laboratory SOP	Preparation: Lab SOP Analysis: Lab SOP	40 mL	9x40 mL VOA	HCL to pH<2 Cool at 0-6°C	14 days for initial VOC analysis NA for isotope analysis

Notes:

°C = degrees Celsius

EDB = ethylene dibromide

EPA = U.S. Environmental Protection Agency

EPH = Extractable petroleum hydrocarbon

HCl = hydrochloric acid

HNO₃ = nitric acid

H₂SO₄ = sulfuric acid

L = liter

MA DEP = Massachusetts Department of Environmental Protection

mL = milliliter

NA = not applicable

SM = standard method

SOP = standard operating procedure

SVOC = semivolatile organic compound

TPH = total petroleum hydrocarbon

VOA = volatile organic analysis

VOC = volatile organic compound

VPH = volatile petroleum hydrocarbon

Table 3-3: Analytical Method, Preservation, and Holding Time Requirements – Soil Sampling

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Soil	VOCs – EPA 8260B	Preparation: EPA 5035 Analysis: EPA 8260B	5 grams	3 X 5 gram Terra Core	Cool at 0-6°C Sodium bisulfate	48 hours for analysis 14 days for analysis if kept frozen
Soil	VPH – MA DEP	Preparation: Method MA DEP Analysis: Method MA DEP	5 grams	3 X 5 gram Terra Core	Cool at 0-6°C	48 hours for analysis 14 days for analysis if kept frozen
Soil	EPH – MA DEP	Preparation: Method MA DEP; and silica gel cleanup Analysis: Method MA DEP	30 grams	1 X 8 oz Jar	Cool at 0-6°C	14 days for extraction 40 days for analysis
Soil IDW	TPH gasoline – EPA 8015B VOCs – EPA 8260B	Preparation: EPA 5035 Analysis: EPA 8015C	5 grams	1 X 4 oz Jar	Cool at 0-6°C	48 hours for analysis 14 days for analysis if kept frozen
Soil IDW	TPH diesel – EPA 8015C	Preparation: EPA3540C/3550C, and silica gel cleanup Analysis: EPA 8015C	30 grams	1 X 8 oz Jar	Cool at 0-6°C	14 days for extraction 40 days for analysis
Soil	SVOCs – EPA 8270D	Preparation: EPA3540C/3550C Analysis: EPA 8270D	30 grams	1 X 8 oz Jar	Cool at 0-6°C	14 days for extraction 40 days for analysis
Soil	Lead – EPA 6010C	Preparation: Method 3050B Analysis: 6010C	2 grams	1 X 8 oz Jar	Cool at 0-6°C	180 days for analysis
Soil IDW	VOCs – EPA 1311/8260B	Preparation: EPA 1311/5035 Analysis: EPA 8260B	25 grams	1 X 8 oz. Jar	Cool at 0-6°C	48 hours for analysis 14 days for analysis
Soil IDW	SVOCs – EPA 1311/8270D	Preparation: EPA 1311/3540C/3550C Analysis: EPA 8270D	30 grams	1 X 8 oz Jar	Cool at 0-6°C	14 days for extraction 40 days for analysis

Table 3-3: Analytical Method, Preservation, and Holding Time Requirements – Soil Sampling (concluded)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Soil IDW	Pesticides – EPA 1311/8081B	Preparation: EPA 1311/3540C/3550C Analysis: EPA 8081B	30 grams	1 X 8 oz Jar	Cool at 0-6°C	14 days for extraction 40 days for analysis
Soil IDW	Herbicides – EPA 1311/8151A	Preparation: EPA 1311/3540C/3550C Analysis: EPA 8151A	30 grams	1 X 8 oz Jar	Cool at 0-6°C	14 days for extraction 40 days for analysis
Soil IDW	Metals – EPA 1311/6010C/7470B	Preparation: EPA 1311/3050B Analysis: EPA 6010C/7471B	2 grams	1 X 8 oz Jar	Cool at 0-6°C	28 days for mercury and 180 days for all other metals
Soil IDW	RCI – SW846 Chapter 7, 7.3.2	Preparation: SW846 Chapter 7, 7.3.2 Analysis: SW846 Chapter 7, 7.3.2	2 grams	1 X 8 oz Jar	Cool at 0-6°C	14 days for reactivity and ignitability, and 24 hours for corrosivity

Notes:

°C = degrees Celsius

EPA = U.S. Environmental Protection Agency

EPH = extractable petroleum hydrocarbon

IDW = investigation-derived waste

MA DEP = Massachusetts Department of Environmental Protection

oz = ounce

RCI = reactivity, corrosivity, and ignitability

SOP = standard operating procedure

SVOC = semivolatile organic compound

TPH = total petroleum hydrocarbon

VOC = volatile organic compound

VPH = volatile petroleum hydrocarbon

Table 3-4: Analytical Method, Preservation, and Holding Time Requirements – Soil-Vapor Monitoring

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container (number, Size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Vapor	VOCs/TPH gasoline – EPA TO15	Preparation: EPA TO15 Analysis: EPA TO15	1 L	1 L Bottle Vac Canister 1L for Vapor	NA	14 days for analysis
Vapor	APH – Method MA DEP	Preparation: Method MA DEP Analysis: Method MA DEP	1 L	1 L Bottle Vac Canister	NA	14 days for analysis
Vapor	Fixed Gases – ASTM D2504	Preparation: ASTM D2504 Analysis: ASTM D2504	1 L	Tedlar Bag	NA	14 days for analysis

*Notes:**APH = air-phase petroleum hydrocarbon**ASTM = ASTM International**EPA = U.S. Environmental Protection Agency**L = liter**MA DEP = Massachusetts Department of Environmental Protection**NA = not applicable**SOP = standard operating procedure**TPH = total petroleum hydrocarbon**VOC = volatile organic compound*

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Table 3-5. Laboratory QC Samples (Gas Chromatography/Mass Spectrometry)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	VOCs, SVOCs, and APH					
Analytical Method	EPA Methods 8260B, 8270D, MA DEP, and TO15					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
Internal standards	Every field sample and QC samples	RT within ±30 seconds from RT of initial calibration midpoint standard; area counts within -50% to +100% of initial calibration midpoint standard	Correct problem, then re-analyze affected samples.	Lab Manager/Analyst	Bias	RT within ±30 seconds and area count within -50% to +100%
Method blank	One per preparation batch	No target analytes detected greater than one-half RL and 1/10 the amount measured in any sample or 1/10 regulatory limit (whichever is greater). No laboratory common contaminants detected greater than RL.	Correct problem, then re-analyze method blank and all samples processed with the contaminated blank	Lab Manager/Analyst	Representativeness	No target analytes detected greater than one-half RL and 1/10 the amount measured in any sample or 1/10 regulatory limit (whichever is greater). No laboratory common contaminants detected greater than RL.

Table 3-5. Laboratory QC Samples (Gas Chromatography/Mass Spectrometry) (continued)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	VOCs, SVOCs, and APH					
Analytical Method	EPA Methods 8260B, 8270D, MA DEP, and TO15					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
MS/MSD for all analytes	One MS/MSD pair per preparation batch per matrix	<u>EPA 8260B and EPA 8270D</u> : LCS control limits specified in the DoD QSM RPD less than 30% between MS and MSD	Identify problem; if not related to matrix interference, re-reanalyze MS/MSD and all associated batch samples	Lab Manager/Analyst	Precisions and Bias	<u>EPA 8260B and EPA 8270D</u> : LCS control limits specified in the DoD QSM RPD less than 30% between MS and MSD
LCS or LCS/LCSD pair for all analytes	One LCS or LCS/LCSD pair per preparation batch per matrix	<u>EPA 8260B and EPA 8270D</u> : LCS control limits specified in the DoD QSM <u>TO15 and MA DEP</u> : Laboratory in-house LCS control limits RPD less than 30% between LCS and LCSD	Correct problem, then re-reanalyze the LCS and all associated batch samples	Lab Manager/Analyst	Precisions and Bias	<u>EPA 8260B and EPA 8270D</u> : LCS control limits specified in the DoD QSM <u>TO15 and MA DEP</u> : Laboratory in-house LCS control limits. RPD less than 30% between LCS and LCSD

Table 3-5. Laboratory QC Samples (Gas Chromatography/Mass Spectrometry) (continued)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	VOCs, SVOCs, and APH					
Analytical Method	EPA Methods 8260B, 8270D, MA DEP, and TO15					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
Surrogate standards	Every field sample and QC sample	<u>EPA 8260B and EPA 8270D</u> : Surrogate recovery acceptance criteria specified in the DoD QSM. <u>TO15</u> : Laboratory in-house surrogate control limits	Correct problem, then re-analyze all affected samples	Lab Manager/Analyst	Bias	<u>EPA 8260B and EPA 8270D</u> : Surrogate recovery acceptance criteria specified in the DoD QSM <u>TO15</u> : Laboratory in-house surrogate control limits
Sample duplicate	Every 20 samples	<u>TO15</u> : RPD less than 25% per method requirements. <u>MA DEP</u> : RPD less than 30% per method requirements	NA	Lab Manager/Analyst	Bias	<u>TO15</u> : RPD less than 25% per method requirements. <u>MA DEP</u> : RPD less than 30% per method requirements
MDL study	Initial setup	Detection limits established will be below the LOQs	Correct problem, then repeat the MDL study	Lab Manager/Analyst	Sensitivity	

Table 3-5. Laboratory QC Samples (Gas Chromatography/Mass Spectrometry) (continued)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	VOCs, SVOCs, and APH					
Analytical Method	EPA Methods 8260B and 8270D, MA DEP, and TO15					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
LOD study	Initial setup and quarterly LOD verification	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat detection limit study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration in accordance with DoD QSM requirements.	Lab Manager/Analyst	Sensitivity	
LOQ study	Annually and quarterly LOQ verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ LOQ>LOD>DL		Lab Manager/Analyst	Sensitivity	

Table 3-5. Laboratory QC Samples (Gas Chromatography/Mass Spectrometry) (concluded)*Notes:**% = percent**APH = air-phase petroleum hydrocarbon**DL = detection limit**DoD = U.S. Department of Defense**EPA = U.S. Environmental Protection Agency**LCS = laboratory control sample**LCSD =laboratory control sample duplicate**LOD = limit of detection**LOQ = limit of quantitation**MA DEP = Massachusetts Department of Environmental Protection**MDL = method detection limit**MS = matrix spike**MSD = matrix spike duplicate**QC = quality control**QSM = Quality Systems Manual**RL = reporting limit**RPD = relative percent difference**RT = retention time**SVOC = semivolatile organic compound**VOC = volatile organic compound*

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Table 3-6. Laboratory QC Samples (Gas Chromatography)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	EDB, TPH, VPH/EPH, Fixed Gases, Stable Isotopes					
Analytical Method	EPA Methods 8011 and 8015B, MA DEP, ASTM 2504, SOPs					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per preparation batch	No target analytes detected greater than one-half RL and >1/10 amount detected in project samples or 1/10 the regulatory limit (whichever is greater).	Correct problem, then re-extract and reanalyze method blank and all samples processed with the contaminated blank	Lab Manager/Analyst	Representativeness	No target analytes detected greater than one-half RL and >1/10 amount detected in project samples or 1/10 the regulatory limit (whichever is greater).
MS/MSD for all analytes	One MS/MSD pair per preparation batch per matrix	<u>EPA 8011 and EPA 8015B, MA DEP:</u> Laboratory in-house LCS control limits RPD less than 30% between MS and MSD	Identify problem; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples	Lab Manager/Analyst	Precisions and Bias	<u>EPA 8011 and EPA 8015B, MA DEP .:</u> Laboratory in-house LCS control limits RPD less than 30% between MS and MSD

Table 3-6. Laboratory QC Samples (Gas Chromatography) (continued)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	EDB, TPH, VPH/EPH, Fixed Gases, Stable Isotopes					
Analytical Method	EPA Methods 8011 and 8015B, MA DEP, ASTM 2504, SOPs					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
LCS or LCS/LCSD pair for all analytes	One LCS or LCS/LCSD pair per preparation batch per matrix	<u>EPA 8011 and EPA 8015B, MA-DEP, ASTM 2504, SOPs (stable isotopes):</u> Laboratory in-house LCS control limits RPD less than 30% between LCS and LCSD	Correct problem, then re-extract and reanalyze the LCS and all associated batch samples	Lab Manager/Analyst	Precisions and Bias	<u>EPA 8011 and EPA 8015B, MA-DEP, ASTM 2504, SOPs (stable isotopes):</u> Laboratory in-house LCS control RPD less than 30% between LCS and LCSD
Surrogate standards	Every field sample and QC sample	<u>EPA 8015B, MA-DEP, and SOP AM24:</u> Laboratory in-house surrogate acceptance criteria	Correct problem, then re-extract and reanalyze all affected samples	Lab Manager/Analyst	Bias	<u>EPA 8015B, MA-DEP and AM24:</u> Laboratory in-house surrogate acceptance criteria

Table 3-6. Laboratory QC Samples (Gas Chromatography) (continued)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	EDB, TPH, VPH/EPH, Fixed Gases, Stable Isotopes					
Analytical Method	EPA Methods 8011 and 8015B, MA DEP, ASTM 2504, SOPs					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
Confirmation of positive results using second column or second detector	All positive results must be confirmed	<u>EPA 8011</u> : Same calibration and QC requirements as for initial or primary column analysis. RPD between primary and second column results less than 40%	NA	Lab Manager/Analyst	Precision	<u>EPA 8011</u> : RPD between primary and second column results less than 40%
MDL study	Initial setup	Detection limits established will be below the LOQs	Correct problem, then repeat the MDL study in accordance with DoD QSM requirements	Lab Manager/Analyst	Sensitivity	

Table 3-6. Laboratory QC Samples (Gas Chromatography) (continued)

Matrix	Groundwater, Soil, and Soil Vapor					
Analytical Group	EDB, TPH, VPH/EPH, Fixed Gases, Stable Isotopes					
Analytical Method	EPA Methods 8011 and 8015B, MA DEP, ASTM 2504, SOPs					
QC Sample	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
LOD study	Initial setup and quarterly LOD verification	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat detection limit study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration per DoD QSM	Lab Manager/Analyst	Sensitivity	
LOQ study	Annually and quarterly LOQ verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ LOQ>LOD>DL		Lab Manager/Analyst	Sensitivity	

Table 3-6. Laboratory QC Samples (Gas Chromatography) (concluded)*Notes:**% = percent**ASTM = ASTM International**DoD = U.S. Department of Defense**EDB = ethylene dibromide**EPA = U.S. Environmental Protection Agency**EPH = extractable petroleum hydrocarbon**LCS = laboratory control sample**LCSD =laboratory control sample duplicate**LOD = limit of detection**LOQ = limit of quantitation**MA DEP = Massachusetts Department of Environmental Protection**MDL = method detection limit**MS = matrix spike**MSD = matrix spike duplicate**QC = quality control**QSM = Quality Systems Manual**RL = reporting limit**RPD = relative percent difference**SOP = standard operating procedure**TPH = total petroleum hydrocarbon*

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Table 3-7. Laboratory QC Samples (Inductively Coupled Plasma Atomic Emission Spectrometry)

Matrix	Groundwater and Soil					
Analytical Group	Metals					
Analytical Method	EPA Method 6010C					
QC Check	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
Calibration blank	After initial calibration, before CCV calibration, after every 10 samples, and at the end of the sequence	No target analytes detected greater than LOD in accordance with DoD QSM requirements	Re-prepare and reanalyze the blank and the affected samples in accordance with DoD QSM requirements	Lab Manager/Analyst	Representativeness	<u>EPA 6010C</u> : No target analytes detected greater than LOD
Method blank	One per preparation batch	No target analytes detected greater than one-half RL and greater than 1/10 amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Correct problem, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank in accordance with DoD QSM requirements	Lab Manager/Analyst	Representativeness	No target analytes detected greater than one-half RL and greater than 1/10 amount measured in any sample or 1/10 the regulatory limit (whichever is greater).
Interference check solution	At the beginning of an analytical run	Within $\pm 20\%$ of expected value in accordance with DoD QSM requirements	Identify and correct problem, then reanalyze the interference check solution and all affected samples in accordance with DoD QSM requirements	Lab Manager/Analyst	Bias	Within $\pm 20\%$ of expected value

Table 3-7. Laboratory QC Samples (Inductively Coupled Plasma Atomic Emission Spectrometry) (continued)

Matrix	Groundwater and Soil					
Analytical Group	Metals					
Analytical Method	EPA Method					
QC Check	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
MS/MSD for all analytes	One MS/MSD pair per preparation batch per matrix	LCS control limits specified in the DoD QSM RPD less than 20% between MS and MSD	Identify problem, if not related to matrix interference, then re-prepare and reanalyze the MS/MSD pair and all samples in the associated batch in accordance with DoD QSM requirements	Lab Manager/Analyst	Precision and Bias	LCS control limits specified in the DoD QSM
LCS for all analytes	One LCS per each preparation batch	LCS control limits specified in the DoD QSM RPD less than 20% between LCS and LCSD	Identify and correct the problem, then reanalyze the LCS and all affected samples in accordance with DoD QSM requirements	Lab Manager/Analyst	Precision and Bias	LCS control limits specified in the DoD QSM

Table 3-7. Laboratory QC Samples (Inductively Coupled Plasma Atomic Emission Spectrometry) (continued)

Matrix	Groundwater and Soil					
Analytical Group	Metals					
Analytical Method	EPA Methods 6010C					
QC Check	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
Dilution test	Each preparation batch	Five-fold dilution results within $\pm 10\%$ of the original results in accordance with DoD QSM requirements	Perform post-digestion spike	Lab Manager/Analyst	Bias	within $\pm 10\%$ difference
Post digestion spike addition	When dilution test fails	Recovery within 75% -125% of expected results in accordance with DoD QSM requirements	Correct problem, then rerun samples by method of standard addition in accordance with DoD QSM requirements	Lab Manager/Analyst	Bias	Recovery within 75% -125% of expected values
MDL study	Initial setup	Detection limits established will be below the LOQs	Correct problem, then repeat the MDL study in accordance with DoD QSM requirements	Lab Manager/Analyst	Sensitivity	

Table 3-7. Laboratory QC Samples (Inductively Coupled Plasma Atomic Emission Spectrometry) (continued)

Matrix	Groundwater and Soil					
Analytical Group	Metals					
Analytical Method	EPA Method 6010C					
QC Check	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
LOD study	Initial setup and quarterly LOD verification	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat detection limit study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration per DoD QSM	Lab Manager/Analyst	Sensitivity	
LOQ study	Annually and quarterly LOQ verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ LOQ>LOD>DL		Lab Manager/Analyst	Sensitivity	

Table 3-7. Laboratory QC Samples (Inductively Coupled Plasma Atomic Emission Spectrometry) (concluded)*Notes:**% = percent**CCV = continuing calibration verification**DL = detection limit**DoD = U.S. Department of Defense**EPA = U.S. Environmental Protection Agency**LCS = laboratory control sample**LCSD = laboratory control sample duplicate**LOD = limit of detection**LOQ = limit of quantitation**MDL = method detection limit**MS = matrix spike**MSD = matrix spike duplicate**QC = quality control**QSM = Quality Systems Manual**RL = reporting limit**RPD = relative percent difference*

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Table 3-8. Laboratory QC Samples Table (Wet Chemistry)

Matrix	Groundwater					
Analytical Group	Anions, Ammonia, Sulfide, Alkalinity, and o-Phosphate					
Analytical Method	EPA Method 300.0, SM4500B, D, 4500S-2CF, 2320B, 4500PE					
QC Check	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
EPA 300.0, SM4500B,D, 4500PE, 4500S-2CF, 2320B: Method blank	EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF, and 2320B: One per preparation batch	EPA 300.0, SM 4500B, D, 4500PE, 4500S-2CF, and 2320B: No target analytes detected greater than one-half RL and 1/10 the amount measured in any samples or 1/10 the regulatory limit (whichever is greater)	EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF, and 2320B: Correct problem, then re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.	Lab Manager/ Analyst	Representativeness	EPA 300.0, SM 4500B, D, 4500PE, 4500S-2CF, and 2320B: No target analytes detected greater than one-half RL and 1/10 the amount measured in any samples or 1/10 the regulatory limit (whichever is greater)
EPA 300.0, 4500B, D, 4500PE, 4500S-2CF: MS/MSD for all analytes	EPA 300.0, SM 4500B, D, 4500PE, 4500S-2CF: One MS/MSD pair per preparation batch	EPA 300.0, SM 4500B, D, 4500PE, 4500S-2CF: Laboratory in-house LCS control limits RPD less than 15% between MS and MSD	EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF: Identify problem, if not related to matrix interference, then re-prepare and reanalyze the MS/MSD pair and all samples in the associated batch	Lab Manager/ Analyst	Precision and Bias	EPA 300.0, 3SM 4500B, D, 4500PE, 4500S-2CF: Laboratory in-house LCS control limits RPD less than 15% between MS and MSD

Table 3-8. Laboratory QC Samples Table (Wet Chemistry) (continued)

Matrix	Groundwater					
Analytical Group	Anions, Ammonia, Sulfide, Alkalinity, and o-Phosphate					
Analytical Method	EPA Method 300.0, SM4500B, D, 4500S-2CF, 2320B, 4500PE					
QC Check	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
<u>EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF and 2320B: LCS for all analytes</u>	<u>EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF and 2320B: One LCS per each preparation batch</u>	<u>EPA 300.0, SM 4500B, D, 4500PE, 4500S-2CF, and 2320B: Laboratory in-house LCS control limits RPD less than 15% RPD less than 15% between LCS and LCSD</u>	<u>EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF and 2320B: Identify and correct the problem, then reanalyze the LCS and all affected samples</u>	Lab Manager/ Analyst	Precision and Bias	<u>EPA 300.0, SM 4500B, D,4500PE, 4500S-2CF, and 2320B: Laboratory in-house LCS control limits not to exceed +20% RPD less than 15% between LCS and LCSD</u>
<u>EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF, and 2320B: Sample duplicate</u>	<u>EPA 300.0, SM 4500B, D, 4500PE, 4500S-2CF, and 2320B: One per every 10 samples</u>	<u>EPA 300.0, SM 4500B,D, 4500PE, 4500S-2CF, and 2320B: Within 10% difference between sample and duplicate</u>	<u>EPA 300.0, SM 4500B, D,4500PE, 4500S-2CF, and 2320B: Correct problem, reanalyze sample and duplicate</u>	Lab Manager/ Analyst	Bias	<u>EPA 300.0, SM 4500B, D, 4500PE, 4500S-2CF, and 2320B: Within 10% difference</u>
<u>MDL study</u>	<u>Initial setup</u>	<u>Detection limits established will be below the LOQs</u>	<u>Correct problem, then repeat the MDL study</u>	Lab Manager/ Analyst	Sensitivity	

Table 3-8. Laboratory QC Samples (Wet Chemistry) (continued)

QC Check	Frequency	QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicators	Measurement Performance Criteria
LOD study	Initial setup and quarterly LOD verification	Signal to noise ratio at the LOD will be greater than 3 and meet method requirements.	Correct problem, then repeat detection limit study and LOD verification at a higher concentration, or pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration per DoD QSM	Lab Manager/ Analyst	Sensitivity	
LOQ study	Annually and quarterly LOQ verification	LOQ will be greater than LOD and within calibration range. Laboratory procedure for establishing the LOQ will empirically demonstrate precision and bias at the LOQ LOQ>LOD>DL		Lab Manager/ Analyst	Sensitivity	

Table 3-8. Laboratory QC Samples (Wet Chemistry) (concluded)

Notes:

% = percent

DL = detection limit

DoD = U.S. Department of Defense

EPA = U.S. Environmental Protection Agency

LCS = laboratory control sample

LCSD = laboratory control sample duplicate

LOD = limit of detection

LOQ = limit of quantitation

MDL = method detection limit

MS = matrix spike

MSD = matrix spike duplicate

QC = quality control

QSM = Quality Systems Manual

RL = reporting limit

RPD = relative percent difference

SM = standard method

Table 3-9. Field Instrument Quality Control

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Photoionization Detector	Check calibration to 100 parts per million isobutylene	Once per day before first use	$\pm 5\%$ of standard value	Recalibrate	Shaw Sampler	Manufacture's Operation Manual
YSI (or equivalent) water quality meter with flow cell	Check calibration against two of the following three traceable standards with nominal pH of 4.0, 7.00 and 10.00	Once per day before first use	± 0.05 pH units	Recalibrate	Shaw Sampler	Manufacture's Operation Manual
	Check calibration against specific conductance standard	Once per day before first use	$\pm 5\%$ of standard value	Recalibrate	Shaw Sampler	Manufacture's Operation Manual
	Check calibration against turbidity standards	Once per day before first use	$\pm 5\%$ of standard value	Recalibrate	Shaw Sampler	Manufacture's Operation Manual
	Check calibration against dissolved oxygen (ambient air)	One per day before first use	$\pm 10\%$ of 100% saturation	Recalibrate	Shaw Sampler	Manufacture's Operation Manual
	Check calibration against oxygen reduction potential standards	One per day before first use	$\pm 10\%$ standard value	Recalibrate	Shaw Sampler	Manufacture's Operation Manual

Notes:

% = percent

SOP = standard operating procedure

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Table 3-10. Laboratory Instrument Quality Control – Groundwater Monitoring

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person²	SOP Reference¹
GC/MS - VOC	Check pressure and gas supply daily. Bake out trap and column, manual tune if BFB not in criteria, change septa as needed, cut column as needed, change trap as needed.	VOCs	Ion source, injector liner, column, column flow, purge lines, purge flow, trap.	Prior to initial calibration and/or as necessary.	Acceptable tune and calibration or CCV.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Empirical Analyst and Laboratory Manager	Empirical SOP 202
GC/MS - SVOC	Check pressure and gas supply daily. Manual tune if DFTPP not in criteria, change septa as needed, change liner as needed, cut column as needed.	SVOCs	Ion source, injector liner, column, column flow.	Prior to initial calibration and/or as necessary.	Acceptable tune and calibration or CCV.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Empirical Analyst and Laboratory Manager	Empirical SOP 201/300

Table 3-10. Laboratory Instrument Quality Control – Groundwater Monitoring (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person²	SOP Reference¹
GC	Check pressure and gas supply daily. Change septa and/or liner as needed; replace or cut column as needed.	GRO 8015B, EPH/VPH MA DEP, 8011, DRO 8015B	Liner, seal, septum, column.	Prior to initial calibration or as necessary.	Acceptable calibration or CCV.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Empirical Analyst and Laboratory Manager	Empirical SOPs 218, 219, 322, 227
ICP-AES	Clean torch assembly and spray chamber when discolored or when degradation in data quality is observed. Clean nebulizer, check argon, replace peristaltic pump tubing as needed.	Metals	Torch, nebulizer chamber, pump, pump tubing.	Prior to initial calibration and as necessary.	Acceptable calibration or CCV.	Correct the problem and repeat calibration or CCV.	Empirical Analyst and Laboratory Manager	Empirical SOP 100/105

Table 3-10. Laboratory Instrument Quality Control – Groundwater Monitoring (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person ²	SOP Reference ¹
Lachat	Check and clean segments weekly, clean reagent tubes monthly. Change lamp, change diluent and wash tubes, change mixing paddles and syringes, and change dispensing needle, all as needed.	Ammonia	Tubing and rollers.	Prior to ICAL or as necessary.	Acceptable ICAL and CCV.	Recalibrate and/or perform necessary equipment maintenance. Reanalyze samples not bracketed by passing CCV.	Empirical Analyst and Laboratory Manager	Empirical SOP 176
IC	Replace column	Anions	Check gas supply, check for leaks, check pistons.	Daily or as needed.	Must meet ICAL and continuing calibration criteria.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Empirical Analyst and Laboratory Manager	Empirical SOP 145
Buret	Check buret for any cracks or chips. Rinse buret prior to each use and at the end of each day.	Sulfide	Visual inspection for cracks or chips.	Each use.	NA	Remove from service.	Empirical Analyst and Laboratory Manager	Empirical SOP 153

Table 3-10. Laboratory Instrument Quality Control – Groundwater Monitoring (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person²	SOP Reference¹
pH Meter	Keep probe wet at all times and inspect prior to use. Rinse thoroughly between uses.	Alkalinity	Visual inspection of probe.	Each use.	Must meet factory specified start up limits.	Remove from service.	Empirical Analyst and Laboratory Manager	Empirical SOP 154
Spectrophotometer	Clean reagent tubes. Change lamp.	Ortho Phosphate	Check wave length.	At the beginning of every run.	Must meet ICAL and continuing calibration criteria.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Empirical Analyst and Laboratory Manager	Empirical SOP 165
Gas Chromatograph/ Isotope Ratio Mass Spectrometer (GC/IRMS)	Check for leaks, replace gas line filters, recondition or replace trap, replace column, clean injection port/liner. Monitor oxidation, pyrolysis, and reduction tubes.	Carbon and hydrogen stable isotopes	Monitor instrument performance via linearity and low LCS and high LCS.	Linearity checks are performed on daily basis. Low LCS and high LCS analyzed every ten samples.	Linearity check must have a slope less than 0.2. LCS should have deltas for compounds being measured that meet acceptance range specified by the SOP.	Replace connections, clean source, replace gas line filters, replace trap, replace GC column, clip column, replace injection port liner, clean injection port. Replace oxidation, pyrolysis and reduction tubes as needed to maintain performance.	Microseeps and its subcontractor Analyst and Laboratory Manager	SOP AM 24 for stable carbon isotope and Lab SOP for stable hydrogen isotope

Table 3-10. Laboratory Instrument Quality Control – Groundwater Monitoring (concluded)*Notes:**AES = atomic emission spectroscopy**BFB = bromofluorobenzene**CCV = continuing calibration verification**DFTPP = decafluorotriphenylphosphine**DRO = diesel range organic**EPH = extractable petroleum hydrocarbon**GC/MS = gas chromatography/mass spectrometry**GRO = gasoline range organic**IC = ion chromatography**ICAL = initial calibration**ICP = inductively coupled plasma**IRMS = isotope ratio mass spectrometer**LCS = laboratory control sample**MA DEP = Massachusetts Department of Environmental Protection**NA = not applicable**SOP = standard operating procedure**SVOC = semivolatile organic compound**VOC = volatile organic compound**VPH = volatile petroleum hydrocarbon*

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Table 3-11. Laboratory Instrument Quality Control – Soil

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person ²	SOP Reference ¹
Gas Chromatograph/ Mass Spectrometer (GC/MS)	Check for leaks, replace gas line filters, recondition or replace trap, replace column, clean injection port/liner.	Volatiles	Monitor instrument performance via continuing calibration verification.	As needed.	No maintenance is required as long as instrument QC meets DoD criteria.	Replace connections, clean source, replace gas line filters, replace trap, replace GC column, clip column, replace injection port liner, clean injection port, replace electron multiplier.	Gulf Coast Analytical Analyst and Supervisor	Gulf Coast Analytical SOP GCMSV-003
Gas Chromatograph/ Mass Spectrometer (GC/MS)	Clean Injection port and replace liner, clip column, check for leaks. Maintain pumps by checking replacing pump oil.	Semi-volatiles	Monitor instrument performance via continuing calibration verification, DFTPP tune, breakdown and tailing.	Daily.	No maintenance is required as long as instrument QC meets DoD criteria.	Change column. Clean source.	Gulf Coast Analytical Analyst and Supervisor	Gulf Coast Analytical SOP GCMSSV-001
Gas Chromatograph	Check for leaks, replace gas line filters, replace column, clean injection port/liner.	EPH	Monitor instrument performance via continuing calibration verification.	As needed.	No maintenance is required as long as instrument QC meets DoD criteria.	Replace connections, replace gas line filters, replace GC column, clip column, replace injection port liner, clean injection port.	Gulf Coast Analytical Analyst and Supervisor	Gulf Coast Analytical SOP GC-032

Table 3-11. Laboratory Instrument Quality Control – Soil (concluded)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person ²	SOP Reference ¹
Gas Chromatograph	Check for leaks, replace gas line filters, recondition or replace trap, replace column, clean injection port/liner.	VPH	Monitor instrument performance via continuing calibration verification.	As needed.	No maintenance is required as long as instrument QC meets DoD criteria.	Replace connections, replace gas line filters, replace trap, replace GC column, clip column, replace injection port liner, clean injection port.	Gulf Coast Analytical Analyst and Supervisor	Gulf Coast Analytical SOP GC-025
ICP - Metals	Perform leak test, change pump tubing, change torch and window, clean filters.	Metals	Monitor instrument performance via continuing calibration verification and CC blank.	As needed.	No maintenance is required as long as instrument QC meets DoD criteria.	Change pump tubing, change torch and window, clean filters. Recalibrate and reanalyze affected data.	Gulf Coast Analytical Analyst and Supervisor	Gulf Coast Analytical SOP MET-010

Notes:

CC = continuing calibration
 DFTPP = decafluorotriphenylphosphine
 DoD = U.S. Department of Defense
 EPH = extractable petroleum hydrocarbon
 GC/MS = gas chromatography/mass spectrometry

ICP = inductively coupled plasma
 QC = quality control
 SOP = standard operating procedure
 VPH = volatile petroleum hydrocarbon

Table 3-12. Laboratory Instrument Quality Control – Soil-Vapor Monitoring

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Daily/regular as specified.	Air samples	Instrument operating parameters	Daily.	Per SOP.	Recalibrate/ stop for service on failure.	RTI Laboratory Analyst and Laboratory Manager	RTI SOP TO15_083109_R0_1_v1
GC	Daily during use.	Air/gas samples	Instrument operating parameters	Daily.	Per SOP.	Recalibrate/ stop for service on failure.	RTI Laboratory Analyst and Laboratory Manager	RTI SOP TO15_083109_R0_1_v1
Decon/Cleaning Oven	Vacuum/helium adjust.	None	Temperature /flow	Daily.	1 clean check per batch.		RTI Laboratory Analyst and Laboratory Manager	RTI SOP TO15_083109_R0_1_v1

Notes:

GC = gas chromatography

GC/MS = gas chromatography/mass spectrometry

SOP = standard operating procedure

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Table 3-13. Analytical Instrument Calibration - Gas Chromatography/Mass Spectrometry

Matrix	Groundwater, Soil, and Soil Vapor				
Analytical Group	VOCs, SVOCs, and APH				
Analytical Method	EPA Methods 8260B, 8270D; MA DEP, TO15				
Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions
GC/MS	<p><u>EPA 8260B, MA DEP and TO15:</u> Check of mass spectral ion intensities (tuning procedure) using bromofluorobenzene.</p> <p><u>EPA 8270D:</u> Check of mass spectral ion intensities (tuning procedure) using decafluorotriphenylphosphine in accordance with DoD QSM requirements</p>	<p><u>EPA 8260B and EPA 8270D:</u> Prior to initial calibration and every 12 hours during sample analysis.</p> <p><u>TO15 and MA DEP:</u> Prior to initial calibration and meet frequency requirements specified in the method.</p>	Must meet the method requirements before samples are analyzed.	Retune instrument and verify the tune acceptability, rerun the affected samples.	Lab Manager/Analyst
	Five-point initial calibration for target analytes, lowest calibration standard at or near the LOQ in accordance with DoD QSM requirements.	Initial calibration prior to sample analysis.	<p><u>EPA 8260B:</u> The minimum average system performance check compound response factor is 0.1 for chloromethane, 1,1-dichloroethane, and bromoform; and 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane.</p> <p><u>EPA 8270D:</u> The minimum average system performance check compound response factor is 0.05.</p> <p><u>EPA 8260B and EPA 8270D:</u> RSD is less than 30% in accordance with DoD QSM requirements.</p> <p><u>TO15 and MA DEP:</u> RSD is less than 30% per method requirements.</p>	Correct problem, then rerun initial calibration in accordance with DoD QSM/method requirements.	Lab Manager/Analyst

Table 3-13. Analytical Instrument Calibration (Gas Chromatography/Mass Spectrometry) (continued)

Matrix	Groundwater, Soil, and Soil Vapor				
Analytical Group	VOCs, SVOCs, and APH				
Analytical Method	EPA Methods 8260B, 8270D; MA DEP, TO15				
Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions
GC/MS	Second-source calibration verification in accordance with DoD QSM requirements.	Once per five-point initial calibration.	<u>EPA 8260B and EPA 8270D</u> : Less than 20% difference for all target analytes in accordance with DoD QSM requirements. <u>MA DEP</u> : 70-130% recovery through LCS analysis per method requirements.	Correct problem, then rerun second source calibration verification in accordance with DoD QSM/method requirements.	Lab Manager/Analyst
	Daily calibration verification in accordance with DoD QSM requirements.	Before sample analysis and every 12 hours of analysis.	<u>EPA 8260B</u> : The minimum average system performance check compound response factor is 0.1 for chloromethane, 1,1-dichloroethane, and bromoform; and 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane. <u>EPA 8270D</u> : The minimum average system performance check compound response factor is 0.05. <u>EPA 8260B and EPA 8270D</u> : Less than 20% difference for all target analytes in accordance with DoD QSM requirements <u>TO15 and MA DEP</u> : Less than 30% difference for all target analytes per method requirements.	Correct problem, then rerun calibration verification in accordance with DoD QSM/method requirements.	Lab Manager/Analyst
	Breakdown check.	Before sample analysis and every 12 hours of analysis.	<u>EPA 8270D</u> : Degradation less than 20% for DDT. Benzidine and pentachlorophenol are present at normal response and not greater than a tailing factor of 2.	Correct problem, then rerun breakdown check.	Lab Manager/Analyst

Table 3-13. Analytical Instrument Calibration (Gas Chromatography/Mass Spectrometry) (concluded)*Notes:**% = percent**APH = air phase petroleum hydrocarbon**DDT = dichlorodipheyl trichloroethane**DoD = U.S. Department of Defense**EPA = U.S. Environmental Protection Agency**GC/MS = gas chromatography/mass spectrometry**LCS = laboratory control sample**LOQ = limit of quantitation**MA DEP = Massachusetts Department of Environmental Protection**QSM = Quality Systems Manual**RSD = relative standard deviation**SVOC = semivolatile organic compound**VOC = volatile organic compound*

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Table 3-14. Analytical Instrument Calibration (Gas Chromatography)

Matrix	Groundwater, Soil, and Soil Vapor				
Analytical Group	EDB, TPH, VPH/EPH, Fixed Gases, Stable Isotopes				
Analytical Method	EPA Methods 8011 and 8015B, MA DEP, ASTM 2504, SOPs				
Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions
GC	<p>Minimum five-point initial calibration for target analytes, lowest calibration standard at or near the LOQ in accordance with DoD QSM requirements.</p> <p>Stable Isotope: perform external calibration of working standard per laboratory SOPs.</p>	Initial calibration prior to sample analysis.	<p><u>EPA 8011, EPA 8015B, ASTM 2504</u>: RSD less than or equal to 20% for all target analytes in accordance with DoD QSM requirements.</p> <p><u>MA DEP</u>: RSD less than 25% for all target analytes per method requirements.</p> <p><u>Stable Isotope SOPs</u>: RSD less than 0.5% per method requirements.</p>	Correct problem, then rerun initial calibration in accordance with DoD QSM requirements.	Lab Manager/Analyst
	Second-source calibration verification.	Once per five-point initial calibration.	<p><u>EPA 8011, EPA 8015B, ASTM 2504</u>: Less than 20% of expected values from the initial calibration for all target analytes in accordance with DoD QSM requirements.</p> <p><u>MA DEP</u>: Less than 25% of expected values from the initial calibration for all target analytes per method requirements.</p>	Correct problem, then rerun second source calibration verification in accordance with DoD QSM requirements.	Lab Manager/Analyst

Table 3-14. Analytical Instrument Calibration (Gas Chromatography) (concluded)

Matrix	Groundwater, Soil, and Soil Vapor				
Analytical Group	EDB, TPH, VPH/EPH, Fixed Gases, Stable Isotopes				
Analytical Method	EPA Methods 8011 and 8015B, MA DEP, ASTM 2504, SOPs				
Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions
GC	Daily calibration verification.	<u>EPA 8011 and EPA 8015B</u> : Before sample analysis and every 10 samples. <u>MA DEP, ASTM 2504</u> : Before sample analysis and at frequency specified in the method.	<u>EPA 8011, EPA 8015B, ASTM 2504</u> : Less than 20% of expected values from the initial calibration for all target analytes in accordance with DoD QSM requirements. <u>MA DEP</u> : Less than 25% of expected values from the initial calibration for all target analytes per method requirements.	Correct problem, then rerun calibration verification in accordance with DoD QSM requirements.	Lab Manager/ Analyst

Notes:

% = percent

ASTM = ASTM International

DoD = U.S. Department of Defense

EDB = ethylene dibromide

EPA = U.S. Environmental Protection Agency

EPH = extractable petroleum hydrocarbon

GC = gas chromatography

LOQ = limit of quantitation

MA DEP = Massachusetts Department of Environmental Protection

QSM = Quality Systems Manual

RSD = relative standard deviation

SOP = standard operating procedure

TPH = total petroleum hydrocarbon

VPH = volatile petroleum hydrocarbon

Table 3-15. Analytical Instrument Calibration (Inductively Coupled Plasma Atomic Emission Spectrometry)

Matrix	Groundwater and Soil				
Analytical Group	Metals				
Analytical Method	EPA Method 6010C				
Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions
ICP	Initial calibration with a minimum of one high standard and one calibration blank in accordance with DoD QSM requirements.	Initial calibration prior to sample analysis.	Correlation coefficient greater than 0.995 in accordance with DoD QSM requirements.	Correct problem, then repeat initial calibration in accordance with DoD QSM requirements.	Lab Manager/Analyst
	Low standard at or near the LOQ in accordance with DoD QSM requirements (ICP/MS only).	Daily after one-point initial calibration.	Within 20% difference from initial calibration for all target analytes in accordance with DoD QSM requirements.	Correct problem, then rerun low standard in accordance with DoD QSM requirements.	Lab Manager/Analyst
	Second source calibration standard, prepared at the calibration midpoint in accordance with DoD QSM requirements.	Once per initial calibration, prior to sample analysis.	Within 10% difference from the expected value for all target analytes in accordance with DoD QSM requirements.	Correct problem, then rerun second source calibration in accordance with DoD QSM requirements.	Lab Manager/Analyst

Table 3-15. Analytical Instrument Calibration (Inductively Coupled Plasma Atomic Emission Spectrometry (concluded))

Matrix	Groundwater and Soil				
Analytical Group	Metals				
Analytical Method	EPA Method 6010C				
Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions
ICP	CCV in accordance with DoD QSM requirements.	Following initial calibration, after every 10 samples and the end of the sequence.	Within 10% difference from initial calibration for all target analytes.	Correct problem, then repeat CCV in accordance with DoD QSM requirements.	Lab Manager/Analyst

Notes:

% = percent

CCV = continuing calibration verification

DoD = U.S. Department of Defense

EPA = U.S. Environmental Protection Agency

ICP = inductively coupled plasma

LOQ = limit of quantitation

MS = mass spectrometry

QSM = Quality Systems Manual

Table 3-16. Analytical Instrument Calibration (Ion Chromatography/Colorimetric)

Matrix	Groundwater				
Analytical Group	Anions and Ammonia				
Analytical Method	EPA Method 300.0, SM4500B, D				
Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions
IC/Colorimetric	<u>EPA 300.0 and SM4500B, D</u> : Initial calibration with a minimum of three calibration standards and one calibration blank	<u>EPA 300.0 and SM4500B, D</u> : Initial calibration prior to sample analysis	<u>EPA 300.0 and SM4500B, D</u> : Correlation coefficient greater than 0.995	<u>EPA 300.0 and SM4500B, D</u> : Correct problem, then repeat initial calibration	Lab Manager/Analyst
	<u>EPA 300.0 and SM4500B, D</u> : Initial calibration verification, prepared at the calibration midpoint.	<u>EPA 300.0 and SM4500B, D</u> : Once after initial calibration, before sample analysis	<u>EPA 300.0 and SM4500B, D</u> : Less than 10% difference from initial calibration for all target analytes	<u>EPA 300.0 and SM4500B, D</u> : Correct problem, then rerun initial calibration verification	Lab Manager/Analyst
	<u>EPA 300.0 and SM4500B, D</u> : CCV	<u>EPA 300.0 and SM4500B, D</u> : Following initial calibration, after every 10 samples and the end of the sequence	<u>EPA 300.0 and SM4500B, D</u> : Less than 10% difference from initial calibration for all target analytes	<u>EPA 300.0 and SM4500B, D</u> : Correct problem, then repeat CCV	Lab Manager/Analyst

Notes:

CCV = continuing calibration verification

EPA = U.S. Environmental Protection Agency.

IC = ion chromatography

SM = standard method

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