Part 2 of Phase I Remedial Investigation for Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6

Contents

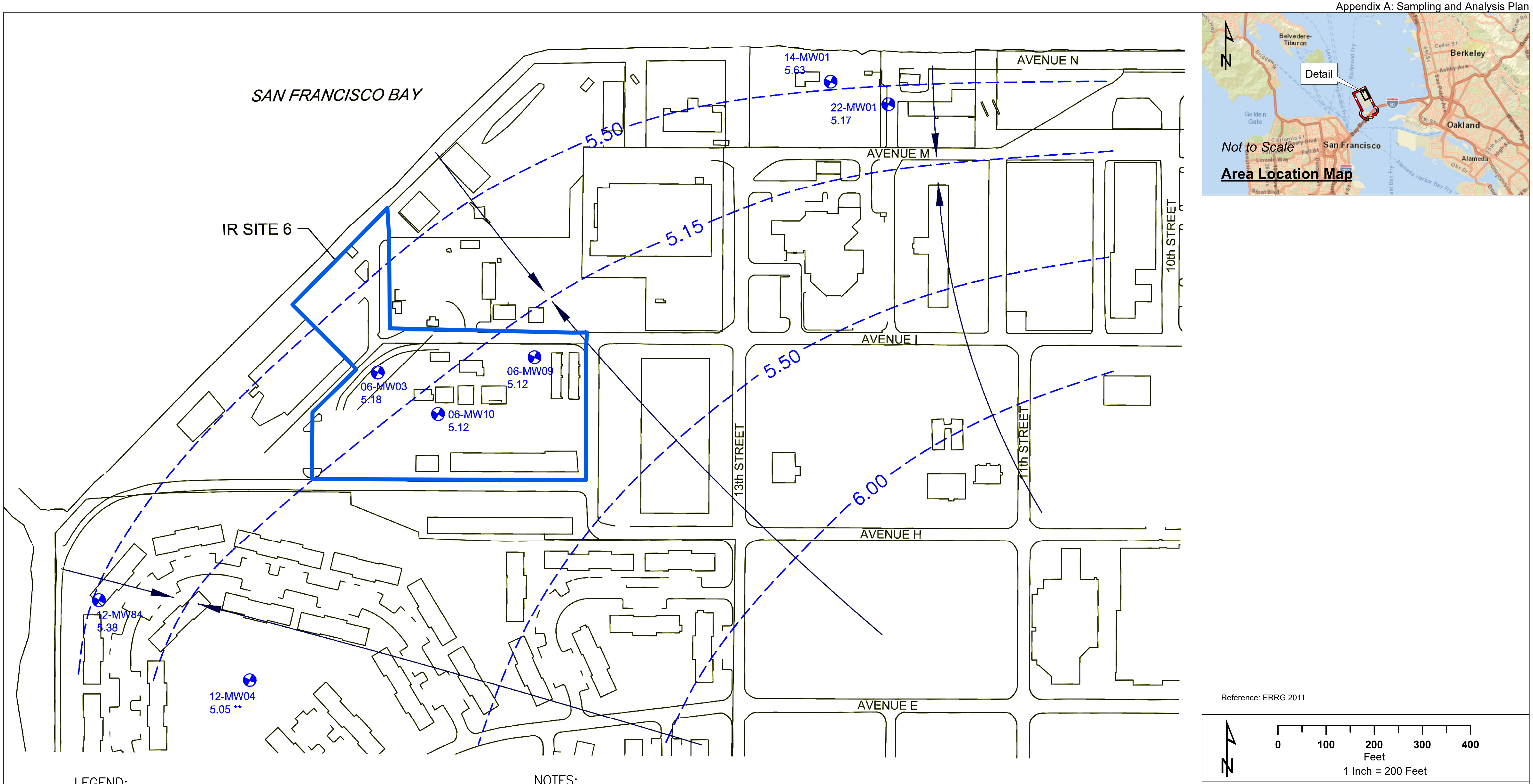
Starts at Figure A-7 of Appendix A and includes Figures through A-13

Attachments 1 – 4 of Appendix A

Appendix B

Appendix C

Appendix D



Reference: ERRG 2011

LEGEND:

06-MW09 5.12 ⊕ MONITORING WELL AND GROUNDWATER ELEVATION IN FEET

5.50 – – – ESTIMATED GROUNDWATER ELEVATION CONTOUR

← INFERRED GROUNDWATER FLOW DIRECTION

═ ROAD

☐ BUILDING

NOTES:

1. ELEVATIONS ARE IN FEET ABOVE THE TREASURE ISLAND MEAN LOWER LOW WATER DATUM.
2. WATER LEVEL DATA COLLECTED AT HIGH TIDE AUGUST 3, 1995.

** VALUE ESTIMATED FROM AUGUST 1, 1995 DATA.

SOURCE:

PHASE IIA REMEDIAL INVESTIGATION TIDAL INFLUENCE STUDY, SUMMARY OF RESULTS
NAVAL STATION TREASURE ISLAND SAN FRANCISCO, CALIFORNIA
(PRC,1995)

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

Groundwater Elevations Contour Map
August 1995 Tidal Study

PROJECT NO.:	5026-20-4451
DATE:	February 2022
DRAWN BY:	KOB
CHECKED BY:	LC

FIGURE
A-7

Path: D:\FilesFromWork\5026-20-4451_TreasureIsland_PFAS_IRP6\GIS\Figs_TI_RI_WP_IRP6_Jan2021\FigA07_TI_Site6_Soil_HistoricTidal.mxd

Date: 1/31/2022

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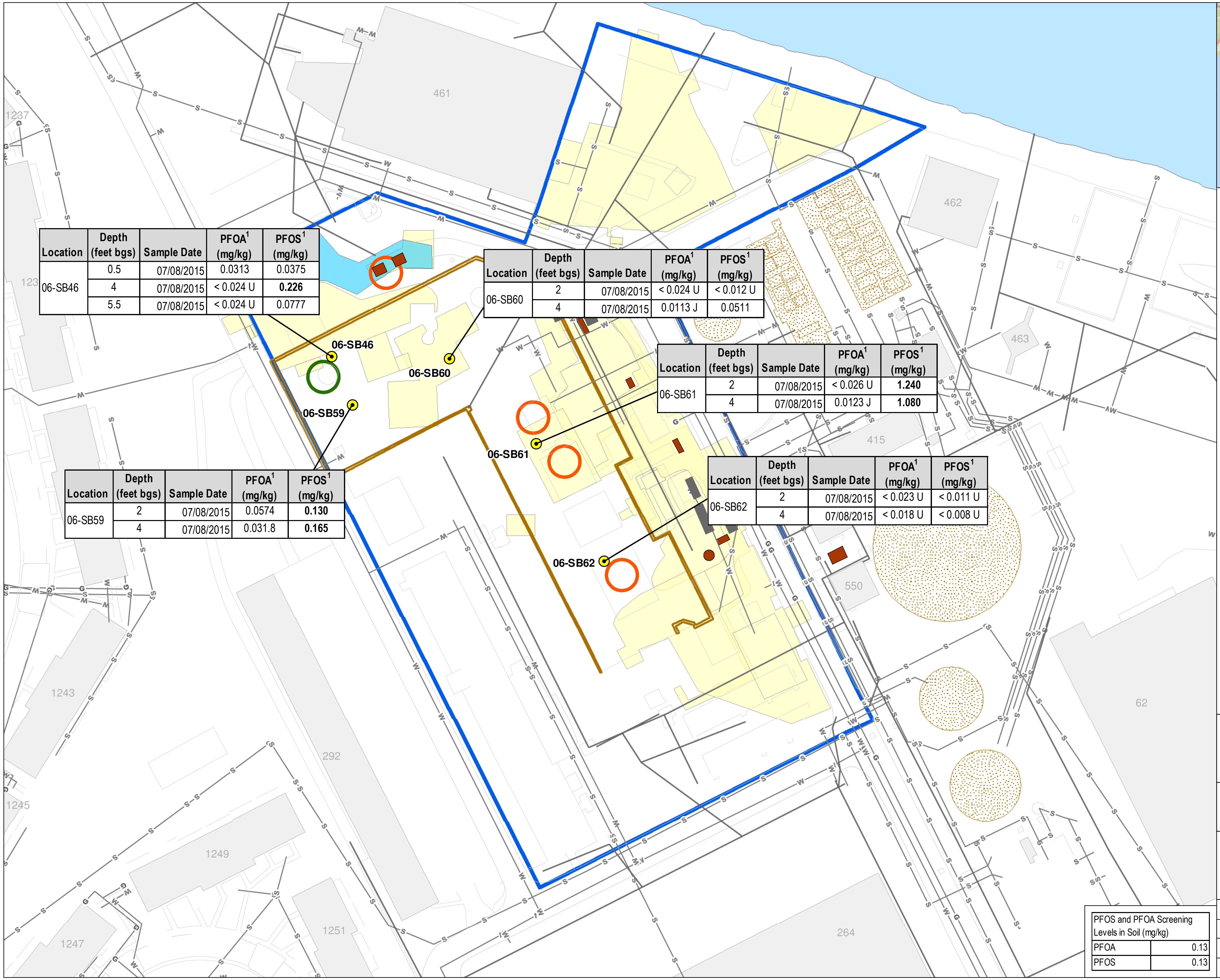


Location	Depth (feet bgs)	Sample Date	PFOA[1] (mg/kg)	PFOS[1] (mg/kg)
06-SB46	0.5	07/08/2015	0.0313	0.0375
	4	07/08/2015	< 0.024 U	**0.226**
	5.5	07/08/2015	< 0.024 U	0.0777

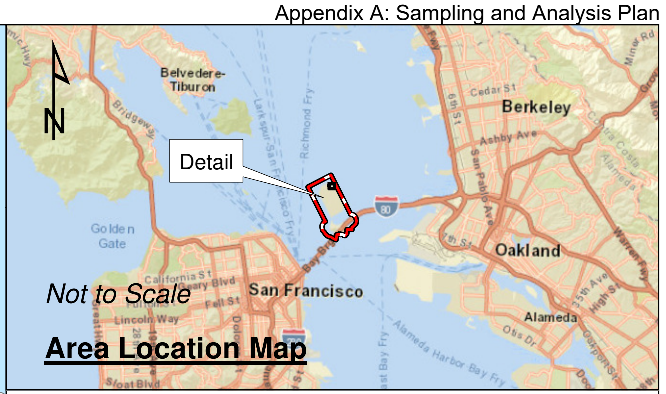
Location	Depth (feet bgs)	Sample Date	PFOA[1] (mg/kg)	PFOS[1] (mg/kg)
06-SB60	2	07/08/2015	< 0.024 U	< 0.012 U
	4	07/08/2015	0.0113 J	0.0511

Location	Depth (feet bgs)	Sample Date	PFOA[1] (mg/kg)	PFOS[1] (mg/kg)
06-SB61	2	07/08/2015	< 0.026 U	**1.240**
	4	07/08/2015	0.0123 J	**1.080**

Location	Depth (feet bgs)	Sample Date	PFOA[1] (mg/kg)	PFOS[1] (mg/kg)
06-SB59	2	07/08/2015	0.0574	**0.130**
	4	07/08/2015	0.031.8	**0.165**

Location	Depth (feet bgs)	Sample Date	PFOA[1] (mg/kg)	PFOS[1] (mg/kg)
06-SB62	2	07/08/2015	< 0.023 U	< 0.011 U
	4	07/08/2015	< 0.018 U	< 0.008 U

PFOS and PFOA Screening Levels in Soil (mg/kg)	
PFOA	0.13
PFOS	0.13



Area Location Map

Legend

- ● Previous Soil Boring
- ― Utilities
- ― Collector Trench
- ■ Oil/Water Seperator System Component
- ▭ Former Burn Area
- ▭ Suspected Former Burn Pit
- ▨ Former Excavation
- ▨ Extent of Petroleum Corrective Action Soil Excavation (July 2013)
- ■ Former Tanks (AST/UST)
- ▨ Wastewater Treatment Plant
- ▨ Building
- ▭ IRP Site 6 Location
- ▭ Treasure Island Boundary

Notes:
Bold = exceeds screening criteria
[1] Only PFOS and PFOA were analyzed as these were the only PFAS with screening levels established at the time of sampling. Department of Defense . 2021. Memorandum on Investigating Per- and Polyfluoroalkyl Substances with the Department of Defense Cleanup Program, Residential Scenario Screening Levels. September 15.

AST = Aboveground Storage Tank
bgs = below grouind surface
IRP = Installation Restoration Program
J = Value is estimated between the Detection Limit (Method Detection Limit) and the Limit of Detection (Reporting Limit)
mg/kg = milligrams per kilogram
PFAS = per- and polyfluorinated substances
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
U = Chemical not detected at or above indicated limit of detection value
UST = Underground Storage Tank

Basemap Source: ESRI Online Streaming Service 2021

N
0 40 80 120 160
Feet
1 Inch = 80 Feet

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

Previous Soil Sampling Results

PROJECT NO.:	5026-20-4451
DATE:	February 2022
DRAWN BY:	KOB
CHECKED BY:	LC

NAVFAC

FIGURE
A-8

Date: 1/31/2022 Path: D:\FilesFromWork\5026-20\4451_TreasureIsland_PFAS_IRP6\GIS\Figs_TI_RI_WP_IRP6_Jan2021\FigA08_TI_Site6_Soil_Historic.mxd

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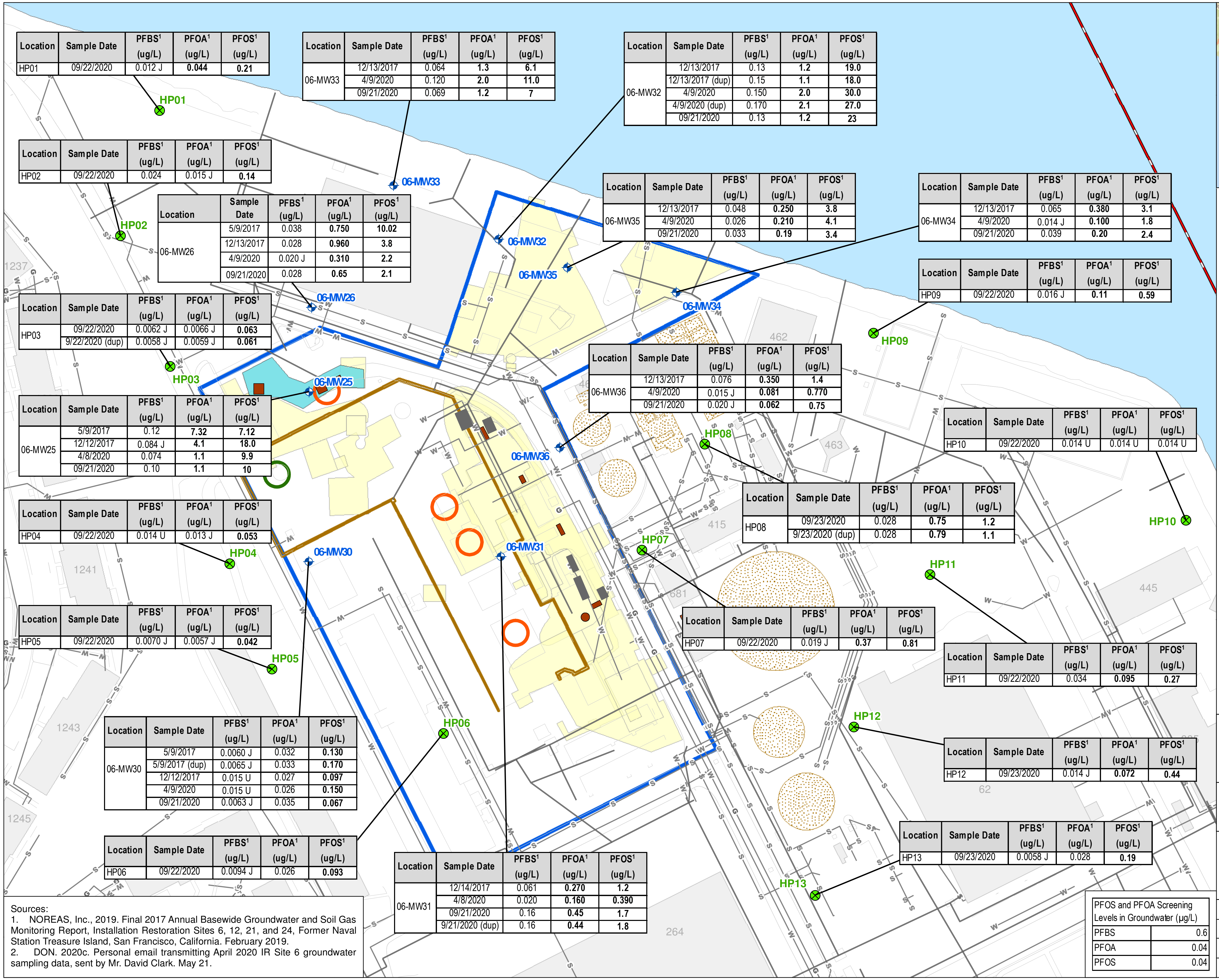


Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP01	09/22/2020	0.012 J	**0.044**	**0.21**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW33	12/13/2017	0.064	**1.3**	**6.1**
	4/9/2020	0.120	**2.0**	**11.0**
	09/21/2020	0.069	**1.2**	**7**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW32	12/13/2017	0.13	**1.2**	**19.0**
	12/13/2017 (dup)	0.15	**1.1**	**18.0**
	4/9/2020	0.150	**2.0**	**30.0**
	4/9/2020 (dup)	0.170	**2.1**	**27.0**
	09/21/2020	0.13	**1.2**	**23**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP02	09/22/2020	0.024	0.015 J	**0.14**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW26	5/9/2017	0.038	**0.750**	**10.02**
	12/13/2017	0.028	**0.960**	**3.8**
	4/9/2020	0.020 J	**0.310**	**2.2**
	09/21/2020	0.028	**0.65**	**2.1**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW35	12/13/2017	0.048	**0.250**	**3.8**
	4/9/2020	0.026	**0.210**	**4.1**
	09/21/2020	0.033	**0.19**	**3.4**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW34	12/13/2017	0.065	**0.380**	**3.1**
	4/9/2020	0.014 J	**0.100**	**1.8**
	09/21/2020	0.039	**0.20**	**2.4**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP09	09/22/2020	0.016 J	**0.11**	**0.59**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP03	09/22/2020	0.0062 J	0.0066 J	**0.063**
	9/22/2020 (dup)	0.0058 J	0.0059 J	**0.061**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW36	12/13/2017	0.076	**0.350**	**1.4**
	4/9/2020	0.015 J	**0.081**	**0.770**
	09/21/2020	0.020 J	**0.062**	**0.75**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW25	5/9/2017	0.12	**7.32**	**7.12**
	12/12/2017	0.084 J	**4.1**	**18.0**
	4/8/2020	0.074	**1.1**	**9.9**
	09/21/2020	0.10	**1.1**	**10**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP10	09/22/2020	0.014 U	0.014 U	0.014 U

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP08	09/23/2020	0.028	**0.75**	**1.2**
	9/23/2020 (dup)	0.028	**0.79**	**1.1**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP04	09/22/2020	0.014 U	0.013 J	**0.053**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP05	09/22/2020	0.0070 J	0.0057 J	**0.042**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP07	09/22/2020	0.019 J	**0.37**	**0.81**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP11	09/22/2020	0.034	**0.095**	**0.27**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW30	5/9/2017	0.0060 J	0.032	**0.130**
	5/9/2017 (dup)	0.0065 J	0.033	**0.170**
	12/12/2017	0.015 U	0.027	**0.097**
	4/9/2020	0.015 U	0.026	**0.150**
	09/21/2020	0.0063 J	0.035	**0.067**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP12	09/23/2020	0.014 J	**0.072**	**0.44**

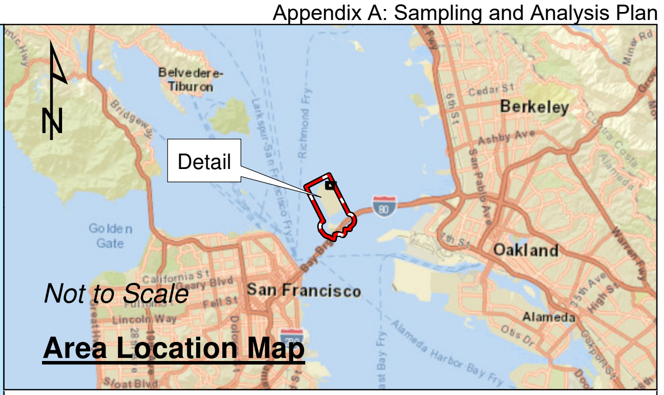
Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP06	09/22/2020	0.0094 J	0.026	**0.093**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
06-MW31	12/14/2017	0.061	**0.270**	**1.2**
	4/8/2020	0.020	**0.160**	**0.390**
	09/21/2020	0.16	**0.45**	**1.7**
	9/21/2020 (dup)	0.16	**0.44**	**1.8**

Location	Sample Date	PFBS[1] (ug/L)	PFOA[1] (ug/L)	PFOS[1] (ug/L)
HP13	09/23/2020	0.0058 J	0.028	**0.19**

Sources:
1. NOREAS, Inc., 2019. Final 2017 Annual Basewide Groundwater and Soil Gas Monitoring Report, Installation Restoration Sites 6, 12, 21, and 24, Former Naval Station Treasure Island, San Francisco, California. February 2019.
2. DON. 2020c. Personal email transmitting April 2020 IR Site 6 groundwater sampling data, sent by Mr. David Clark. May 21.

PFOS and PFOA Screening Levels in Groundwater (µg/L)	
PFBS	0.6
PFOA	0.04
PFOS	0.04



Area Location Map

Legend

- ⊗ Temporary Well Sampling
- ⌖ Existing Groundwater Monitoring Well
- — Utilities
- — Collector Trench
- ■ Oil/Water Seperator System Component
- ▭ Former Burn Area
- ▭ Suspected Former Burn Pit
- ■ Former Excavation
- ■ Extent of Petroleum Corrective Action Soil Excavation (July 2013)
- ■ Former Tanks (AST/UST)
- ▨ Wastewater Treatment Plant
- ■ Building
- ▭ IRP Site 6 Location
- ▭ Former Naval Station Treasure Island Boundary

Notes:
Bold = exceeded screening criteria
[1] Screening criteria for groundwater sample results follows Department of Defense . 2021. Memorandum on Investigating Per- and Polyfluoroalkyl Substances with the Department of Defense Cleanup Program, Residential Scenario Screening Levels. September 15.

-- = not analyzed
µg/L = microgram(s) per liter
AST = Aboveground Storage Tank
dup = field duplicate sample
IRP = Installation Restoration Program
J = Value is estimated between the Detection Limit (Method Detection Limit) and the Limit of Detection (Reporting Limit)
PFAS = per- and polyfluorinated substances
PFBS = perfluorobutanesulfonic acid;
PFOA = perfluorooctanoic acid
PFOS = perfluorooctane sulfonate
U = analyte not reported at or above the method detection limit.
UST = Underground Storage Tank

Basemap Source: ESRI Online Streaming Service 2021

N
0 50 100 150 200
Feet
1 Inch = 100 Feet

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

Previous Groundwater Sampling Results

PROJECT NO.:	**5026-20-4451**
DATE:	**February 2022**
DRAWN BY:	**KOB**
CHECKED BY:	**LC**

NAVFAC

FIGURE
A-9

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Date: 1/31/2022

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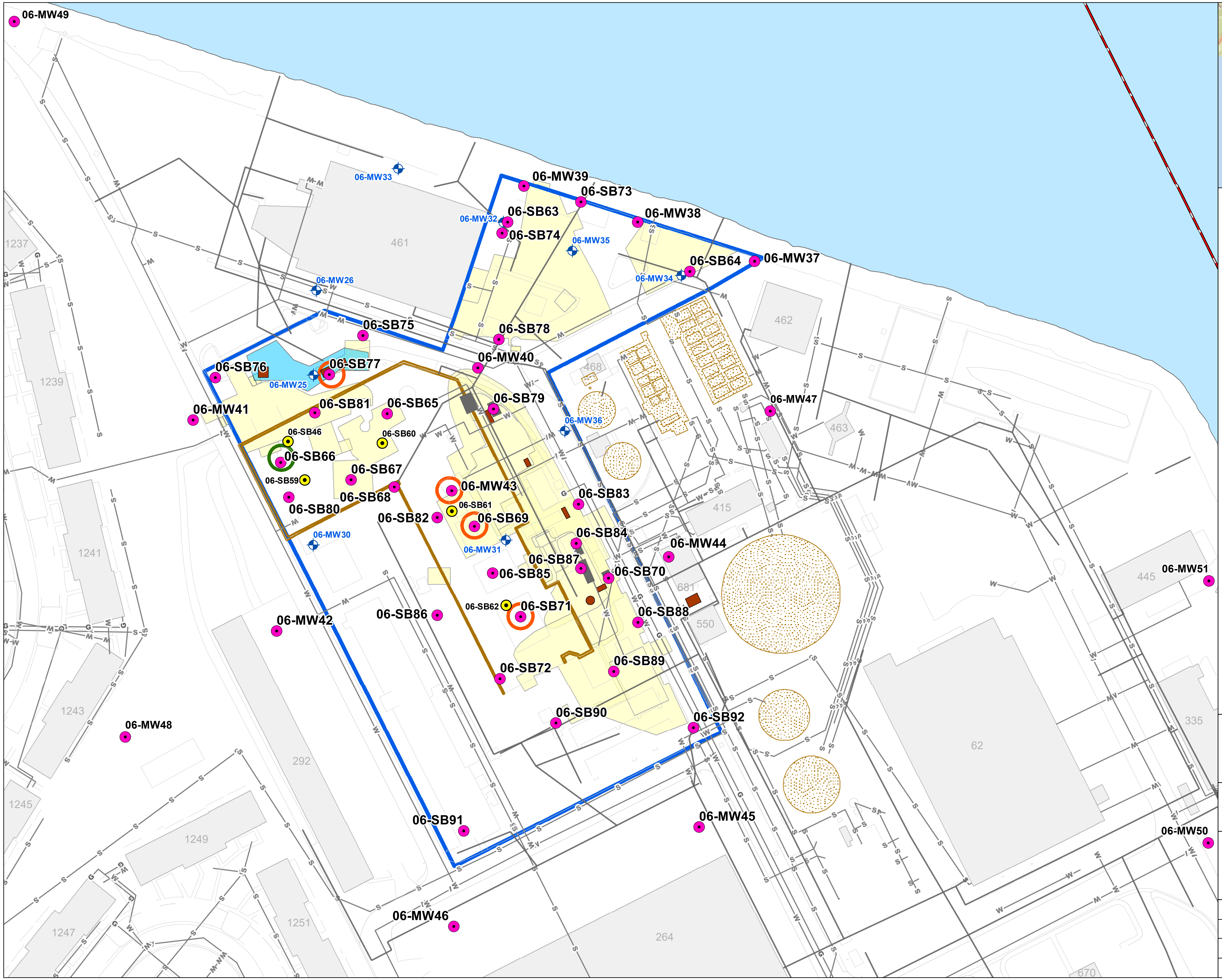

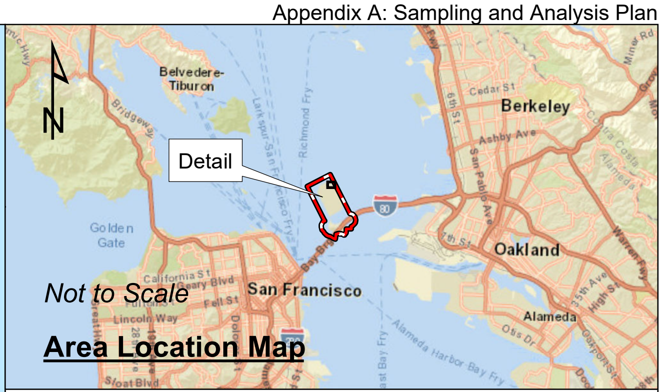

Not to Scale

Area Location Map

Legend

●	Proposed Soil Boring and Geochemical Sampling Location
●	Previous Soil Boring
⊕	Existing Groundwater Monitoring Well
—	Utilities
—	Collector Trench
■	Oil/Water Seperator System Component
☐	Former Burn Area
☐	Suspected Former Burn Pit
■	Former Excavation
■	Extent of Petroleum Corrective Action Soil Excavation (July 2013)
■	Former Tanks (AST/UST)
▨	Wastewater Treatment Plant
■	Building
☐	IRP Site 6 Location
☐	Treasure Island Boundary

Notes:
AST = Aboveground Storage Tank
IRP = Installation Restoration Program
PFAS = Per- and Polyfluoroalkyl Substances
UST = Underground Storage Tank

Basemap Source: ESRI Online Streaming Service 2021

N

0 50 100 150 200
Feet
1 Inch = 100 Feet

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

Proposed Soil Sampling Location Map

PROJECT NO.:	5026-20-4451
DATE:	February 2022
DRAWN BY:	KOB
CHECKED BY:	LC

NAVFAC

FIGURE
A-10

Path: D:\FilesFromWork\5026-20-4451_TreasureIsland_PFAS_IRP6\GIS\Figs_TI_RI_WP_IRP6_Jan2021\FigA10_TI_Site6_Soil_Proposed.mxd

Date: 3/10/2022

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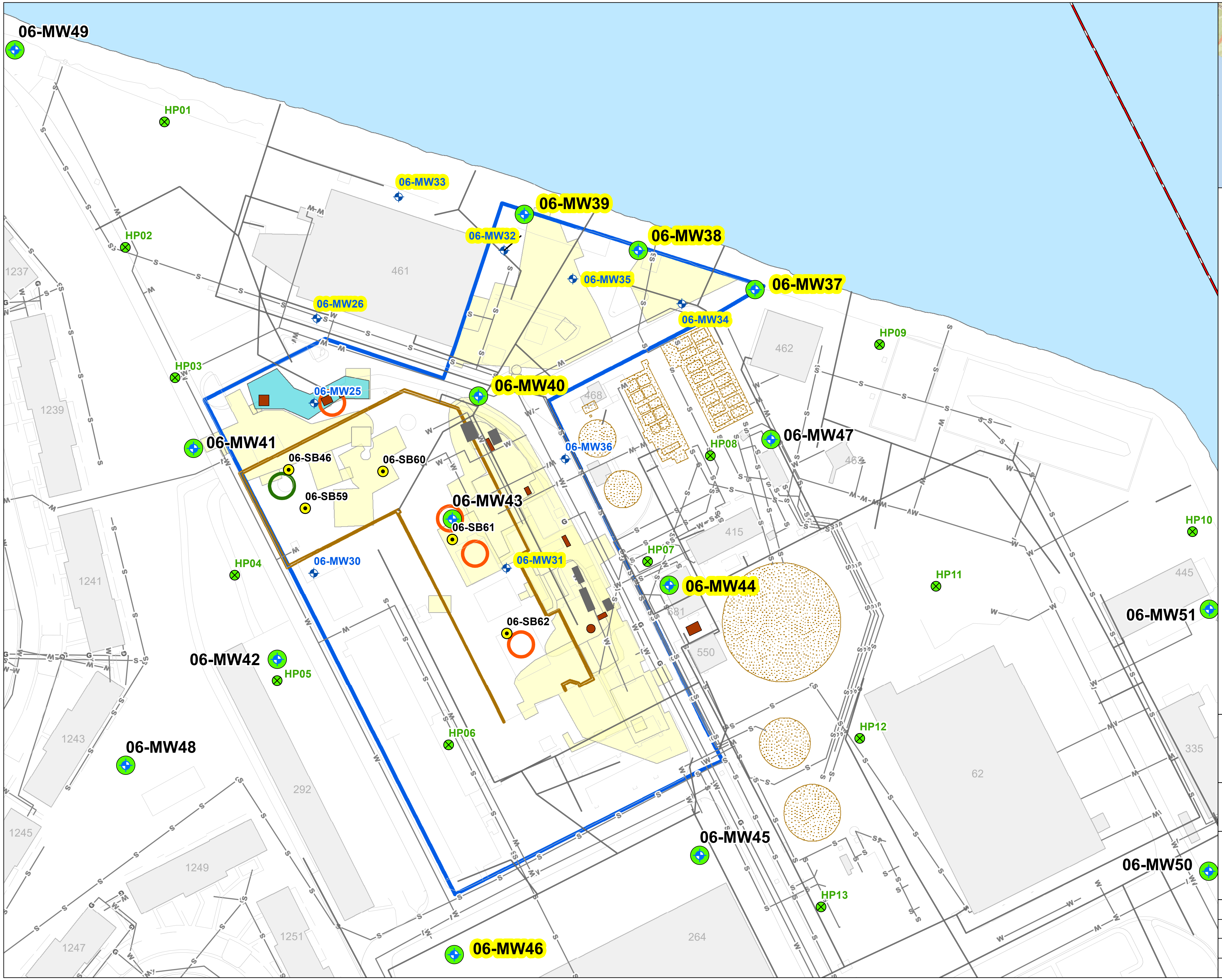

Legend

- Proposed Groundwater Monitoring Well
- Previous Soil Boring
- Temporary Well Sampling
- Existing Groundwater Monitoring Well
- Utilities
- Collector Trench
- Oil/Water Seperator System Component
- Former Burn Area
- Suspected Former Burn Pit
- Former Excavation
- Extent of Petroleum Corrective Action Soil Excavation (July 2013)
- Former Tanks (AST/UST)
- Wastewater Treatment Plant
- Building
- IRP Site 6 Location
- Treasure Island Boundary

Notes:
Yellow Highlighted Wells Indicate Tidal Influence Study Well

AST = Aboveground Storage Tank
IRP = Installation Restoration Program
PFAS = Per- and Polyfluoroalkyl Substances
UST = Underground Storage Tank

Basemap Source: ESRI Online Streaming Service 2021

N
0 50 100 150 200
Feet
1 Inch = 100 Feet

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

Proposed Groundwater Sampling Location Map

PROJECT NO.: 5026-20-4451
DATE: February 2022
DRAWN BY: KOB
CHECKED BY: LC

FIGURE
A-11

Date: 3/10/2022 Path: D:\FilesFromWork\5026-20\4451_TreasureIsland_PFAS_IRP6\GIS\Figs_TI_RI_WP_IRP6_Jan2021\FigA11_TI_Site6_GW_Proposed.mxd

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Project No: 5026204451

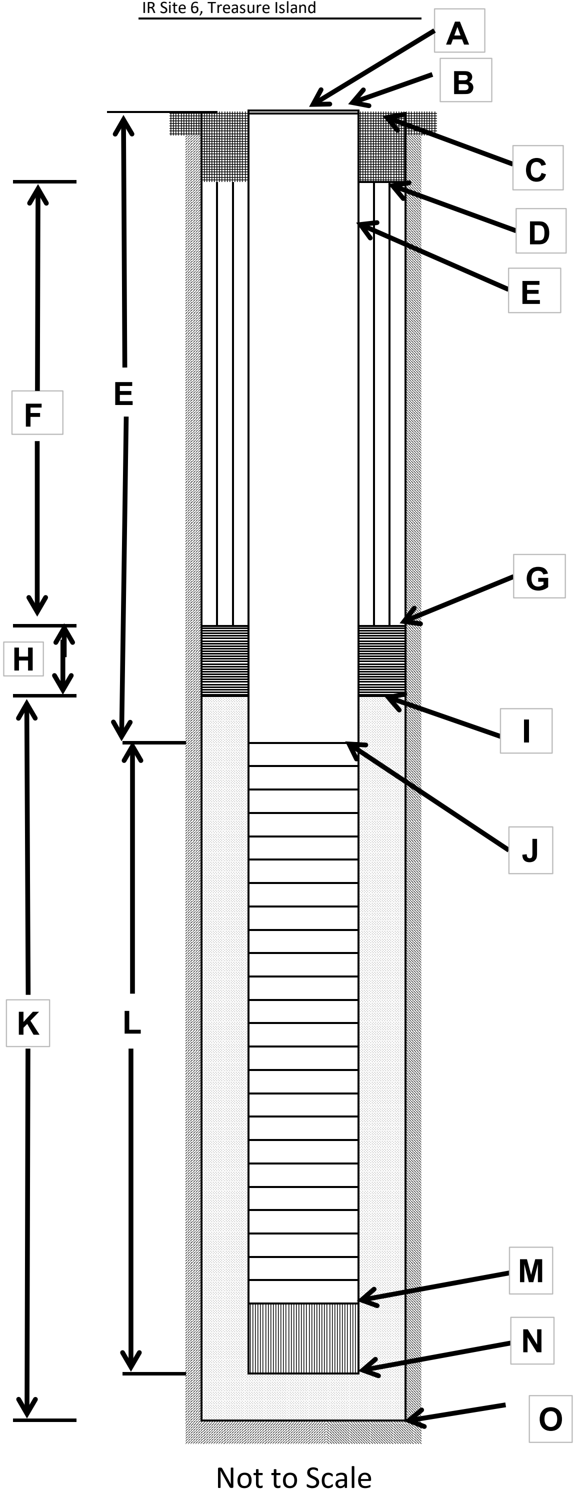
Project Name: Treasure Island PFAS RI

Site Address: IR Site 6, Treasure Island

Well ID:

Borehole Diameter (in): 8.5

Casing Diameter (in): 2" PVC



Not to Scale

	Depth ft BGS	Description
A		Lockable J-plug/compression cap
B		Flush-mounted well vault
C		Top of Cement in Borehole
D		Bottom of Cement and Top of Grout Seal
E		2-inch PVC, SCH 40 Blank casing
F		Grout Seal. Type:
G		Bottom of Grout Seal and Top of Transition Seal (Bentonite Chips)
H		Bentonite Chips Seal Hydrated in Place
I		Top of Transition Sand and Bottom of Transition Seal
J		Top of Screen and Bottom of Blank Casing
K		Filter Pack Interval. Type:
L		Screen Interval, SCH 40 PVC with 0.010 inch slots
M		Bottom of Screen, Top of Sump
N		Bottom of sump (bottom of casing)
O		Bottom of Borehole

PROJECT NO:	**5026-20-4451**	Sampling and Analysis Plan Remedial Investigation for PFAS at Installation Restoration Site 6 Former Naval Station Treasure Island San Francisco, California	**FIGURE**
DATE:	**November 2020**		
DRAWN BY:	**CH**	**Conceptual Monitoring Well Diagram**	**A-12**
CHECKED BY:	**LC**		

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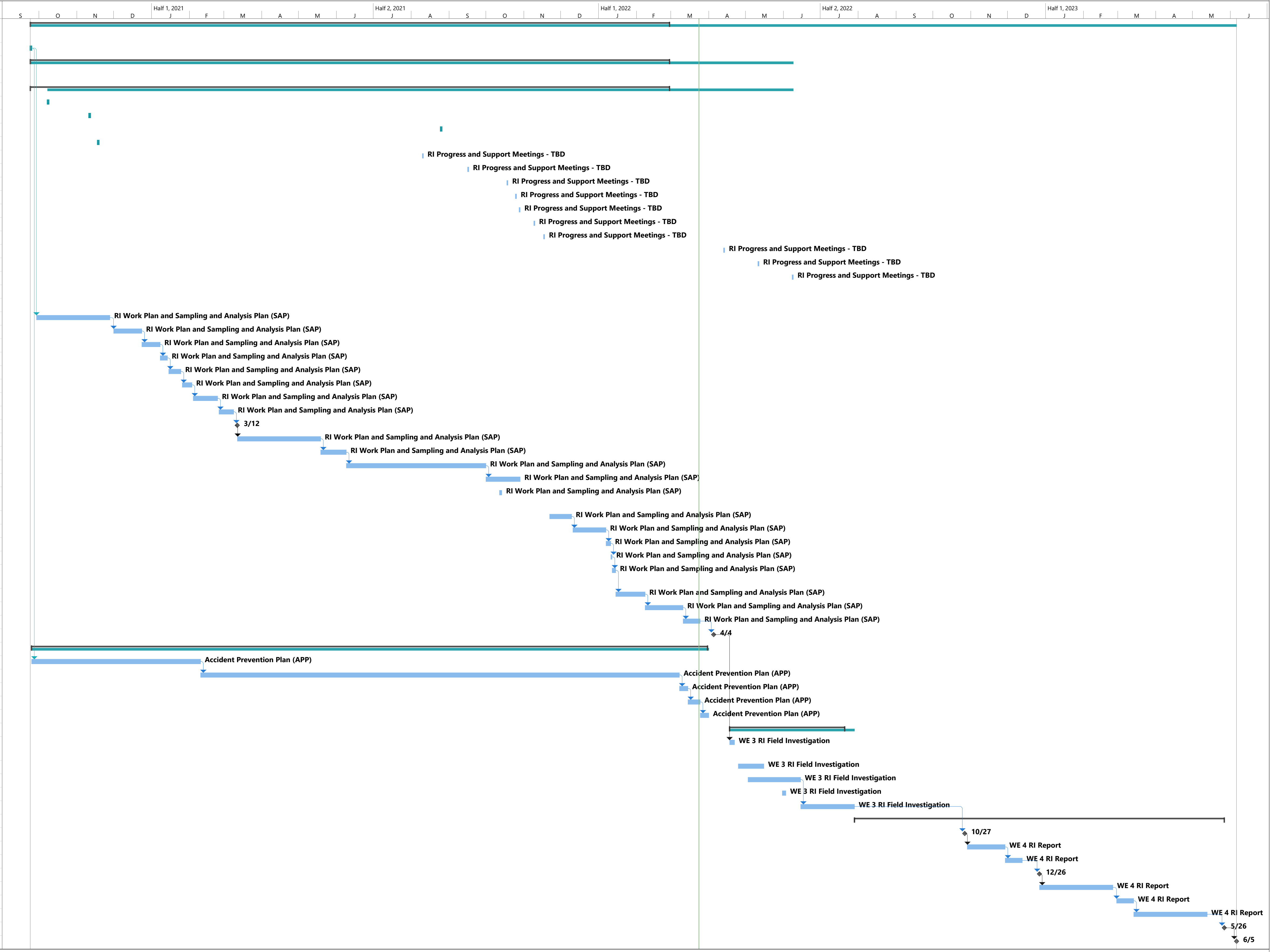
Figure A-13 Project Schedule
Remedial Investigation for PFAS at Installation Restoration Site 6
Naval Station Treasure Island, San Francisco, California

ID	Task Name	Duration	Start	Finish
1	**N62470-19-D-4010 PTO X0842 IR Site 6 Remedial Investigation for PFAS (24-Month POP)**	**522 edays?**	**Thu 9/24/20**	**Mon 2/28/22**
2	Contract Award	1 eday	Thu 9/24/20	Fri 9/25/20
3	**Work Element (WE) 1 Project Management**	**522 edays?**	**Thu 9/24/20**	**Mon 2/28/22**
4	Monthly Status Reports	521 edays	Fri 9/25/20	Mon 2/28/22
5	**RI Progress and Support Meetings - TBD**	***522 edays?***	***Thu 9/24/20***	***Mon 2/28/22***
6	RI Kickoff Meeeting	1 eday	Thu 10/8/20	Fri 10/9/20
7	RI Planning Meeting with BRAC PMO	1 eday	Wed 11/11/20	Thu 11/12/20
8	RI WP RTCs meeting (Navy+Multi-MAC)	*1 eday*	*Wed 8/25/21*	*Thu 8/26/21*
9	*BCT Meetin 1 (Technical Approach)*	*1 eday*	*Wed 11/18/20*	*Thu 11/19/20*
10	RAB Meeting 1	*1 eday*	*Tue 8/10/21*	*Wed 8/11/21*
11	*BCT Meeting 2 (RTCs resolution)*	*1 eday*	*Thu 9/16/21*	*Fri 9/17/21*
12	BCT Meeting 3 (RTCs resolution)	*1 eday*	*Mon 10/18/21*	*Tue 10/19/21*
13	*BCT Meeting 4 (RTCs resolution)*	*1 eday*	*Mon 10/25/21*	*Tue 10/26/21*
14	*BCT Meeting 5 (RTCs resolution)*	*1 eday*	*Thu 10/28/21*	*Fri 10/29/21*
15	BCT Meeting 6 (RTCs resolution)	1 eday	Tue 11/9/21	Wed 11/10/21
16	BCT Meeting 7 (RTCs resolution)	1 eday	Wed 11/17/21	Thu 11/18/21
17	Technical Workgroup Meeting 1	1 eday	Wed 4/13/22	Thu 4/14/22
18	Technical Workgroup Meeting 2	1 eday	Wed 5/11/22	Thu 5/12/22
19	Technical Workgroup Meeting 3	1 eday	Wed 6/8/22	Thu 6/9/22
20	**WE 2 Planning Documents**	**535 edays?**	**Fri 9/25/20**	**Mon 3/14/22**
21	**RI Work Plan and Sampling and Analysis Plan (SAP)**	**535 edays?**	**Fri 9/25/20**	**Mon 3/14/22**
22	Internal Draft RI Work Plan	60 edays	Mon 9/28/20	Fri 11/27/20
23	Navy Review of Pre-Draft Work Plan	23 edays	Mon 11/30/20	Wed 12/23/20
24	Response to Navy Comments on Work Plan	15 edays	Wed 12/23/20	Thu 1/7/21
25	Additional Navy Comments#1	6 edays	Fri 1/8/21	Thu 1/14/21
26	Response to Additional Comments#1	10 edays	Fri 1/15/21	Mon 1/25/21
27	Additional Navy Comments#2	8 edays	Tue 1/26/21	Wed 2/3/21
28	Response to Additional Comments#2	20 edays	Thu 2/4/21	Wed 2/24/21
29	Navy Review/Concurrence on RTCs/QAO Review	12 edays	Thu 2/25/21	Tue 3/9/21
30	Draft Work Plan	3 edays	Tue 3/9/21	Fri 3/12/21
31	Agency Review of Draft Work Plan	68 edays	Fri 3/12/21	Wed 5/19/21
32	Responses to Agency Comments	21 edays	Wed 5/19/21	Wed 6/9/21
33	Navy Review/Concurrence on RTCs	114 edays	Wed 6/9/21	Fri 10/1/21
34	Agency Review of RTCs	28 edays	Fri 10/1/21	Fri 10/29/21
35	Submit Draft Final Work Plan as Redline/Strikeout Work Plan	2 edays	Tue 10/12/21	Thu 10/14/21
36	*Revised-Draft Work Plan (Phase I) for Onshore*	*18 edays*	*Mon 11/22/21*	*Fri 12/10/21*
37	Navy Review of Revised-Draft Final Work Plan	27 edays	Fri 12/10/21	Thu 1/6/22
38	Response to Navy Comments on Work Plan	4 edays	Thu 1/6/22	Mon 1/10/22
39	Navy concurrence	1 eday	Mon 1/10/22	Tue 1/11/22
40	Revised-Draft Work Plan submission for Agency Review	3 edays	Tue 1/11/22	Fri 1/14/22
41	Agency Review of Revised-Draft Work Plan	24 edays	Fri 1/14/22	Mon 2/7/22
42	Resolution of RTCs on Draft Final	31 edays	Mon 2/7/22	Thu 3/10/22
43	Navy QAO Review and Signature of Final SAP	14 edays	Thu 3/10/22	Thu 3/24/22
44	Final RI Work Plan	11 edays	Thu 3/24/22	Mon 4/4/22
45	**Accident Prevention Plan (APP)**	**394 days**	**Fri 9/25/20**	**Wed 3/30/22**
46	Draft APP	138 edays	Fri 9/25/20	Wed 2/10/21
47	Navy Review and Comment of Draft APP	279 days	Wed 2/10/21	Mon 3/7/22
48	RTCs to Navy Comments	7 edays	Mon 3/7/22	Mon 3/14/22
49	Resolution of Comments	10 edays	Mon 3/14/22	Thu 3/24/22
50	Final APP	7 edays	Thu 3/24/22	Thu 3/31/22
51	**WE 3 RI Field Investigation**	**68 days**	**Mon 4/18/22**	**Wed 7/20/22**
52	Mark Well/Soil Locations and Underground Utility Survey	4 edays	Mon 4/18/22	Fri 4/22/22
53	Soil Sampling	21 edays	Mon 4/25/22	Mon 5/16/22
54	Well Installation, Sampling, Land Surveying, Tidal Study	43 edays	Tue 5/3/22	Wed 6/15/22
55	IDW Management	3 edays	Tue 5/31/22	Fri 6/3/22
56	Laboratory Data and Validation	44 edays	Wed 6/15/22	Fri 7/29/22
57	**WE 4 RI Report**	**216 days**	**Fri 7/29/22**	**Fri 5/26/23**
58	Internal Draft RI Report	90 edays	Fri 7/29/22	Thu 10/27/22
59	Navy Review of Internal Draft RI Report	31 edays	Fri 10/28/22	Mon 11/28/22
60	RTCs delivered to Navy	14 edays	Mon 11/28/22	Mon 12/12/22
61	Draft RI Report	14 edays	Mon 12/12/22	Mon 12/26/22
62	Agency Review of Draft RI Report	60 edays	Mon 12/26/22	Fri 2/24/23
63	Respond to Agency Comments	14 edays	Mon 2/27/23	Mon 3/13/23
64	Redline/Strikeout RI Report and Comment Resolution	60 edays	Mon 3/13/23	Fri 5/12/23
65	Final RI Report	14 edays	Fri 5/12/23	Fri 5/26/23
66	**Data Entry and NIRIS Support**	**10 edays**	**Fri 5/26/23**	**Mon 6/5/23**



Project:
Date: Thu 3/24/22

Task	▬	Milestone	◆	Project Summary	⊓	Inactive Milestone	◇	Manual Task	▬	Manual Summary Rollup	▬	Start-only	[	External Tasks	▬	Deadline	⇩	Manual Progress	▬
Split	⋯	Summary	⊓	Inactive Task	▭	Inactive Summary	⊓	Duration-only	▬	Manual Summary	⊓	Finish-only	]	External Milestone	◆	Progress	▬		

Page 1

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Attachment 1
Laboratory Accreditation

(Provided on CD)

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CERTIFICATE OF ACCREDITATION

The ANSI National Accreditation Board

Hereby attests that

SGS North America Inc. - Orlando
4405 Vineland Road, Suite C-15
Orlando, FL 32811

Fulfills the requirements of

ISO/IEC 17025:2017

and

U.S. Department of Defense (DoD) Quality Systems Manual for Environmental Laboratories (DoD QSM V 5.3)

In the field of

TESTING

This certificate is valid only when accompanied by a current scope of accreditation document. The current scope of accreditation can be verified at www.anab.org.

R. Douglas Leonard Jr., VP, PILR SBU

Expiry Date: 15 December 2024
Certificate Number: L2229

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

AND

U.S. DEPARTMENT OF DEFENSE (DOD) QUALITY SYSTEMS MANUAL FOR ENVIRONMENTAL LABORATORIES (DOD QSM V 5.3)

SGS North America Inc. - Orlando

4405 Vineland Road, Suite C-15
Orlando, FL 32811
Svetlana Izosimova, Ph. D., QA Officer
407-425-6700

TESTING

Valid to: **December 15, 2024**

Certificate Number: **L2229**

Environmental

Drinking Water		
Technology	**Method**	**Analyte**
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537 rev. 1.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537 rev. 1.1	N-Ethyl perfluorooctanesulfonamidoacetic acid

ANSI National Accreditation Board

Drinking Water

Technology	Method	Analyte
LC/MS/MS	EPA 537.1	Perfluorohexanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroheptanoic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanoic Acid
LC/MS/MS	EPA 537.1	Perfluorononanoic Acid
LC/MS/MS	EPA 537.1	Perfluorodecanoic Acid
LC/MS/MS	EPA 537.1	Perfluoroundecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorododecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotridecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorotetradecanoic Acid
LC/MS/MS	EPA 537.1	Perfluorobutanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorohexanesulfonic Acid
LC/MS/MS	EPA 537.1	Perfluorooctanesulfonic Acid
LC/MS/MS	EPA 537.1	N-Methyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	N-Ethyl perfluorooctanesulfonamidoacetic acid
LC/MS/MS	EPA 537.1	ADONA
LC/MS/MS	EPA 537.1	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	EPA 537.1	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	EPA 537.1	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	EPA 533	Perfluorobutanoic acid
LC/MS/MS	EPA 533	Perfluoropentanoic acid
LC/MS/MS	EPA 533	Perfluorohexanoic acid
LC/MS/MS	EPA 533	Perfluoroheptanoic acid
LC/MS/MS	EPA 533	Perfluorooctanoic acid
LC/MS/MS	EPA 533	Perfluorononanoic acid

Drinking Water

Technology	Method	Analyte
LC/MS/MS	EPA 533	Perfluorodecanoic acid
LC/MS/MS	EPA 533	Perfluoroundecanoic acid
LC/MS/MS	EPA 533	Perfluorododecanoic acid
LC/MS/MS	EPA 533	Perfluorobutanesulfonic acid
LC/MS/MS	EPA 533	Perfluoropentanesulfonic acid
LC/MS/MS	EPA 533	Perfluorohexanesulfonic acid
LC/MS/MS	EPA 533	Perfluoroheptanesulfonic acid
LC/MS/MS	EPA 533	Perfluorooctanesulfonic acid
LC/MS/MS	EPA 533	4:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	6:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	8:2 Fluorotelomer sulfonate
LC/MS/MS	EPA 533	Perfluoro-3-methoxypropanoic acid
LC/MS/MS	EPA 533	Perfluoro-4-methoxybutanoic acid
LC/MS/MS	EPA 533	Nonafluoro-3,6-dioxaheptanoic acid
LC/MS/MS	EPA 533	Perfluoro(2-ethoxyethane)sulfonic acid
LC/MS/MS	EPA 533	Hexafluoropropylene oxide dimer acid
LC/MS/MS	EPA 533	4,8-Dioxa-3H-perfluorononanoic acid
LC/MS/MS	EPA 533	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid
LC/MS/MS	EPA 533	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid

Non-Potable Water

Technology	Method	Analyte
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2-Dibromoethane (EDB)
GC/ECD	EPA 504.1	1,2-Dibromo-3-Chloropropane (DBCP)
GC/ECD	EPA 504.1	1,2,3-Trichloropropane (1,2,3-TCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)

Non-Potable Water

Technology	Method	Analyte
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDD
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDE
GC/ECD	EPA 608.3; EPA 8081B	4,4`-DDT
GC/ECD	EPA 608.3; EPA 8081B	Aldrin
GC/ECD	EPA 608.3; EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	delta-BHC
GC/ECD	EPA 608.3; EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 608.3; EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 608.3; EPA 8081B	alpha-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	gamma-Chlordane
GC/ECD	EPA 608.3; EPA 8081B	Dieldrin
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan I
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan II
GC/ECD	EPA 608.3; EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 608.3; EPA 8081B	Endrin
GC/ECD	EPA 608.3; EPA 8081B	Endrin aldehyde
GC/ECD	EPA 608.3; EPA 8081B	Endrin ketone
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor
GC/ECD	EPA 608.3; EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 608.3; EPA 8081B	Methoxychlor
GC/ECD	EPA 608.3; EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 608.3; EPA 8081B	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)
GC/ECD	EPA 8082A	Total PCB

Non-Potable Water

Technology	Method	Analyte
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4-D

Non-Potable Water

Technology	Method	Analyte
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	RSK-175	Acetylene
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/FID	RSK-175	Propane
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	WI-DRO	Diesel range organics (DRO)
GC/FID	KS LRH	Low-Range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,1,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,1-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1,2-Trichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1-Dichloroethane

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,1-Dichloropropene
GC/MS	EPA 624.1; EPA 8260B/C/D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,3-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,3-Trichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2,4-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichloroethene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,2-Dichloropropane
GC/MS	EPA 8260B/C/D	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,3,5-Trimethylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,3-Dichloropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2,2-Dichloropropane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 624.1; EPA 8260B/C/D	2-Chloroethyl vinyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	2-Hexanone
GC/MS	EPA 8260B/C	2-Nitropropane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	4-Chlorotoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	4-Methyl-2-pentanone (MIBK)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Acetone
GC/MS	EPA 8260B/C/D	Acetonitrile
GC/MS	EPA 624.1; EPA 8260B/C/D	Acrolein (Propenal)
GC/MS	EPA 624.1; EPA 8260B/C/D	Acrylonitrile
GC/MS	EPA 8260B/C/D	Allyl chloride (3-Chloropropene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Benzene
GC/MS	EPA 8260B/C/D	Benzyl Chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromodichloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Bromoform
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	n-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	sec-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Butylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Carbon disulfide
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Carbon tetrachloride

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Chlorobenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Chloroethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Chloroform
GC/MS	EPA 8260B/C/D	Chloroprene
GC/MS	EPA 624.1; EPA 8260B/C/D	Cyclohexane
GC/MS	EPA 8260B/C/D	Cyclohexanone
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	cis-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	trans-1,2-Dichloroethylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	cis-1,3-Dichloropropene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C/D	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C/D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Di-isopropylether (DIPE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Dibromochloromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Dibromomethane (Methylene Bromide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Dichlorodifluoromethane
GC/MS	EPA 8260B/C/D	Diethyl ether
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C/D	Ethyl acetate
GC/MS	EPA 8260B/C/D	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Ethylbenzene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Hexachlorobutadiene
GC/MS	EPA 8260B/C/D	Hexane
GC/MS	EPA 8260B/C/D	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	p-Isopropyltoluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Isopropylbenzene
GC/MS	EPA 8260B/C/D	Methacrylonitrile
GC/MS	EPA 624.1; EPA 8260B/C/D	Methyl Acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methyl bromide (Bromomethane)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methyl chloride (Chloromethane)
GC/MS	EPA 624.1; EPA 8260B/C/D	Methylcyclohexane
GC/MS	EPA 8260B/C/D	Methyl methacrylate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Methylene chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Naphthalene
GC/MS	EPA 8260B/C/D	Pentachloroethane
GC/MS	EPA 8260B/C/D	Propionitrile (Ethyl cyanide)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	n-Propylbenzene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Styrene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Amyl alcohol (TAA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Amyl methyl ether (TAME)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Butyl alcohol (TBA)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	tert-Butyl formate (TBF)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Tetrachloroethylene (Perchloroethylene)

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8260B/C/D	Tetrahydrofuran
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Toluene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Trichloroethene (Trichloroethylene)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Trichlorofluoromethane
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Vinyl acetate
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Vinyl chloride
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	Xylene (total)
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	m,p-Xylene
GC/MS	EPA 624.1; SM 6200B-11; EPA 8260B/C/D	o-Xylene
GC/MS	EPA 625.1; EPA 8270D/E	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	1,2,4-Trichlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 625.1; EPA 8270D/E	1,2-Diphenylhydrazine
GC/MS	EPA 8270D/E	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 625.1; EPA 8270D/E	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 625.1; EPA 8270D/E	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,4-Naphthoquinone
GC/MS	EPA 8270D/E	1,4-Phenylenediamine
GC/MS	EPA 8270D/E	1-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	1-Methylnaphthalene
GC/MS	EPA 8270D/E	1-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D/E	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4,5-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4,6-Trichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dimethylphenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dinitrophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,4-Dinitrotoluene (2,4-DNT)

ANSI National Accreditation Board

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D/E	2,6-Dichlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D/E	2-Acetylaminofluorene
GC/MS	EPA 625.1; EPA 8270D/E	2-Chloronaphthalene
GC/MS	EPA 625.1; EPA 8270D/E	2-Chlorophenol
GC/MS	EPA 625.1; EPA 8270D/E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	2-Methylnaphthalene
GC/MS	EPA 625.1; EPA 8270D/E	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D/E	2-Naphthylamine
GC/MS	EPA 625.1; EPA 8270D/E	2-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D/E	2-Nitrophenol
GC/MS	EPA 8270D/E	2-Picoline (2-Methylpyridine)
GC/MS	EPA 625.1; EPA 8270D/E	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D/E	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D/E	3-Methylcholanthrene
GC/MS	EPA 625.1; EPA 8270D/E	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 625.1; EPA 8270D/E	3-Nitroaniline
GC/MS	EPA 8270D/E	4-Aminobiphenyl
GC/MS	EPA 625.1; EPA 8270D/E	4-Bromophenyl phenyl ether
GC/MS	EPA 625.1; EPA 8270D/E	4-Chloro-3-methylphenol
GC/MS	EPA 625.1; EPA 8270D/E	4-Chloroaniline
GC/MS	EPA 625.1; EPA 8270D/E	4-Chlorophenyl phenylether
GC/MS	EPA 8270D/E	4-Dimethyl aminoazobenzene
GC/MS	EPA 625.1; EPA 8270D/E	4-Nitroaniline
GC/MS	EPA 625.1; EPA 8270D/E	4-Nitrophenol
GC/MS	EPA 8270D/E	5-Nitro-o-toluidine
GC/MS	EPA 8270D/E	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Acenaphthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Acenaphthylene
GC/MS	EPA 625.1; EPA 8270D/E	Acetophenone
GC/MS	EPA 625.1; EPA 8270D/E	Aniline
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Anthracene

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D/E	Aramite
GC/MS	EPA 625.1; EPA 8270D/E	Atrazine
GC/MS	EPA 625.1; EPA 8270D/E	Benzaldehyde
GC/MS	EPA 625.1; EPA 8270D/E	Benzidine
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)anthracene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)pyrene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(b)fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(g,h,i)perylene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Benzo(k)fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E	Benzoic acid
GC/MS	EPA 625.1; EPA 8270D/E	Benzyl alcohol
GC/MS	EPA 625.1; EPA 8270D/E	Biphenyl (1,1’-Biphenyl)
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroethoxy)methane
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroethyl) ether
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 625.1; EPA 8270D/E	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 625.1; EPA 8270D/E	Butyl benzyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Carbazole
GC/MS	EPA 625.1; EPA 8270D/E	Caprolactam
GC/MS	EPA 8270D/E	Chlorobenzilate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Chrysene
GC/MS	EPA 8270D/E	Diallate
GC/MS	EPA 625.1; EPA 8270D/E	Di-n-butyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Di-n-octyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D/E	Dibenz(a,j)acridine
GC/MS	EPA 625.1; EPA 8270D/E	Dibenzofuran
GC/MS	EPA 625.1; EPA 8270D/E	Diethyl phthalate
GC/MS	EPA 625.1; EPA 8270D/E	Dimethyl phthalate

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D/E	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D/E	Diphenyl Ether
GC/MS	EPA 8270D/E	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8270D/E	Ethyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Fluoranthene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Fluorene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorobenzene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorobutadiene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachlorocyclopentadiene
GC/MS	EPA 625.1; EPA 8270D/E	Hexachloroethane
GC/MS	EPA 8270D/E	Hexachlorophene
GC/MS	EPA 8270D/E	Hexachloropropene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D	Isodrin
GC/MS	EPA 625.1; EPA 8270D/E	Isophorone
GC/MS	EPA 8270D/E	Isosafrole
GC/MS	EPA 8270D/E	Kepone
GC/MS	EPA 8270D/E	Methapyrilene
GC/MS	EPA 8270D/E	Methyl methanesulfonate
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Naphthalene
GC/MS	EPA 625.1; EPA 8270D/E	Nitrobenzene
GC/MS	EPA 8270D/E	Nitroquinoline-1-oxide
GC/MS	EPA 8270D/E	n-Nitroso-di-n-butylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D/E	n-Nitrosodiethylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodimethylamine
GC/MS	EPA 625.1; EPA 8270D/E	n-Nitrosodiphenylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D/E	n-Nitrosomethylethylamine
GC/MS	EPA 8270D/E	n-Nitrosomorpholine
GC/MS	EPA 8270D/E	n-Nitrosopiperidine
GC/MS	EPA 8270D/E	n-Nitrosopyrrolidine

Non-Potable Water

Technology	Method	Analyte
GC/MS	EPA 8270D/E	Pentachlorobenzene
GC/MS	EPA 8270D/E	Pentachloroethane
GC/MS	EPA 8270D/E	Pentachloronitrobenzene
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Pentachlorophenol
GC/MS	EPA 8270D/E	Phenacetin
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Phenanthrene
GC/MS	EPA 625.1; EPA 8270D/E	Phenol
GC/MS	EPA 8270D/E	Pronamide (Kerb)
GC/MS	EPA 625.1; EPA 8270D/E; EPA 8270D/E SIM	Pyrene
GC/MS	EPA 625.1; EPA 8270D/E	Pyridine
GC/MS	EPA 8270D/E	Safrole
GC/MS	EPA 8270D/E	Simazine
GC/MS	EPA 8270D/E	Thionazin (Zinophos)
GC/MS	EPA 8270D/E	o-Toluidine
GC/MS	EPA 8270D/E	Dimethoate
GC/MS	EPA 8270D/E	Disulfoton
GC/MS	EPA 8270D/E	Famphur
GC/MS	EPA 8270D/E	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D/E	Parathion ethyl
GC/MS	EPA 8270D/E	Phorate
GC/MS	EPA 8270D/E	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)

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Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)
HPLC	EPA 8330A/B	2,4-diamino-6-Nitrotoluene
HPLC	EPA 8330A/B	2,6-diamino-4-Nitrotoluene
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctanesulfonic Acid(PFOS)

Non-Potable Water

Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	3:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	5:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	7:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	10:2 Fluorotelomer sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorododecanesulfonic acid

Non-Potable Water

Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctadecanoic acid (PFOcDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	4-PFecHS (Perfluoro-4-ethylcyclohexanesulfonate)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane sulfonamidoethanol
ICP	EPA 200.7; EPA 6010C/D	Aluminum
ICP	EPA 200.7; EPA 6010C/D	Antimony
ICP	EPA 200.7; EPA 6010C/D	Arsenic
ICP	EPA 200.7; EPA 6010C/D	Barium
ICP	EPA 200.7; EPA 6010C/D	Beryllium
ICP	EPA 200.7; EPA 6010C/D	Cadmium
ICP	EPA 200.7; EPA 6010C/D	Calcium
ICP	EPA 200.7; EPA 6010C/D	Chromium
ICP	EPA 200.7; EPA 6010C/D	Cobalt
ICP	EPA 200.7; EPA 6010C/D	Copper
ICP	EPA 200.7; EPA 6010C/D	Iron
ICP	EPA 200.7; EPA 6010C/D	Lead
ICP	EPA 200.7; EPA 6010C/D	Magnesium
ICP	EPA 200.7; EPA 6010C/D	Manganese
ICP	EPA 200.7; EPA 6010C/D	Molybdenum
ICP	EPA 200.7; EPA 6010C/D	Nickel
ICP	EPA 200.7; EPA 6010C/D	Potassium

Non-Potable Water

Technology	Method	Analyte
ICP	EPA 200.7; EPA 6010C/D	Selenium
ICP	EPA 200.7; EPA 6010C/D	Silver
ICP	EPA 200.7; EPA 6010C/D	Sodium
ICP	EPA 200.7; EPA 6010C/D	Strontium
ICP	EPA 200.7; EPA 6010C/D	Thallium
ICP	EPA 200.7; EPA 6010C/D	Tin
ICP	EPA 200.7; EPA 6010C/D	Titanium
ICP	EPA 200.7; EPA 6010C/D	Vanadium
ICP	EPA 200.7; EPA 6010C/D	Zinc
ICP/MS	EPA 200.8; EPA 6020A/B	Aluminum
ICP/MS	EPA 200.8; EPA 6020A/B	Antimony
ICP/MS	EPA 200.8; EPA 6020A/B	Arsenic
ICP/MS	EPA 200.8; EPA 6020A/B	Barium
ICP/MS	EPA 200.8; EPA 6020A/B	Beryllium
ICP/MS	EPA 200.8; EPA 6020A/B	Cadmium
ICP/MS	EPA 200.8; EPA 6020A/B	Calcium
ICP/MS	EPA 200.8; EPA 6020A/B	Chromium
ICP/MS	EPA 200.8; EPA 6020A/B	Cobalt
ICP/MS	EPA 200.8; EPA 6020A/B	Copper
ICP/MS	EPA 200.8; EPA 6020A/B	Iron
ICP/MS	EPA 200.8; EPA 6020A/B	Lead
ICP/MS	EPA 200.8; EPA 6020A/B	Magnesium
ICP/MS	EPA 200.8; EPA 6020A/B	Manganese
ICP/MS	EPA 200.8; EPA 6020A/B	Molybdenum
ICP/MS	EPA 200.8; EPA 6020A/B	Nickel
ICP/MS	EPA 200.8; EPA 6020A/B	Potassium
ICP/MS	EPA 200.8; EPA 6020A/B	Selenium
ICP/MS	EPA 200.8; EPA 6020A/B	Silver
ICP/MS	EPA 200.8; EPA 6020A/B	Sodium
ICP/MS	EPA 200.8; EPA 6020A/B	Strontium
ICP/MS	EPA 200.8; EPA 6020A/B	Thallium
ICP/MS	EPA 200.8; EPA 6020A/B	Tin
ICP/MS	EPA 200.8; EPA 6020A/B	Titanium
ICP/MS	EPA 200.8; EPA 6020A/B	Vanadium
ICP/MS	EPA 200.8; EPA 6020A/B	Zinc
CVAA	EPA 7470A	Mercury

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Non-Potable Water

Technology	Method	Analyte
CVAA	EPA 245.1	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 300; EPA 9056A	Bromide
IC	EPA 300; EPA 9056A	Chloride
IC	EPA 300; EPA 9056A	Fluoride
IC	EPA 300; EPA 9056A	Nitrate
IC	EPA 300; EPA 9056A	Nitrite
IC	EPA 300; EPA 9056A	Sulfate
IC	EPA 300; EPA 9056A	Total nitrate-nitrite
IC	EPA 300; EPA 9056A	Orthophosphate
Automated Colorimetry	EPA 350.1	Ammonia
Automated Colorimetry	EPA 350.1	Ammonia, Gas Diffusion Option
Automated Colorimetry	EPA 351.2	Total Kjeldahl Nitrogen
Automated Colorimetry	EPA 420.4	Total Phenolics
Manual Colorimetry	EPA 365.3	Orthophosphate
Automated Colorimetry	EPA 365.1	Orthophosphate
Automated Colorimetry	EPA 365.1	Total Phosphorus
Manual Colorimetry	EPA 365.3	Total Phosphorus
Titrimetric	SM 2320B-11	Alkalinity, Total
Titrimetric	SM 4500-S2 F-11	Sulfide, Iodometric
Gravimetric Methods	EPA 1664A; EPA 1664B; EPA 9070A	Oil and Grease
Gravimetric Methods	SM 2540B-11	Total Residue (Total Solids)
Gravimetric Methods	SM 2540C-11	Filterable Residue (Total Dissolved Solids)
Gravimetric Methods	SM 2540D-11	Non-Filterable Residue (Total Suspended Solids)
Electrometric Methods	SM 4500H+B-11; EPA 9040C	Hydrogen Ion (Ph)
Electrometric Methods	EPA 120.1	Specific conductivity
Combustion	EPA 9060A	Total Organic Carbon
Combustion	SM 5310B-11	Total Organic Carbon
Ignitability	EPA 1010A	Flash Point
Ignitability	EPA 1020B/ASTM D3278-78	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide

Non-Potable Water		
Technology	**Method**	**Analyte**
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organic Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction
Organic Preparation	EPA 3511	Micro-extraction
Organic Preparation	EPA 3535A; EPA 3535A MOD	Solid Phase Extraction
Organic Preparation	EPA 8015C/D	Non-Halogenated Organics (Alcohols), direct injection
Organic Preparation	EPA 8151A	Chlorinated Herbicides, Liquid-Liquid Extraction
Organic Preparation	EPA 608; EPA 625	Separatory Funnel Liquid-Liquid Extraction
Volatile Organic Preparation	SW836 5030B	Closed System Purge and Trap
Volatile Organic Preparation	EPA 624	Closed System Purge and Trap
Volatile Organic Preparation	SM 6200B-11	Closed System Purge and Trap
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-Chloropropane (DBCP)
GC/FID	EPA 8015C/D	Diesel range organics (DRO)
GC/FID	EPA 8015C/D	Oil Range Organics (ORO)
GC/FID	EPA 8015C/D	Gasoline range organics (GRO)
GC/FID	EPA 8015C/D	Ethanol
GC/FID	EPA 8015C/D	2-Ethoxyethanol
GC/FID	EPA 8015C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/FID	EPA 8015C/D	Isopropyl alcohol (2-Propanol)

Solid and Chemical Materials

Technology	Method	Analyte
GC/FID	EPA 8015C/D	Methanol
GC/FID	EPA 8015C/D	n-Butyl alcohol
GC/FID	EPA 8015C/D	n-Propanol
GC/ECD	EPA 8081B	4,4`-DDD
GC/ECD	EPA 8081B	4,4`-DDE
GC/ECD	EPA 8081B	4,4`-DDT
GC/ECD	EPA 8081B	Aldrin
GC/ECD	EPA 8081B	alpha-BHC (alpha-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	beta-BHC (beta-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	delta-BHC
GC/ECD	EPA 8081B	gamma-BHC (Lindane gamma-Hexachlorocyclohexane)
GC/ECD	EPA 8081B	Chlordane (tech.)
GC/ECD	EPA 8081B	alpha-Chlordane
GC/ECD	EPA 8081B	gamma-Chlordane
GC/ECD	EPA 8081B	Dieldrin
GC/ECD	EPA 8081B	Endosulfan I
GC/ECD	EPA 8081B	Endosulfan II
GC/ECD	EPA 8081B	Endosulfan sulfate
GC/ECD	EPA 8081B	Endrin
GC/ECD	EPA 8081B	Endrin aldehyde
GC/ECD	EPA 8081B	Endrin ketone
GC/ECD	EPA 8081B	Heptachlor
GC/ECD	EPA 8081B	Heptachlor epoxide
GC/ECD	EPA 8081B	Methoxychlor
GC/ECD	EPA 8081B	Toxaphene (Chlorinated camphene)
GC/ECD	EPA 8082A	Aroclor-1016 (PCB-1016)
GC/ECD	EPA 8082A	Aroclor-1221 (PCB-1221)
GC/ECD	EPA 8082A	Aroclor-1232 (PCB-1232)
GC/ECD	EPA 8082A	Aroclor-1242 (PCB-1242)
GC/ECD	EPA 8082A	Aroclor-1248 (PCB-1248)
GC/ECD	EPA 8082A	Aroclor-1254 (PCB-1254)
GC/ECD	EPA 8082A	Aroclor-1260 (PCB-1260)
GC/ECD	EPA 8082A	Aroclor-1262 (PCB-1262)
GC/ECD	EPA 8082A	Aroclor-1268 (PCB-1268)

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Solid and Chemical Materials

Technology	Method	Analyte
GC/ECD	EPA 8082A	Total PCB
GC/FPD	EPA 8141B	Azinphos-methyl (Guthion)
GC/FPD	EPA 8141B	Bolstar (Sulprofos)
GC/FPD	EPA 8141B	Carbophenothion
GC/FPD	EPA 8141B	Chlorpyrifos
GC/FPD	EPA 8141B	Coumaphos
GC/FPD	EPA 8141B	Demeton-o
GC/FPD	EPA 8141B	Demeton-s
GC/FPD	EPA 8141B	Demeton
GC/FPD	EPA 8141B	Diazinon
GC/FPD	EPA 8141B	Dichlorovos (DDVP Dichlorvos)
GC/FPD	EPA 8141B	Dimethoate
GC/FPD	EPA 8141B	Disulfoton
GC/FPD	EPA 8141B	EPN
GC/FPD	EPA 8141B	Ethion
GC/FPD	EPA 8141B	Ethoprop
GC/FPD	EPA 8141B	Famphur
GC/FPD	EPA 8141B	Fensulfothion
GC/FPD	EPA 8141B	Fenthion
GC/FPD	EPA 8141B	Malathion
GC/FPD	EPA 8141B	Merphos
GC/FPD	EPA 8141B	Methyl parathion (Parathion methyl)
GC/FPD	EPA 8141B	Mevinphos
GC/FPD	EPA 8141B	Monocrotophos
GC/FPD	EPA 8141B	Naled
GC/FPD	EPA 8141B	Parathion ethyl
GC/FPD	EPA 8141B	Phorate
GC/FPD	EPA 8141B	Ronnel
GC/FPD	EPA 8141B	Stirofos
GC/FPD	EPA 8141B	Sulfotepp
GC/FPD	EPA 8141B	Tetraethyl pyrophosphate (TEPP)
GC/FPD	EPA 8141B	Thionazin (Zinophos)
GC/FPD	EPA 8141B	Tokuthion (Prothiophos)
GC/FPD	EPA 8141B	Trichloronate
GC/FPD	EPA 8141B	O,O,O-Triethyl phosphorothioate
GC/ECD	EPA 8151A	2,4,5-T

Solid and Chemical Materials

Technology	Method	Analyte
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichloroprop (Dichlorprop)
GC/ECD	EPA 8151A	Dinoseb (2-sec-butyl-4,6-dinitrophenol DNBP)
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP
GC/ECD	EPA 8151A	Pentachlorophenol
GC/ECD	EPA 8151A	Silvex (2,4,5-TP)
GC/FID	FL-PRO	Total Petroleum Hydrocarbons (TPH)
GC/FID	MA-VPH	Volatile petroleum range organics (VPH)
GC/FID	MA-EPH	Extractable petroleum range organics (EPH)
GC/FID	IA-OA1	Gasoline range organics (GRO)
GC/FID	IA-OA2	Diesel range organics (DRO)
GC/FID	TN-GRO	Gasoline range organics (GRO)
GC/FID	TN-EPH	Extractable petroleum range organics (EPH)
GC/FID	KS LRH	Low-range Hydrocarbons (LRH)
GC/FID	KS MRH	Mid-Range Hydrocarbons (MRH)
GC/FID	KS HRH	High-Range Hydrocarbons (HRH)
GC/MS	EPA 8260B/C/D	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C/D	1,1,1-Trichloroethane
GC/MS	EPA 8260B/C/D	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C/D	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C/D	1,1-Dichloroethane
GC/MS	EPA 8260B/C/D	1,1-Dichloroethylene
GC/MS	EPA 8260B/C/D	1,1-Dichloropropene
GC/MS	EPA 8260B/C/D	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)
GC/MS	EPA 8260B/C/D	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C/D	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C/D	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C/D	1,2-Dibromo-3-chloropropane (DBCP)

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B/C/D	1,2-Dibromoethane (EDB Ethylene dibromide)
GC/MS	EPA 8260B/C/D	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8260B/C/D	1,2-Dichloroethane
GC/MS	EPA 8260B/C/D	1,2-Dichloroethene (total)
GC/MS	EPA 8260B/C/D	1,2-Dichloropropane
GC/MS	EPA 8260B/C/D	1,2-Dichlorotrifluoroethane (Freon 123)
GC/MS	EPA 8260B/C/D	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C/D	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8260B/C/D	1,3-Dichloropropane
GC/MS	EPA 8260B/C/D	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8260B/C/D	1-Chlorohexane
GC/MS	EPA 8260B/C/D	2,2-Dichloropropane
GC/MS	EPA 8260B/C/D	2-Butanone (Methyl ethyl ketone MEK)
GC/MS	EPA 8260B/C/D	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C/D	2-Chlorotoluene
GC/MS	EPA 8260B/C/D	2-Hexanone
GC/MS	EPA 8260B/C/D	2-Nitropropane
GC/MS	EPA 8260B/C/D	4-Chlorotoluene
GC/MS	EPA 8260B/C/D	4-Methyl-2-pentanone (MBK)
GC/MS	EPA 8260B/C/D	Acetone
GC/MS	EPA 8260B/C/D	Acetonitrile
GC/MS	EPA 8260B/C/D	Acrolein (Propenal)
GC/MS	EPA 8260B/C/D	Acrylonitrile
GC/MS	EPA 8260B/C/D	Allyl chloride (3-Chloropropene)
GC/MS	EPA 8260B/C/D	Benzene
GC/MS	EPA 8260B/C/D	Benzyl Chloride
GC/MS	EPA 8260B/C/D	Bromobenzene
GC/MS	EPA 8260B/C/D	Bromochloromethane
GC/MS	EPA 8260B/C/D	Bromodichloromethane
GC/MS	EPA 8260B/C/D	Bromoform
GC/MS	EPA 8260B/C/D	n-Butylbenzene
GC/MS	EPA 8260B/C/D	sec-Butylbenzene
GC/MS	EPA 8260B/C/D	tert-Butylbenzene
GC/MS	EPA 8260B/C/D	Carbon disulfide
GC/MS	EPA 8260B/C/D	Carbon tetrachloride

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8260B/C/D	Chlorobenzene
GC/MS	EPA 8260B/C/D	Chloroethane
GC/MS	EPA 8260B/C/D	Chloroform
GC/MS	EPA 8260B/C/D	Chloroprene
GC/MS	EPA 8260B/C/D	Cyclohexane
GC/MS	EPA 8260B/C/D	Cyclohexanone
GC/MS	EPA 8260B/C/D	cis-1,2-Dichloroethylene
GC/MS	EPA 8260B/C/D	trans-1,2-Dichloroethylene
GC/MS	EPA 8260B/C/D	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C/D	trans-1,3-Dichloropropylene
GC/MS	EPA 8260B/C/D	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C/D	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C/D	Di-isopropylether (DIPE)
GC/MS	EPA 8260B/C/D	Dibromochloromethane
GC/MS	EPA 8260B/C/D	Dibromomethane (Methylene Bromide)
GC/MS	EPA 8260B/C/D	Dichlorodifluoromethane
GC/MS	EPA 8260B/C/D	Diethyl ether
GC/MS	EPA 8260B/C/D; EPA 8260B/C/D SIM	p-Dioxane (1,4-Dioxane)
GC/MS	EPA 8260B/C/D	Ethanol (Ethyl Alcohol)
GC/MS	EPA 8260B/C/D	Ethyl acetate
GC/MS	EPA 8260B/C/D	Ethyl methacrylate
GC/MS	EPA 8260B/C/D	Ethyl tert-butyl alcohol (ETBA)
GC/MS	EPA 8260B/C/D	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C/D	Ethylbenzene
GC/MS	EPA 8260B/C/D	Ethylene Oxide
GC/MS	EPA 8260B/C/D	Hexachlorobutadiene
GC/MS	EPA 8260B/C/D	Hexane
GC/MS	EPA 8260B/C/D	Iodomethane (Methyl iodide)
GC/MS	EPA 8260B/C/D	Isobutyl alcohol (2-Methyl-1-propanol)
GC/MS	EPA 8260B/C/D	p-Isopropyltoluene
GC/MS	EPA 8260B/C/D	Isopropylbenzene
GC/MS	EPA 8260B/C/D	Methacrylonitrile
GC/MS	EPA 8260B/C/D	Methyl Acetate
GC/MS	EPA 8260B/C/D	Methyl bromide (Bromomethane)
GC/MS	EPA 8260B/C/D	Methyl chloride (Chloromethane)
GC/MS	EPA 8260B/C/D	Methylcyclohexane

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Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	EPA 8260B/C/D	Methyl methacrylate
GC/MS	EPA 8260B/C/D	Methyl tert-butyl ether (MTBE)
GC/MS	EPA 8260B/C/D	Methylene chloride
GC/MS	EPA 8260B/C/D	Naphthalene
GC/MS	EPA 8260B/C/D	Pentachloroethane
GC/MS	EPA 8260B/C/D	Propionitrile (Ethyl cyanide)
GC/MS	EPA 8260B/C/D	n-Propylbenzene
GC/MS	EPA 8260B/C/D	Styrene
GC/MS	EPA 8260B/C/D	tert-Amyl alcohol (TAA)
GC/MS	EPA 8260B/C/D	tert-Amyl methyl ether (TAME)
GC/MS	EPA 8260B/C/D	tert-Butyl alcohol (TBA)
GC/MS	EPA 8260B/C/D	tert-Butyl formate (TBF)
GC/MS	EPA 8260B/C/D	Tetrachloroethylene (Perchloroethylene)
GC/MS	EPA 8260B/C/D	Tetrahydrofuran
GC/MS	EPA 8260B/C/D	Toluene
GC/MS	EPA 8260B/C/D	Trichloroethene (Trichloroethylene)
GC/MS	EPA 8260B/C/D	Trichlorofluoromethane
GC/MS	EPA 8260B/C/D	Vinyl acetate
GC/MS	EPA 8260B/C/D	Vinyl chloride
GC/MS	EPA 8260B/C/D	Xylene (total)
GC/MS	EPA 8260B/C/D	m,p-Xylene
GC/MS	EPA 8260B/C/D	o-Xylene
GC/MS	EPA 8270D/E	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270D/E	1,2,4-Trichlorobenzene
GC/MS	EPA 8270D/E	1,2-Dichlorobenzene (o-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,2-Diphenylhydrazine
GC/MS	EPA 8270D/E	1,3,5-Trinitrobenzene (1,3,5-TNB)
GC/MS	EPA 8270D/E	1,3-Dichlorobenzene (m-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,3-Dinitrobenzene (1,3-DNB)
GC/MS	EPA 8270D/E	1,4-Dichlorobenzene (p-Dichlorobenzene)
GC/MS	EPA 8270D/E	1,4-Naphthoquinone
GC/MS	EPA 8270D/E	1,4-Phenylenediamine
GC/MS	EPA 8270D/E	1-Chloronaphthalene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	1-Methylnaphthalene
GC/MS	EPA 8270D/E	1-Naphthylamine
GC/MS	EPA 8270D/E	2,3,4,6-Tetrachlorophenol

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D/E	2,4,5-Trichlorophenol
GC/MS	EPA 8270D/E	2,4,6-Trichlorophenol
GC/MS	EPA 8270D/E	2,4-Dichlorophenol
GC/MS	EPA 8270D/E	2,4-Dimethylphenol
GC/MS	EPA 8270D/E	2,4-Dinitrophenol
GC/MS	EPA 8270D/E	2,4-Dinitrotoluene (2,4-DNT)
GC/MS	EPA 8270D/E	2,6-Dichlorophenol
GC/MS	EPA 8270D/E	2,6-Dinitrotoluene (2,6-DNT)
GC/MS	EPA 8270D/E	2-Acetylaminofluorene
GC/MS	EPA 8270D/E	2-Chloronaphthalene
GC/MS	EPA 8270D/E	2-Chlorophenol
GC/MS	EPA 8270D/E	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-o-cresol)
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	2-Methylnaphthalene
GC/MS	EPA 8270D/E	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270D/E	2-Naphthylamine
GC/MS	EPA 8270D/E	2-Nitroaniline
GC/MS	EPA 8270D/E	2-Nitrophenol
GC/MS	EPA 8270D/E	2-Picoline (2-Methylpyridine)
GC/MS	EPA 8270D/E	3,3`-Dichlorobenzidine
GC/MS	EPA 8270D/E	3,3`-Dimethylbenzidine
GC/MS	EPA 8270D/E	3-Methylcholanthrene
GC/MS	EPA 8270D/E	3&4-Methylphenol (m,p-Cresol)
GC/MS	EPA 8270D/E	3-Nitroaniline
GC/MS	EPA 8270D/E	4-Aminobiphenyl
GC/MS	EPA 8270D/E	4-Bromophenyl phenyl ether
GC/MS	EPA 8270D/E	4-Chloro-3-methylphenol
GC/MS	EPA 8270D/E	4-Chloroaniline
GC/MS	EPA 8270D/E	4-Chlorophenyl phenylether
GC/MS	EPA 8270D/E	4-Dimethyl aminoazobenzene
GC/MS	EPA 8270D/E	4-Nitroaniline
GC/MS	EPA 8270D/E	4-Nitrophenol
GC/MS	EPA 8270D/E	5-Nitro-o-toluidine
GC/MS	EPA 8270D/E	7,12-Dimethylbenz(a) anthracene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Acenaphthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Acenaphthylene

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Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D/E	Acetophenone
GC/MS	EPA 8270D/E	Aniline
GC/MS	EPA 8270D; EPA 8270D SIM	Anthracene
GC/MS	EPA 8270D/E	Aramite
GC/MS	EPA 8270D/E	Atrazine
GC/MS	EPA 8270D/E	Benzaldehyde
GC/MS	EPA 8270D/E	Benzidine
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)anthracene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(a)pyrene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(b)fluoranthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(g,h,i)perylene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Benzo(k)fluoranthene
GC/MS	EPA 8270D/E	Benzoic acid
GC/MS	EPA 8270D/E	Benzyl alcohol
GC/MS	EPA 8270D/E	Biphenyl (1,1'-Biphenyl)
GC/MS	EPA 8270D/E	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270D/E	bis(2-Chloroethyl) ether
GC/MS	EPA 8270D/E	bis(2-Chloroisopropyl) ether (2,2`-Oxybis(1-chloropropane))
GC/MS	EPA 8270D/E	bis(2-Ethylhexyl) phthalate (DEHP)
GC/MS	EPA 8270D/E	Butyl benzyl phthalate
GC/MS	EPA 8270D/E	Carbazole
GC/MS	EPA 8270D/E	Caprolactam
GC/MS	EPA 8270D/E	Chlorobenzilate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Chrysene
GC/MS	EPA 8270D/E	Diallate
GC/MS	EPA 8270D/E	Di-n-butyl phthalate
GC/MS	EPA 8270D/E	Di-n-octyl phthalate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Dibenz(a,h)anthracene
GC/MS	EPA 8270D/E	Dibenz(a,j)acridine
GC/MS	EPA 8270D/E	Dibenzofuran
GC/MS	EPA 8270D/E	Diethyl phthalate
GC/MS	EPA 8270D/E	Dimethyl phthalate
GC/MS	EPA 8270D/E	a,a-Dimethylphenethylamine
GC/MS	EPA 8270D/E	Diphenyl Ether
GC/MS	EPA 8270D/E	p-Dioxane (1,4-Dioxane)

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D/E	Ethyl methanesulfonate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Fluoranthene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Fluorene
GC/MS	EPA 8270D/E	Hexachlorobenzene
GC/MS	EPA 8270D/E	Hexachlorobutadiene
GC/MS	EPA 8270D/E	Hexachlorocyclopentadiene
GC/MS	EPA 8270D/E	Hexachloroethane
GC/MS	EPA 8270D/E	Hexachlorophene
GC/MS	EPA 8270D/E	Hexachloropropene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270D/E	Isodrin
GC/MS	EPA 8270D/E	Isophorone
GC/MS	EPA 8270D/E	Isosafrole
GC/MS	EPA 8270D/E	Kepone
GC/MS	EPA 8270D/E	Methapyrilene
GC/MS	EPA 8270D/E	Methyl methanesulfonate
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Naphthalene
GC/MS	EPA 8270D/E	Nitrobenzene
GC/MS	EPA 8270D/E	Nitroquinoline-1-oxide
GC/MS	EPA 8270D/E	n-Nitroso-di-n-butylamine
GC/MS	EPA 8270D/E	n-Nitrosodi-n-propylamine
GC/MS	EPA 8270D/E	n-Nitrosodiethylamine
GC/MS	EPA 8270D/E	n-Nitrosodimethylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine
GC/MS	EPA 8270D/E	n-Nitrosodiphenylamine/Diphenylamine (analyte pair)
GC/MS	EPA 8270D/E	n-Nitrosomethylethylamine
GC/MS	EPA 8270D/E	n-Nitrosomorpholine
GC/MS	EPA 8270D/E	n-Nitrosopiperidine
GC/MS	EPA 8270D/E	n-Nitrosopyrrolidine
GC/MS	EPA 8270D/E	Pentachlorobenzene
GC/MS	EPA 8270D/E	Pentachloroethane
GC/MS	EPA 8270D/E	Pentachloronitrobenzene
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Pentachlorophenol
GC/MS	EPA 8270D/E	Phenacetin
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Phenanthrene

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	EPA 8270D/E	Phenol
GC/MS	EPA 8270D/E	Pronamide (Kerb)
GC/MS	EPA 8270D/E; EPA 8270D/E SIM	Pyrene
GC/MS	EPA 8270D/E	Pyridine
GC/MS	EPA 8270D/E	Safrole
GC/MS	EPA 8270D/E	Simazine
GC/MS	EPA 8270D/E	o-Toluidine
GC/MS	EPA 8270D/E	Dimethoate
GC/MS	EPA 8270D/E	Disulfoton
GC/MS	EPA 8270D/E	Famphur
GC/MS	EPA 8270D/E	Methyl parathion (Parathion methyl)
GC/MS	EPA 8270D/E	Parathion ethyl
GC/MS	EPA 8270D/E	Phorate
GC/MS	EPA 8270D/E	Sulfotepp
GC/MS	EPA 8270D/E	Thionazin (Zinophos)
GC/MS	EPA 8270D/E	O,O,O-Triethyl phosphorothioate
HPLC	EPA 8330A/B	1,3,5-Trinitrobenzene (1,3,5-TNB)
HPLC	EPA 8330A/B	1,3-Dinitrobenzene (1,3-DNB)
HPLC	EPA 8330A/B	2,4,6-Trinitrotoluene (2,4,6-TNT)
HPLC	EPA 8330A/B	2,4-Dinitrotoluene (2,4-DNT)
HPLC	EPA 8330A/B	2,6-Dinitrotoluene (2,6-DNT)
HPLC	EPA 8330A/B	2-Amino-4,6-dinitrotoluene (2-am-dnt)
HPLC	EPA 8330A/B	2-Nitrotoluene
HPLC	EPA 8330A/B	3,5-Dinitroaniline
HPLC	EPA 8330A/B	3-Nitrotoluene
HPLC	EPA 8330A/B	4-Amino-2,6-dinitrotoluene (4-am-dnt)
HPLC	EPA 8330A/B	4-Nitrotoluene
HPLC	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC	EPA 8330A/B	Nitrobenzene
HPLC	EPA 8330A/B	Nitroglycerin
HPLC	EPA 8330A/B	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
HPLC	EPA 8330A/B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC	EPA 8330A/B	Pentaerythritoltetranitrate (PETN)

Solid and Chemical Materials

Technology	Method	Analyte
HPLC	EPA 8330A/B	DNX
HPLC	EPA 8330A/B	MNX
HPLC	EPA 8330A/B	TNX
LC/MS/MS	EPA 6850	Perchlorate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorobutanoic Acid (PFBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoropentanoic Acid (PFPeA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorohexanoic Acid (PFHxA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoroheptanoic Acid (PFHpA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctanoic Acid (PFOA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorononanoic Acid (PFNA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorodecanoic Acid (PFDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoroundecanoic Acid (PFUnA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorododecanoic Acid(PFDoA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorotridecanoic Acid (PFTrDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorotetradecanoic Acid (PFTA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorobutanesulfonic Acid (PFBS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorohexanesulfonic Acid(PFHxS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctanesulfonic Acid(PFOS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorononanesulfonic Acid(PFNS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorodecanesulfonic Acid(PFDS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoroheptanesulfonic acid(PFHpS)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoropentanesulfonic Acid(PFPeS)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctane sulfonamide (PFOSA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctanesulfonamidoacetic acid (MeFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctanesulfonamidoacetic acid (EtFOSAA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	4:2 Fluorotelomer Sulfonate (FTS 4:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	6:2 Fluorotelomer Sulfonate(FTS 6:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	8:2 Fluorotelomer Sulfonate (FTS 8:2)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	ADONA
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	2,3,3,3-Tetrafluoro-2-(heptafluoropropoxy)propanoic acid (HFPO-DA; GenX)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS; F53B minor)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	9-Chlorohexadecafluoro-3-oxanone-1-sulfonic acid (9Cl-PF3ONS; F53B major)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	3:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	5:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	7:3 Fluorotelomer carboxylate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	10:2 Fluorotelomer sulfonate
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorododecanesulfonic acid
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoro-3-methoxypropanoic acid (PFMPA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoro-4-methoxybutanoic acid (PFMBA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Nonafluoro-3,6-dioxaheptanoic acid (NFDHA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluoro (2-ethoxyethane) sulfonic acid (PFEESA)

ANSI National Accreditation Board

Solid and Chemical Materials

Technology	Method	Analyte
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorohexadecanoic acid (PFHxDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	Perfluorooctadecanoic acid (PFOcDA)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	4-PFecHS (Perfluoro-4-ethylcyclohexanesulfonate)
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane sulfonamide
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Methyl perfluorooctane sulfonamidoethanol
LC/MS/MS	PFAS by LCMSMS Compliant with QSM 5.3 Table B-15	N-Ethyl perfluorooctane sulfonamidoethanol
ICP	EPA 6010C/D	Aluminum
ICP	EPA 6010C/D	Antimony
ICP	EPA 6010C/D	Arsenic
ICP	EPA 6010C/D	Barium
ICP	EPA 6010C/D	Beryllium
ICP	EPA 6010C/D	Cadmium
ICP	EPA 6010C/D	Calcium
ICP	EPA 6010C/D	Chromium
ICP	EPA 6010C/D	Cobalt
ICP	EPA 6010C/D	Copper
ICP	EPA 6010C/D	Iron
ICP	EPA 6010C/D	Lead
ICP	EPA 6010C/D	Magnesium
ICP	EPA 6010C/D	Manganese
ICP	EPA 6010C/D	Molybdenum
ICP	EPA 6010C/D	Nickel
ICP	EPA 6010C/D	Potassium
ICP	EPA 6010C/D	Selenium
ICP	EPA 6010C/D	Silver
ICP	EPA 6010C/D	Sodium
ICP	EPA 6010C/D	Strontium
ICP	EPA 6010C/D	Thallium
ICP	EPA 6010C/D	Tin
ICP	EPA 6010C/D	Titanium

Solid and Chemical Materials

Technology	Method	Analyte
ICP	EPA 6010C/D	Vanadium
ICP	EPA 6010C/D	Zinc
ICP/MS	EPA 6020A/B	Aluminum
ICP/MS	EPA 6020A/B	Antimony
ICP/MS	EPA 6020A/B	Arsenic
ICP/MS	EPA 6020A/B	Barium
ICP/MS	EPA 6020A/B	Beryllium
ICP/MS	EPA 6020A/B	Cadmium
ICP/MS	EPA 6020A/B	Calcium
ICP/MS	EPA 6020A/B	Chromium
ICP/MS	EPA 6020A/B	Cobalt
ICP/MS	EPA 6020A/B	Copper
ICP/MS	EPA 6020A/B	Iron
ICP/MS	EPA 6020A/B	Lead
ICP/MS	EPA 6020A/B	Magnesium
ICP/MS	EPA 6020A/B	Manganese
ICP/MS	EPA 6020A/B	Molybdenum
ICP/MS	EPA 6020A/B	Nickel
ICP/MS	EPA 6020A/B	Potassium
ICP/MS	EPA 6020A/B	Selenium
ICP/MS	EPA 6020A/B	Silver
ICP/MS	EPA 6020A/B	Sodium
ICP/MS	EPA 6020A/B	Strontium
ICP/MS	EPA 6020A/B	Thallium
ICP/MS	EPA 6020A/B	Tin
ICP/MS	EPA 6020A/B	Titanium
ICP/MS	EPA 6020A/B	Vanadium
ICP/MS	EPA 6020A/B	Zinc
CVAA	EPA 7471B	Mercury
UV/VIS	EPA 7196A	Hexavalent Chromium (Cr6+)
UV/VIS	EPA 9012B	Cyanide (Total)
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride

Solid and Chemical Materials

Technology	Method	Analyte
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
IC	EPA 9056A	Total nitrate-nitrite
Gravimetric Methods	SM 2540G	% solids
Electrometric Methods	EPA 9045D	Hydrogen Ion (pH)
Ignitability	EPA 1010A MOD	Flash Point
Ignitability	EPA 1020B MOD	Flash Point
Waste Characterization	EPA Ch.7	Reactive Cyanide and Reactive Sulfide
Waste Characterization	EPA Section 7.3	Reactive Cyanide
Waste Characterization	EPA Section 7.3	Reactive Sulfide
Preparation	**Method**	**Type**
Organics Preparation	EPA 3510C	Separatory Funnel Liquid-Liquid Extraction; Leachates
TCLP Preparation	EPA 1311	Toxicity Characteristic Leaching Procedure
SPLP Preparation	EPA 1312	Synthetic Precipitation Leaching Procedure
Organics Preparation	EPA 8011	Microextraction
Organics Preparation	EPA 3546	Microwave Extraction
Organics Preparation	EPA 3550C	Ultrasonic Extraction
Organics Preparation	EPA 3580A	Waste Dilution for Extractable Organics
Organics Preparation	EPA 8330A; EPA 8332	Ultrasonic Extraction
Organics Preparation	EPA 8330B	Shaker Table Extraction
Volatile Organics Preparation	EPA 3585	Waste Dilution for Volatile Organics
Volatile Organics Preparation	EPA 5030A	Closed System Purge and Trap; Bulk Soils
Volatile Organics Preparation	EPA 5030B	Closed System Purge and Trap; Leachates and Methanol Extracts
Volatile Organics Preparation	EPA 5035; EPA 5035A	Closed System Purge and Trap
Organics Cleanup	EPA 3660B	Sulfur Cleanup
Organics Cleanup	EPA 3665A	Sulfuric Acid Cleanup
Lachat MicroDistillation	EPA 9012B	Cyanide MicroDistillation; proprietary method
Inorganic Preparation	EPA 3010A	Metals Acid Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 3050B	Metals Acid Digestion by Hotblock

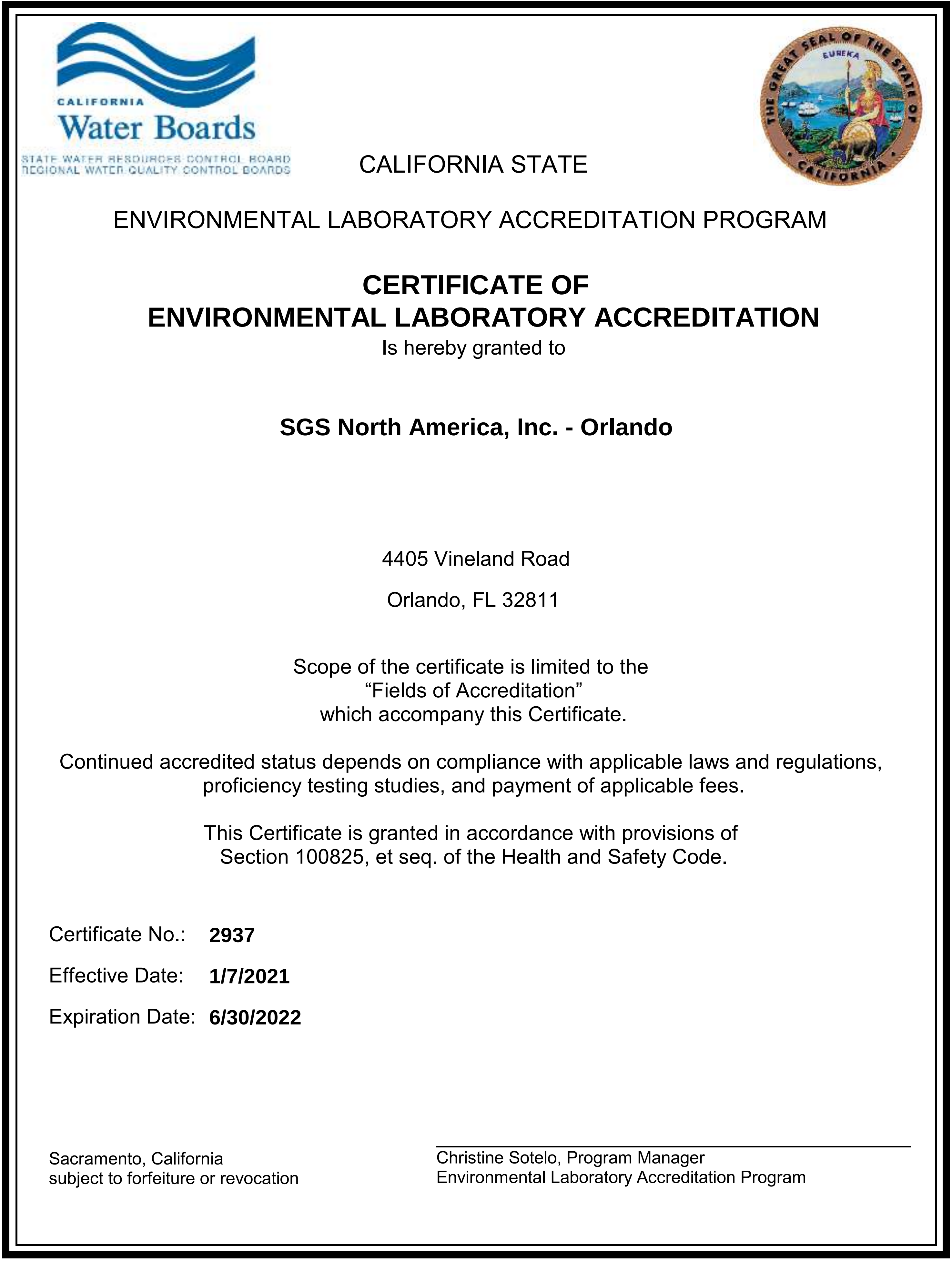
Solid and Chemical Materials

Technology	Method	Analyte
Inorganic Preparation	EPA 3060A	Alkaline Digestion, Cr6+
Inorganic Preparation	EPA 7470A	CVAA Digestion by Hotblock; Leachates
Inorganic Preparation	EPA 7471B	CVAA Digestion by Hotblock

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. L2229.

R. Douglas Leonard Jr., VP, PILR SBU



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

CALIFORNIA STATE

ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

CERTIFICATE OF ENVIRONMENTAL LABORATORY ACCREDITATION

Is hereby granted to

SGS North America, Inc. - Orlando

4405 Vineland Road

Orlando, FL 32811

Scope of the certificate is limited to the
“Fields of Accreditation”
which accompany this Certificate.

Continued accredited status depends on compliance with applicable laws and regulations, proficiency testing studies, and payment of applicable fees.

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

Certificate No.: **2937**

Effective Date: **1/7/2021**

Expiration Date: **6/30/2022**

Sacramento, California
subject to forfeiture or revocation

Christine Sotelo, Program Manager
Environmental Laboratory Accreditation Program

CALIFORNIA STATE
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Fields of Accreditation

SGS North America, Inc. - Orlando

4405 Vineland Road
Orlando, FL 32811
Phone: 4074256700

Certificate Number: 2937
Expiration Date: 6/30/2022

Primary Accreditation Body

Field of Accreditation:105 - Semi-volatile Organic Chemistry of Drinking Water

105.106	001	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	EPA 537.1	FL
105.106	002	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	EPA 537.1	FL
105.106	003	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	EPA 537.1	FL
105.106	004	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	EPA 537.1	FL
105.106	005	N-Ethylperfluorooctane Sulfonamido Acetic Acid (NEtFOSAA)	EPA 537.1	FL
105.106	006	N-Methylperfluorooctane Sulfonamido Acetic Acid (NMeFOSAA)	EPA 537.1	FL
105.106	007	Perfluorobutane Sulfonic Acid (PFBS)	EPA 537.1	FL
105.106	008	Perfluorodecanoic Acid (PFDA)	EPA 537.1	FL
105.106	009	Perfluorododecanoic Acid (PFDoA)	EPA 537.1	FL
105.106	010	Perfluoroheptanoic Acid (PFHpA)	EPA 537.1	FL
105.106	011	Perfluorohexane Sulfonic Acid (PFHxS)	EPA 537.1	FL
105.106	012	Perfluorohexanoic Acid (PFHxA)	EPA 537.1	FL
105.106	013	Perfluorononanoic Acid (PFNA)	EPA 537.1	FL
105.106	014	Perfluorooctanoic Acid (PFOA)	EPA 537.1	FL
105.106	015	Perfluorooctane Sulfonic Acid (PFOS)	EPA 537.1	FL
105.106	016	Perfluorotetradecanoic Acid (PFTDA)	EPA 537.1	FL
105.106	017	Perfluorotridecanoic Acid (PFTrDA)	EPA 537.1	FL
105.106	018	Perfluoroundecanoic Acid (PFUnDA)	EPA 537.1	FL

Field of Accreditation:108 - Inorganic Constituents in Non-Potable Water

108.001	001	Specific Conductance	EPA 120.1 (1982 Rev.1.0)	FL
108.013	001	Calcium	EPA 200.7 (1994 Rev. 4.4)	FL
108.013	002	Magnesium	EPA 200.7 (1994 Rev. 4.4)	FL
108.013	004	Potassium	EPA 200.7 (1994 Rev. 4.4)	FL
108.013	006	Sodium	EPA 200.7 (1994 Rev. 4.4)	FL
108.015	001	Calcium	EPA 200.8 (1994 Rev. 5.4)	FL
108.015	002	Magnesium	EPA 200.8 (1994 Rev. 5.4)	FL
108.015	003	Potassium	EPA 200.8 (1994 Rev. 5.4)	FL
108.015	005	Sodium	EPA 200.8 (1994 Rev. 5.4)	FL
108.017	001	Bromide	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	002	Chloride	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	003	Fluoride	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	004	Nitrate (as N)	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	005	Nitrate-Nitrite (as N)	EPA 300.0 (1993 Rev. 2.1)	FL

As of 2/4/2022 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

108.017	006	Nitrite (as N)	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	007	Phosphate,Ortho (as P)	EPA 300.0 (1993 Rev. 2.1)	FL
108.017	008	Sulfate (as SO4)	EPA 300.0 (1993 Rev. 2.1)	FL
108.023	001	Cyanide, Total	EPA 335.4 (1993 Rev. 1.0)	FL
108.025	001	Ammonia (as N)	EPA 350.1 (1993 Rev. 2.0)	FL
108.029	001	Kjeldahl Nitrogen,Total (as N)	EPA 351.2 (1993 Rev. 2.0)	FL
108.033	001	Nitrate-Nitrite (as N)	EPA 353.2 (1993 Rev. 2.0)	FL
108.033	002	Nitrite (as N)	EPA 353.2 (1993 Rev. 2.0)	FL
108.035	001	Phosphate,Ortho (as P)	EPA 365.1 (1993 Rev. 2.0)	FL
108.035	002	Phosphorus,Total	EPA 365.1 (1993 Rev. 2.0)	FL
108.037	001	Phosphate,Ortho (as P)	EPA 365.3 (1978)	FL
108.037	002	Phosphorus,Total	EPA 365.3 (1978)	FL
108.047	001	Phenols, Total	EPA 420.1 (1978 Rev. 1.0)	FL
108.053	001	Oil & Grease, Total Recoverable	EPA 1664 A	FL
108.055	001	Color	SM 2120 B-2011	FL
108.063	001	Alkalinity	SM 2320 B-2011	FL
108.065	001	Hardness (Calculation)	SM 2340 B-2011	FL
108.071	001	Residue, Total	SM 2540 B-2011	FL
108.073	001	Residue, Filterable TDS	SM 2540 C-2011	FL
108.075	001	Residue, Non-filterable TSS	SM 2540 D-2011	FL
108.137	001	Hydrogen Ion (pH)	SM 4500-H+ B-2011	FL
108.203	001	Sulfide (as S)	SM 4500-S F-2011	FL
108.207	001	Biochemical Oxygen Demand	SM 5210 B-2011	FL
108.207	002	Carbonaceous BOD	SM 5210 B-2011	FL
108.211	001	Chemical Oxygen Demand	SM 5220 C-2011	FL
108.215	001	Organic Carbon-Total (TOC)	SM 5310 B-2011	FL

Field of Accreditation:109 - Metals and Trace Elements in Non-Potable Water

109.623	001	Aluminum	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	002	Antimony	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	003	Arsenic	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	004	Barium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	005	Beryllium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	007	Cadmium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	008	Chromium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	009	Cobalt	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	010	Copper	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	011	Iron	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	012	Lead	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	013	Manganese	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	014	Molybdenum	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	015	Nickel	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	016	Selenium	EPA 200.7 (1994 Rev. 4.4)	FL

109.623	017	Silver	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	018	Thallium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	019	Tin	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	020	Titanium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	021	Vanadium	EPA 200.7 (1994 Rev. 4.4)	FL
109.623	022	Zinc	EPA 200.7 (1994 Rev. 4.4)	FL
109.625	001	Aluminum	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	002	Antimony	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	003	Arsenic	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	004	Barium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	005	Beryllium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	007	Cadmium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	008	Chromium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	009	Cobalt	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	010	Copper	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	012	Iron	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	013	Lead	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	014	Manganese	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	015	Molybdenum	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	016	Nickel	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	017	Selenium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	018	Silver	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	019	Thallium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	020	Tin	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	021	Titanium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	022	Vanadium	EPA 200.8 (1994 Rev. 5.4)	FL
109.625	023	Zinc	EPA 200.8 (1994 Rev. 5.4)	FL
109.635	001	Mercury	EPA 245.1 (1994 Rev. 3.0)	FL

Field of Accreditation:110 - Volatile Organic Constituents in Non-Potable Water

110.040	003	Acrolein	EPA 624.1	FL
110.040	004	Acrylonitrile	EPA 624.1	FL
110.040	005	Benzene	EPA 624.1	FL
110.040	006	Bromodichloromethane	EPA 624.1	FL
110.040	007	Bromoform	EPA 624.1	FL
110.040	008	Bromomethane (Methyl Bromide)	EPA 624.1	FL
110.040	010	Carbon Tetrachloride	EPA 624.1	FL
110.040	011	Chlorobenzene	EPA 624.1	FL
110.040	012	Chloroethane	EPA 624.1	FL
110.040	013	2-Chloroethyl vinyl Ether	EPA 624.1	FL
110.040	014	Chloroform	EPA 624.1	FL
110.040	015	Chloromethane (Methyl Chloride)	EPA 624.1	FL
110.040	016	Dibromochloromethane (Chlorodibromomethane)	EPA 624.1	FL

110.040	017	1,2-Dichlorobenzene	EPA 624.1	FL
110.040	018	1,3-Dichlorobenzene	EPA 624.1	FL
110.040	019	1,4-Dichlorobenzene	EPA 624.1	FL
110.040	020	1,1-Dichloroethane	EPA 624.1	FL
110.040	021	1,2-Dichloroethane (Ethylene Dichloride)	EPA 624.1	FL
110.040	022	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 624.1	FL
110.040	023	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 624.1	FL
110.040	024	1,2-Dichloropropane	EPA 624.1	FL
110.040	025	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 624.1	FL
110.040	026	trans-1,3-Dichloropropylene (trans-1,3 Dichloropropene)	EPA 624.1	FL
110.040	029	Ethylbenzene	EPA 624.1	FL
110.040	031	Methylene Chloride (Dichloromethane)	EPA 624.1	FL
110.040	034	1,1,2,2-Tetrachloroethane	EPA 624.1	FL
110.040	035	Tetrachloroethylene (Tetrachloroethene)	EPA 624.1	FL
110.040	037	Toluene	EPA 624.1	FL
110.040	038	1,1,1-Trichloroethane	EPA 624.1	FL
110.040	039	1,1,2-Trichloroethane	EPA 624.1	FL
110.040	040	Trichloroethylene (Trichloroethene)	EPA 624.1	FL
110.040	041	Vinyl Chloride	EPA 624.1	FL
110.040	042	m-Xylene	EPA 624.1	FL
110.040	043	o-Xylene	EPA 624.1	FL
110.040	044	p-Xylene	EPA 624.1	FL
110.040	045	Trichlorofluoromethane	EPA 624.1	FL
110.040	046	m+p-Xylene	EPA 624.1	FL

Field of Accreditation:111 - Semi-volatile Organic Constituents in Non-Potable Water

111.055	001	Aldrin	EPA 608.3	FL
111.055	002	alpha-BHC	EPA 608.3	FL
111.055	003	beta-BHC	EPA 608.3	FL
111.055	004	delta-BHC	EPA 608.3	FL
111.055	005	gamma-BHC (Lindane)	EPA 608.3	FL
111.055	006	Chlordane	EPA 608.3	FL
111.055	007	4,4'-DDD	EPA 608.3	FL
111.055	008	4,4'-DDE	EPA 608.3	FL
111.055	009	4,4'-DDT	EPA 608.3	FL
111.055	010	Dieldrin	EPA 608.3	FL
111.055	011	Endosulfan I	EPA 608.3	FL
111.055	012	Endosulfan II	EPA 608.3	FL
111.055	013	Endosulfan Sulfate	EPA 608.3	FL
111.055	014	Endrin	EPA 608.3	FL
111.055	015	Endrin Aldehyde	EPA 608.3	FL
111.055	016	Heptachlor	EPA 608.3	FL
111.055	017	Heptachlor Epoxide	EPA 608.3	FL

111.055	019	PCB-1016 (Aroclor-1016)	EPA 608.3	FL
111.055	020	PCB-1221 (Aroclor-1221)	EPA 608.3	FL
111.055	021	PCB-1232 (Aroclor-1232)	EPA 608.3	FL
111.055	022	PCB-1242 (Aroclor-1242)	EPA 608.3	FL
111.055	023	PCB-1248 (Aroclor-1248)	EPA 608.3	FL
111.055	024	PCB-1254 (Aroclor-1254)	EPA 608.3	FL
111.055	025	PCB-1260 (Aroclor-1260)	EPA 608.3	FL
111.055	046	Methoxychlor	EPA 608.3	FL
111.055	060	Toxaphene	EPA 608.3	FL
111.160	001	Acenaphthene	EPA 625.1	FL
111.160	002	Acenaphthylene	EPA 625.1	FL
111.160	003	Anthracene	EPA 625.1	FL
111.160	004	Benzidine	EPA 625.1	FL
111.160	005	Benzo(a)anthracene	EPA 625.1	FL
111.160	006	Benzo(a)pyrene	EPA 625.1	FL
111.160	007	Benzo(b)fluoranthene	EPA 625.1	FL
111.160	008	Benzo(g,h,i)perylene	EPA 625.1	FL
111.160	009	Benzo(k)fluoranthene	EPA 625.1	FL
111.160	010	Bis(2-chloroethoxy) Methane	EPA 625.1	FL
111.160	011	Bis(2-chloroethyl) Ether	EPA 625.1	FL
111.160	012	bis(2-Chloroisopropyl) ether (2,2'-Oxybis[1-chloropropane])	EPA 625.1	FL
111.160	013	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl) phthalate)	EPA 625.1	FL
111.160	014	4-Bromophenyl Phenyl Ether	EPA 625.1	FL
111.160	015	Butyl Benzyl Phthalate	EPA 625.1	FL
111.160	016	2-Chloronaphthalene	EPA 625.1	FL
111.160	017	4-Chlorophenyl Phenyl Ether	EPA 625.1	FL
111.160	018	Chrysene	EPA 625.1	FL
111.160	019	Dibenz(a,h)anthracene	EPA 625.1	FL
111.160	020	3,3'-Dichlorobenzidine	EPA 625.1	FL
111.160	021	Diethyl Phthalate	EPA 625.1	FL
111.160	022	Dimethyl Phthalate	EPA 625.1	FL
111.160	023	Di-n-butyl Phthalate	EPA 625.1	FL
111.160	024	2,4-Dinitrotoluene	EPA 625.1	FL
111.160	025	2,6-Dinitrotoluene	EPA 625.1	FL
111.160	026	Di-n-octyl Phthalate	EPA 625.1	FL
111.160	027	Fluoranthene	EPA 625.1	FL
111.160	028	Fluorene	EPA 625.1	FL
111.160	029	Hexachlorobenzene	EPA 625.1	FL
111.160	030	Hexachlorobutadiene	EPA 625.1	FL
111.160	031	Hexachloroethane	EPA 625.1	FL
111.160	032	Indeno(1,2,3-c,d)pyrene	EPA 625.1	FL
111.160	033	Isophorone	EPA 625.1	FL

111.160	034	Naphthalene	EPA 625.1	FL
111.160	035	Nitrobenzene	EPA 625.1	FL
111.160	036	N-nitroso-di-n-propylamine	EPA 625.1	FL
111.160	037	Phenanthrene	EPA 625.1	FL
111.160	038	Pyrene	EPA 625.1	FL
111.160	039	1,2,4-Trichlorobenzene	EPA 625.1	FL
111.160	040	4-Chloro-3-methylphenol	EPA 625.1	FL
111.160	041	2-Chlorophenol	EPA 625.1	FL
111.160	042	2,4-Dichlorophenol	EPA 625.1	FL
111.160	043	2,4-Dimethylphenol	EPA 625.1	FL
111.160	044	2,4-Dinitrophenol	EPA 625.1	FL
111.160	045	2-Methyl-4,6-dinitrophenol	EPA 625.1	FL
111.160	046	2-Nitrophenol	EPA 625.1	FL
111.160	047	4-Nitrophenol	EPA 625.1	FL
111.160	048	Pentachlorophenol	EPA 625.1	FL
111.160	049	Phenol	EPA 625.1	FL
111.160	050	2,4,6-Trichlorophenol	EPA 625.1	FL
111.345	001	N-Ethylperfluorooctane Sulfonamido Acetic Acid (NEtFOSAA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	002	4:2 Fluorotelomer Sulfonic Acid (4:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	003	6:2 Fluorotelomer Sulfonic Acid (6:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	004	8:2 Fluorotelomer Sulfonic Acid (8:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	005	N-Methylperfluorooctane Sulfonamido Acetic Acid (NMeFOSAA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	006	Perfluorobutanoic Acid (PFBA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	007	Perfluorobutane Sulfonic Acid (PFBS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	008	Perfluorodecanoic Acid (PFDA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	009	Perfluorododecanoic Acid (PFDoA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	010	Perfluorodecane Sulfonic Acid (PFDS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	011	Perfluoroheptanoic Acid (PFHpA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	012	Perfluoroheptane Sulfonic Acid (PFHpS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	013	Perfluorohexane Sulfonic Acid (PFHxS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	014	Perfluorohexanoic Acid (PFHxA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	015	Perfluorononanoic Acid (PFNA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	016	Perfluorooctanoic Acid (PFOA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	017	Perfluorooctane Sulfonic Acid (PFOS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	018	Perfluorooctane Sulfonamide (PFOSAm)	DoD QSM Version 5.1 (or newer)	DOD
111.345	019	Perfluoropentanoic Acid (PFPeA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	020	Perfluoropentane Sulfonic Acid (PFPeS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	021	Perfluorotetradecanoic Acid (PFTDA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	022	Perfluorotridecanoic Acid (PFTrDA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	023	Perfluoroundecanoic Acid (PFUnDA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	024	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	DoD QSM Version 5.1 (or newer)	DOD
111.345	025	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	DoD QSM Version 5.1 (or newer)	DOD

111.345	026	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	027	N-Ethylperfluorooctane Sulfonamide (EtFOSAm)	DoD QSM Version 5.1 (or newer)	DOD
111.345	028	N-Ethylperfluorooctane Sulfonamido Ethanol (EtFOSE)	DoD QSM Version 5.1 (or newer)	DOD
111.345	030	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	031	N-Methylperfluorooctane Sulfonamide (NMeFOSA)	DoD QSM Version 5.1 (or newer)	DOD
111.345	032	N-Methylperfluorooctane Sulfonamido Ethanol (NMeFOSE)	DoD QSM Version 5.1 (or newer)	DOD

Field of Accreditation:114 - Inorganic Constituents in Hazardous Waste

114.325	001	Aluminum	EPA 6010 D	FL
114.325	002	Antimony	EPA 6010 D	FL
114.325	003	Arsenic	EPA 6010 D	FL
114.325	004	Barium	EPA 6010 D	FL
114.325	005	Beryllium	EPA 6010 D	FL
114.325	007	Cadmium	EPA 6010 D	FL
114.325	008	Calcium	EPA 6010 D	FL
114.325	009	Chromium	EPA 6010 D	FL
114.325	010	Cobalt	EPA 6010 D	FL
114.325	011	Copper	EPA 6010 D	FL
114.325	012	Iron	EPA 6010 D	FL
114.325	013	Lead	EPA 6010 D	FL
114.325	014	Magnesium	EPA 6010 D	FL
114.325	015	Manganese	EPA 6010 D	FL
114.325	016	Molybdenum	EPA 6010 D	FL
114.325	017	Nickel	EPA 6010 D	FL
114.325	018	Potassium	EPA 6010 D	FL
114.325	019	Selenium	EPA 6010 D	FL
114.325	020	Silver	EPA 6010 D	FL
114.325	021	Sodium	EPA 6010 D	FL
114.325	022	Strontium	EPA 6010 D	FL
114.325	023	Thallium	EPA 6010 D	FL
114.325	024	Tin	EPA 6010 D	FL
114.325	025	Titanium	EPA 6010 D	FL
114.325	026	Vanadium	EPA 6010 D	FL
114.325	027	Zinc	EPA 6010 D	FL
114.335	001	Aluminum	EPA 6020	FL
114.335	002	Antimony	EPA 6020	FL
114.335	003	Arsenic	EPA 6020	FL
114.335	004	Barium	EPA 6020	FL
114.335	005	Beryllium	EPA 6020	FL
114.335	006	Cadmium	EPA 6020	FL
114.335	007	Chromium	EPA 6020	FL
114.335	008	Cobalt	EPA 6020	FL
114.335	009	Copper	EPA 6020	FL

114.335	010	Lead	EPA 6020	FL
114.335	011	Manganese	EPA 6020	FL
114.335	012	Nickel	EPA 6020	FL
114.335	013	Silver	EPA 6020	FL
114.335	014	Thallium	EPA 6020	FL
114.335	015	Zinc	EPA 6020	FL
114.335	016	Molybdenum	EPA 6020	FL
114.335	017	Selenium	EPA 6020	FL
114.345	001	Aluminum	EPA 6020 B	FL
114.345	002	Antimony	EPA 6020 B	FL
114.345	003	Arsenic	EPA 6020 B	FL
114.345	004	Barium	EPA 6020 B	FL
114.345	005	Beryllium	EPA 6020 B	FL
114.345	006	Cadmium	EPA 6020 B	FL
114.345	007	Calcium	EPA 6020 B	FL
114.345	008	Chromium	EPA 6020 B	FL
114.345	009	Cobalt	EPA 6020 B	FL
114.345	010	Copper	EPA 6020 B	FL
114.345	011	Iron	EPA 6020 B	FL
114.345	012	Lead	EPA 6020 B	FL
114.345	013	Magnesium	EPA 6020 B	FL
114.345	014	Manganese	EPA 6020 B	FL
114.345	015	Mercury	EPA 6020 B	FL
114.345	016	Nickel	EPA 6020 B	FL
114.345	017	Potassium	EPA 6020 B	FL
114.345	018	Selenium	EPA 6020 B	FL
114.345	019	Silver	EPA 6020 B	FL
114.345	020	Sodium	EPA 6020 B	FL
114.345	021	Thallium	EPA 6020 B	FL
114.345	022	Vanadium	EPA 6020 B	FL
114.345	023	Zinc	EPA 6020 B	FL
114.345	024	Molybdenum	EPA 6020 B	FL
114.545	001	Mercury	EPA 7471 B	FL
114.715	001	Cyanide, Total	EPA 9012 B	FL
114.755	001	Fluoride	EPA 9056 A	FL

Field of Accreditation:115 - Leaching/Extraction Tests and Physical Characteristics of Hazardous Waste

115.085	001	Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	FL
115.095	001	Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	FL

Field of Accreditation:116 - Volatile Organic Compounds in Hazardous Waste

116.215	001	1,2-Dibromoethane (EDB)	EPA 8011	FL
116.215	002	1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	FL
116.265	001	Benzene	EPA 8260 B	FL

SGS North America, Inc. - Orlando

Certificate Number: 2937
Expiration Date: 6/30/2022

116.265	002	Bromobenzene	EPA 8260 B	FL
116.265	003	Bromochloromethane	EPA 8260 B	FL
116.265	004	Bromodichloromethane	EPA 8260 B	FL
116.265	005	Bromoform	EPA 8260 B	FL
116.265	006	Bromomethane (Methyl Bromide)	EPA 8260 B	FL
116.265	007	n-Butylbenzene	EPA 8260 B	FL
116.265	008	sec-Butylbenzene	EPA 8260 B	FL
116.265	009	tert-Butylbenzene	EPA 8260 B	FL
116.265	010	Carbon Disulfide	EPA 8260 B	FL
116.265	011	Carbon Tetrachloride	EPA 8260 B	FL
116.265	012	Chlorobenzene	EPA 8260 B	FL
116.265	013	Chlorodibromomethane (Dibromochloromethane)	EPA 8260 B	FL
116.265	014	Chloroethane	EPA 8260 B	FL
116.265	015	Chloroform	EPA 8260 B	FL
116.265	016	Chloromethane (Methyl Chloride)	EPA 8260 B	FL
116.265	017	Dibromomethane	EPA 8260 B	FL
116.265	018	Dichlorodifluoromethane (Freon 12)	EPA 8260 B	FL
116.265	019	cis-1,2-Dichloroethylene (cis 1,2 Dichloroethene)	EPA 8260 B	FL
116.265	020	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 8260 B	FL
116.265	021	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 8260 B	FL
116.265	022	trans-1,3-Dichloropropylene (trans-1,3 Dichloropropene)	EPA 8260 B	FL
116.265	023	Ethylbenzene	EPA 8260 B	FL
116.265	024	Hexachlorobutadiene	EPA 8260 B	FL
116.265	025	Methyl tert-butyl Ether (MTBE)	EPA 8260 B	FL
116.265	026	Methylene Chloride (Dichloromethane)	EPA 8260 B	FL
116.265	027	Naphthalene	EPA 8260 B	FL
116.265	028	Nitrobenzene	EPA 8260 B	FL
116.265	029	N-propylbenzene	EPA 8260 B	FL
116.265	030	Styrene	EPA 8260 B	FL
116.265	031	Tetrachloroethylene (Tetrachloroethene)	EPA 8260 B	FL
116.265	032	Toluene	EPA 8260 B	FL
116.265	033	Trichloroethylene (Trichloroethene)	EPA 8260 B	FL
116.265	034	Trichlorofluoromethane	EPA 8260 B	FL
116.265	035	Vinyl Chloride	EPA 8260 B	FL
116.265	036	m+p-Xylene	EPA 8260 B	FL
116.265	037	o-Xylene	EPA 8260 B	FL
116.265	038	m-Xylene	EPA 8260 B	FL
116.265	039	p-Xylene	EPA 8260 B	FL
116.265	040	1,1-Dichloroethane	EPA 8260 B	FL
116.265	041	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 8260 B	FL
116.265	042	1,1,1-Trichloroethane	EPA 8260 B	FL
116.265	043	1,1,1,2-Tetrachloroethane	EPA 8260 B	FL

116.265	044	1,1,2,2-Tetrachloroethane	EPA 8260 B	FL
116.265	045	1,1,2-Trichloroethane	EPA 8260 B	FL
116.265	046	1,2-Dichlorobenzene	EPA 8260 B	FL
116.265	047	1,2-Dichloroethane (Ethylene Dichloride)	EPA 8260 B	FL
116.265	048	1,2-Dibromoethane (EDB)	EPA 8260 B	FL
116.265	049	1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260 B	FL
116.265	050	1,2-Dichloropropane	EPA 8260 B	FL
116.265	051	1,2,3-Trichloropropane (TCP)	EPA 8260 B	FL
116.265	052	1,2,4-Trichlorobenzene	EPA 8260 B	FL
116.265	053	1,3-Dichlorobenzene	EPA 8260 B	FL
116.265	054	1,4-Dichlorobenzene	EPA 8260 B	FL
116.265	055	2-Chloroethyl vinyl Ether	EPA 8260 B	FL
116.265	056	4-Chlorotoluene	EPA 8260 B	FL
116.265	057	4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	EPA 8260 B	FL
116.275	001	Benzene	EPA 8260 D	FL
116.275	002	Bromobenzene	EPA 8260 D	FL
116.275	003	Bromochloromethane	EPA 8260 D	FL
116.275	004	Bromodichloromethane	EPA 8260 D	FL
116.275	005	Bromoform	EPA 8260 D	FL
116.275	006	Bromomethane (Methyl Bromide)	EPA 8260 D	FL
116.275	007	n-Butylbenzene	EPA 8260 D	FL
116.275	008	sec-Butylbenzene	EPA 8260 D	FL
116.275	009	tert-Butylbenzene	EPA 8260 D	FL
116.275	010	Carbon Disulfide	EPA 8260 D	FL
116.275	011	Carbon Tetrachloride	EPA 8260 D	FL
116.275	012	Chlorobenzene	EPA 8260 D	FL
116.275	013	Chlorodibromomethane (Dibromochloromethane)	EPA 8260 D	FL
116.275	014	Chloroethane	EPA 8260 D	FL
116.275	015	Chloroform	EPA 8260 D	FL
116.275	016	Chloromethane (Methyl Chloride)	EPA 8260 D	FL
116.275	017	Dibromomethane	EPA 8260 D	FL
116.275	018	Dichlorodifluoromethane (Freon 12)	EPA 8260 D	FL
116.275	019	cis-1,2-Dichloroethylene (cis 1,2 Dichloroethene)	EPA 8260 D	FL
116.275	020	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 8260 D	FL
116.275	021	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 8260 D	FL
116.275	022	trans-1,3-Dichloropropylene (trans-1,3 Dichloropropene)	EPA 8260 D	FL
116.275	023	Ethylbenzene	EPA 8260 D	FL
116.275	024	Hexachlorobutadiene	EPA 8260 D	FL
116.275	025	Methyl tert-butyl Ether (MTBE)	EPA 8260 D	FL
116.275	026	Methylene Chloride (Dichloromethane)	EPA 8260 D	FL
116.275	027	Naphthalene	EPA 8260 D	FL
116.275	028	Nitrobenzene	EPA 8260 D	FL

As of 2/4/2022 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

116.275	029	N-propylbenzene	EPA 8260 D	FL
116.275	030	Styrene	EPA 8260 D	FL
116.275	031	Tetrachloroethylene (Tetrachloroethene)	EPA 8260 D	FL
116.275	032	Toluene	EPA 8260 D	FL
116.275	033	Trichloroethylene (Trichloroethene)	EPA 8260 D	FL
116.275	034	Trichlorofluoromethane	EPA 8260 D	FL
116.275	035	Vinyl Chloride	EPA 8260 D	FL
116.275	036	m+p-Xylene	EPA 8260 D	FL
116.275	037	o-Xylene	EPA 8260 D	FL
116.275	038	m-Xylene	EPA 8260 D	FL
116.275	039	p-Xylene	EPA 8260 D	FL
116.275	040	1,1-Dichloroethane	EPA 8260 D	FL
116.275	041	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 8260 D	FL
116.275	042	1,1,1-Trichloroethane	EPA 8260 D	FL
116.275	043	1,1,1,2-Tetrachloroethane	EPA 8260 D	FL
116.275	044	1,1,2,2-Tetrachloroethane	EPA 8260 D	FL
116.275	045	1,1,2-Trichloroethane	EPA 8260 D	FL
116.275	046	1,2-Dichlorobenzene	EPA 8260 D	FL
116.275	047	1,2-Dichloroethane (Ethylene Dichloride)	EPA 8260 D	FL
116.275	048	1,2-Dibromoethane (EDB)	EPA 8260 D	FL
116.275	049	1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260 D	FL
116.275	050	1,2-Dichloropropane	EPA 8260 D	FL
116.275	051	1,2,3-Trichloropropane (TCP)	EPA 8260 D	FL
116.275	052	1,2,4-Trichlorobenzene	EPA 8260 D	FL
116.275	053	1,3-Dichlorobenzene	EPA 8260 D	FL
116.275	054	1,4-Dichlorobenzene	EPA 8260 D	FL
116.275	055	2-Chloroethyl vinyl Ether	EPA 8260 D	FL
116.275	056	4-Chlorotoluene	EPA 8260 D	FL
116.275	057	4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	EPA 8260 D	FL
116.285	001	Acrylamide	EPA 8316	FL

Field of Accreditation:117 - Semi-volatile Organic Chemistry of Hazardous Waste

117.245	001	Gasoline Range Organics (GRO)	EPA 8015 C	FL
117.245	002	Diesel Range Organics (DRO)	EPA 8015 C	FL
117.265	006	n-Butyl Alcohol (1-Butanol)	EPA 8015 C	FL
117.265	012	Ethanol	EPA 8015 C	FL
117.265	016	Isobutyl Alcohol	EPA 8015 C	FL
117.265	017	Isopropyl Alcohol (Isopropanol)	EPA 8015 C	FL
117.265	018	Methanol	EPA 8015 C	FL
117.265	025	1-Propanol	EPA 8015 C	FL
117.315	001	Aldrin	EPA 8081 A	FL
117.315	002	alpha-BHC	EPA 8081 A	FL
117.315	003	beta-BHC	EPA 8081 A	FL

117.315	004	delta-BHC	EPA 8081 A	FL
117.315	005	gamma-BHC (Lindane)	EPA 8081 A	FL
117.315	006	Chlordane (total)	EPA 8081 A	FL
117.315	007	trans-Chlordane	EPA 8081 A	FL
117.315	008	4,4'-DDD	EPA 8081 A	FL
117.315	009	4,4'-DDE	EPA 8081 A	FL
117.315	010	4,4'-DDT	EPA 8081 A	FL
117.315	011	Dieldrin	EPA 8081 A	FL
117.315	012	Endosulfan I	EPA 8081 A	FL
117.315	013	Endosulfan II	EPA 8081 A	FL
117.315	014	Endosulfan Sulfate	EPA 8081 A	FL
117.315	015	Endrin	EPA 8081 A	FL
117.315	016	Endrin Aldehyde	EPA 8081 A	FL
117.315	017	Endrin Ketone	EPA 8081 A	FL
117.315	018	Heptachlor	EPA 8081 A	FL
117.315	019	Heptachlor Epoxide	EPA 8081 A	FL
117.315	020	Methoxychlor	EPA 8081 A	FL
117.315	021	Toxaphene	EPA 8081 A	FL
117.325	001	Aldrin	EPA 8081 B	FL
117.325	002	alpha-BHC	EPA 8081 B	FL
117.325	003	beta-BHC	EPA 8081 B	FL
117.325	004	delta-BHC	EPA 8081 B	FL
117.325	005	gamma-BHC (Lindane)	EPA 8081 B	FL
117.325	006	Chlordane (total)	EPA 8081 B	FL
117.325	007	trans-Chlordane	EPA 8081 B	FL
117.325	008	4,4'-DDD	EPA 8081 B	FL
117.325	009	4,4'-DDE	EPA 8081 B	FL
117.325	010	4,4'-DDT	EPA 8081 B	FL
117.325	011	Dieldrin	EPA 8081 B	FL
117.325	012	Endosulfan I	EPA 8081 B	FL
117.325	013	Endosulfan II	EPA 8081 B	FL
117.325	014	Endosulfan Sulfate	EPA 8081 B	FL
117.325	015	Endrin	EPA 8081 B	FL
117.325	016	Endrin Aldehyde	EPA 8081 B	FL
117.325	017	Endrin Ketone	EPA 8081 B	FL
117.325	018	Heptachlor	EPA 8081 B	FL
117.325	019	Heptachlor Epoxide	EPA 8081 B	FL
117.325	020	Methoxychlor	EPA 8081 B	FL
117.325	021	Toxaphene	EPA 8081 B	FL
117.335	001	Aroclor 1016	EPA 8082	FL
117.335	002	Aroclor 1221	EPA 8082	FL
117.335	003	Aroclor 1232	EPA 8082	FL

117.335	004	Aroclor 1242	EPA 8082	FL
117.335	005	Aroclor 1248	EPA 8082	FL
117.335	006	Aroclor 1254	EPA 8082	FL
117.335	007	Aroclor 1260	EPA 8082	FL
117.345	001	Aroclor 1016	EPA 8082 A	FL
117.345	002	Aroclor 1221	EPA 8082 A	FL
117.345	003	Aroclor 1232	EPA 8082 A	FL
117.345	004	Aroclor 1242	EPA 8082 A	FL
117.345	005	Aroclor 1248	EPA 8082 A	FL
117.345	006	Aroclor 1254	EPA 8082 A	FL
117.345	007	Aroclor 1260	EPA 8082 A	FL
117.415	001	Azinphos Methyl	EPA 8141 B	FL
117.415	002	Chlorpyrifos	EPA 8141 B	FL
117.415	003	Demeton-O	EPA 8141 B	FL
117.415	004	Demeton-S	EPA 8141 B	FL
117.415	005	Diazinon	EPA 8141 B	FL
117.415	006	Dichlorvos (DDVP)	EPA 8141 B	FL
117.415	007	Disulfoton	EPA 8141 B	FL
117.415	008	Malathion	EPA 8141 B	FL
117.415	009	Parathion Ethyl	EPA 8141 B	FL
117.415	011	Phorate	EPA 8141 B	FL
117.415	012	Ronnel	EPA 8141 B	FL
117.415	013	Stirophos (Tetrachlorovinphos)	EPA 8141 B	FL
117.415	014	Terbufos	EPA 8141 B	FL
117.425	001	2,4-D	EPA 8151 A	FL
117.425	002	2,4-DB	EPA 8151 A	FL
117.425	003	2,4,5-TP (Silvex)	EPA 8151 A	FL
117.425	004	2,4,5-T	EPA 8151 A	FL
117.425	005	Dalapon	EPA 8151 A	FL
117.425	006	Dicamba	EPA 8151 A	FL
117.425	007	Dichloroprop	EPA 8151 A	FL
117.425	008	Dinoseb	EPA 8151 A	FL
117.425	009	MCPA	EPA 8151 A	FL
117.425	010	MCPP	EPA 8151 A	FL
117.425	012	Pentachlorophenol	EPA 8151 A	FL
117.445	001	Acenaphthene	EPA 8270 E	FL
117.445	002	Acenaphthylene	EPA 8270 E	FL
117.445	003	Aniline	EPA 8270 E	FL
117.445	004	Anthracene	EPA 8270 E	FL
117.445	005	Benzidine	EPA 8270 E	FL
117.445	006	Benzoic Acid	EPA 8270 E	FL
117.445	007	Benzo(a)anthracene	EPA 8270 E	FL

SGS North America, Inc. - Orlando **Certificate Number:** 2937
Expiration Date: 6/30/2022

117.445	008	Benzo(b)fluoranthene	EPA 8270 E	FL
117.445	009	Benzo(k)fluoranthene	EPA 8270 E	FL
117.445	010	Benzo(g,h,i)perylene	EPA 8270 E	FL
117.445	011	Benzo(a)pyrene	EPA 8270 E	FL
117.445	012	Benzyl Alcohol	EPA 8270 E	FL
117.445	013	Bis(2-chloroethoxy) Methane	EPA 8270 E	FL
117.445	014	Bis(2-chloroethyl) Ether	EPA 8270 E	FL
117.445	015	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl) phthalate)	EPA 8270 E	FL
117.445	016	Butyl Benzyl Phthalate	EPA 8270 E	FL
117.445	017	Chrysene	EPA 8270 E	FL
117.445	018	Dibenz(a,h)anthracene	EPA 8270 E	FL
117.445	019	Dibenzofuran	EPA 8270 E	FL
117.445	020	Di-n-butyl Phthalate	EPA 8270 E	FL
117.445	021	Diethyl Phthalate	EPA 8270 E	FL
117.445	022	Dimethyl Phthalate	EPA 8270 E	FL
117.445	023	Di-n-octyl Phthalate	EPA 8270 E	FL
117.445	024	Fluoranthene	EPA 8270 E	FL
117.445	025	Fluorene	EPA 8270 E	FL
117.445	026	Naphthalene	EPA 8270 E	FL
117.445	027	Nitrobenzene	EPA 8270 E	FL
117.445	028	Pentachlorobenzene	EPA 8270 E	FL
117.445	029	Pentachlorophenol	EPA 8270 E	FL
117.445	030	1-Chloronaphthalene	EPA 8270 E	FL
117.445	031	1,2-Dichlorobenzene	EPA 8270 E	FL
117.445	032	1,3-Dichlorobenzene	EPA 8270 E	FL
117.445	033	1,4-Dichlorobenzene	EPA 8270 E	FL
117.445	034	2-Chloronaphthalene	EPA 8270 E	FL
117.445	035	2-Chlorophenol	EPA 8270 E	FL
117.445	036	2,4-Dichlorophenol	EPA 8270 E	FL
117.445	037	2,4-Dimethylphenol	EPA 8270 E	FL
117.445	038	2,4-Dinitrophenol	EPA 8270 E	FL
117.445	039	2,4-Dinitrotoluene	EPA 8270 E	FL
117.445	040	2,6-Dichlorophenol	EPA 8270 E	FL
117.445	041	2,6-Dinitrotoluene	EPA 8270 E	FL
117.445	042	2-Nitroaniline	EPA 8270 E	FL
117.445	043	2-Nitrophenol	EPA 8270 E	FL
117.445	044	3-Nitroaniline	EPA 8270 E	FL
117.445	045	3,3'-Dichlorobenzidine	EPA 8270 E	FL
117.445	046	4-Chloroaniline	EPA 8270 E	FL
117.445	047	4-Chloro-3-methylphenol	EPA 8270 E	FL
117.445	048	4-Bromophenyl Phenyl Ether	EPA 8270 E	FL
117.445	049	4-Chlorophenyl Phenyl Ether	EPA 8270 E	FL

117.445	050	4-Nitroaniline	EPA 8270 E	FL
117.445	051	4-Nitrophenol	EPA 8270 E	FL
117.445	074	Disulfoton	EPA 8270 E	FL
117.445	076	Parathion Ethyl	EPA 8270 E	FL
117.445	077	Parathion Methyl	EPA 8270 E	FL
117.445	078	Phorate	EPA 8270 E	FL
117.445	087	N-nitrosodiethylamine	EPA 8270 E	FL
117.445	088	N-nitrosodimethylamine	EPA 8270 E	FL
117.445	089	N-nitrosodiphenylamine	EPA 8270 E	FL
117.445	090	N-nitroso-di-n-propylamine	EPA 8270 E	FL
117.535	001	Nitrobenzene	EPA 8330	FL
117.535	002	1,3-Dinitrobenzene	EPA 8330	FL
117.535	003	1,3,5-Trinitrobenzene	EPA 8330	FL
117.535	004	2,4-Dinitrotoluene	EPA 8330	FL
117.535	005	2,4,6-Trinitrotoluene	EPA 8330	FL
117.535	006	2,6-Dinitrotoluene	EPA 8330	FL
117.535	007	2-Nitrotoluene	EPA 8330	FL
117.535	008	3-Nitrotoluene	EPA 8330	FL
117.535	009	4-Nitrotoluene	EPA 8330	FL
117.545	001	1,3,5-Trinitrobenzene	EPA 8330 A	FL
117.545	002	1,3-Dinitrobenzene	EPA 8330 A	FL
117.545	003	Nitrobenzene	EPA 8330 A	FL
117.545	004	2,4,6-Trinitrotoluene	EPA 8330 A	FL
117.545	005	2,4-Dinitrotoluene	EPA 8330 A	FL
117.545	006	2,6-Dinitrotoluene	EPA 8330 A	FL
117.545	007	2-Nitrotoluene	EPA 8330 A	FL
117.545	008	3-Nitrotoluene	EPA 8330 A	FL
117.545	009	4-Nitrotoluene	EPA 8330 A	FL
117.575	001	N-Ethylperfluorooctane Sulfonamide (EtFOSAm)	DoD QSM Version 5.1 (or newer)	DOD
117.575	002	N-Ethylperfluorooctane Sulfonamido Acetic Acid (NEtFOSAA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	003	N-Ethylperfluorooctane Sulfonamido Ethanol (EtFOSE)	DoD QSM Version 5.1 (or newer)	DOD
117.575	004	4:2 Fluorotelomer Sulfonic Acid (4:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	005	6:2 Fluorotelomer Sulfonic Acid (6:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	006	8:2 Fluorotelomer Sulfonic Acid (8:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	007	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	008	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	009	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	010	N-Methylperfluorooctane Sulfonamide (NMeFOSA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	011	N-Methylperfluorooctane Sulfonamido Acetic Acid (NMeFOSAA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	012	N-Methylperfluorooctane Sulfonamido Ethanol (NMeFOSE)	DoD QSM Version 5.1 (or newer)	DOD
117.575	013	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	014	Perfluorobutanoic Acid (PFBA)	DoD QSM Version 5.1 (or newer)	DOD

117.575	015	Perfluorobutanoic Acid (PFBA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	016	Perfluorodecanoic Acid (PFDA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	017	Perfluorododecanoic Acid (PFDoA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	018	Perfluorodecanoic Acid (PFDA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	019	Perfluoroheptanoic Acid (PFHpA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	020	Perfluoroheptane Sulfonic Acid (PFHpS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	021	Perfluorohexane Sulfonic Acid (PFHxS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	022	Perfluorohexanoic Acid (PFHxA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	023	Perfluorononanoic Acid (PFNA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	024	Perfluorooctanoic Acid (PFOA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	025	Perfluorooctane Sulfonic Acid (PFOS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	026	Perfluorooctane Sulfonamide (PFOSAm)	DoD QSM Version 5.1 (or newer)	DOD
117.575	027	Perfluoropentanoic Acid (PFPeA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	028	Perfluoropentane Sulfonic Acid (PFPeS)	DoD QSM Version 5.1 (or newer)	DOD
117.575	029	Perfluorotetradecanoic Acid (PFTDA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	030	Perfluorotridecanoic Acid (PFTrDA)	DoD QSM Version 5.1 (or newer)	DOD
117.575	031	Perfluoroundecanoic Acid (PFUnDA)	DoD QSM Version 5.1 (or newer)	DOD

Field of Accreditation:130 - Inorganic constituents in Hazardous waste (Matrix Aqueous)

130.020	001	Aluminum	EPA 6010 D	FL
130.020	002	Antimony	EPA 6010 D	FL
130.020	003	Arsenic	EPA 6010 D	FL
130.020	004	Barium	EPA 6010 D	FL
130.020	005	Beryllium	EPA 6010 D	FL
130.020	007	Cadmium	EPA 6010 D	FL
130.020	008	Calcium	EPA 6010 D	FL
130.020	009	Chromium	EPA 6010 D	FL
130.020	010	Cobalt	EPA 6010 D	FL
130.020	011	Copper	EPA 6010 D	FL
130.020	012	Iron	EPA 6010 D	FL
130.020	013	Lead	EPA 6010 D	FL
130.020	014	Magnesium	EPA 6010 D	FL
130.020	015	Manganese	EPA 6010 D	FL
130.020	016	Molybdenum	EPA 6010 D	FL
130.020	017	Nickel	EPA 6010 D	FL
130.020	018	Potassium	EPA 6010 D	FL
130.020	019	Selenium	EPA 6010 D	FL
130.020	020	Silver	EPA 6010 D	FL
130.020	021	Sodium	EPA 6010 D	FL
130.020	022	Strontium	EPA 6010 D	FL
130.020	023	Thallium	EPA 6010 D	FL
130.020	024	Tin	EPA 6010 D	FL
130.020	025	Titanium	EPA 6010 D	FL

SGS North America, Inc. - Orlando

Certificate Number: 2937
Expiration Date: 6/30/2022

130.020	026	Vanadium	EPA 6010 D	FL
130.020	027	Zinc	EPA 6010 D	FL
130.030	001	Aluminum	EPA 6020	FL
130.030	002	Antimony	EPA 6020	FL
130.030	003	Arsenic	EPA 6020	FL
130.030	004	Barium	EPA 6020	FL
130.030	005	Beryllium	EPA 6020	FL
130.030	006	Cadmium	EPA 6020	FL
130.030	007	Chromium	EPA 6020	FL
130.030	008	Cobalt	EPA 6020	FL
130.030	009	Copper	EPA 6020	FL
130.030	010	Lead	EPA 6020	FL
130.030	011	Manganese	EPA 6020	FL
130.030	012	Nickel	EPA 6020	FL
130.030	013	Silver	EPA 6020	FL
130.030	014	Thallium	EPA 6020	FL
130.030	015	Zinc	EPA 6020	FL
130.030	016	Molybdenum	EPA 6020	FL
130.030	017	Selenium	EPA 6020	FL
130.040	001	Aluminum	EPA 6020 B	FL
130.040	002	Antimony	EPA 6020 B	FL
130.040	003	Arsenic	EPA 6020 B	FL
130.040	004	Barium	EPA 6020 B	FL
130.040	005	Beryllium	EPA 6020 B	FL
130.040	006	Cadmium	EPA 6020 B	FL
130.040	007	Calcium	EPA 6020 B	FL
130.040	008	Chromium	EPA 6020 B	FL
130.040	009	Cobalt	EPA 6020 B	FL
130.040	010	Copper	EPA 6020 B	FL
130.040	011	Iron	EPA 6020 B	FL
130.040	012	Lead	EPA 6020 B	FL
130.040	013	Magnesium	EPA 6020 B	FL
130.040	014	Manganese	EPA 6020 B	FL
130.040	016	Nickel	EPA 6020 B	FL
130.040	017	Potassium	EPA 6020 B	FL
130.040	018	Selenium	EPA 6020 B	FL
130.040	019	Silver	EPA 6020 B	FL
130.040	020	Sodium	EPA 6020 B	FL
130.040	021	Thallium	EPA 6020 B	FL
130.040	022	Vanadium	EPA 6020 B	FL
130.040	023	Zinc	EPA 6020 B	FL
130.040	024	Molybdenum	EPA 6020 B	FL

130.140	001	Chromium VI (Hexavalent Chromium)	EPA 7196 A	FL
130.250	001	Mercury	EPA 7470 A	FL
130.440	001	Cyanide, Total	EPA 9012 B	FL
130.470	001	Fluoride	EPA 9056	FL
130.480	001	Fluoride	EPA 9056 A	FL
130.490	001	Organic Carbon-Total (TOC)	EPA 9060 A	FL

Field of Accreditation:131 - Leaching/Extraction, Physical Chacterstics in Hazardous Waste (Matrix Aqueous)

131.060	001	Ignitability	EPA 1010	FL
131.070	001	Ignitability	EPA 1010 A	FL
131.080	001	Ignitability	EPA 1020 A	FL
131.090	001	Ignitability	EPA 1020 B	FL

Field of Accreditation:132 - Volatile Organic Compounds in Hazardous Waste (Matrix Aqueous)

132.010	001	1,2-Dibromoethane (EDB)	EPA 8011	FL
132.010	002	1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	FL
132.060	001	Benzene	EPA 8260 B	FL
132.060	002	Bromobenzene	EPA 8260 B	FL
132.060	003	Bromochloromethane	EPA 8260 B	FL
132.060	004	Bromodichloromethane	EPA 8260 B	FL
132.060	005	Bromoform	EPA 8260 B	FL
132.060	006	Bromomethane (Methyl Bromide)	EPA 8260 B	FL
132.060	007	n-Butylbenzene	EPA 8260 B	FL
132.060	008	sec-Butylbenzene	EPA 8260 B	FL
132.060	009	tert-Butylbenzene	EPA 8260 B	FL
132.060	010	Carbon Disulfide	EPA 8260 B	FL
132.060	011	Carbon Tetrachloride	EPA 8260 B	FL
132.060	012	Chlorobenzene	EPA 8260 B	FL
132.060	013	Chlorodibromomethane (Dibromochloromethane)	EPA 8260 B	FL
132.060	014	Chloroethane	EPA 8260 B	FL
132.060	015	Chloroform	EPA 8260 B	FL
132.060	016	Chloromethane (Methyl Chloride)	EPA 8260 B	FL
132.060	017	Dibromomethane	EPA 8260 B	FL
132.060	018	Dichlorodifluoromethane (Freon 12)	EPA 8260 B	FL
132.060	019	cis-1,2-Dichloroethylene (cis 1,2 Dichloroethene)	EPA 8260 B	FL
132.060	020	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 8260 B	FL
132.060	021	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 8260 B	FL
132.060	022	trans-1,3-Dichloropropylene (trans-1,3 Dichloropropene)	EPA 8260 B	FL
132.060	023	Ethylbenzene	EPA 8260 B	FL
132.060	024	Hexachlorobutadiene	EPA 8260 B	FL
132.060	025	Methyl tert-butyl Ether (MTBE)	EPA 8260 B	FL
132.060	026	Methylene Chloride (Dichloromethane)	EPA 8260 B	FL
132.060	027	Naphthalene	EPA 8260 B	FL
132.060	028	Nitrobenzene	EPA 8260 B	FL

SGS North America, Inc. - Orlando

Certificate Number: 2937
Expiration Date: 6/30/2022

132.060	029	N-propylbenzene	EPA 8260 B	FL
132.060	030	Styrene	EPA 8260 B	FL
132.060	031	Tetrachloroethylene (Tetrachloroethene)	EPA 8260 B	FL
132.060	032	Toluene	EPA 8260 B	FL
132.060	033	Trichloroethylene (Trichloroethene)	EPA 8260 B	FL
132.060	034	Trichlorofluoromethane	EPA 8260 B	FL
132.060	035	Vinyl Chloride	EPA 8260 B	FL
132.060	036	m+p-Xylene	EPA 8260 B	FL
132.060	037	o-Xylene	EPA 8260 B	FL
132.060	038	m-Xylene	EPA 8260 B	FL
132.060	039	p-Xylene	EPA 8260 B	FL
132.060	040	1,1-Dichloroethane	EPA 8260 B	FL
132.060	041	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 8260 B	FL
132.060	042	1,1,1-Trichloroethane	EPA 8260 B	FL
132.060	043	1,1,1,2-Tetrachloroethane	EPA 8260 B	FL
132.060	044	1,1,2,2-Tetrachloroethane	EPA 8260 B	FL
132.060	045	1,1,2-Trichloroethane	EPA 8260 B	FL
132.060	046	1,2-Dichlorobenzene	EPA 8260 B	FL
132.060	047	1,2-Dichloroethane (Ethylene Dichloride)	EPA 8260 B	FL
132.060	048	1,2-Dibromoethane (EDB)	EPA 8260 B	FL
132.060	049	1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260 B	FL
132.060	050	1,2-Dichloropropane	EPA 8260 B	FL
132.060	051	1,2,3-Trichloropropane (TCP)	EPA 8260 B	FL
132.060	052	1,2,4-Trichlorobenzene	EPA 8260 B	FL
132.060	053	1,3-Dichlorobenzene	EPA 8260 B	FL
132.060	054	1,4-Dichlorobenzene	EPA 8260 B	FL
132.060	055	2-Chloroethyl vinyl Ether	EPA 8260 B	FL
132.060	056	4-Chlorotoluene	EPA 8260 B	FL
132.060	057	4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	EPA 8260 B	FL
132.070	001	Benzene	EPA 8260 D	FL
132.070	002	Bromobenzene	EPA 8260 D	FL
132.070	003	Bromochloromethane	EPA 8260 D	FL
132.070	004	Bromodichloromethane	EPA 8260 D	FL
132.070	005	Bromoform	EPA 8260 D	FL
132.070	006	Bromomethane (Methyl Bromide)	EPA 8260 D	FL
132.070	007	n-Butylbenzene	EPA 8260 D	FL
132.070	008	sec-Butylbenzene	EPA 8260 D	FL
132.070	009	tert-Butylbenzene	EPA 8260 D	FL
132.070	010	Carbon Disulfide	EPA 8260 D	FL
132.070	011	Carbon Tetrachloride	EPA 8260 D	FL
132.070	012	Chlorobenzene	EPA 8260 D	FL
132.070	013	Chlorodibromomethane (Dibromochloromethane)	EPA 8260 D	FL

As of 2/4/2022 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

132.070	014	Chloroethane	EPA 8260 D	FL
132.070	015	Chloroform	EPA 8260 D	FL
132.070	016	Chloromethane (Methyl Chloride)	EPA 8260 D	FL
132.070	017	Dibromomethane	EPA 8260 D	FL
132.070	018	Dichlorodifluoromethane (Freon 12)	EPA 8260 D	FL
132.070	019	cis-1,2-Dichloroethylene (cis 1,2 Dichloroethene)	EPA 8260 D	FL
132.070	020	trans-1,2-Dichloroethylene (trans- 1,2 Dichloroethene)	EPA 8260 D	FL
132.070	021	cis-1,3-Dichloropropylene (cis 1,3 Dichloropropene)	EPA 8260 D	FL
132.070	022	trans-1,3-Dichloropropylene (trans-1,3 Dichloropropene)	EPA 8260 D	FL
132.070	023	Ethylbenzene	EPA 8260 D	FL
132.070	024	Hexachlorobutadiene	EPA 8260 D	FL
132.070	025	Methyl tert-butyl Ether (MTBE)	EPA 8260 D	FL
132.070	026	Methylene Chloride (Dichloromethane)	EPA 8260 D	FL
132.070	027	Naphthalene	EPA 8260 D	FL
132.070	028	Nitrobenzene	EPA 8260 D	FL
132.070	029	N-propylbenzene	EPA 8260 D	FL
132.070	030	Styrene	EPA 8260 D	FL
132.070	031	Tetrachloroethylene (Tetrachloroethene)	EPA 8260 D	FL
132.070	032	Toluene	EPA 8260 D	FL
132.070	033	Trichloroethylene (Trichloroethene)	EPA 8260 D	FL
132.070	034	Trichlorofluoromethane	EPA 8260 D	FL
132.070	035	Vinyl Chloride	EPA 8260 D	FL
132.070	036	m+p-Xylene	EPA 8260 D	FL
132.070	037	o-Xylene	EPA 8260 D	FL
132.070	038	m-Xylene	EPA 8260 D	FL
132.070	039	p-Xylene	EPA 8260 D	FL
132.070	040	1,1-Dichloroethane	EPA 8260 D	FL
132.070	041	1,1-Dichloroethylene (1,1-Dichloroethene)	EPA 8260 D	FL
132.070	042	1,1,1-Trichloroethane	EPA 8260 D	FL
132.070	043	1,1,1,2-Tetrachloroethane	EPA 8260 D	FL
132.070	044	1,1,2,2-Tetrachloroethane	EPA 8260 D	FL
132.070	045	1,1,2-Trichloroethane	EPA 8260 D	FL
132.070	046	1,2-Dichlorobenzene	EPA 8260 D	FL
132.070	047	1,2-Dichloroethane (Ethylene Dichloride)	EPA 8260 D	FL
132.070	048	1,2-Dibromoethane (EDB)	EPA 8260 D	FL
132.070	049	1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260 D	FL
132.070	050	1,2-Dichloropropane	EPA 8260 D	FL
132.070	051	1,2,3-Trichloropropane (TCP)	EPA 8260 D	FL
132.070	052	1,2,4-Trichlorobenzene	EPA 8260 D	FL
132.070	053	1,3-Dichlorobenzene	EPA 8260 D	FL
132.070	054	1,4-Dichlorobenzene	EPA 8260 D	FL
132.070	055	2-Chloroethyl vinyl Ether	EPA 8260 D	FL

132.070	056	4-Chlorotoluene	EPA 8260 D	FL
132.070	057	4-Methyl-2-pentanone (Methyl Isobutyl Ketone)	EPA 8260 D	FL
132.080	001	Acrylamide	EPA 8316	FL

Field of Accreditation:133 - Semi-Volatile Organic Chemistry in Hazardous Waste (Matrix Aqueous)

133.020	001	Gasoline Range Organics (GRO)	EPA 8015 C	FL
133.020	002	Diesel Range Organics (DRO)	EPA 8015 C	FL
133.040	006	n-Butyl Alcohol (1-Butanol)	EPA 8015 C	FL
133.040	012	Ethanol	EPA 8015 C	FL
133.040	016	Isobutyl Alcohol	EPA 8015 C	FL
133.040	017	Isopropyl Alcohol (Isopropanol)	EPA 8015 C	FL
133.040	018	Methanol	EPA 8015 C	FL
133.040	025	1-Propanol	EPA 8015 C	FL
133.090	001	Aldrin	EPA 8081 A	FL
133.090	002	alpha-BHC	EPA 8081 A	FL
133.090	003	beta-BHC	EPA 8081 A	FL
133.090	004	delta-BHC	EPA 8081 A	FL
133.090	005	gamma-BHC (Lindane)	EPA 8081 A	FL
133.090	006	Chlordane	EPA 8081 A	FL
133.090	007	trans-Chlordane	EPA 8081 A	FL
133.090	008	4,4'-DDD	EPA 8081 A	FL
133.090	009	4,4'-DDE	EPA 8081 A	FL
133.090	010	4,4'-DDT	EPA 8081 A	FL
133.090	011	Dieldrin	EPA 8081 A	FL
133.090	012	Endosulfan I	EPA 8081 A	FL
133.090	013	Endosulfan II	EPA 8081 A	FL
133.090	014	Endosulfan Sulfate	EPA 8081 A	FL
133.090	015	Endrin	EPA 8081 A	FL
133.090	016	Endrin Aldehyde	EPA 8081 A	FL
133.090	017	Endrin Ketone	EPA 8081 A	FL
133.090	018	Heptachlor	EPA 8081 A	FL
133.090	019	Heptachlor Epoxide	EPA 8081 A	FL
133.090	020	Methoxychlor	EPA 8081 A	FL
133.090	021	Toxaphene	EPA 8081 A	FL
133.110	001	Aldrin	EPA 8081 B	FL
133.110	002	alpha-BHC	EPA 8081 B	FL
133.110	003	beta-BHC	EPA 8081 B	FL
133.110	004	delta-BHC	EPA 8081 B	FL
133.110	005	gamma-BHC (Lindane)	EPA 8081 B	FL
133.110	006	Chlordane	EPA 8081 B	FL
133.110	007	trans-Chlordane	EPA 8081 B	FL
133.110	008	4,4'-DDD	EPA 8081 B	FL
133.110	009	4,4'-DDE	EPA 8081 B	FL

133.110	010	4,4'-DDT	EPA 8081 B	FL
133.110	011	Dieldrin	EPA 8081 B	FL
133.110	012	Endosulfan I	EPA 8081 B	FL
133.110	013	Endosulfan II	EPA 8081 B	FL
133.110	014	Endosulfan Sulfate	EPA 8081 B	FL
133.110	015	Endrin	EPA 8081 B	FL
133.110	016	Endrin Aldehyde	EPA 8081 B	FL
133.110	017	Endrin Ketone	EPA 8081 B	FL
133.110	018	Heptachlor	EPA 8081 B	FL
133.110	019	Heptachlor Epoxide	EPA 8081 B	FL
133.110	020	Methoxychlor	EPA 8081 B	FL
133.110	021	Toxaphene	EPA 8081 B	FL
133.120	001	Aroclor 1016	EPA 8082	FL
133.120	002	Aroclor 1221	EPA 8082	FL
133.120	003	Aroclor 1232	EPA 8082	FL
133.120	004	Aroclor 1242	EPA 8082	FL
133.120	005	Aroclor 1248	EPA 8082	FL
133.120	006	Aroclor 1254	EPA 8082	FL
133.120	007	Aroclor 1260	EPA 8082	FL
133.130	001	Aroclor 1016	EPA 8082 A	FL
133.130	002	Aroclor 1221	EPA 8082 A	FL
133.130	003	Aroclor 1232	EPA 8082 A	FL
133.130	004	Aroclor 1242	EPA 8082 A	FL
133.130	005	Aroclor 1248	EPA 8082 A	FL
133.130	006	Aroclor 1254	EPA 8082 A	FL
133.130	007	Aroclor 1260	EPA 8082 A	FL
133.210	001	Azinphos Methyl	EPA 8141 B	FL
133.210	002	Chlorpyrifos	EPA 8141 B	FL
133.210	003	Demeton-O	EPA 8141 B	FL
133.210	004	Demeton-S	EPA 8141 B	FL
133.210	005	Diazinon	EPA 8141 B	FL
133.210	006	Dichlorvos (DDVP)	EPA 8141 B	FL
133.210	007	Disulfoton	EPA 8141 B	FL
133.210	008	Malathion	EPA 8141 B	FL
133.210	009	Parathion Ethyl	EPA 8141 B	FL
133.210	011	Phorate	EPA 8141 B	FL
133.210	012	Ronnel	EPA 8141 B	FL
133.210	013	Stirophos (Tetrachlorovinphos)	EPA 8141 B	FL
133.220	001	2,4-D	EPA 8151 A	FL
133.220	002	2,4-DB	EPA 8151 A	FL
133.220	003	2,4,5-TP (Silvex)	EPA 8151 A	FL
133.220	004	2,4,5-T	EPA 8151 A	FL

133.220	005	Dalapon	EPA 8151 A	FL
133.220	006	Dicamba	EPA 8151 A	FL
133.220	007	Dichloroprop	EPA 8151 A	FL
133.220	008	Dinoseb	EPA 8151 A	FL
133.220	009	MCPA	EPA 8151 A	FL
133.220	010	MCPP	EPA 8151 A	FL
133.220	012	Pentachlorophenol	EPA 8151 A	FL
133.240	001	Acenaphthene	EPA 8270 E	FL
133.240	002	Acenaphthylene	EPA 8270 E	FL
133.240	003	Aniline	EPA 8270 E	FL
133.240	004	Anthracene	EPA 8270 E	FL
133.240	005	Benzidine	EPA 8270 E	FL
133.240	006	Benzoic Acid	EPA 8270 E	FL
133.240	007	Benzo(a)anthracene	EPA 8270 E	FL
133.240	008	Benzo(b)fluoranthene	EPA 8270 E	FL
133.240	009	Benzo(k)fluoranthene	EPA 8270 E	FL
133.240	010	Benzo(g,h,i)perylene	EPA 8270 E	FL
133.240	011	Benzo(a)pyrene	EPA 8270 E	FL
133.240	012	Benzyl Alcohol	EPA 8270 E	FL
133.240	013	Bis(2-chloroethoxy) Methane	EPA 8270 E	FL
133.240	014	Bis(2-chloroethyl) Ether	EPA 8270 E	FL
133.240	015	Bis(2-ethylhexyl)phthalate (Di(2-ethylhexyl) phthalate)	EPA 8270 E	FL
133.240	016	Butyl Benzyl Phthalate	EPA 8270 E	FL
133.240	017	Chrysene	EPA 8270 E	FL
133.240	018	Dibenz(a,h)anthracene	EPA 8270 E	FL
133.240	019	Dibenzofuran	EPA 8270 E	FL
133.240	020	Di-n-butyl Phthalate	EPA 8270 E	FL
133.240	021	Diethyl Phthalate	EPA 8270 E	FL
133.240	022	Dimethyl Phthalate	EPA 8270 E	FL
133.240	023	Di-n-octyl Phthalate	EPA 8270 E	FL
133.240	024	Fluoranthene	EPA 8270 E	FL
133.240	025	Fluorene	EPA 8270 E	FL
133.240	026	Naphthalene	EPA 8270 E	FL
133.240	027	Nitrobenzene	EPA 8270 E	FL
133.240	028	Pentachlorobenzene	EPA 8270 E	FL
133.240	029	Pentachlorophenol	EPA 8270 E	FL
133.240	030	1-Chloronaphthalene	EPA 8270 E	FL
133.240	031	1,2-Dichlorobenzene	EPA 8270 E	FL
133.240	032	1,3-Dichlorobenzene	EPA 8270 E	FL
133.240	033	1,4-Dichlorobenzene	EPA 8270 E	FL
133.240	034	2-Chloronaphthalene	EPA 8270 E	FL
133.240	035	2-Chlorophenol	EPA 8270 E	FL

133.240	036	2,4-Dichlorophenol	EPA 8270 E	FL
133.240	037	2,4-Dimethylphenol	EPA 8270 E	FL
133.240	038	2,4-Dinitrophenol	EPA 8270 E	FL
133.240	039	2,4-Dinitrotoluene	EPA 8270 E	FL
133.240	040	2,6-Dichlorophenol	EPA 8270 E	FL
133.240	041	2,6-Dinitrotoluene	EPA 8270 E	FL
133.240	042	2-Nitroaniline	EPA 8270 E	FL
133.240	043	2-Nitrophenol	EPA 8270 E	FL
133.240	044	3-Nitroaniline	EPA 8270 E	FL
133.240	045	3,3'-Dichlorobenzidine	EPA 8270 E	FL
133.240	046	4-Chloroaniline	EPA 8270 E	FL
133.240	047	4-Chloro-3-methylphenol	EPA 8270 E	FL
133.240	048	4-Bromophenyl Phenyl Ether	EPA 8270 E	FL
133.240	049	4-Chlorophenyl Phenyl Ether	EPA 8270 E	FL
133.240	050	4-Nitroaniline	EPA 8270 E	FL
133.240	051	4-Nitrophenol	EPA 8270 E	FL
133.240	074	Disulfoton	EPA 8270 E	FL
133.240	076	Parathion Ethyl	EPA 8270 E	FL
133.240	077	Parathion Methyl	EPA 8270 E	FL
133.240	078	Phorate	EPA 8270 E	FL
133.240	087	N-nitrosodiethylamine	EPA 8270 E	FL
133.240	088	N-nitrosodimethylamine	EPA 8270 E	FL
133.240	089	N-nitrosodiphenylamine	EPA 8270 E	FL
133.240	090	N-nitroso-di-n-propylamine	EPA 8270 E	FL
133.340	001	1,3,5-Trinitrobenzene	EPA 8330	FL
133.340	002	1,3-Dinitrobenzene	EPA 8330	FL
133.340	003	Nitrobenzene	EPA 8330	FL
133.340	004	2,4,6-Trinitrotoluene	EPA 8330	FL
133.340	005	2,4-Dinitrotoluene	EPA 8330	FL
133.340	006	2,6-Dinitrotoluene	EPA 8330	FL
133.340	007	2-Nitrotoluene	EPA 8330	FL
133.340	008	3-Nitrotoluene	EPA 8330	FL
133.340	009	4-Nitrotoluene	EPA 8330	FL
133.350	001	1,3,5-Trinitrobenzene	EPA 8330 A	FL
133.350	002	1,3-Dinitrobenzene	EPA 8330 A	FL
133.350	003	Nitrobenzene	EPA 8330 A	FL
133.350	004	2,4,6-Trinitrotoluene	EPA 8330 A	FL
133.350	005	2,4-Dinitrotoluene	EPA 8330 A	FL
133.350	006	2,6-Dinitrotoluene	EPA 8330 A	FL
133.350	007	2-Nitrotoluene	EPA 8330 A	FL
133.350	008	3-Nitrotoluene	EPA 8330 A	FL
133.350	009	4-Nitrotoluene	EPA 8330 A	FL

SGS North America, Inc. - Orlando

Certificate Number: 2937
Expiration Date: 6/30/2022

133.380	001	N-Ethylperfluorooctane Sulfonamide (EtFOSAm)	DoD QSM Version 5.1 (or newer)	DOD
133.380	002	N-Ethylperfluorooctane Sulfonamido Acetic Acid (NEtFOSAA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	003	N-Ethylperfluorooctane Sulfonamido Ethanol (EtFOSE)	DoD QSM Version 5.1 (or newer)	DOD
133.380	004	4:2 Fluorotelomer Sulfonic Acid (4:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	005	6:2 Fluorotelomer Sulfonic Acid (6:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	006	8:2 Fluorotelomer Sulfonic Acid (8:2 FTS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	007	11-Chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (11Cl-PF3OUdS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	008	9-Chlorohexadecafluoro-3-oxanonane-1-sulfonic acid (9Cl-PF3ONS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	009	4,8-Dioxa-3H-perfluorononanoic acid (ADONA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	010	N-Methylperfluorooctane Sulfonamide (NMeFOSA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	011	N-Methylperfluorooctane Sulfonamido Acetic Acid (NMeFOSAA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	012	N-Methylperfluorooctane Sulfonamido Ethanol (NMeFOSE)	DoD QSM Version 5.1 (or newer)	DOD
133.380	013	Hexafluoropropylene Oxide Dimer Acid (HFPO-DA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	014	Perfluorobutanoic Acid (PFBA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	015	Perfluorobutane Sulfonic Acid (PFBS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	016	Perfluorodecanoic Acid (PFDA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	017	Perfluorododecanoic Acid (PFDoA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	018	Perfluorodecane Sulfonic Acid (PFDS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	019	Perfluoroheptanoic Acid (PFHpA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	020	Perfluoroheptane Sulfonic Acid (PFHpS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	021	Perfluorohexane Sulfonic Acid (PFHxS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	022	Perfluorohexanoic Acid (PFHxA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	023	Perfluorononanoic Acid (PFNA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	024	Perfluorooctanoic Acid (PFOA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	025	Perfluorooctane Sulfonic Acid (PFOS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	026	Perfluorooctane Sulfonamide (PFOSAm)	DoD QSM Version 5.1 (or newer)	DOD
133.380	027	Perfluoropentanoic Acid (PFPeA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	028	Perfluoropentane Sulfonic Acid (PFPeS)	DoD QSM Version 5.1 (or newer)	DOD
133.380	029	Perfluorotetradecanoic Acid (PFTDA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	030	Perfluoroundecanoic Acid (PFUnDA)	DoD QSM Version 5.1 (or newer)	DOD
133.380	031	Perfluoroundecanoic Acid (PFUnDA)	DoD QSM Version 5.1 (or newer)	DOD

As of 2/4/2022 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

Attachment 2
Standard Operating Procedures

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RAE SYSTEMS
by Honeywell

MiniRAE 3000
ppbRAE 3000

Basic Operation
Pocket Reference

PN: 059-4030-000-D
Rev. B August 2010

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Read Before Operating

This Pocket Reference is intended as a quick guide to basic use and calibration of your instrument. It does not cover advanced features. Information on advanced features and other operation modes is included in the User's Guide.

The User's Guide must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

CAUTION!

To reduce the risk of electric shock, turn the power off before removing the instrument cover. Disconnect the battery before removing sensor module for service. Never operate the instrument when the cover is removed. Remove instrument cover and sensor module only in an area known to be non-hazardous.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

WARNINGS

STATIC HAZARD: Clean only with damp cloth.
For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand the User's Guide completely before operating or servicing.

Use only RAE Systems battery packs, part numbers 059-3051-000, 059-3052-000, and 059-3054-000. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

Do not mix old and new batteries or batteries from different manufacturers.

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

For maximum safety, the accuracy of the instrument should be checked by exposing it to a known concentration calibration gas before each day's use.

Do not use USB/PC communication in hazardous locations.

Intrinsic Safety: US and Canada: Class I, Division 1,
Groups A,B, C, D
Europe: ATEX (0575 Ex II 2G Ex ia
IIC/IIB T4 Gb)
KEMA 07 ATEX 0127
Complies with EN60079-0:2009,
EN60079-11:2007
IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb
Complies with IEC 60079-0:2007,
IEC 60079-11:2006
(IIC: 059-3051-000 Li-ion bat pack or
059-3054-000 NiMH bat pack;
IIB: 059-3052-000 alkaline bat pack)

Special Notes

⚠ When the instrument is taken out of the transport case and turned on for the first time, there may be some residual organic or inorganic vapor trapped inside the detector chamber. The initial PID sensor reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the instrument. After running for several minutes, the residual vapor in the detector chamber will be cleared and the reading should return to zero.

⚠ The battery of the instrument discharges slowly even if it is turned off. If the instrument has not been charged for 5 to 7 days, the battery voltage will be low. Therefore, it is a good practice to always charge the instrument before using it. It is also recommended to fully charge the instrument for *at least 10 hours* before first use. Refer to the User Guide’s section on battery charging for more information on battery charging and replacement.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Contents

Charging The Battery 6
Charging A Spare Rechargeable Battery 8
Pump Status & Calibration Status 10
User Interface 12
Display 15
Operating The Instrument 16
  Turning The Instrument On 17
  Turning The Instrument Off 18
  Operating The Built-In Flashlight 18
Basic User Mode/Hygiene Mode 19
Entering Calibration 21
Standard Two-Point Calibration (Zero & Span) 23
  Zero (Fresh Air) Calibration 25
  Span Calibration 28
  Exiting Two-Point Calibration 32
Alarm Signal Summary 33
Preset Alarm Limits & Calibration 35
Sampling Pump 36
Ordering Replacement Parts 37
Special Servicing Note 38
Troubleshooting 38
Technical Support .... Back cover

MiniRAE 3000/ppbRAE 3000 Pocket Reference

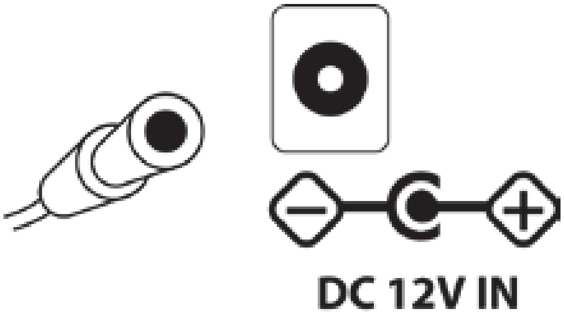
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion battery is charged by placing the instrument in its cradle. Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glow

The instrument begins charging automatically. The “Primary” LED in the cradle blinks green to indicate charging. During charging, the diagonal lines in the battery icon on the instrument’s display are animated and you see the message “Charging...”

When the instrument’s battery is fully charged, the battery icon is no longer animated and shows a full battery. The message “Fully charged!” is shown. The cradle’s LED glows continuously green.

Note: If you see the “Battery Charging Error” icon (a battery outline with an exclamation mark inside), check that the instrument or rechargeable battery has been set into the cradle properly. If you still receive the message, check the Troubleshooting section of this guide.

Charging A Spare Rechargeable Battery

A rechargeable Li-ion battery can be charged when it is not inside the monitor. The charging cradle is designed to accommodate both types of charging. Contacts on the bottom of the battery meet the contacts on the cradle, transferring power without other connections, and a spring-loaded capture holds the battery in place during charging.

1. Plug the AC/DC adapter into the monitor's cradle.
2. Place the battery into the cradle, with the gold-plated contacts on top of the six matching charging pins.
3. Plug the AC/DC adapter into the wall outlet.

The battery begins charging automatically. During charging, the Secondary LED in the cradle blinks green. When charging is complete, it glows steady green.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Release the battery from the cradle by pulling it back toward the rear of the cradle and tilting it out of its slot.

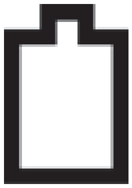
Note: If you need to replace the Li-ion battery pack, replacements are available from RAE Systems. The part number is 059-3051-000.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. Remove and replace batteries only in areas known to be non-hazardous.

Low Voltage Warning



When the battery’s charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the “empty battery” icon blinks on and off once per second. Turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Pump Status

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:

During duty cycling (PID lamp cleaning), the display shows these icons in alternation:

MiniRAE 3000/ppbRAE 3000 Pocket Reference

If there is a pump failure or obstruction that disrupts the pump, you will see this icon blinking on and off:

If you see this blinking icon, consult the Troubleshooting section in the User's Guide.

Calibration Status

The instrument displays this icon if it requires calibration:

Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor has been replaced.
- It has been 30 days or more since the instrument was last calibrated.
- If you have changed the calibration gas type without recalibrating the instrument.

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User Interface

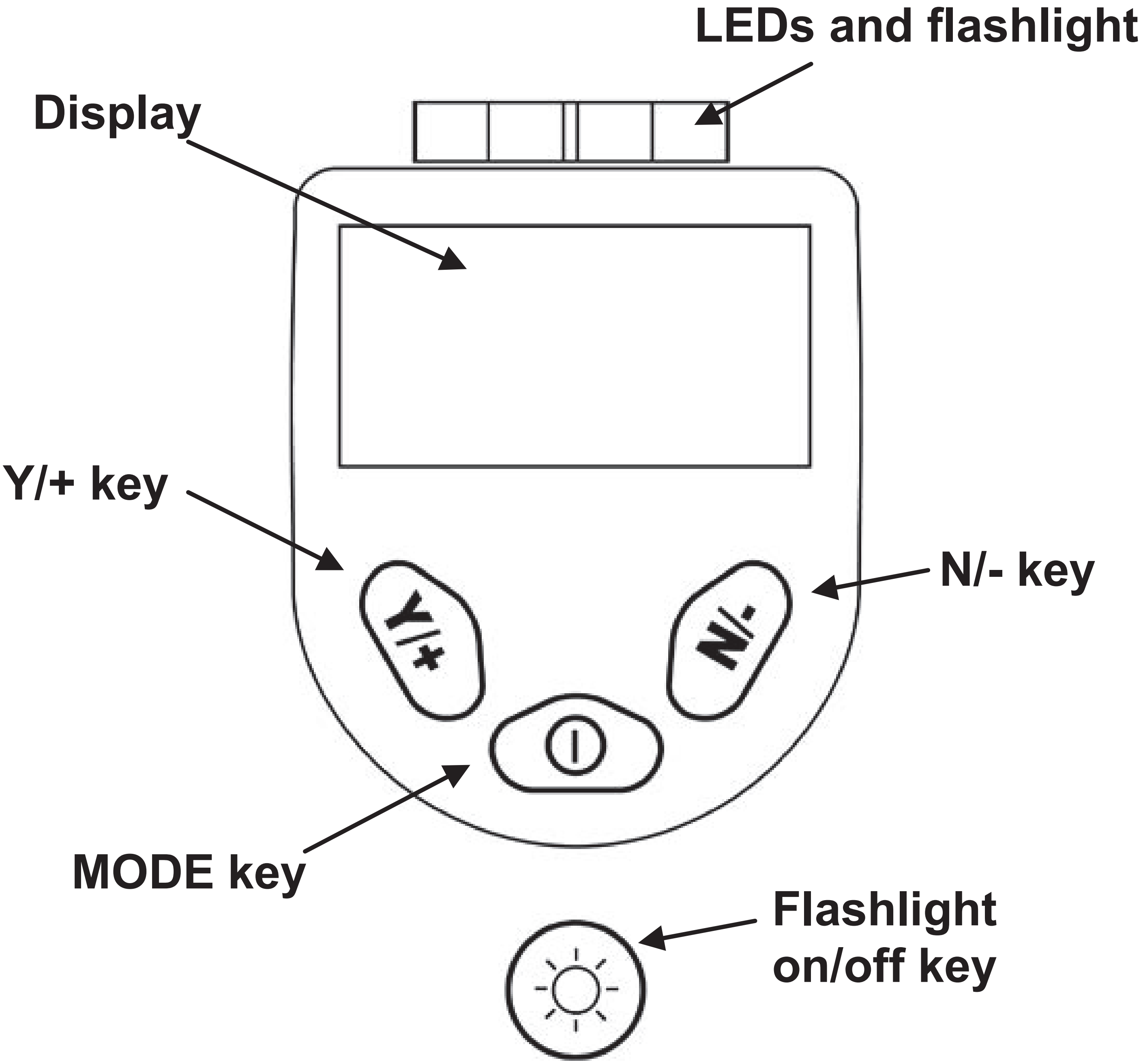
The instrument's user interface consists of the display, LEDs, an alarm transducer, and four keys. The keys are:

Y/+
MODE
N/-
Flashlight on/off

The LCD display provides visual feedback that includes time, battery condition, and other functions.

In addition to their labeled functions, the keys labeled Y/+, MODE, and N/- act as "soft keys" that control different parameters and make different selections within the instrument's menus. From menu to menu, each key controls a different parameter or makes a different selection.

MiniRAE 3000/ppbRAE 3000 Pocket Reference



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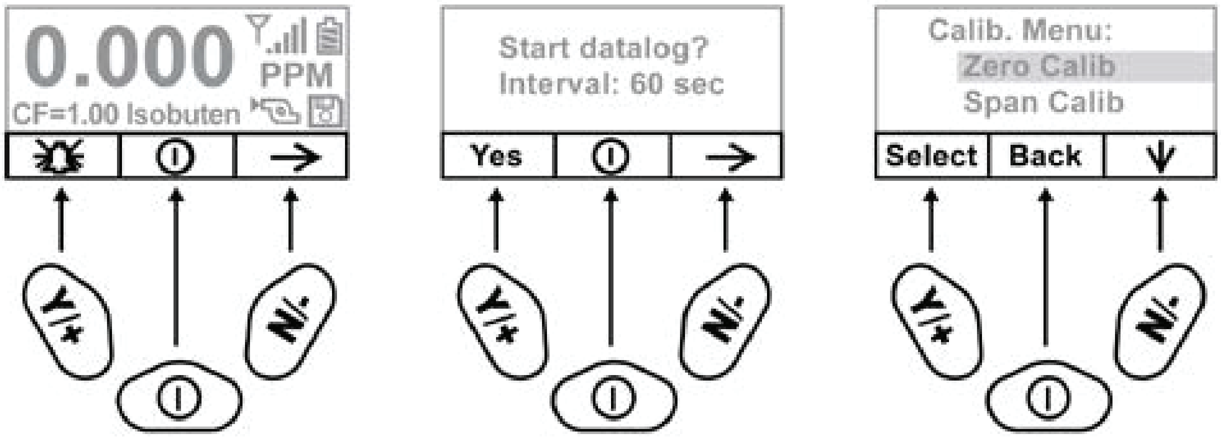
Three panes along the bottom of the display are "mapped" to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are three examples of different menus with the relationships of the keys clearly shown:

RELATIONSHIP OF BUTTONS TO CONTROL FUNCTIONS



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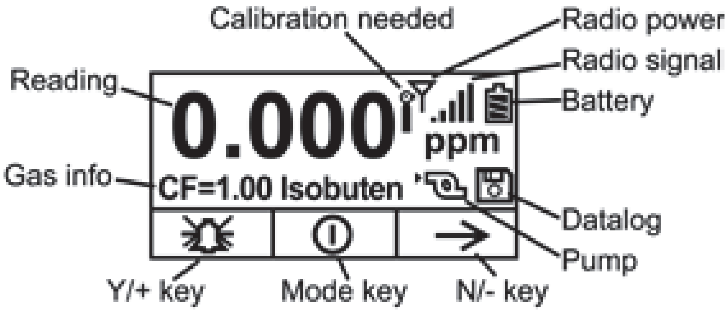
Display

The display shows the following information:



Graph	Graphic representation of concentration plotted over time
Gas info*	Tells the Correction Factor and type of calibration gas
Reading	Concentration of gas as measured
Calibration needed	Indicates that calibration should be performed
Radio power	Indicates whether radio connection is on or off
Radio signal	Indicates signal strength in 5-bar bargraph
Battery	Indicates battery level in 3 bars
Pump	Indicates that pump is working
Datalog	Indicates whether datalog is on or off
Y/+	Y/+ key's function for this screen
MODE	MODE key's function for this screen
N/-	N/- key's function for this screen

MiniRAE 3000/ppbRAE 3000 Pocket Reference

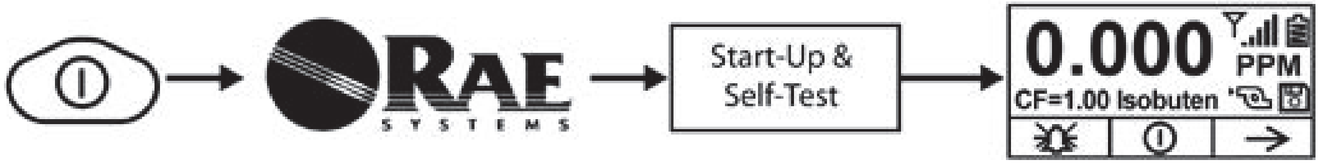
Operating The Instrument

The instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It gives real-time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment, the instrument is preset with default alarm limits and the sensor is pre-calibrated with standard calibration gas. However, you should test the instrument and verify the calibration before the first use. After the instrument is fully charged and calibrated, it is ready for immediate operation.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.



The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting section of the User's Guide.

Note: In Basic User/Hygiene Mode (the default setting), the instrument stops after self-testing, and asks whether to perform a zero air (fresh air) calibration. You can start this calibration, quit, or abort the calibration while the instrument is undergoing calibration. When the zero calibration is done, you see screen telling you that the zero calibration is complete, along with its value. After calibration (or after you abort the calibration), the instrument then shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. Once the countdown stops, the instrument is off. Release the Mode key.
3. When you see “Unit off...” release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Operating The Built-In Flashlight

The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off.

Note: Using the flashlight for extended periods shortens the battery’s operating time before it needs recharging.

Basic User Mode/Hygiene Mode (Default Settings)

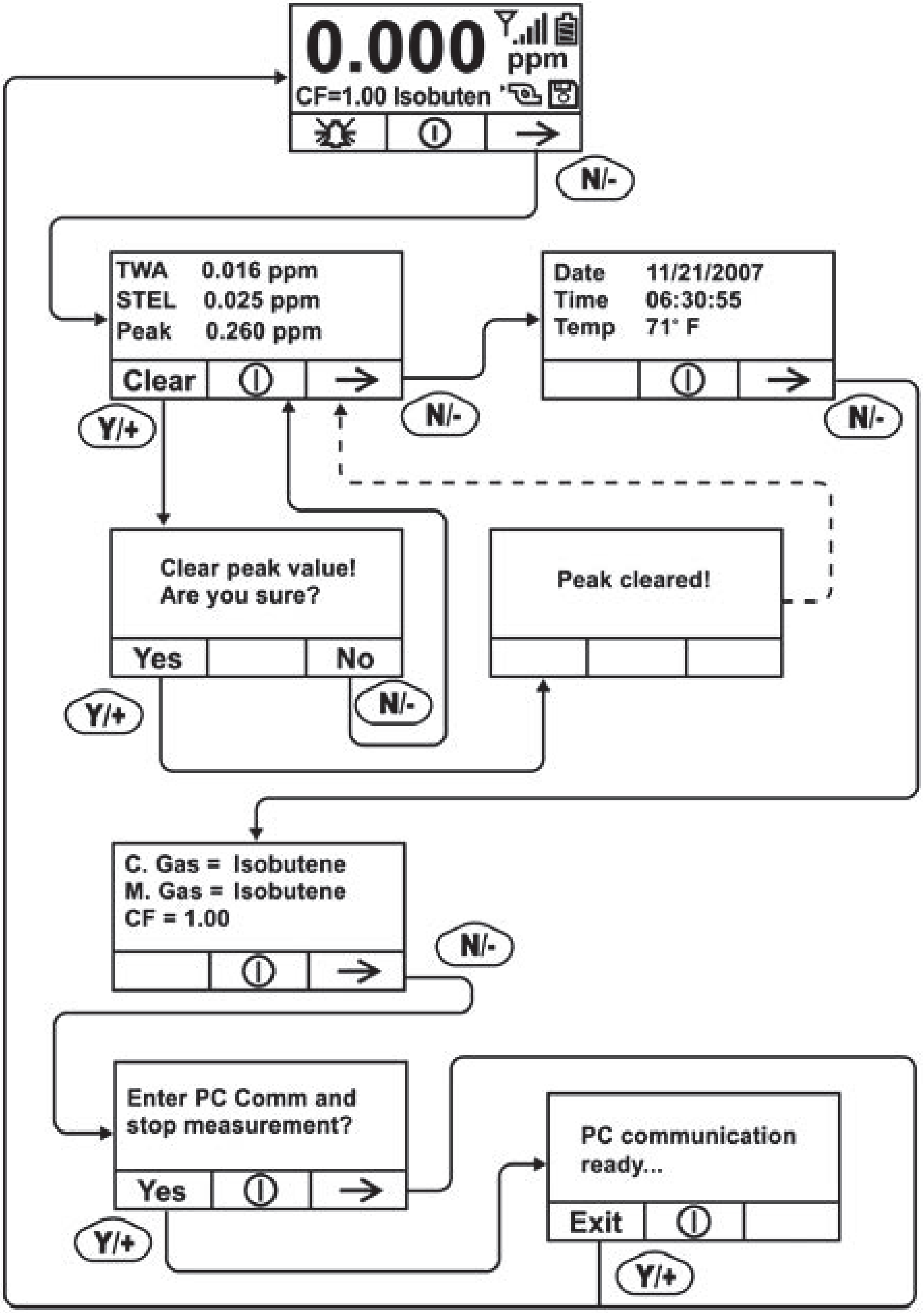
The instrument is programmed to operate in Basic User Mode/Hygiene Mode as its default. This gives you the most commonly needed features while requiring the fewest parameter adjustments.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].

Note: Whenever you see the alarm icon in the lower left pane, you can press [Y/+] to test the alarms.

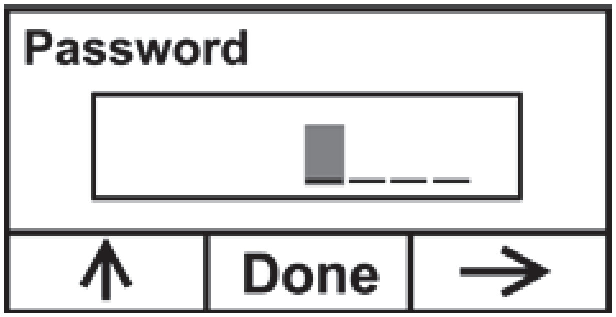
MiniRAE 3000/ppbRAE 3000 Pocket Reference



MiniRAE 3000/ppbRAE 3000 Pocket Reference

Entering Calibration

1. Press and hold [MODE] and [N/-] until you see the Password screen.

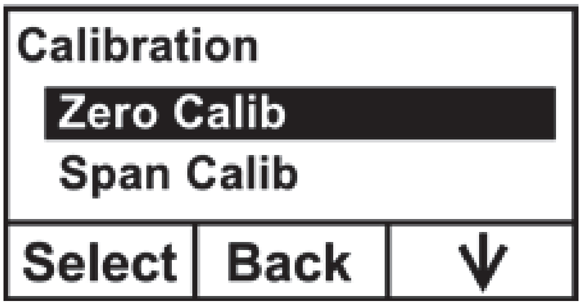


2. In Basic User Mode, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

   Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

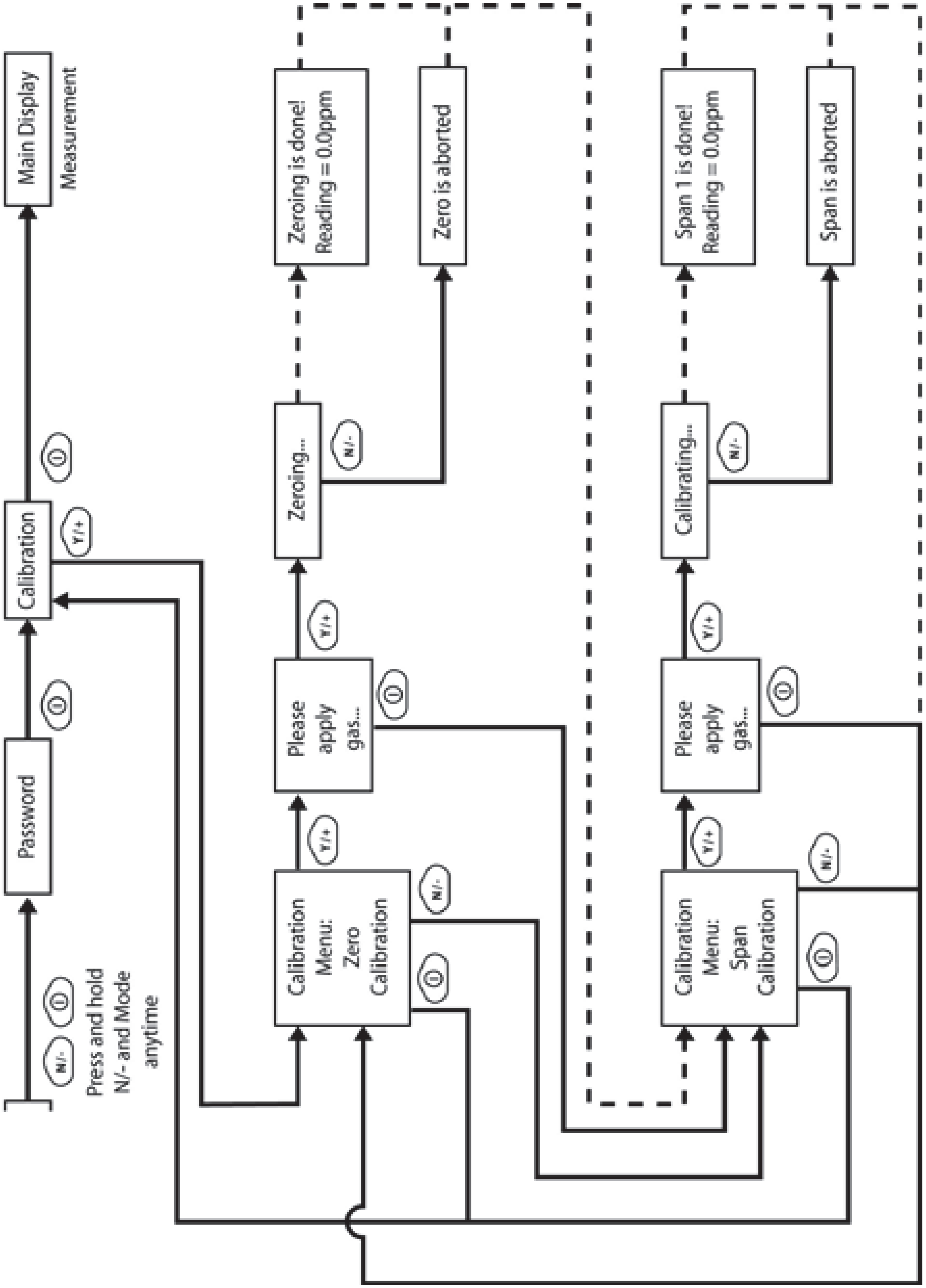
- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

Standard Two-Point Calibration (Zero & Span)

The following diagram shows the instrument’s calibrations in Basic/Hygiene mode.

Note: In the diagram, a dashed line indicates automatic change to another screen.

MiniRAE 3000/ppbRAE 3000 Pocket Reference



Zero (Fresh Air) Calibration

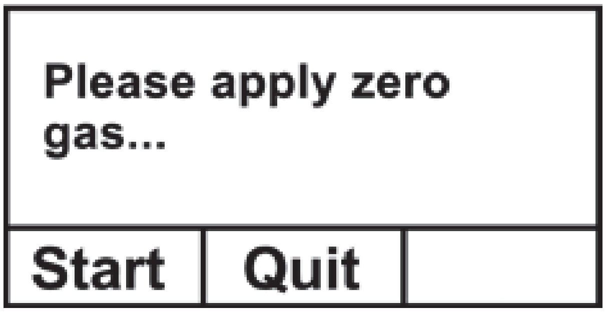
This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a “fresh” air source such as from a cylinder or Tedlar bag (optional accessory). The “fresh” air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:


Please apply zero gas...

1. Turn on your Zero calibration gas.
2. Press [Y/+] to start calibration.

   Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts and displays this message:

   Zeroing...

MiniRAE 3000/ppbRAE 3000 Pocket Reference

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any actions on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says “Zero is aborted!” and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

Zeroing is done!
Reading = 0.000 ppm

The instrument will then show the Calibration menu on its display, with Span Calib hightlighted.

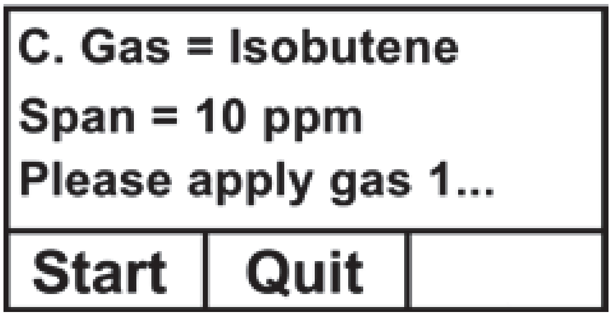
Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube. At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:



C. Gas = Isobutene
Span = 10 ppm
Please apply gas 1...

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

   Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

   Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says “Span is aborted!” and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you see this message:

> Span 1 is done!
> Reading = 100.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Exiting Two-Point Calibration

When you are done performing calibrations, press [MODE], which corresponds with “Back” on the display. You will see the following message:

Updating settings…

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Alarm Signal Summary

If the measured gas concentration exceeds any of the preset limits, the buzzer and red flashing LED are activated immediately to warn you of the alarm condition. The instrument also alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, or pump stall.

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*

MiniRAE 3000/ppbRAE 3000 Pocket Reference

STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display
Battery icon flashes	Low battery	1 flash per minute, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

* Hygiene mode only. In Search mode, the number of beeps per second (1 to 7) depends upon the concentration of the sampled gas.

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	**Cal Span**	**unit**	**Low**	**High**	**TWA**	**STEL**
ppbRAE 3000	10	ppm	10	25	10	25
MiniRAE 3000	100	ppm	50	100	10	25

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Sampling Pump

When approaching the end of the specified lifetime of the pump, it will consume higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace or rebuild the pump. When checking the pump flow, make sure that the inlet connector is tight and the inlet tubing is in good condition. Connect a flow meter to the gas inlet probe. The flow rate should be above 450 cc/min when there is no air leakage.

If the pump is not working properly, refer the instrument to qualified service personnel for further testing and, if necessary, pump repair or replacement.

Ordering Replacement Parts

If you need replacement parts, contact your local RAE Systems distributor. A list is available online:

http://www.raesystems.com

In the U.S., you can order sensors, replacement batteries, and other accessories online at:

http://istore.raesystems.com/

MiniRAE 3000/ppbRAE 3000 Pocket Reference

Special Servicing Note

If the instrument needs to be serviced, contact either:

1. The RAE Systems distributor from whom the instrument was purchased; they will return the instrument on your behalf.
2. The RAE Systems Technical Service Department. Before returning the instrument for service or repair, obtain a Returned Material Authorization (RMA) number for proper tracking of your equipment. This number needs to be on all documentation and posted on the outside of the box in which the instrument is returned for service or upgrade. Packages without RMA Numbers will be refused at the factory.

Troubleshooting

Refer to the User's Guide for troubleshooting details.

RAE Systems by Honeywell
3775 N. First St.
San Jose, CA 95134-1708 USA

Web: www.raesystems.com

Technical Support

To contact RAE Systems Technical Support Team:

Monday through Friday, 7:00AM to 5:00PM Pacific (US) Time

Phone (toll-free): +1 888-723-4800
Phone: +1 408-952-8461
Email: tech@raesystems.com

PN: 059-4030-000-D
Rev. B August 2010

MiniRAE 3000
User's Guide

RAE SYSTEMS
by Honeywell

Rev. F
February 2016
P/N 059-4020-000

FCC Information

Contains FCC ID: PI4411B or SU3RM900

The enclosed device complies with part 15 of the FCC rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

Wireless Approval For UAE In Middle East

TRA REGISTERED No: ER36153/14 or ER36153/15
DEALER No.: HONEYWELL INTERNATIONAL MIDDLE EAST – LTD – DUBAI BR

Wireless Approval For QATAR In Middle East

ictQATAR
Type Approval Reg. No.: R-4466 or R-4635

contém o módulo wireless: RM900

ANATEL

2781-14-6496

(01)07898911288364

Este equipamento opera em caráter secundário, isto é, não tem direito a proteção contra interferência prejudicial, mesmo de estações do mesmo tipo, e não pode causar interferência a sistemas operando em caráter primário.

Contents

- Read Before Operating 6
- Special Notes 7
- Warnings 8
- Standard Contents 10
- General Information 10
- Physical Description 12
- Specifications 12
- Charging The Battery 16
  - Charging A Spare Rechargeable Battery 17
  - Low Voltage Warning 18
  - Clock Battery 18
  - Data Protection While Power Is Off 18
- User Interface 19
- Display 21
- Operating The Instrument 22
- Turning The Instrument On 22
- Turning The Instrument Off 23
- Operating The Built-In Flashlight 23
- Pump Status 23
- Calibration Status 24
- Operating Modes 29
- Basic User Level/Hygiene Mode (Default Settings) 30
- Alarm Signals 32
  - Alarm Signal Summary 33
  - Preset Alarm Limits & Calibration 34
- Testing The Alarm 34
- Integrated Sampling Pump 34
- Backlight 35
  - Datalogging 35
    - Datalogging event 35
    - Datalogging sample 35
    - Auto/Manual/Snapshot Datalogging 36
- Standard Kit & Accessories 37
  - AC Adapter (Battery Charger) 37
  - Alkaline Battery Adapter 38
  - External Filter 39

Optional Accessories 40
  Calibration Adapter 40
  Calibration Regulator 40
  Organic Vapor Zeroing Kit 40
Standard Two-Point Calibration (Zero & Span) 41
  Entering Calibration 42
  Zero (Fresh Air) Calibration 44
  Span Calibration 46
  Exiting Two-Point Calibration In Basic User Level 48
Three-Point Calibration 49
    Span 2 Calibration 50
  Exiting Three-Point Calibration 53
Bump Test 48
Programming Mode 53
  Entering Programming Mode 54
Programming Mode Menus 56
  Zero Calibration 57
  Meas. Gas 57
  High Alarm 57
  Clear Datalog 57
  Radio 57
  Power 57
  Span Calibration 57
  Meas. Unit 57
  Low Alarm 57
  Interval 57
  Op Mode 57
  Bump 57
  STEL Alarm 57
  Data Selection 57
  Site ID 57
  TWA Alarm 57
  Datalog Type 57
  User ID 57
  Alarm Mode 57
  User Mode 57
  Buzzer & Light 57
  Date 57
  Time 57

MiniRAE 3000 User's Guide

Pump Duty Cycle 57
Pump Speed 57
Temperature Unit 57
Language 57
Real Time Protocol 57
Power On Zero 57
Unit ID 57
LCD Contrast 57
Lamp ID 57
PAN ID 57
Mesh Channel 57
Mesh Interval 57
Exiting Programming Mode 58
Navigating Programming Mode Menus 58
Calibration 59
    Zero Calibration 59
    Span Calibration 59
    Bump 59
Measurement 60
    Meas. Gas 60
    Meas. Unit 61
Alarm Setting 62
    High Alarm 63
    Low Alarm 63
    STEL Alarm 64
    TWA Alarm 65
    Alarm Type 66
    Buzzer & Light 67
Datalog 67
    Interval 68
    Data Selection 69
    Datalog Type 70
    Manual Datalog 70
    Snapshot Datalog 71
Monitor Setup 72
    Radio Power 72
    Op Mode 73
Hygiene 73
Search 73

MiniRAE 3000 User's Guide

    - Site ID.. 73
    - User ID 74
    - User Mode 74
    - Date... 75
    - Time... 76
    - Pump Duty Cycle.. 76
    - Pump Speed 77
    - Temperature Unit... 77
    - Language 78
    - Real Time Protocol... 78
    - Power On Zero.. 79
    - Unit ID 79
    - LCD Contrast... 80
    - Lamp ID.. 80
    - PAN ID 80
    - Mesh Channel 81
    - Mesh Interval 81
- Hygiene Mode 82
- Advanced User Level (Hygiene Mode Or Search Mode) 86
  - Advanced User Level & Hygiene Mode.. 86
  - Basic User Level & Search Mode.. 88
  - Advanced User Level & Search Mode... 89
  - Diagnostic Mode 90
    - Entering Diagnostic Mode... 91
    - Adjusting The Pump Stall Threshold 92
    - Pump High.. 92
    - Pump Low... 92
    - Exiting Diagnostic Mode.. 93
- Transferring Data To & From A Computer 94
  - Downloading The Datalog To A PC... 94
  - Connection. 94
  - Uploading Firmware To The instrument From A PC 95
- Maintenance 96
  - Battery Charging & Replacement 96
    - Replacing The Li-ion Battery 97
    - Replacing The Alkaline Battery Adapter... 97
  - PID Sensor & Lamp Cleaning/Replacement... 99
- Sensor Components.. 99
    - Cleaning The Lamp Housing Or Changing The Lamp.......... 100

Determining The Lamp Type 101
Sampling Pump 102
Cleaning The Instrument 102
Ordering Replacement Parts 102
Special Servicing Note 103
Troubleshooting 104
Technical Support 105
RAE Systems Contacts 106
Controlled Part of Manual 107
Basic Operation 107
Turning The Instrument On 107
Turning The Instrument Off 107
Alarm Signals 108
Alarm Signal Summary 108
Preset Alarm Limits & Calibration 109
Charging The Battery 110
Low Voltage Warning 111
Clock Battery 111
Replacing Rechargeable Li-Ion or NiMH Battery 112
Alkaline Battery Adapter 112
Troubleshooting 113

Read Before Operating

This manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

CAUTION!

To reduce the risk of electric shock, turn the power off before removing the instrument cover. Disconnect the battery before removing sensor module for service. Never operate the instrument when the cover is removed. Remove instrument cover and sensor module only in an area known to be non-hazardous.

Special Notes

⚠ When the instrument is taken out of the transport case and turned on for the first time, there may be some residual organic or inorganic vapor trapped inside the detector chamber. The initial PID sensor reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the instrument. After running for several minutes, the residual vapor in the detector chamber will be cleared and the reading should return to zero.

⚠ The battery of the instrument discharges slowly even if it is turned off. If the instrument has not been charged for 5 to 7 days, the battery voltage will be low. Therefore, it is a good practice to always charge the instrument before using it. It is also recommended to fully charge the instrument for *at least 10 hours* before first use. Refer to this User Guide's section on battery charging for more information on battery charging and replacement.

WARNINGS

STATIC HAZARD: Clean only with damp cloth.

For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand instruction manual completely before operating or servicing.

Use only RAE Systems battery packs, part numbers 059-3051-000, 059-3052-000, and 059-3054-000. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

Do not mix old and new batteries or batteries from different manufacturers.

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service.

For maximum safety, the accuracy of the instrument should be checked by exposing it to a known concentration calibration gas before each day's use.

Do not use USB/PC communication in hazardous locations.

AVERTISSEMENT

DANGER RISQUE D'ORIGINE ELECTROSTATIQUE: Nettoyer uniquement avec un chiffon humide.

Pour des raisons de sécurité, cet équipment doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d’instructions en entier avant d’utiliser, d’entretenir ou de réparer l’équipement.

Utiliser seulement l'ensemble de batterie RAE Systems, la reference 059-3051-000 au 059-3052-000 au 059-3054-000. Cet instrument n’a pas été essayé dans une atmosphère de gaz/air explosive ayant une concentration d’oxygène plus élevée que 21%. La substitution de composants peut compromettre la sécurité intrinsique. Ne charger les batteries que dans emplacements désignés non-dangereuse.

Ne pas melanger les anciennes et les nouvelles batteries, ou bien encore les batteries de differents fabriquants.

La calibration de toute instruments de RAE Systems doivent être testé en exposant l’instrument a une concentration de gaz connue par une procédure diétalonnage avant de mettre en service l’instrument pour la première fois.

Pour une securite maximale, la sensibilité du l’instrument doit être verifier en exposant l’instrument a une concentration de gaz connue par une procédure diétalonnage avant chaque utilisation journalière.

Ne pas utiliser de connection USB/PC en zone dangereuse.

Standard Contents

Instrument
Calibration Kit
Charging Cradle
AC/DC Adapter
Alkaline Battery Adapter
Data Cable
CD-ROM With User's Guide, Quick Start Guide, and related materials

General Information

The compact instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It monitors Volatile Organic Compounds (VOC) using a photoionization detector (PID) with a 9.8 eV, 10.6 eV, or 11.7 eV gas-discharge lamp. Features are:

Lightweight and Compact

- Compact, lightweight, rugged design
- Built-in sample draw pump

Dependable and Accurate

- Up to 16 hours of continuous monitoring with rechargeable battery pack
- Designed to continuously monitor VOC vapor at parts-per-million (ppm) levels

User-friendly

- Preset alarm thresholds for STEL, TWA, low- and high-level peak values.
- Audio buzzer and flashing LED display are activated when the limits are exceeded.

Datalogging Capabilities

- 260,000-point datalogging storage capacity for data download to PC

The instrument consists of a PID with associated microcomputer and electronic circuit. The unit is housed in a rugged case with a backlit LCD and 3 keys to provide easy user interface. It also has a built-in flashlight for operational ease in dark locations.

Physical Description

The main components of the portable VOC monitoring instrument include:

- Three keys for user to interact with the instrument: 3 operation/programming keys for normal operation or programming
- LCD display with back light for direct readout and calculated measurements
- Built-in flashlight for illuminating testing points in dark environments
- Buzzer and red LEDs for alarm signaling whenever exposures exceed preset limits
- Charge contacts for plugging directly to its charging station
- Gas entry and exit ports
- USB communication port for PC interface
- Protective rubber cover

Specifications

Size:	9.25" L x 3.6" W x 2.9" H
Weight:	28 oz with battery pack
Detector:	Photoionization sensor with 9.8, 10.6, or 11.7 eV UV lamp
Battery:	A 3.7V rechargeable Lithium-Ion battery pack (snap in, field replaceable, at non-hazardous location only) Alkaline battery holder (for 4 AA batteries)
Battery Charging:	Less than 8 hours to full charge
Operating Hours:	Up to16 hours continuous operation
Display:	Large dot matrix screen with backlight

Measurement range & resolution

Lamp	Range	Resolution
10.6 eV	0.1 ppm to 15,000 ppm	0.1 ppm
9.8 eV	0.1 ppm to 5,000 ppm	0.1 ppm
11.7 eV	0.1 ppm to 2,000 ppm	0.1 ppm

Response time (T_{90}):	2 seconds
Accuracy (Isobutylene):	10 to 2000 ppm: ±3% at calibration point.
PID Detector:	Easy access to lamp and sensor for cleaning and replacement
Correction Factors:	Over 200 VOC gases built in (based on RAE Systems Technical Note TN-106)
Calibration:	Two-point field calibration of zero and standard reference gases
Calibration Reference:	Store up to 8 sets of calibration data, alarm limits and span values
Inlet Probe:	Flexible 5" tubing
Radio module:	Bluetooth (2.4GHz) or RF module (433MHz, 868MHz , 915MHz, or 2.4GHz)
Keypad:	1 operation key and 2 programming keys; 1 flashlight switch
Direct Readout:	Instantaneous, average, STEL, TWA and peak value, and battery voltage
Intrinsic Safety:	US and Canada: Class I, Division 1, Groups A, B, C, D Europe: ATEX (0575 Ex II 2G Ex ia IIC/IIB T4 Gb) KEMA 07 ATEX 0127 Complies with EN60079-0:2009, EN60079-11:2007

	IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb Complies with IEC 60079-0:2007, IEC 60079-11:2006 (IIC: 059-3051-000 Li-ion bat pack or 059-3054-000 NiMH bat pack; IIB: 059-3052-000 alkaline bat pack)
EM Interference:	Highly resistant to EMI/RFI. Compliant with EMC R&TTE (RF Modules)
Alarm Setting:	Separate alarm limit settings for Low, High, STEL and TWA alarm
Operating Mode:	Hygiene or Search mode
Alarm:	Buzzer 95dB at 30cm and flashing red LEDs to indicate exceeded preset limits, low battery voltage, or sensor failure
Alarm Type:	Latching or automatic reset
Real-time Clock:	Automatic date and time stamps on datalogged information
Datalogging:	260,000 points with time stamp, serial number, user ID, site ID, etc.
Communication:	Upload data to PC and download instrument setup from PC via USB on charging station.
Sampling Pump:	Internally integrated. Flow rate: 450 to 550 cc/min.
Wireless Network:	Mesh RAE Systems Dedicated Wireless Network (or WiFi network for WiFi-equipped instruments)
Wireless Frequency:	ISM license-free band, 902 to 907.5 MHz and 915 to 928 MHz, FCC Part 15, CE R&TTE, IEEE 802.11 b/g bands (2.4 GHz)
Modulation:	802.15.4 DSSS BPSK
RF Power (Tx):	10dBm
Temperature:	-20º C to 50º C (-4º to 122º F)

Humidity:	0% to 95% relative humidity (non-condensing)
Housing (including rubber boot):	Polycarbonate, splashproof and dustproof Battery can be changed without removing rubber boot.

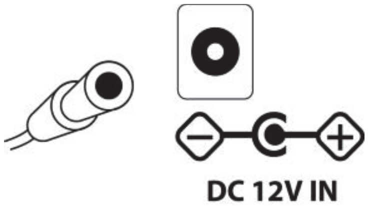
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion battery is charged by placing the instrument in its cradle. (The battery can also be charged by placing the instrument in an AutoRAE 2 Cradle.) Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glow

The instrument begins charging automatically. The "Primary" LED in the cradle blinks green to indicate charging. During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown. The cradle's LED glows continuously green.

Note: If you see the "Battery Charging Error" icon (a battery outline with an exclamation mark inside), check that the instrument or rechargeable battery has been set into the cradle properly. If you still receive the message, check the Troubleshooting section of this guide.

Note: If the instrument or battery has been in the cradle for more than 10 hours and you see the "Battery Charging Error" icon and a message that says, "Charging Too Long," this indicates that the battery is not reaching a full charge. Try changing the battery and make sure the contacts between the instrument (or battery) are meeting the cradle. If the message is still shown, consult your distributor or RAE Systems Technical Services.

Charging A Spare Rechargeable Battery

A rechargeable Li-ion battery can be charged when it is not inside the monitor. The charging cradle is designed to accommodate both types of charging. Contacts on the bottom of the battery meet the contacts on the cradle, transferring power without other connections, and a spring-loaded capture holds the battery in place during charging.

1. Plug the AC/DC adapter into the monitor's cradle.
2. Place the battery into the cradle, with the gold-plated contacts on top of the six matching charging pins.
3. Plug the AC/DC adapter into the wall outlet.

The battery begins charging automatically. During charging, the Secondary LED in the cradle blinks green. When charging is complete, it glows steady green.

Release the battery from the cradle by pulling it back toward the rear of the cradle and tilting it out of its slot.

Note: If you need to replace the Li-ion battery pack, replacements are available from RAE Systems. The part number is 059-3051-000.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. Remove and replace batteries only in areas known to be non-hazardous.

Low Voltage Warning

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the "empty battery" icon blinks on and off once per second. You should turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Clock Battery

An internal clock battery is mounted on one of the instrument's printed circuit boards. This long-life battery keeps settings in memory from being lost whenever the Li-ion battery or alkaline batteries are removed. This backup battery should last approximately five years, and must be replaced by an authorized RAE Systems service technician. It is not user-replaceable.

Data Protection While Power Is Off

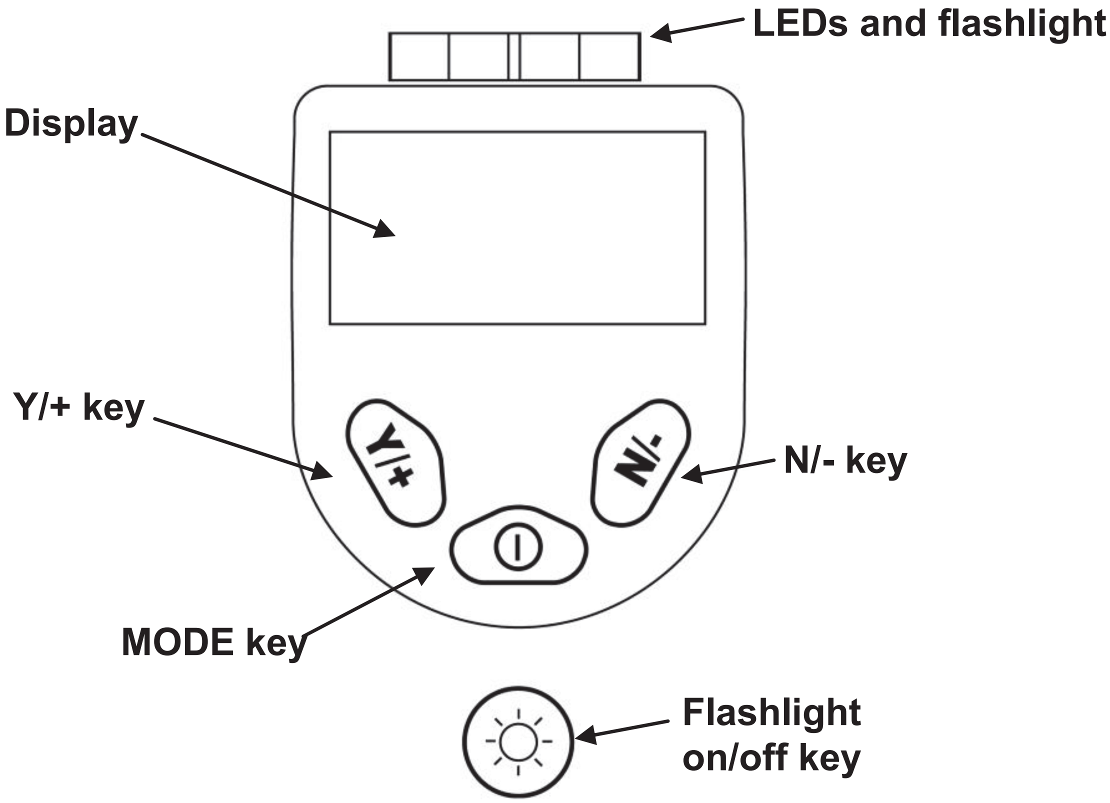
When the instrument is turned off, all the current real-time data including last measured values are erased. However, the datalog data is preserved in non-volatile memory. Even if the battery is disconnected, the datalog data will not be lost.

User Interface

The instrument's user interface consists of the display, LEDs, an alarm transducer, and four keys. The keys are:

Y/+
MODE
N/-
Flashlight on/off

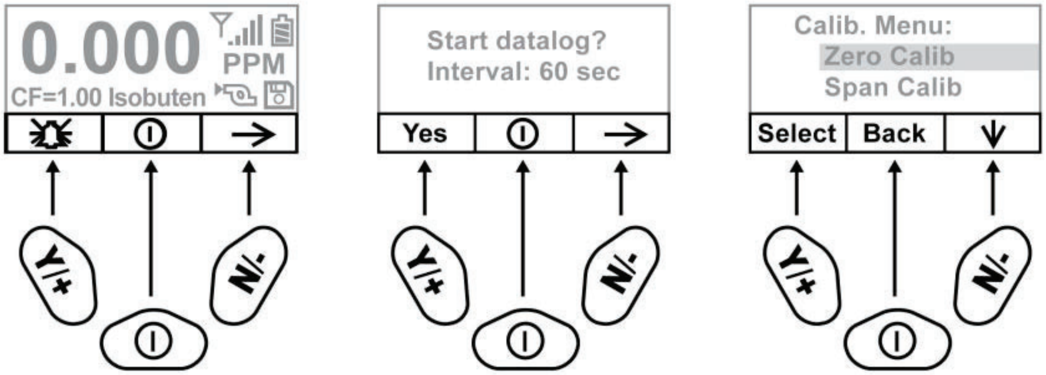
The LCD display provides visual feedback that includes the reading, time, battery condition, and other functions.



In addition to their labeled functions, the keys labeled Y/+, MODE, and N/- act as "soft keys" that control different parameters and make different selections within the instrument's menus. From menu to menu, each key controls a different parameter or makes a different selection.

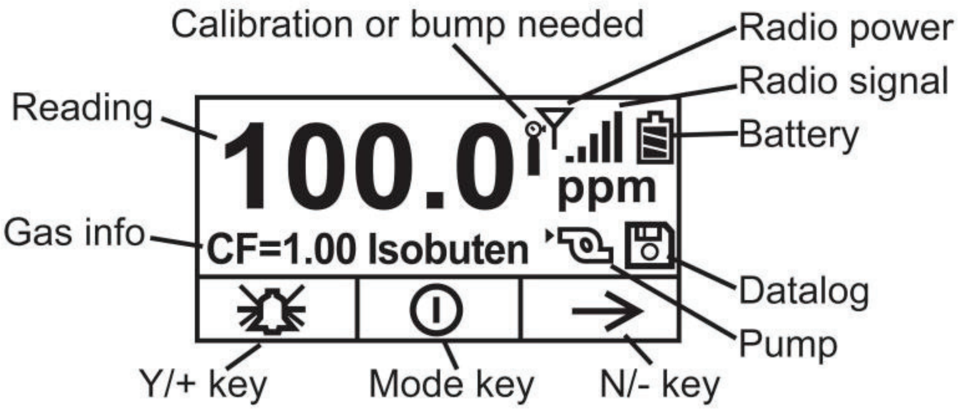
Three panes along the bottom of the display are "mapped" to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are three examples of different menus with the relationships of the keys clearly shown:

RELATIONSHIP OF BUTTONS TO CONTROL FUNCTIONS



Display

The display shows the following information:



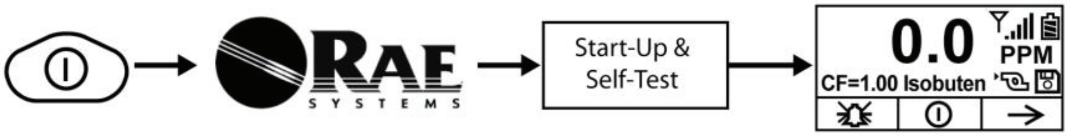
Gas info	Tells the Correction Factor and type of calibration gas
Reading	Concentration of gas as measured by the instrument
Calibration or bump needed	Dark icon indicates that calibration should be performed; light icon indicates bump should be performed
Radio power	Indicates whether radio (Mesh wireless or Bluetooth) connection is on or off
Radio signal	Indicates signal strength in 5-bar bargraph
Battery	Indicates battery level in 3 bars
Pump	Indicates that pump is working
Datalog	Indicates whether datalog is on or off
Y/+	Y/+ key's function for this screen
MODE	MODE key's function for this screen
N/-	N/- key's function for this screen

Operating The Instrument

The instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It gives real-time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment, the instrument is preset with default alarm limits and the sensor is pre-calibrated with standard calibration gas. However, you should test the instrument and verify the calibration before the first use. After the instrument is fully charged and calibrated, it is ready for immediate operation.

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.



The RAE Systems logo should appear first. (If the logo does not appear, there is likely a problem and you should contact your distributor or RAE Systems Technical Support.) The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting section of this guide.

Once the startup procedure is complete, the instrument shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. Once the countdown stops, the instrument is off. Release the Mode key.
3. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Operating The Built-In Flashlight

The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off.

Note: Using the flashlight for extended periods shortens the battery's operating time before it needs recharging.

Pump Status

IMPORTANT!

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:

During duty cycling (PID lamp cleaning), the display shows these icons in alternation:

If there is a pump failure or obstruction that disrupts the pump, you will see this icon blinking on and off:

If you see this blinking icon, consult the Troubleshooting section of this guide.

Calibration Status

The instrument displays this icon if it requires calibration:

Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor has been replaced.
- It has been 30 days or more since the instrument was last calibrated.
- If you have changed the calibration gas type without recalibrating the instrument.

Bump Status

The instrument displays this icon if it requires a bump test:

A bump test is required (and indicated by this icon) if:

- The defined period of time between bump tests has been exceeded (bump test overdue).
- The sensor has failed a previous bump test.
- The sensor(s) should be challenged on a periodic basis.

Policy Enforcement

The MiniRAE 3000 can be configured to enforce a facility/company's requirements that calibration and/or bump testing be performed at specified intervals, and to explicitly prompt the user that calibration/bump testing is required. Depending on how Policy Enforcement features are configured, the user may be required to perform a bump test or calibration prior to being able to use the instrument. That is, it can be set to not allow normal operation of the instrument unless calibration or bump testing is performed.

If the instrument has been bump tested and calibrated in compliance with the policy settings, a check-mark icon is included along the top of the MiniRAE 3000 screen:

✓

If Policy Enforcement is enabled, then after startup the MiniRAE 3000 displays a screen that informs the user that the instrument requires either a bump test or a calibration. If both are required, then they are shown in sequence.

Note: Policy enforcement features are disabled by default.

Setting Policy Enforcement

You must use ProRAE Studio II to make changes to Policy Enforcement settings. You must use an AutoRAE 2 Cradle, a MiniRAE 3000 Travel Charger, or a MiniRAE 3000 Desktop Cradle. Policy violations are captured in the datalog.

Using The Travel Charger, Desktop Charger, or AutoRAE 2 Automatic Test And Calibration System

To program a MiniRAE 3000 via an AutoRAE 2, you need ProRAE Studio II Instrument Configuration and Data Management Software, the AutoRAE 2 connected to a power source, and a USB PC communications cable.

1. Connect a USB cable between a PC with ProRAE Studio II and the AutoRAE 2 Cradle, Travel Charger, or Desktop Cradle.
2. Apply power to the AutoRAE 2 Cradle, Travel Charger, or Desktop Cradle.
3. Turn off the MiniRAE 3000 (or put the MiniRAE 3000 into AutoRAE 2 Mode or Communication Mode) and set it in the cradle.
4. Start ProRAE Studio II software on the PC.
5. Select "Administrator" and input the password (the default is "rae").
6. Click "Detect the instruments automatically" (the magnifying glass icon with the letter "A" in it). After a few seconds, the AutoRAE 2 Cradle is found and it is shown, along with its serial number.
7. Click on the icon to highlight it, and then click "Select."
8. In ProRAE Studio II, the instrument or AutoRAE 2 Cradle is shown, including its Serial Number, under "Online."
9. Expand the view to show the instrument or to show the instrument in the AutoRAE 2 Cradle by clicking the "+" to the left of the image of the AutoRAE 2 Cradle.
10. Double-click on the icon representing the MiniRAE 3000.
11. Click "Setup."
12. In the menu that now appears on the left side, click "Policy Enforcement." It is highlighted, and the Policy Enforcement pane is shown. For "Must Calibrate" and "Must Bump," you have the options of no enforcement or enforcement (including "Can't Bypass," and "Can Bypass").

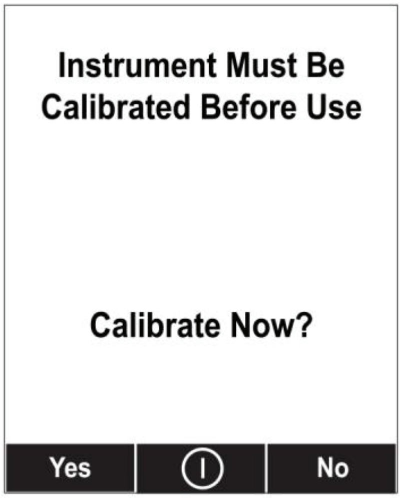
Must Calibrate. The user is prompted to calibrate the instrument when calibration is due (as set by the calibration interval). There are two programmable options:

- **Can't Bypass.** Unless calibration is performed, the instrument cannot be used, and the only option is to turn off the instrument.
- **Can Bypass.** If calibration is due but the user does not want to perform a calibration, the instrument can still be used. In this case, the instrument records that the user has bypassed the calibration requirement in a Policy Violation report.

Must Bump. The user is prompted to bump test the instrument when a bump test is due (as set by the bump test interval). There are two programmable options:

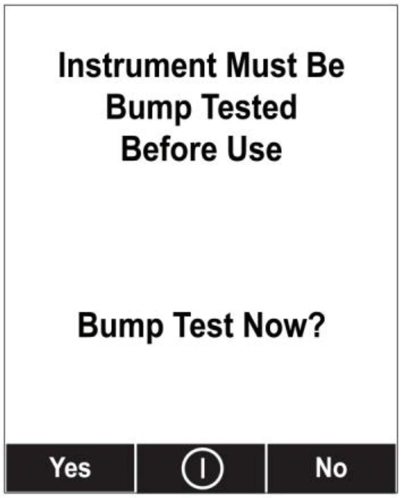
- **Can't Bypass.** Unless a bump test is performed, the instrument cannot be used, and the only option is to turn off the instrument.
- **Can Bypass.** If a bump test is due but the user does not want to perform one, the instrument can still be used. In this case, the instrument records that the user has bypassed the bump testing requirement in a Policy Violation report.

These are the screens that are shown on a MiniRAE 3000 after startup if "Can Bypass" is selected:



Instrument Must Be Calibrated Before Use

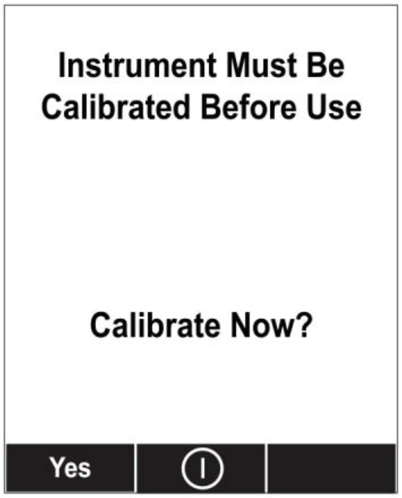
Calibrate Now?



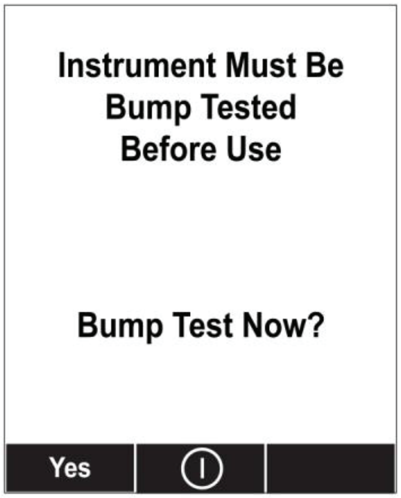
Instrument Must Be Bump Tested Before Use

Bump Test Now?

If “Can’t Bypass” is selected, the display looks like this, and only allows the options of performing the test or shutting down:


Instrument Must Be Calibrated Before Use

Calibrate Now?


Instrument Must Be Bump Tested Before Use

Bump Test Now?

16. Once you have made your selections in ProRAE Studio II, you must upload the changes to the instrument. Click the icon labeled “Upload all settings to the instrument.”

17. A confirmation screen is shown. Click “Yes” to perform the upload, or “No” to abort.
    Uploading takes a few seconds, and a progress bar is shown. You can abort the upload by clicking “Cancel.”

18. Exit ProRAE Studio II.

19. Press [Y/+] on the MiniRAE 3000 to exit Communication Mode.

Operating Modes

Your instrument operates in different modes, depending on the model and its factory default settings. In some cases, you can change modes using a password and using the instrument's navigation. In other cases, you must use ProRAE Studio software.

The default setting for your instrument is:

User Mode: Basic
Operation Mode: Hygiene

This is outlined in detail on page 83.

The other options, covered later in this guide, are:

User Mode: Advanced (page 86)
Operation Mode: Hygiene

User Mode: Advanced (page 90)
Operation Mode: Search

Using ProRAE Studio allows access to other options. In addition, Diagnostic Mode (page 91) is available for service technicians.

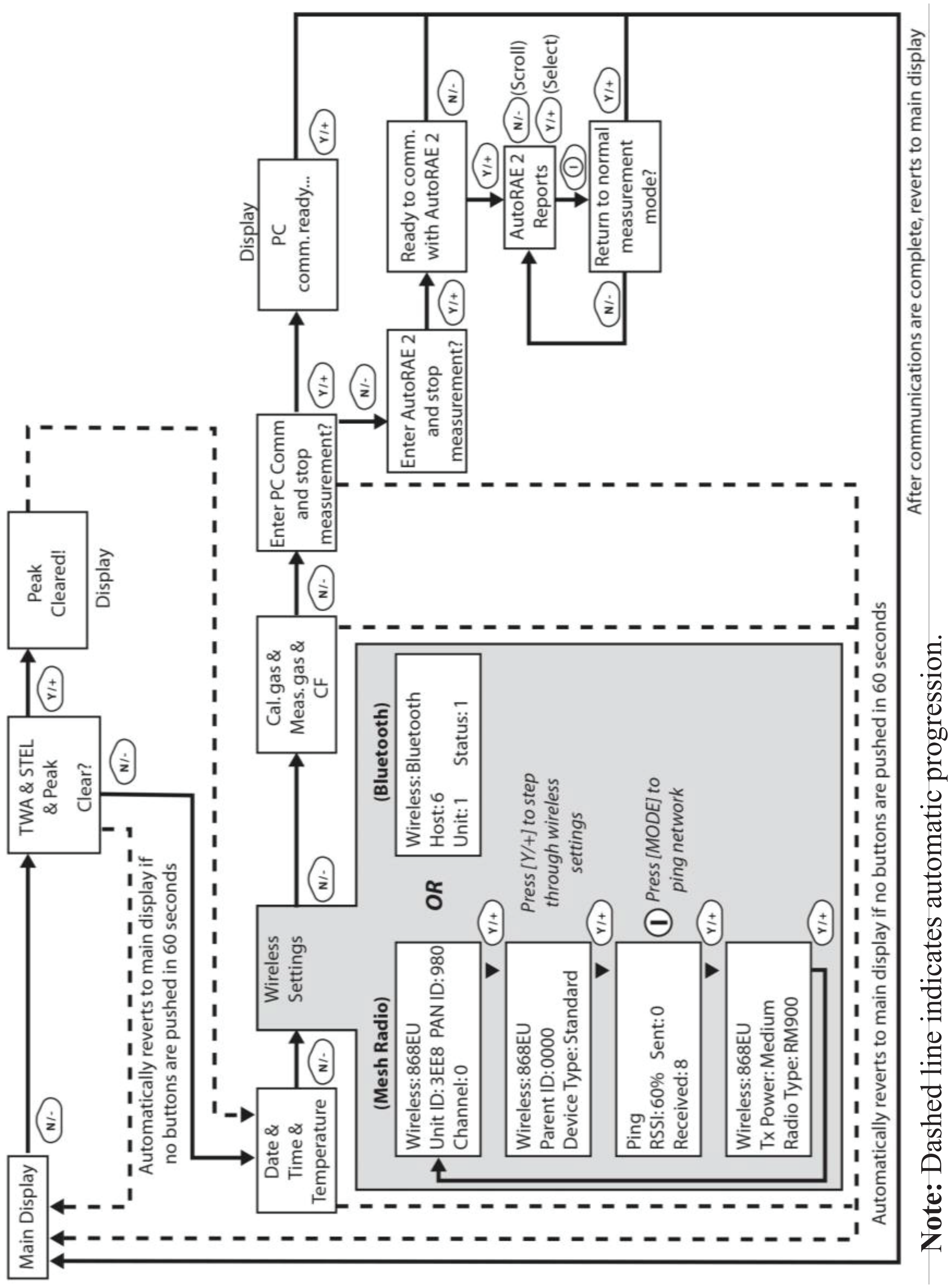
Basic User Level/Hygiene Mode (Default Settings)

The instrument is programmed to operate in Basic User Level/Hygiene Mode as its default. This gives you the most commonly needed features while requiring the fewest parameter adjustments.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].

MiniRAE 3000 User's Guide



Note: Dashed line indicates automatic progression.

After the instrument is turned on, it runs through the start-up menu. Then the message "**Please apply zero gas…**" is displayed.

At this point, you can perform a zero air (fresh air) calibration. If the ambient air is clean, you can use that. Otherwise, use a cylinder of zero air. Refer to Zero Calibration on page 44 for a more detailed description of zero calibration.

Start zero calibration by pressing Start. You see the message "Zeroing…" followed by a 30-second countdown.

Note: You can press [MODE] to quit, bypassing the zero air calibration.

When zero calibration is complete, you see the message:

Zeroing is done!

Reading = 0.0 ppm

The instrument is now sampling and collecting data.

Note: At the Average & Peak, Date & Time & Temperature, Calibration Gas & Measurement Gas & Correction Factor, and PC Communications screens, the instrument automatically goes to the main display after 60 seconds if you do not push a key to make a selection.

Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn you of the alarm condition.

In addition, the instrument alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, or pump stall.

Alarm Signal Summary

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second*
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second*
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display
Battery icon flashes	Low battery	1 flash, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

* Hygiene mode only. In Search mode, the number of beeps per second (1 to 7) depends upon the concentration of the sampled gas. Faster rates indicate higher concentrations.

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	Cal Span	unit	Low	High	TWA	STEL
MiniRAE 3000	100	ppm	50	100	10	25

Testing The Alarm

You can test the alarm whenever the main (Reading) display is shown. Press [Y/+], and the audible and visible alarms are tested.

Integrated Sampling Pump

The instrument includes an integrated sampling pump. This diaphragm-type pump that provides a 450 to 550 cc per minute flow rate. Connecting a Teflon or metal tubing with 1/8" inside diameter to the gas inlet port of the instrument, this pump can pull in air samples from 100' (30 m) away horizontally or vertically.

Note: In Search Mode, the pump turns on when a sample measurement is started, and turns off when the sample is manually stopped.

If liquid or other objects are pulled into the inlet port filter, the instrument detects the obstruction and immediately shuts down the pump. The alarm is activated and a flashing pump icon is displayed.

You should acknowledge the pump shutoff condition by clearing the obstruction and pressing the [Y/+] key while in the main reading display to restart the pump.

Backlight

The LCD display is equipped with an LED backlight to assist in reading the display under poor lighting conditions.

Datalogging

During datalogging, the instrument displays a disk icon to indicate that datalogging is enabled. The instrument stores the measured gas concentration at the end of every sample period (when data logging is enabled). In addition, the following information is stored: user ID, site ID, serial number, last calibration date, and alarm limits. All data are retained (even after the unit is turned off) in non-volatile memory so that it can be down- loaded at a later time to a PC.

Datalogging event

When Datalogging is enabled, measurement readings are being saved. These data are stored in "groups" or "events." A new event is created and stored each time the instrument is turned on and is set to automatic datalogging, or a configuration parameter is changed, or datalogging is interrupted. The maximum time for one event is 24 hours or 28,800 points. If an event exceeds 24 hours, a new event is automatically created. Information, such as start time, user ID, site ID, gas name, serial number, last calibration date, and alarm limits are recorded.

Datalogging sample

After an event is recorded, the unit records a shorter form of the data. When transferred to a PC running ProRAE Studio, this data is arranged with a sample number, time, date, gas concentration, and other related information.

Auto/Manual/Snapshot Datalogging

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see page 63 for details).
Snapshot	Datalogs only during snapshot (single-event capture, initiated by pressing [MODE]) sampling. See page 65 for details.

Note: You can only choose one datalog type to be active at a time.

Accessories

The following accessories are included with the instrument:

- An AC Adapter (Battery Charger)
- Alkaline battery adapter
- External Filter
- Organic Vapor Zeroing kit

Hard-case kits also include these accessories:

- Calibration adapter
- Calibration regulator and Flow controller

Standard Kit & Accessories

AC Adapter (Battery Charger)

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in area known to be non-hazardous.

Ne charger les batteries que dans emplacements designés non-dangereuses.

A battery charging circuit is built into the instrument cradle. It only needs a regular AC to 12 VDC adapter (wall-mount transformer, part number 500-0114-000) to charge the instrument.

To charge the battery inside the instrument:

1. Power off the instrument.
2. Connect the AC adapter to the DC jack on the instrument's cradle. If the instrument is off, it automatically turns on.
3. While charging, the display message shows "Charging." The Primary LED on the cradle flashes green when charging.
4. When the battery is fully charged, the LED changes to glowing green continuously, and the message "Fully charged" appears on the

display. If there is a charging error, the LED glows red continuously.

A completely discharged instrument can be charged to full capacity within 8 hours. Batteries drain slowly even if an instrument is off. Therefore, if the instrument has been in storage or has not been charged for several days or longer, check the charge before using it.

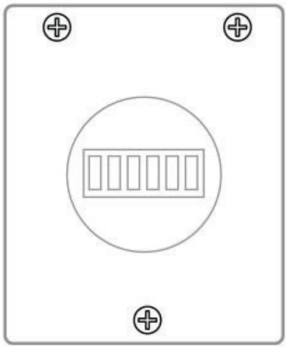
The factory-supplied battery is designed to last for 16 hours of normal operation (no alarm), for a new battery under the optimum circumstances. As the battery becomes older or is subject to adverse conditions (such as cold ambient temperature), its capacity will be significantly reduced.

Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500) and provides approximately 12 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Li-ion battery pack.

To insert batteries into the adapter:

1. Remove the three Philips-head screws to open the compartment in the adapter.
2. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
3. Replace the cover. Replace the three screws.



To install the adapter in the instrument:

1. Remove the Li-ion battery pack from the instrument by sliding the tab and tilting out the battery.
2. Replace it with the alkaline battery adapter
3. Slide the tab back into place to secure the battery adapter.

IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline batteries and will not allow recharging. If you place the instrument in its cradle, the alkaline battery will not be recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument. If you try to charge an alkaline batteries installed in the instrument, the instrument's display will say, "Alkaline Battery," indicating that it will not charge the alkaline batteries.

Note: When replacing alkaline batteries, dispose of old ones properly.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge the battery only in areas known to be non-hazardous. Remove and replace the battery only in areas known to be non-hazardous.

External Filter

The external filter is made of PTFE (Teflon®) membrane with a 0.45 micron pore size to prevent dust or other particles from being sucked into the sensor manifold, which would cause extensive damage to the instrument. It prolongs the operating life of the sensor. To install the external filter, simply connect it to the instrument's inlet tube.

Optional Accessories

Calibration Adapter

The calibration adapter for the instrument is a simple 6-inch Tygon tubing with a metal adapter on one end. During calibration, simply insert the metal adapter into the regular gas inlet probe of the instrument and the tubing to the gas regulator on the gas bottle.

Calibration Regulator

The Calibration Regulator is used in the calibration process. It regulates the gas flow rate from the Span gas cylinder into the gas inlet of the instrument during calibration process. The maximum flow rate allowed by the flow controller is about 0.5L/min (500 cc per min.). Alternatively, a demand-flow regulator or a Tedlar gas bag may be used to match the pump flow precisely.

Organic Vapor Zeroing Kit

The Organic Vapor Zeroing Kit is used for filtering organic air contaminants that may affect the zero calibration reading. To use the Organic Vapor Zeroing Kit, simply connect the filter to the inlet port of the instrument.

AutoRAE 2 Automatic Test & Calibration System

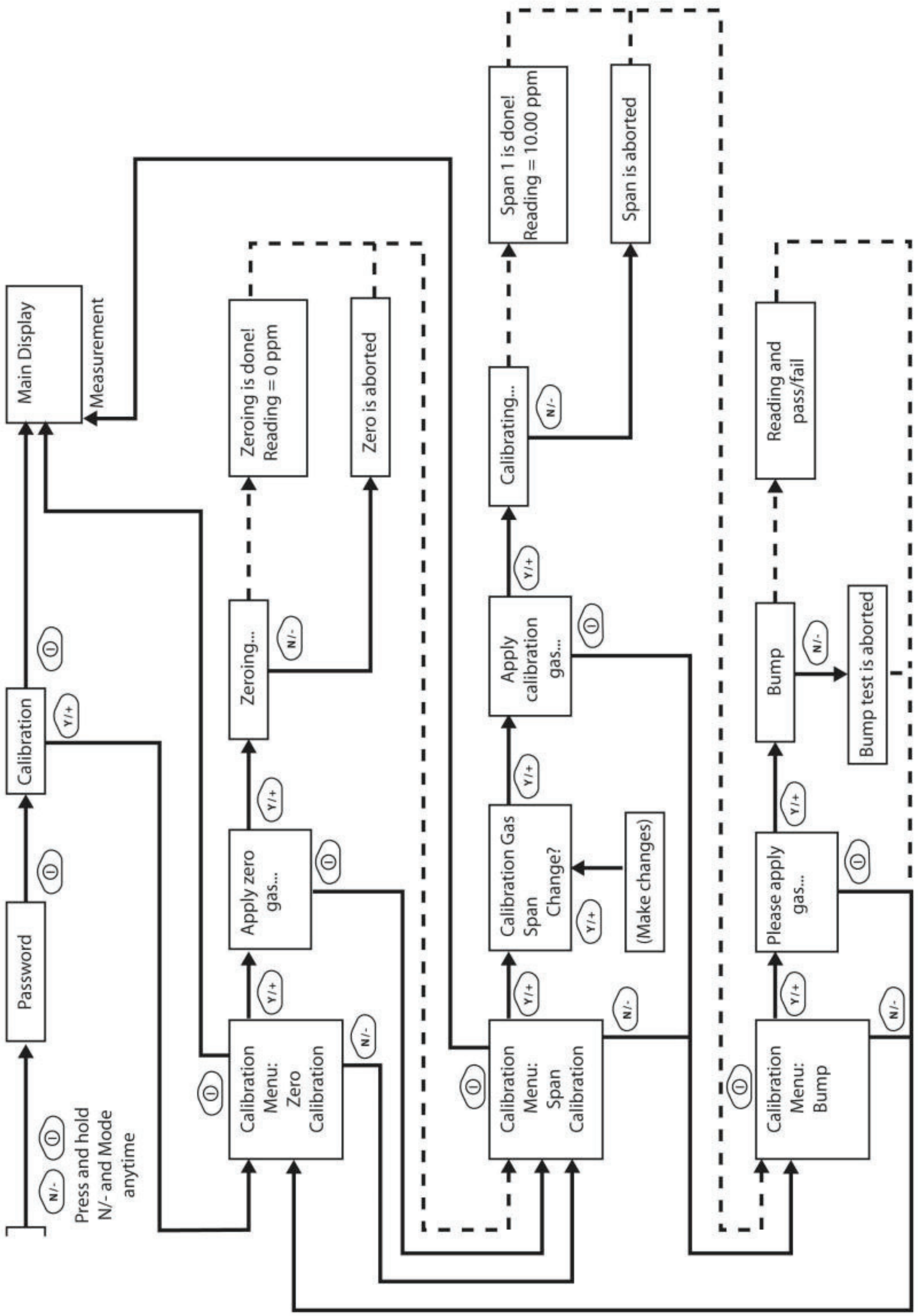
The AutoRAE 2 Automatic Test and Calibration System for RAE Systems portable gas monitors makes compliance with monitor test and calibration requirements as easy as pressing a button. Simply cradle the monitor and the system will take care of all calibration, testing, and recharging.

The AutoRAE 2 is a flexible, modular system that can be configured to meet your calibration requirements effectively and efficiently. An AutoRAE 2 system can be as simple as a single cradle deployed in standalone mode to calibrate one instrument at a time, or as powerful as a networked, controller-based system supporting ten monitors and five distinct calibration gas cylinders.

Standard Two-Point Calibration (Zero & Span, Optional Bump)

The following diagram shows the instrument's calibrations in Basic/Hygiene mode.

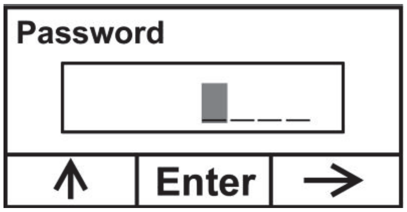
MiniRAE 3000 User's Guide



Note: Dashed line indicates automatic progression.

Entering Calibration

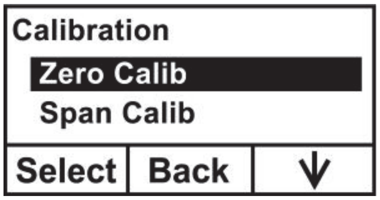
1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. In Basic User Level, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

   Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

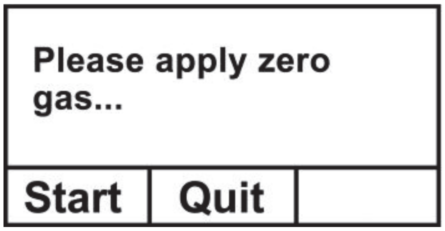
Zero (Fresh Air) Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a "fresh" air source such as from a cylinder or Tedlar bag (optional accessory). The "fresh" air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:



Please apply zero gas...

1. Turn on your Zero calibration gas.
2. Press [Y/+] to start calibration.

   Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts a 30-second countdown and displays this message:

Zeroing...

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any action on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says "Zero aborted!" and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

Zeroing is done!
Reading = 0.0 ppm

The instrument will then show the Calibration menu on its display, with Span Calib highlighted.

Span Calibration

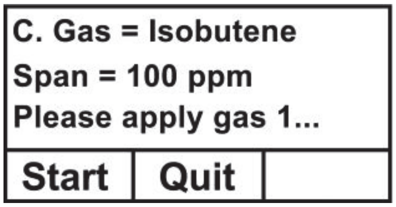
This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:


C. Gas = Isobutene
Span = 100 ppm
Please apply gas 1...

1. Turn on your span calibration gas.
2. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you see a message similar to this (the value is an example only):

Span 1 is done!
Reading = 100.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Two-Point Calibration In Basic User Level

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display. You will see the following message:

Updating settings…

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Three-Point Calibration

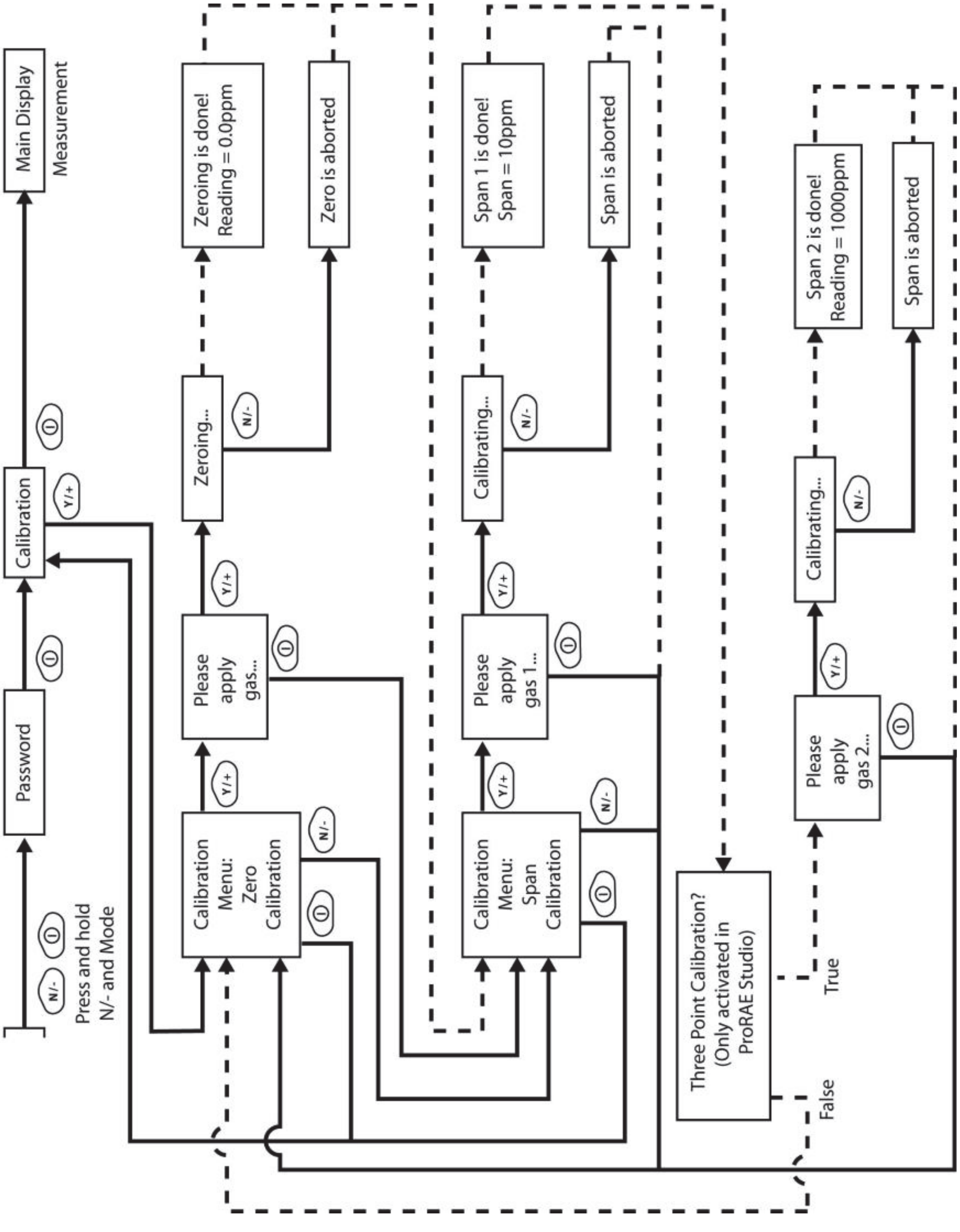
For enhanced accuracy, it is possible to perform a second Span calibration in addition to the Zero and Span calibrations outlined in the previous section. Your instrument first must be set to allow this third calibration. This requires using ProRAE Studio software and a PC, as well as a higher concentration of calibration gas.

Note: Once the third calibration is set, you do not need to use ProRAE Studio to allow future 3-point calibrations. Also, you can only disable 3-point calibration capability by using ProRAE Studio again.

Perform the Zero and Span calibrations. After the first Span calibration (Span 1) is completed, the display a second Span calibration (Span 2) can be performed. The process is identical to the first calibration. As in the Span 1 calibration, you may exit and return to the Zero calibration screen if you choose not to perform this calibration or to abort it.

Note: If a bump test is available, it appears after the last calibration in the menu. See "Two-Point Calibration," page 38, for details. Also, refer to page 53 for details on how to perform a bump test.

MiniRAE 3000 User's Guide



Note: Dashed line indicates automatic progression.

Span 2 Calibration

A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure.

Note: This gas should be of a higher concentration than the gas used for Span 1 calibration.

Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span 2 calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

Please apply gas...

4. Turn on your span calibration gas.
5. Press [Y/+] to initiate calibration.

Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu for Zero calibration.

6. Span calibration starts a 30-second countdown and displays this message:

Calibrating...

During the Span calibration process, the instrument performs the Span calibration automatically and does not require any action on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu will appear. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you will see a message similar to this (the value shown here is for example only):

Span 2 is done!
Reading = 1000 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Three-Point Calibration

When you are done performing calibrations, press [MODE], which corresponds with “Back” on the display. You will see the following message:

Updating settings…

The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Bump Test

RAE Systems recommends that a bump test be conducted prior to each day’s use. The purpose of a bump test is to ensure that the instrument’s sensors respond to gas and all the alarms are enabled and functional.

- The MiniRAE 3000 must be calibrated if it does not pass a bump test when a new sensor is installed, after sensor maintenance has been performed, or at least once every 180 days, depending on use and sensor exposure to poisons and contaminants.
- Calibration and bump test intervals and procedures may vary due to national legislation and company policy.

To perform a bump test (functional challenge), follow these steps:

1. Select “Bump.”
2. Install the calibration adapter and connect it to a source of calibration gas.
3. Verify that the displayed calibration value meets the concentration specified on the gas cylinder.
4. Start the flow of calibration gas.
5. Press [Y/+] to start the bump test.
6. You can abort the calibration at any time during the countdown by pressing [N/-].

7. If the calibration is not aborted, the display shows reading and then tells you whether the bump test passed or failed. If the bump test failed, then it automatically advances to the Calibration screen.

Important!

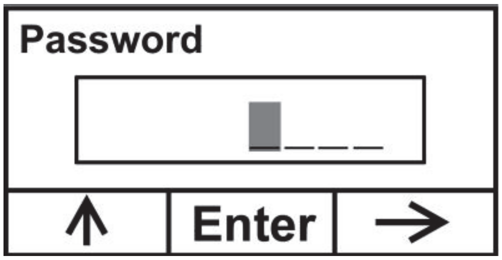
Anytime a bump test fails, you should perform a full calibration of the instrument.

Programming Mode

Programming Mode can be entered from either Hygiene Mode or Search Mode. If the current user mode is Basic, you must provide a 4-digit password to enter.

Entering Programming Mode

1. Press and hold [MODE] and [N/-] until you see the Password screen.



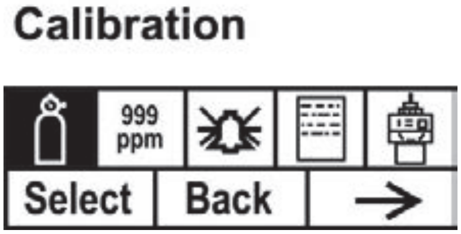
2. Input the 4-digit password:

- Increase the number from 0 through 9 by pressing [Y/+].
- Step from digit to digit using [N/-].
- Press [MODE] when you are done.

If you make a mistake, you can cycle through the digits by pressing [N/-] and then using [Y/+] to change the number in each position.

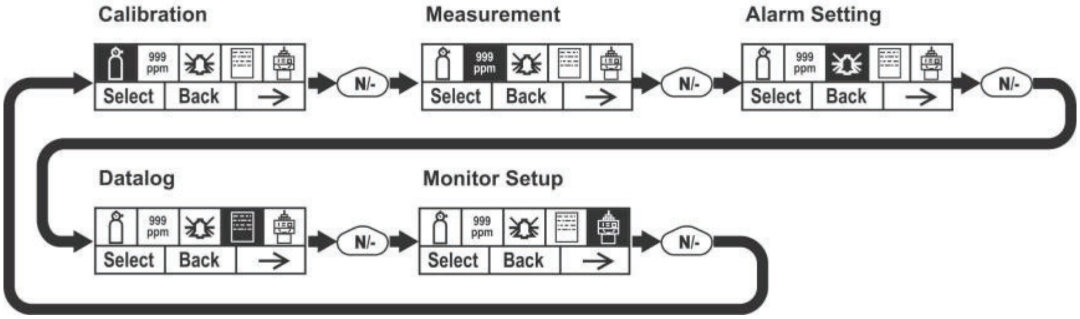
Note: The default password is 0000.

When you have successfully entered Programming Mode, you see this screen:



Note: The password can only be changed by connecting the instrument to a PC running ProRAE Studio software. Follow the instructions in ProRAE Studio to change it.

The Calibration label is shown and its icon is highlighted, but you can press [N/-] to step from one programming menu to the next, with the name of the menu shown at the top of the display and the corresponding icon highlighted. As you repeatedly press [N/-], the selection moves from left to right, and you see these screens:



Note: When you reach Monitor Setup and press [N/-], the menu cycles back to Calibration.

Programming Mode Menus

The Programming Mode allows anyone with the password to change the instrument's settings, calibrate the instrument, modify the sensor configuration, enter user information, etc. Programming Mode has five menus. Each menu includes several sub-menus to perform additional programming functions.

This table shows the menus and sub-menus:

	999 ppm			
Calibration	**Measurement**	**Alarm Setting**	**Datalog**	**Monitor Setup**
Zero Calibration	Meas. Gas	High Alarm	Clear Datalog	Radio Power
Span Calibration	Meas. Unit	Low Alarm	Interval	Op Mode
Bump		STEL Alarm	Data Selection	Site ID
		TWA Alarm	Datalog Type	User ID
		Alarm Mode		User Mode
		Buzzer & Light		Date
				Time
				Pump Duty Cycle
				Pump Speed
				Temperature Unit
				Language
				Real Time Protocol
				Power On Zero
				Unit ID
				LCD Contrast
				Lamp ID
				PAN ID
				Mesh Channel
				Mesh Interval

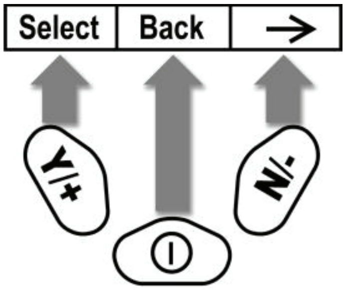
Once you enter Programming Mode, the LCD displays the first menu, Calibration. Each subsequent menu is accessed by pressing [N/-] repeatedly until the desired menu is displayed. To enter a sub-menu of a menu, press [Y/+].

Exiting Programming Mode

To exit Programming Mode and return to normal operation, press [MODE] once at any of the programming menu displays. You will see "Updating Settings…" as changes are registered and the mode changes.

Navigating Programming Mode Menus

Navigating through the Programming Mode menus is easy and consistent, using a single interface format of "Select," "Back" and "Next" at the top level. The three control buttons correspond to these choices as shown:



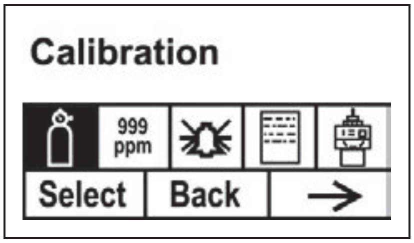
Note: Pressing [MODE] in the Programming Mode's top level causes the instrument to exit Programming Mode and return to monitoring.

The three keys perform the following functions in Programming Mode:

Key	Function in Programming Mode
[MODE]:	Exit menu when pressed momentarily or exit data entry mode
[Y/+]:	Increase alphanumerical value for data entry or confirm (yes) for a question
[N/-]:	Provides a "no" response to a question

Calibration

Two types of calibration are available: Zero (fresh air) and Span.



Select Zero or Span Calibration by pressing [N/+]. Once your choice is highlighted, press [Y/+].

Zero Calibration

The procedure for performing a zero calibration is covered on page 41.

Span Calibration

The procedure for performing a basic span calibration is covered on page 41.

Bump

The procedure for performing a bump calibration is covered on page 53.

A bump test can be performed either manually or using the AutoRAE 2 Automatic Test and Calibration System. When a bump test is done manually, the instrument makes a pass/fail decision based on sensor performance, but the user still has the responsibility to make sure all the alarms are enabled and functional.

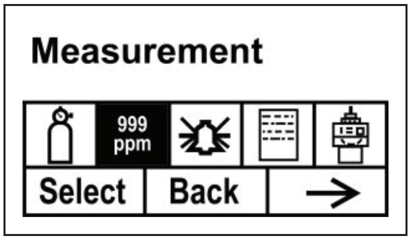
Note: Bump testing and calibration can be performed using an AutoRAE 2 Automatic Test & Calibration System. An AutoRAE 2 bump test takes care of both the sensor and alarm tests. Consult the AutoRAE 2 User's guide for details.

IMPORTANT!

If the instrument does not pass a bump test, perform a full calibration. If calibration also fails, the PID sensor or lamp may require cleaning or replacement. If the instrument repeatedly fails to calibrate, turn it off and refer it for servicing.

Measurement

The sub-menus for Measurement are Measurement Gas and Measurement Unit.



Meas. Gas

Measurement gases are organized in four lists:

- My List is a customized list of gases that you create. It contains a maximum of 10 gases and can only be built in ProRAE Studio on a PC and transferred to the instrument. **Note:** The first gas in the list is always isobutylene (it cannot be removed from the list).
- Last Ten is a list of the last ten gases used by your instrument. The list is built automatically and is only updated if the gas selected from Custom Gases or Library is not already in the Last Ten. This ensures that there is no repetition.
- Gas Library is a library that consists of all the gases found in RAE Systems' Technical Note TN-106 (available online at www.raesystems.com).
- Custom Gases are gases with user-modified parameters. Using ProRAE Studio, all parameters defining a gas can be modified,

including the name, span value(s), correction factor, and default alarm limits.

1. Scroll through each list by pressing [N/-].
2. Press [Y/+] to select one (My List, Last Ten, Gas Library, or Custom Gases).
3. Once you are in one of the categories, press [N/-] to scroll through its list of options and [Y/+] to select one. (If you press [MODE], you exit to the next submenu.)
4. Press [Y/+] to save your choice or [N/-] to undo your selection.

Leave the sub-menu and return to the Programming Mode menus by pressing [MODE].

Meas. Unit

Standard available measurement units include:

Abbreviation	Unit	MiniRAE 3000
ppm	parts per million	Yes
ppb	parts per billion	
mg/m3	milligrams per cubic meter	Yes
ug/m3	micrograms per cubic meter	

- Scroll through the list by pressing [N/-].
- Select by pressing [Y/+].
- Save your selection by pressing [Y/+] or undo your selection by pressing [N/-].

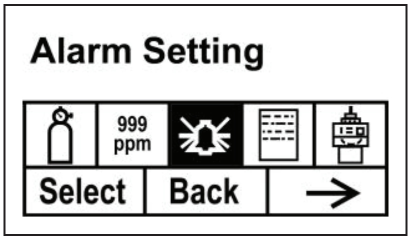
Leave the sub-menu and return to the Programming Mode menus by pressing [MODE].

Alarm Setting

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings: Low, High, TWA and STEL). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn of the alarm condition.

An alarm signal summary is shown on page 33.

In this menu, you can change the High and Low alarm limits, the STEL limit, and the TWA. Press [Y/+] to to enter the Alarm Setting menu. **Note:** All settings are shown in ppb (parts per billion), or µg/m^3 (micrograms per cubic meter), depending on your setting.



1. Scroll through the Alarm Limit sub-menu using the [N/-] key until the display shows the desired limit to be changed (High Alarm, Low Alarm, STEL Alarm, and TWA Alarm)
2. Press [Y/+] to select one of the alarm types. The display shows a flashing cursor on the left-most digit of the previously stored alarm limit.
3. Press [Y/+] to increase each digit's value.
4. Press [N/-] to advance to the next digit.
5. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

Press [MODE] when you are done.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

When all alarm types have been changed or bypassed, press [MODE] to exit to the Programming Menu.

High Alarm

You can change the High Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the High Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.
When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

Press [Y/+] to save the changes.
Press [N/-] to undo the changes and revert to the previous settings.

Low Alarm

You can change the Low Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the Low Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

STEL Alarm

You can change the STEL Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the STEL Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

TWA Alarm

You can change the TWA (time-weighted average) Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the TWA Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices:

- Save
- Undo

You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Alarm Mode

There are two selectable alarm modes:

Auto Reset	When the alarm condition is no longer present, the alarm stops and automatically resets itself.
Latch	When the alarm is triggered, you can manually stop the alarm. The latched setting only controls alarms for High Alarm, Low Alarm, STEL Alarm, and TWA alarm. **Note:** To clear an alarm when the instrument is set to "Latched," press [Y/+] when the main (Reading) display is shown.

1. Press **[N/-]** to step from one alarm type to the other.
2. Press **[Y/+]** to select an alarm type.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Buzzer & Light

The buzzer and light alarms can be programmed to be on or off individually or in combination. Your choices are:

- Both on
- Light only
- Buzzer only
- Both off

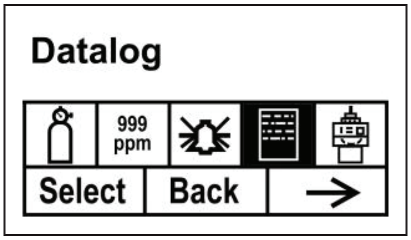
1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates your selection).
3. When you have completed your selections, press [MODE].

   You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

   - Press [Y/+] to save the changes.
   - Press [N/-] to undo the changes and revert to the previous settings.

Datalog

The instrument calculates and stores the concentration and ID of each sample taken. In the datalog sub-menu, a user can perform the tasks and functions shown below.



1. Scroll through the Datalog sub-menu using the [N/-] key until the display shows the desired parameter to be changed:

   Clear Datalog
   Interval
   Data Selection
   Datalog Type

2. Press [Y/+] to make your selection. Exit by pressing [MODE] for Back.

Clear Datalog

This erases all the data stored in the datalog.

Note: Once the datalog is cleared, the data cannot be recovered.

Press [Y/+] to clear the datalog. The display asks, "Are you sure?"

- Press [Y/+] if you want to clear the datalog. When it has been cleared, the display shows "Datalog Cleared!"
- Press [N/-] if you do not want to clear the datalog.

The display changes, and you are taken to the next sub-menu, Interval.

Interval

Intervals are shown in seconds. The default value is 60 seconds. The maximum interval is 3600 seconds.

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Data Selection

Data Selection allows you to select which types of data are stored and made available when you offload your datalog to a computer via ProRAE Studio software.

You can choose any or all of three types of data (you must choose at least one):

- Average
- Maximum
- Minimum

1. Press [N/-] to step from one option to the next. The highlighter indicates your choice.
2. Press [Y/+] to toggle your selection on or off (the check box indicates "on" with an "X").
3. When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Datalog Type

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see below for details).
Snapshot	Datalogs only during single-event capture sampling.

Note: You can only choose one datalog type to be active at a time.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.

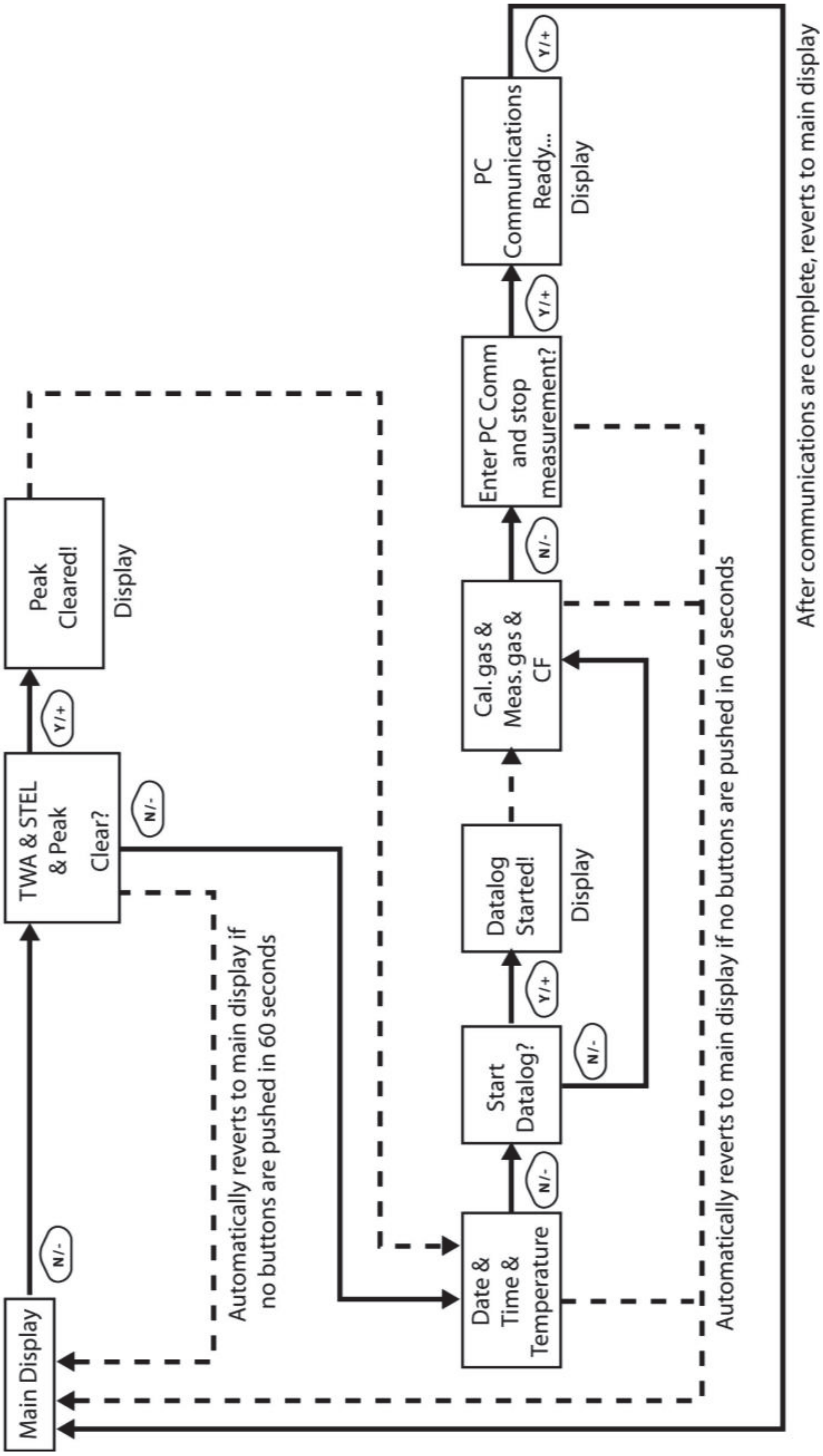
Press [N/-] to undo the changes and revert to the previous settings.

Manual Datalog

When the instrument is set to Manual Datalog, you turn datalogging on and off by stepping through the displays from the Main Display, and then pressing the keys to select datalog on/off functions.

- When you reach the screen that says "Start Datalog?" press [Y/+] to start it. You see "Datalog Started," confirming that datalogging is now on.

When you reach the screen that says "Stop Datalog?" press [Y/+] to stop it. You see "Datalog Stopped," confirming that datalogging is now off.



Note: Dashed line indicates automatic progression.

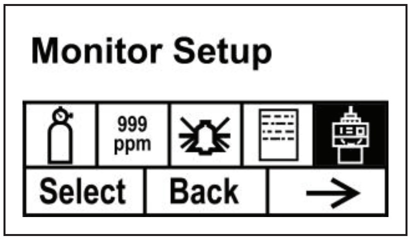
Snapshot Datalog

When the instrument is in Snapshot datalogging mode, it captures a single "snapshot" of the data at the moment of your choosing. Whenever the instrument is on and it is set to Snapshot, all you have to do is press [MODE] each time you want to capture a snapshot of the data at that instant.

When you send the data to a computer using ProRAE Studio, the data snapshots are uniquely identified by time and other parameters.

Monitor Setup

Many settings can be accessed in this menu, including setting the date and time and adjusting the pump's on/off duty cycle.



Radio Power

The radio connection can be turned on or off.

1. Press [N/-] to step from one option to the next (on or off).
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates that the option is selected).
3. When you have completed your selection, press [MODE].

   - Press [Y/+] to accept the new radio setting (on or off).
   - Press [N/-] to discard the change and move to the next sub-menu.

Op Mode

Under Monitor Setup is "Op Mode."

Press [Y/+] to select.

You see two options (one is highlighted):

Hygiene
Search

The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-]. The highlighting changes from one to the other each time you press [N/-].
2. Press [Y/+] to select that mode for the instrument.
3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

Site ID

Enter an 8-digit alphanumeric/character Site ID in the programming mode. This Site ID is included in the datalog report.

1. Press [Y/+] and the display shows the current site ID. Example: "RAE00001." Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).
   Note: The last four digits must be numerals.
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all eight digits of the new site ID are entered.

Press [MODE] to exit.

If there is any change to the existing site ID, the display shows "Save?" Press [Y/+] to accept the new site ID. Press [N/-] to discard the change and move to the next sub-menu.

User ID

Enter an 8-digit alphanumeric User ID in the programming mode. This User ID is included in the datalog report.

1. Press [Y/+] and the display shows the current User ID. Example: "RAE00001." Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all eight digits of the new User ID are entered.

Press [MODE] to exit.

If there is any change to the existing User ID, the display shows "Save" Press [Y/+] to accept the new site ID. Press [N/-] to discard (undo) the change and move to the next sub-menu.

User Mode

The instrument has two user modes:

Basic Basic users can only see and use a basic set of functions.
Advanced Advanced users can see all screens and perform all available functions.

Note: The default value for User Mode is Basic.

To change the User Mode:

1. Press [N/-] to step from one option to the next. The highlighting changes each time you press [N/-].
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
4. Press [Y/+] to accept the new User Mode. Press [N/-] to discard the change and move to the next sub-menu.

Date

The Date is expressed as Month/Day/Year, with two digits for each.

1. Press [Y/+] and the display shows the current date. Note that the left-most digit flashes to indicate it is selected.
2. Press [Y/+] to step through all 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all six digits of the new date are entered.

Press [MODE] to exit.

- Press [Y/+] to save the new date.
- Press [N/-] to undo the change and move to the next sub-menu.

Time

The Time is expressed as Hours/Minutes/Seconds, with two digits for each. The time is in 24-hour (military) format.

1. Press [Y/+] and the display shows the current time. Note that the left-most digit flashes to indicate it is selected.
2. Press [Y/+] to step through all 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all six digits of the new time are entered.

Press [MODE] to exit.

- Press [Y/+] to save the new date.
- Press [N/-] to undo the change and move to the next sub-menu.

Pump Duty Cycle

The pump's duty cycle is the ratio of its on time to off time. The duty cycle ranges from 50% to 100% (always on), and the period is 10 seconds. Therefore, a duty cycle of 60% means that the pump is on for 6 seconds and off for four seconds. Duty cycling is employed by the instrument to clean the PID. A lower duty cycle has a greater effect on keeping the PID clean than a higher duty cycle.

Important! Pump duty cycling is interrupted when the instrument senses a gas. The pump's duty cycle is disabled when the measurement is greater than the 2ppm threshold and is re-enabled when the reading falls below 90% of the threshold (1.8 ppm).

1. Press [Y/+] to increase the value.
2. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new duty cycle value.
   - Press [N/-] to undo the change and move to the next sub-menu.

Pump Speed

The pump can operate at two speeds, high and low. Running at low speed is quieter and conserves a small amount of power. There is almost no difference in sampling accuracy.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new temperature unit.
   - Press [N/-] to undo the change and move to the next sub-menu.

Temperature Unit

The temperature display can be switched between Fahrenheit and Celsius units.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new temperature unit.
   - Press [N/-] to undo the change and move to the next sub-menu.

Language

English is the default language, but other languages can be selected for the instrument.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
    - Press [Y/+] to save your new language choice.
    - Press [N/-] to undo it and return to the previous language selection.

Real Time Protocol

Real Time Protocol is the setting for data transmission.

The choices are:

P2M (cable)	Point to multipoint. Data is transferred from the instrument to multiple locations using a wired connection. Default data rate: 19200 bps.
P2P (cable)	Point to point. Data is transferred only between the instrument and one other location, such as a computer. Default data rate: 9600 bps.
P2M (wireless)	Point to multipoint, wireless. Data is transferred wirelessly and can be received by multiple receivers.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
    - Press [Y/+] to save the new real-time communications protocol.
    - Press [N/-] to undo the change and move to the next sub-menu.

Power On Zero

When Power On Zero is on, the instrument performs a zero calibration when it is turned on.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates your selection).
3. When you have completed your selection, press [MODE].
    - Press [Y/+] to save the change.
    - Press [N/-] to discard the change and move to the next sub-menu.

Unit ID

This three-digit number keeps data separated by instrument when more than one instrument is used in a network. If multiple sensing units are attempting to communicate with the same Host, then the units must all have a different Unit ID.

1. Press [Y/+] to step through all 10 numerals (0 to 9). If you pass the numeral you want, keep pressing [Y/+]. After it counts up to 9, it starts counting up from 0 again.
2. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all three digits of the Unit ID are entered.

3. Press [MODE] when you are done.
    - Press [Y/+] to save the change.
    - Press [N/-] to discard the change and move to the next sub-menu.

LCD Contrast

The display's contrast can be increased or decreased from its default setting. You may not need to ever change the default setting, but sometimes you can optimize the display to suit extreme temperature and ambient brightness/darkness conditions.

- The minimum value is 20.
- The maximum value is 60.

1. Press [Y/+] to increase the value or [N/-] to decrease the value.
2. Press [MODE] to save your selection.
    - Press [Y/+] to save your new contrast value.
    - Press [N/-] to undo it and return to the previous value.

Lamp ID

The instrument must be set to the correct lamp value in order to function correctly. Always match the value that was installed in your instrument from the factory or the value of the PID lamp you are replacing.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].

PAN ID

The MiniRAE 3000 and any other devices that you want to interconnect wirelessly must have the same PAN ID. You can set the PAN ID in the instrument or through ProRAE Studio II.

1. Press [N/-] to advance through the digits from left to right.
2. Press [Y/+] to] to advance through the numbers (1, 2, 3, etc.).
3. Press [MODE] to register your choice when you are done.

Mesh Channel

Note: For mesh radio modems operating at 868MHz, only channel 0 is available. For other frequencies, channels 1 through 10 are allowed.

1. Press [Y/+] to increase the number and [N/-] to advance to the next digit.
2. After moving to the last digit and making changes, press [MODE].
    - Press [Y/+] to save the change.
    - Press [N/-] to undo the change.

Mesh Interval

Set the time interval at which the instrument's mesh radio sends out a signal. This can range from once every 10 seconds to once every four minutes (240 seconds). The transmission frequency is user-adjustable, but a rate of at least once every 30 seconds is recommended. **Note:** Shorter intervals reduce battery life.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make a selection.
3. When you are done, press [MODE].

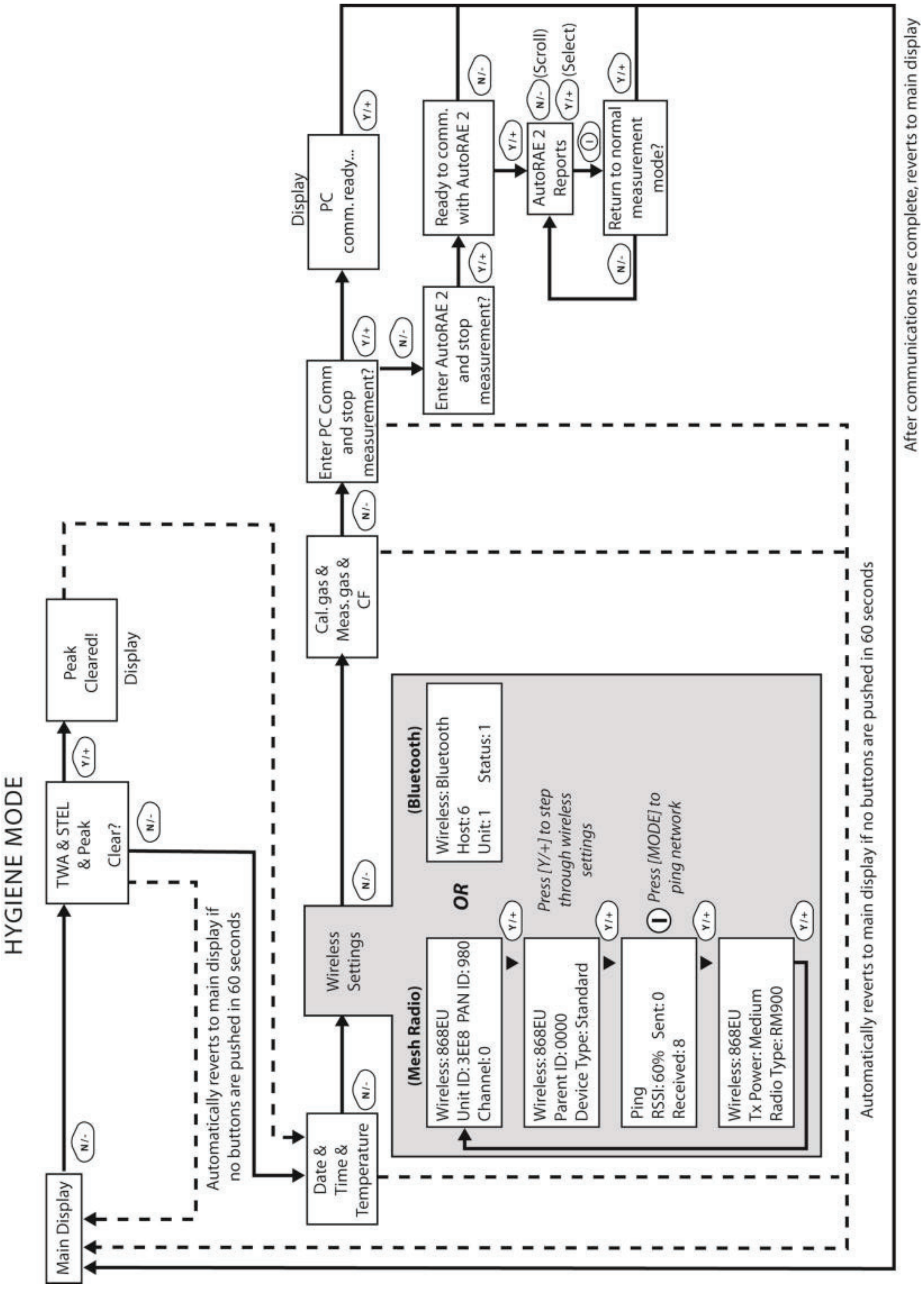
Hygiene Mode

The instrument usually operates in Hygiene Mode, which provides basic functionality. However, it is possible to operate it in a second mode called Search Mode. Here are the primary differences:

Hygiene Mode: Automatic measurements, continuously running and datalogging, and calculates additional exposure values.
Search Mode: Manual start/stop of measurements and display of certain exposure values.

Basic User Level & Hygiene Mode

The default setting is navigated in the following way:



Note: Dashed line indicates automatic progression.

Pressing [N/-] steps you from screen to screen. Options include clearing the Peak value and turning on the instrument's PC Communications for data transfer to a PC.

Entering Search Mode From Hygiene Mode

In order to change the instrument's operational mode from Hygiene Mode to Search Mode, you must enter the password-protected Programming Mode:

1. Hold [MODE] and [N/-] until you see the password screen.
2. Use [Y/+] to increment to the number you want for the first digit. (If you pass by the desired number, press [Y/+] until it cycles through to 0 again. Then press [Y/+] until you reach the desired number.)
3. Press [N/-] to advance to the next digit.
4. Again press [Y/+] to increment the number.
5. Press [N/-] to advance to the next digit.

Continue the process until all four numbers of the password have been input. Then press [MODE] to proceed.

The screen changes to icons with the label "Calibration."

1. Press [N/-] to advance to "Monitor Setup."
2. Press [Y/+] to select Monitor Setup.

Under Monitor Setup, you will see "Op Mode."

Press [Y/+] to select.

You will see:

Hygiene
Search

The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-].
2. Press [Y/+] to place the instrument into the selected mode.

3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

Advanced User Level (Hygiene Mode Or Search Mode)

The User Mode called Advanced User Level allows a greater number of parameters to be changed than Basic User Level. It can be used with either of the Operation Modes, Hygiene Mode or Search Mode.

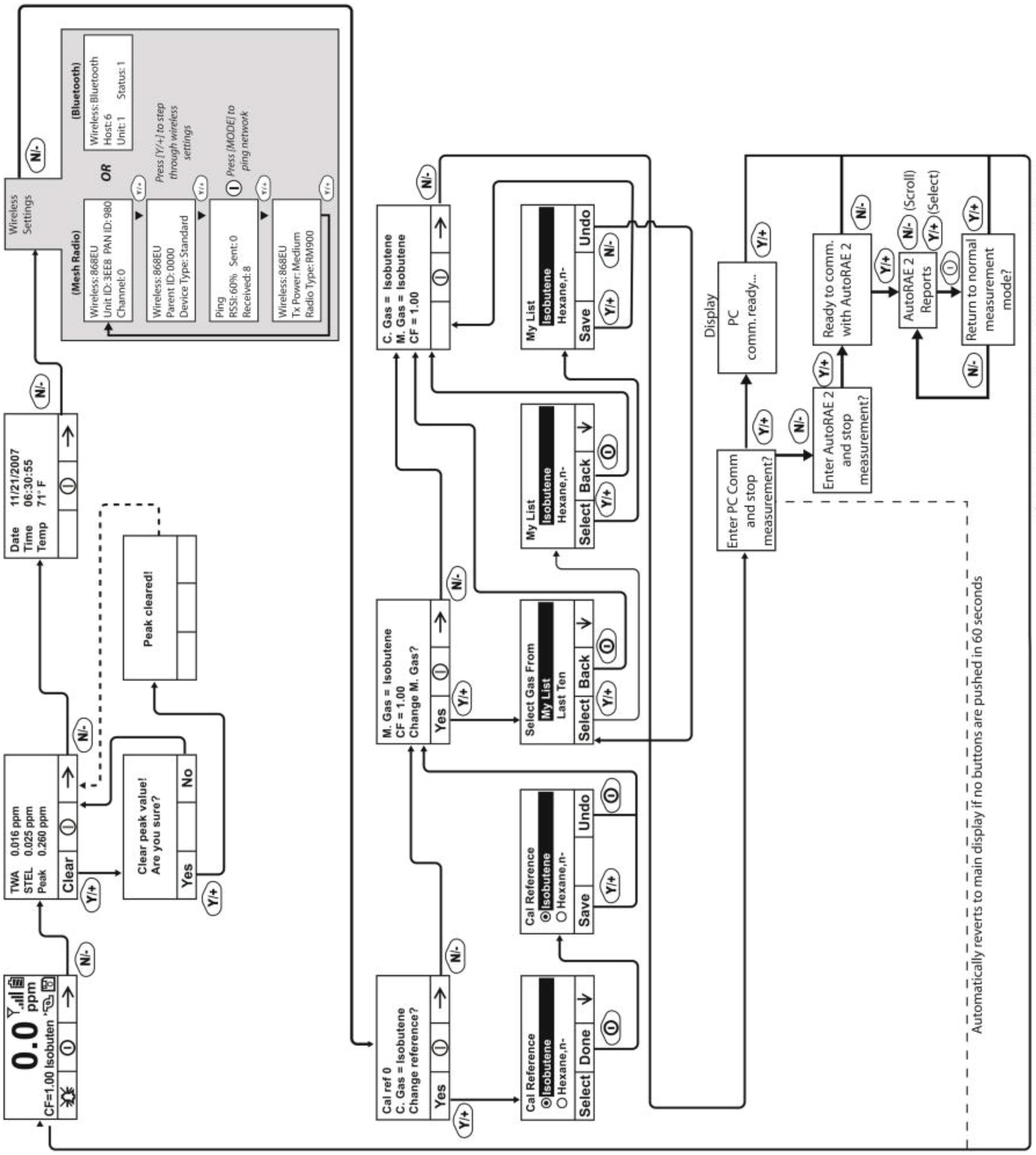
Advanced User Level & Hygiene Mode

With the instrument in Operation Mode: Hygiene Mode, enter User Mode: Advanced User Level (refer to the section called Monitor Mode for instructions).

Once you are in Advanced User Level and Hygiene Mode together, you can change the calibration reference and measurement gas, in addition to performing normal monitoring functions.

Pressing [N/-] progresses through the screens, while pressing [Y/+] selects options. Pressing [MODE] makes menu choices when it is shown for "Done" or "Back." Pressing and holding [Mode] whenever the circle with a vertical line in the middle is shown activates the countdown to shutoff.

MiniRAE 3000 User's Guide

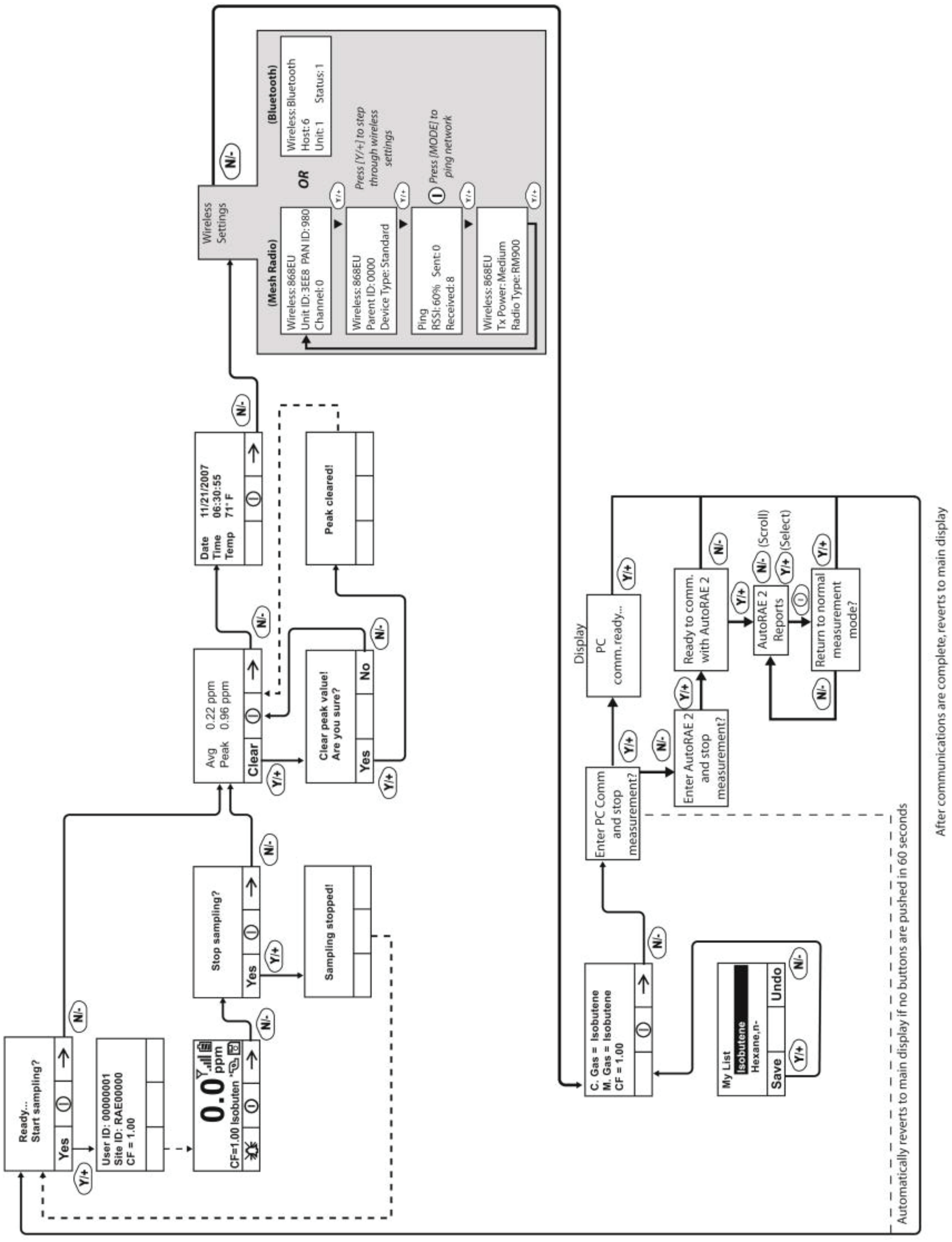


Note: Dashed line indicates automatic progression.

Basic User Level & Search Mode

With the instrument in Operation Mode: Search Mode, enter User Mode and select Basic User Level (refer to the section called User Mode for instructions).

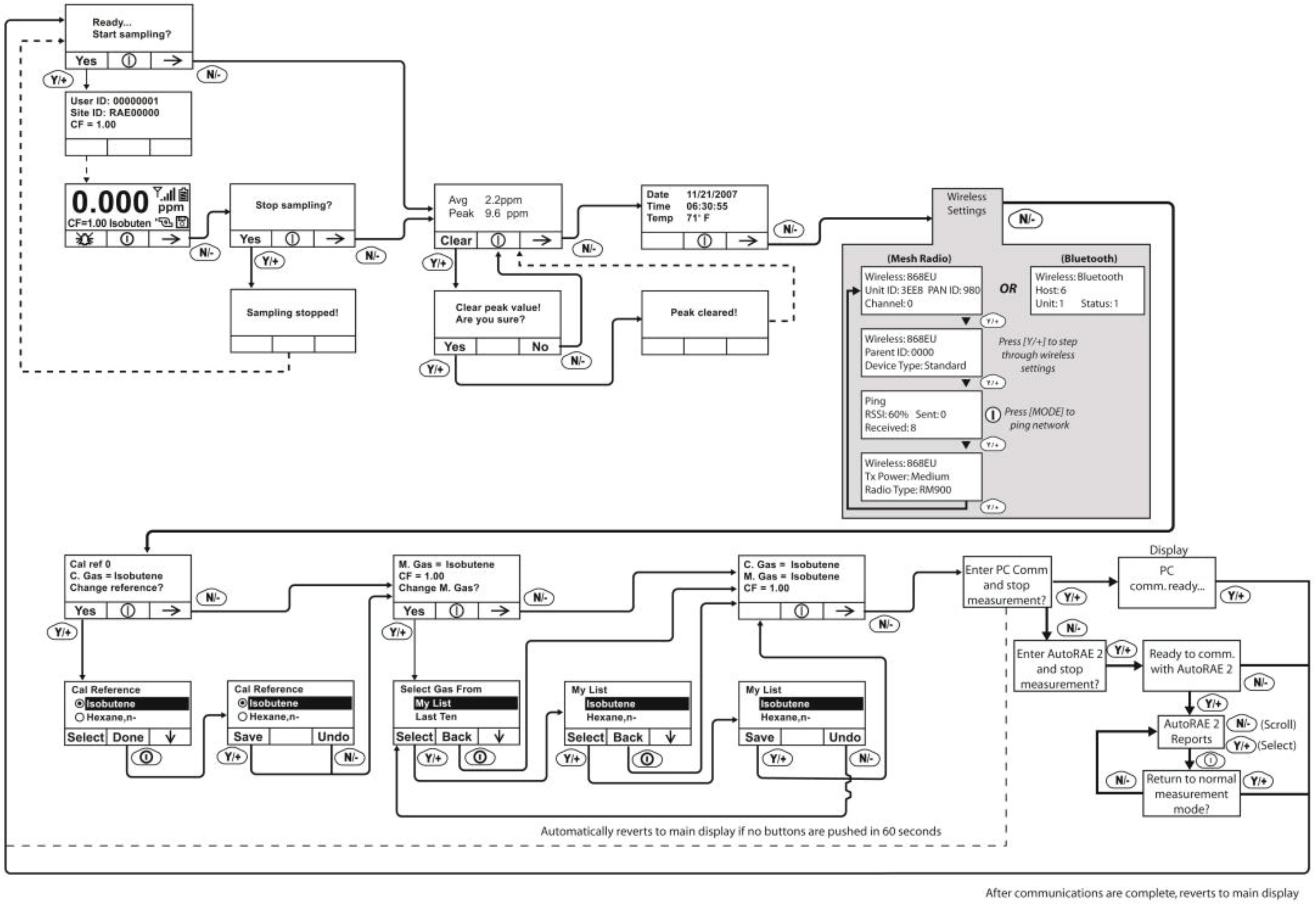
When the instrument is in Search Mode, it only samples when you activate sampling. When you see the display that says, "Ready…Start sampling?" press [Y/+] to start. The pump turns on and the instrument begins collecting data. To stop sampling, press [N/-] while the main display is showing. You will see a new screen that says, "Stop sampling?" Press [Y/+] to stop sampling. Press [N/-] if you want sampling to continue.



Note: Dashed line indicates automatic progression.

Advanced User Level & Search Mode

With the instrument in Operation Mode: Search Mode, enter User Mode and select Advanced User Level (refer to the section called Monitor Mode for instructions). Operation is similar to Basic User Level & Sampling Mode, but now allows you to change calibration and measurement reference gases. Refer to the section on measurement gases on page 60 for more details.



Note: Dashed line indicates automatic progression.

Diagnostic Mode

IMPORTANT! Diagnostic Mode is designed for servicing and manufacturing, and therefore is not intended for everyday use, even by advanced users. It provides raw data from sensors and about settings, but only allows adjustment of pump stall parameters, which should only be changed by qualified personnel.

Note: If the instrument is turned on in Diagnostic Mode and you switch to User Mode, datalog data remains in raw count form. To change to standard readings, you must restart the instrument.

Entering Diagnostic Mode

Note: To enter Diagnostic Mode, you must begin with the instrument turned off.

Press and hold [Y/+] and [MODE] until the instrument starts.

The instrument goes through a brief startup, and then displays raw data for the PID sensor. These numbers are raw sensor readings without calibration. The instrument is now in Diagnostic Mode.

Note: In Diagnostic Mode, the pump and lamp are normally on.

You can enter Programming Mode and calibrate the instrument as usual by pressing both [MODE] and [N/-] for three seconds.

You can enter Monitoring Mode by pressing [MODE] and [Y/+] together for three seconds.

Once the instrument is started up in Diagnostic Mode, you can switch between Diagnostic Mode and Monitoring Mode by pressing and holding [MODE] and [Y/+] simultaneously for two seconds.

In Diagnostic mode, you can step through parameter screens by pressing [MODE].

Adjusting The Pump Stall Threshold

If the gas inlet is blocked but the pump does not shut down, or the pump shuts down too easily with a slight blockage, the pump stall threshold value may be set too high or too low.

Use the following steps to adjust the pump stall threshold:

Pump High

In Diagnostic Mode, press the [MODE] key until "Pump High" is displayed. The display shows the maximum, minimum, and stall values for the pump at its high speed. Write down the "Max" reading.

Block the gas inlet and watch the pump current reading (labeled "I") increase. Write down its blocked reading. **Note:** If the pump current reading does not increase significantly (less than 10 counts), then there may be a leak in the gas inlet or the pump is weak or defective.

Add the two readings you wrote down. This is the average of the maximum block count and the maximum idle count. Divide that number by 2. Use the [Y/+] or [N/-] key to increase or decrease the stall value to equal that number.

Press the [MODE] key to exit this display.

Pump Low

In Diagnostic Mode, press the [MODE] key until "Pump Low" is displayed. The display shows the maximum, minimum, and stall values for the pump at its low speed. Write down the "Max" reading.

Block the gas inlet and watch the pump current reading (labeled "I") increase. Write down its blocked reading. **Note:** If the pump current reading does not increase significantly (less than 10 counts), then there may be a leak in the gas inlet or the pump is weak or defective.

Add the two readings you wrote down. This is the average of the maximum block count and the maximum idle count. Divide that number by 2. Use the [Y/+] or [N/-] key to increase or decrease the stall value to equal that number.

Press the [MODE] key to exit this display.

Exiting Diagnostic Mode

You can exit Diagnostic Mode and go directly to Programming Mode or Monitor Mode as outlined above, or you can exit Diagnostic Mode completely.

To exit Diagnostic Mode so that it cannot be re-entered without a restart:

Shut down the instrument. When it is off, restart it by holding the [MODE] key. Diagnostic Mode cannot be entered until the instrument is restarted as outlined in "Entering Diagnostic Mode."

Transferring Data To & From A Computer

Once you have connected your instrument cradle to the PC, you can can transfer data, including a download of the datalog to the computer and updates of firmware to the instrument (should this ever be necessary).

Downloading The Datalog To A PC

1. Connect the data cable to the PC and the cradle.
2. Place the instrument into its cradle. The charging LED should be illuminated.
3. Start ProRAE Studio on your PC.
4. From ProRAE Studio, select “Operation” and select Setup Connection.
5. Select the COM port to establish a communication link between the PC and the instrument.
6. To receive the datalog in the PC, select “Downlog Datalog.”
7. When you see “Unit Information,” click OK.

During the data transfer, the display shows a progress bar.

When the transfer is done, you will see a screen with the datalog information. You can now export this datalog for other use or printing.

Uploading Firmware To The instrument From A PC

Uploading new firmware to your instrument requires connecting the instrument and PC. Follow these steps to make the connection:

1. Connect the data cable to the PC and the cradle.
2. Place the instrument into its cradle. The charging LED should be illuminated.
3. Start RAEProgrammer 7000 on your PC.
4. From RAEProgrammer 7000, select "Operation" and select Setup Connection.
5. Select the COM port to establish a communication link between the PC and the instrument.
6. Select Operation → Download Firmware.

Once communication is established, follow the instructions that accompany RAEProgrammer 7000 and the firmware to upload the new firmware to your instrument.

Note: Check for the latest updates to ProRAEProgrammer 7000 at www.raesystems.com.

Maintenance

The major maintenance items of the instrument are:

- Battery pack
- Sensor module
- PID lamp
- Sampling pump
- Inlet connectors and filters

Note: Maintenance should be performed by qualified personnel only.

NOTE: The printed circuit board of the instrument is connected to the battery pack even if the power is turned off. Therefore, it is very important to disconnect the battery pack before servicing or replacing any components inside the instrument. Severe damage to the printed circuit board or battery may occur if the battery pack is not disconnected before servicing the unit.

Battery Charging & Replacement

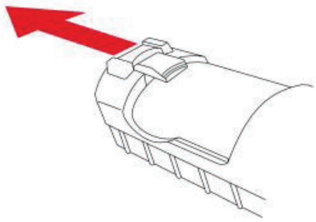
When the display shows a flashing empty battery icon, the battery requires recharging. It is recommended to recharge the instrument upon returning from fieldwork. A fully charged battery runs a instrument for 16 hours continuously. The charging time is less than 8 hours for a fully discharged battery. The battery may be replaced in the field (in areas known to be non-hazardous), if required.

WARNING!

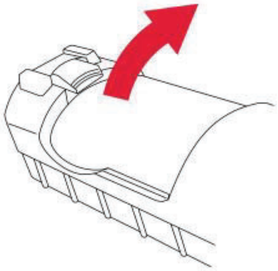
To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in areas known to be non-hazardous.

Replacing The Li-ion Battery

1. Turn off the instrument.
2. Located on the rear of the instrument is a battery tab. Slide it down to unlock the battery.



3. Remove the battery pack from the battery compartment by tilting it out.



4. Replace a fully charged spare battery pack inside the battery compartment. Make sure the battery pack is oriented properly inside the compartment.
5. Slide the capture tab back up to its locked position.

Replacing The Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500) and provides approximately 12 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Li-ion battery pack.

To insert batteries into the adapter:

1. Remove the three Philips-head screws to open the compartment.
2. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
3. Replace the cover. Replace the three screws.

To install the adapter in the instrument:

1. Remove the Li-ion battery pack from the battery compartment by sliding the tab and tilting out the battery.
2. Replace it with the alkaline battery adapter
3. Slide the tab back into place to secure the battery adapter.

IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline batteries and will not allow recharging. If you place the instrument in its cradle, the alkaline battery will not be recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument.

Note: When replacing alkaline batteries, dispose of old ones properly.

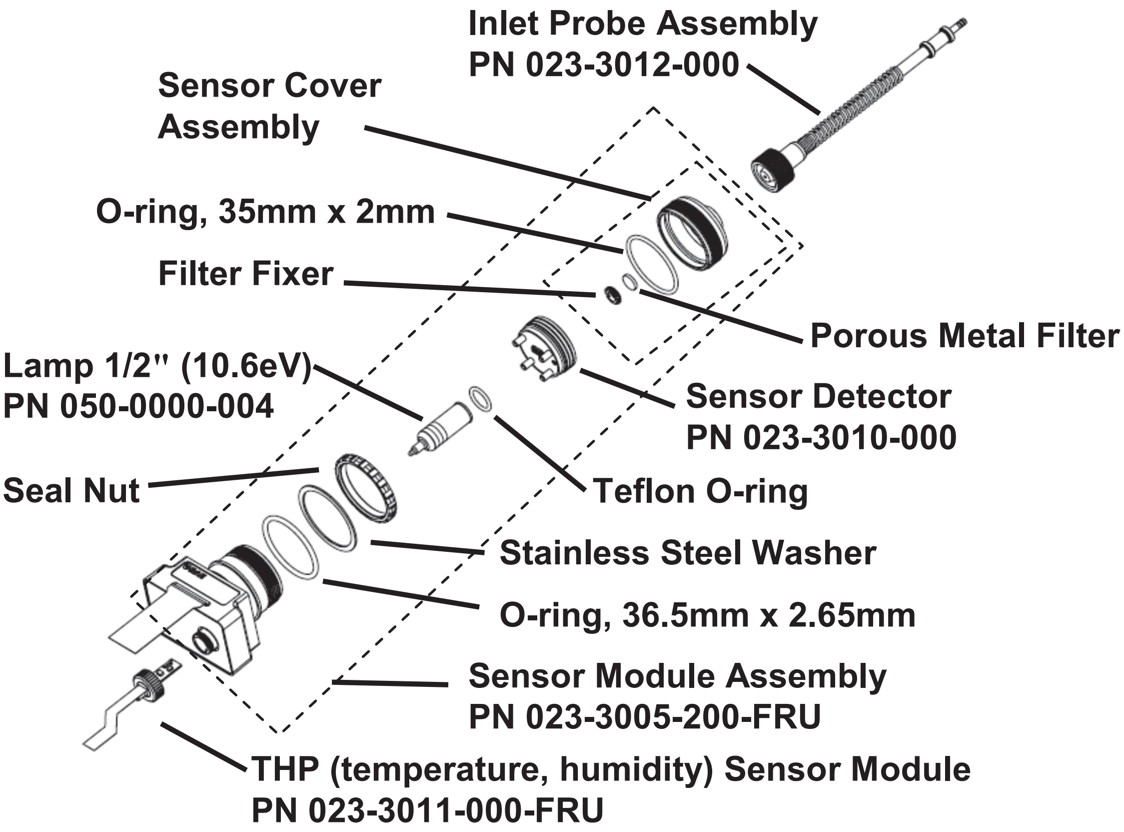
WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge the battery only in areas known to be non-hazardous. Remove and replace the battery only in areas known to be non-hazardous.

Note: The internal charging circuit is designed to prevent charging to alkaline batteries.

PID Sensor & Lamp Cleaning/Replacement

The sensor module is made of several components and is attached to the lamp-housing unit as shown below.



Sensor Components

Note: The cleaning procedure is not normally needed. Clean the PID sensor module, the lamp and the lamp housing only if:

1. The reading is inaccurate even after calibration.
2. The reading is very sensitive to air moisture.
3. A liquid has been sucked into the unit and damaged the unit.

Use of the external filter helps to prevent contamination of the sensor.

To access the sensor components and lamp, gently unscrew the lamp-housing cap, remove the sensor adapter with the gas inlet probe and the metal filter all together. Then hold the PID sensor and pull it straight out. A slight, gentle rocking motion helps release the sensor.

Cleaning The PID Sensor

Place the entire PID sensor module into GC grade methanol. It is highly recommended that an ultrasound bath to be used to clean the sensor for at least 15 minutes. Then dry the sensor thoroughly. Never touch the electrodes of the sensor by hand.
Also use a methanol-soaked cotton swab to wipe off the lamp housing where it contacts the sensor when the sensor is installed.

Turn over the sensor so that the pins point up and the sensor cavity is visible. Examine the sensor electrodes for any corrosion, damage, or bending out of alignment. The metal sensor electrode "fingers" should be flat and straight. If necessary, carefully bend the sensor fingers to ensure that they do not touch the Teflon portions and that they are parallel to each other. Make sure that the nuts on the sensor pins are snug but not overtight. If the sensor is corroded or otherwise damaged, it should be replaced.

Cleaning The Lamp Housing Or Changing The Lamp

If the lamp does not turn on, the instrument will display an error message to indicate replacement of the lamp may be required.

1. If the lamp is operational, clean the lamp window surface and the lamp housing by wiping it with GC grade methanol using a cotton swab using moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean. Never use water solutions to clean the lamp. Dry the lamp and the lamp housing thoroughly after cleaning.

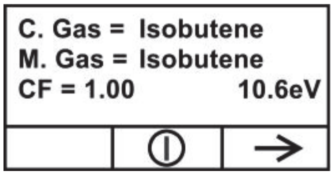
   CAUTION: Never touch the window surface with the fingers or anything else that may leave a film. Never use acetone or aqueous solutions.

2. If the lamp does not turn on, remove the lamp from the lamp housing. Place the lamp O-ring onto the new lamp. Insert the new lamp, avoiding contact with the flat window surface.
3. Reinstall the PID sensor module.
4. Tighten the Lamp Housing Cap.

Determining The Lamp Type

The monitor can accommodate three lamp values: 10.6eV (standard), 9.8eV, and 11.7eV. Always make sure you are using the correct lamp value and that the instrument is set to use that lamp.

Also, when the monitor is running, the lamp type is shown along with the calibration and measurement gas and Correction Factor:



C. Gas = Isobutene
M. Gas = Isobutene
CF = 1.00 10.6eV

Note: This screen can be accessed from the reading screen by pressing [N/-] four times.

You can manually determine the lamp type, too:

1. Turn off the instrument and remove the lamp. Now look at the serial number. The following identify the lamp type:

• 10.6eV	SN: 106 2Nxxxxx
• 9.8eV	SN: 098 2Nxxxxx
• 11.7eV	SN: 117 2Nxxxxx

Programming The Lamp ID

The correct measurement gas library is used by the instrument when you ensure that the right lamp value is programmed.

To manually select the Lamp ID:

1. Enter the Programming menu.
2. Select Monitor Setup.
3. Scroll down and select the Lamp ID sub-menu.
4. Press [N/-] to scroll down to the desired Lamp ID.
5. Press [Y/+] to select.
6. Press [MODE] to select Done.
7. Select "Save."
8. Return to the main menu.

Recalibrate the instrument before returning it to service.

Sampling Pump

When approaching the end of the specified lifetime of the pump, it will consume higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace or rebuild the pump. When checking the pump flow, make sure that the inlet connector is tight and the inlet tubing is in good condition. Connect a flow meter to the gas inlet probe. The flow rate should be above 450 cc/min when there is no air leakage.

If the pump is not working properly, refer the instrument to qualified service personnel for further testing and, if necessary, pump repair or replacement.

Cleaning The Instrument

Occasional cleaning with a soft cloth is recommended. Do not use detergents or chemicals.

Visually inspect the contacts at the base of the instrument, on the battery, and on the charging cradle to make sure they are clean. If they are not, wipe them with a soft, dry cloth. Never use solvents or cleaners.

Ordering Replacement Parts

If you need replacement parts, contact your local RAE Systems distributor. A list is available online:

http://www.raesystems.com

In the U.S., you can order sensors, replacement batteries, and other accessories online at:

http://istore.raesystems.com/

Special Servicing Note

If the instrument needs to be serviced, contact either:

1. The RAE Systems distributor from whom the instrument was purchased; they will return the instrument on your behalf.

   or

2. The RAE Systems Technical Service Department. Before returning the instrument for service or repair, obtain a Returned Material Authorization (RMA) number for proper tracking of your equipment. This number needs to be on all documentation and posted on the outside of the box in which the instrument is returned for service or upgrade. Packages without RMA Numbers will be refused at the factory.

Troubleshooting

Problem	Possible Reasons & Solutions	
Cannot turn on power after charging the battery	**Reasons:**	Discharged battery. Defective battery.
	Solutions:	Charge or replace battery.
Lost password	**Solutions:**	Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
Reading abnormally High	**Reasons:**	Dirty filter. Dirty sensor module. Excessive moisture and water condensation. Incorrect calibration.
	Solutions:	Replace filter. Blow-dry the sensor module. Calibrate the unit.
Reading abnormally Low	**Reasons:**	Dirty filter. Dirty sensor module. Weak or dirty lamp. Incorrect calibration.
	Solutions:	Replace filter. Remove Calibration Adapter. Calibrate the unit. Check for air leakage.
Buzzer Inoperative	**Reasons:**	Bad buzzer.
	Solutions:	Check that buzzer is not turned off. Call authorized service center.

Inlet flow too low	**Reasons:**	Pump diaphragm damaged or has debris. Flow path leaks.
	Solutions:	Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
"Lamp" message during operation	**Reasons:**	Lamp drive circuit. Weak or defective PID lamp, defective.
	Solutions:	Turn the unit off and back on. Replace UV lamp

Technical Support

To contact RAE Systems Technical Support Team:

Monday through Friday, 7:00AM to 5:00PM Pacific (US) Time
Phone (toll-free): +1 888-723-4800
Phone: +1 408-952-8461
Email: tech@raesystems.com

RAE Systems Contacts

RAE Systems by Honeywell
World Headquarters
3775 N. First St.
San Jose, CA 95134-1708 USA
Phone: 408.952.8200
Toll-Free: 888.723.4800
Fax: 408.952.8480

E-mail (technical support): RAE-tech@honeywell.com
Web Site: www.raesystems.com

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Controlled Part of Manual

Intrinsic Safety:
US and Canada: Class I, Division 1, Groups A,B,C,D T4

Europe: ATEX (0575 Ex II 2G Ex ia IIC/IIB T4 Gb)
KEMA 07 ATEX 0127
Complies with EN60079-0:2009, EN60079-11:2007
IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb
Complies with IEC 60079-0:2007, IEC 60079-11:2006

Temperature:	-20º C to 50º C (-4º to 122º F)
Humidity:	0% to 95% relative humidity (non-condensing)

Basic Operation

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.

The instrument is now operating and performs self tests. Once the self tests are complete, the display shows a graph or numerical gas reading. This indicates that the instrument is fully functional and ready to use.

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn you of the alarm condition.

In addition, the instrument alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, pump stall, or when the datalog memory is full.

Alarm Signal Summary

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second*
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second*
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display

Battery icon flashes	Low battery	1 flash, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	Cal Span	unit	Low	High	TWA	STEL
ppbRAE 3000	10	ppm	10	25	10	25
MiniRAE 3000	100	ppm	50	100	10	25
MiniRAE Lite	100	ppm	50	100	10	25
UltraRAE 3000	100	ppm	50	100	10	25

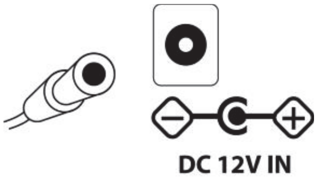
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion/NiMH battery is charged by placing the instrument in its cradle. Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glows.

Note: To release the instrument, press down and tilt the top out of the cradle and lift up.

The instrument begins charging automatically. The LED on the front of the cradle marked "Primary" blinks during charging. During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown and the Primary LED on the cradle glows continuously green.

Note: A spare Li-ion battery (059-3051-000) or NiMH(059-3054-000) can be charged by placing it directly in the charging port on the back of the cradle. It can be charged at the same time as the instrument. Press the battery in place, sliding it slightly toward the front of the cradle. This locks it in the cradle. To release the battery, slide it forward again and tilt it up.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. Remove and replace batteries only in areas known to be non-hazardous.

Low Voltage Warning

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the battery icon blinks once per second. You should turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Clock Battery

An internal clock battery is mounted on one of the instrument's printed circuit boards. This long-life battery keeps settings in memory from being lost whenever the Li-ion, NiMH, or alkaline batteries are removed. This backup battery should last approximately five years, and must be replaced by an authorized RAE Systems service technician. It is not user-replaceable.

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in an area known to be non-hazardous.

Replacing Rechargeable Li-Ion or NiMH Battery

Caution: Turn off the instrument before removing or replacing the battery.

Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500).

Do not mix old and new batteries or different type batteries.

Troubleshooting

Problem	Possible Reasons & Solutions	
Cannot turn on power after charging the battery	**Reasons:**	Discharged battery. Defective battery.
	Solutions:	Charge or replace battery.
Lost password	**Solutions:**	Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
Reading abnormally High	**Reasons:**	Dirty filter. Dirty sensor module. Excessive moisture and water condensation. Incorrect calibration.
	Solutions:	Replace filter. Blow-dry the sensor module. Calibrate the unit.
Reading abnormally Low	**Reasons:**	Dirty filter. Dirty sensor module. Weak or dirty lamp. Incorrect calibration.
	Solutions:	Replace filter. Remove Calibration Adapter. Calibrate the unit. Check for air leakage.
Buzzer Inoperative	**Reasons:**	Bad buzzer.
	Solutions:	Check that buzzer is not turned off. Call authorized service center.

Inlet flow too low	**Reasons:**	Pump diaphragm damaged or has debris. Flow path leaks.
	Solutions:	Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
"Lamp" message during operation	**Reasons:**	Lamp drive circuit. Weak or defective PID lamp, defective.
	Solutions:	Turn the unit off and back on. Replace UV lamp

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Rev. F
February 2016
P/N 059-4020-000

FIELD SAMPLING PROTOCOLS TO AVOID CROSS-CONTAMINATION OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

SOP Wood-01 (PFAS)

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the procedures/considerations when collecting soil, sediment, surface water, groundwater, and potable water samples at potential per- and polyfluoroalkyl substances (PFAS) release areas. This SOP also describes a tiered approach that should be used to assist with field decisions. Sampling specific SOPs should also be reviewed prior to conducting field sampling activities at PFAS areas. The information contained within this SOP is included within sampling specific SOPs as applicable.

2.0 SCOPE

This procedure applies to all Wood personnel and subcontractors who collect or otherwise handle samples of soil, sediment, surface water, groundwater, and potable water for analysis of PFAS. This SOP should be reviewed by all on-site personnel prior to the implementation of field activities.

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

Delta Consultants, 2010. *Report of Investigation Activities at Select Firefighting Foam Training Areas and Foam Discharge Sites in Minnesota*. February. MPCA, 2008. *Closed Landfill Program Sampling Protocol for Monitoring Wells.* October.

Transport Canada, 2013. *Perfluorochemical (PFAS) Field Sampling Protocol*. May.

United States Department of Defense (DoD). 2021. Memorandum for Assistant Secretary of the Army (Installation, Energy, and Environment); Assistant Secretary of the Navy (Energy, Installations and Environment); Assistant Secretary of the Air Force (Installations, Environment and Energy); Director, National Guard Bureau (Joint Staff, J8); Director, Defense Logistics Agency (Installation Support). Subject: Investigating Per- and Polyfluoroalkyl Substances with the Department of Defense Cleanup Program. September 15.

4.0 GENERAL

Given the low detection limits associated with laboratory PFAS analysis and the many potential sources of trace levels of PFAS in environmental sampling equipment, field personnel are advised to be cautious and strictly follow the subject protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFAS. Specific items related to field sampling are discussed below.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with field sampling for the analysis of PFAS. Proper procedures are necessary to ensure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project-specific work plans. The project-specific work plans will generally provide the following information:

- Sample collection objectives
- Locations to be sampled
- Number and volume of samples to be collected at each location
- Types of chemical analyses to be conducted for the samples
- Specific quality control (QC) procedures and sampling required
- Any additional sampling requirements or procedures beyond those covered in this SOP, as necessary
- At a minimum, the procedures outlined in this SOP for field sampling will be followed

5.1 RESPONSIBILITIES

Project Manager

The Project Manager shall provide the sampling and analysis plan (SAP) and a project-specific work plan to the Field Lead, including the sampling requirements for each investigation area. If there are any deviations to the procedure detailed in this SOP, the Project Manager will report said deviations to the QC Manager and the client representative.

Field Lead

The Field Lead shall ensure that samples are collected using procedures that are in accordance with the SAP, project-specific work plans, and applicable SOPs. The Field Lead shall also be required to make rational and justifiable decisions when deviations from these procedures are necessary due to field conditions or unforeseen issues, in which case the Field Lead will report the deviations to the Project Manager.

Quality Control (QC) Manager

The QC Manager will be responsible for conducting field audits during selected sampling activities. During these audits, the QC Manager will ensure that field crews are adhering to the procedures provided in the SAP and in the project-specific work plans, including, but not limited to, sampling techniques, field documentation, decontamination, sample packaging, chain of custody documentation procedures, and equipment calibration.

Field Personnel

Field personnel assigned to sampling activities are responsible for completing their tasks according to specifications outlined in the SAP, project-specific work plans, applicable SOPs, and other appropriate procedures. Field personnel are responsible for reporting deviations from procedures to the Field Lead.

5.2 FIELD PROCEDURES/CONSIDERATIONS

The following are procedures/considerations to be made during field activities at potential PFAS release and investigation areas. A summary of the prohibited and acceptable items for PFAS investigation areas is included in Table 1. A checklist, provided as Attachment 1, shall be used daily by the Field Lead prior to the commencement of fieldwork to ensure the field team is in compliance with this protocol.

Field Equipment

- **Do not use Teflon®-containing materials** (e.g., Teflon® tubing, bailers, tape, plumbing paste, or other Teflon® materials) since Teflon® contains fluorinated compounds.
- **Do not use (polytetrafluoroethylene) PTFE and related fluorinated materials** (i.e., polyvinylidene fluoride (PVDF), polychlorotrifluoroethylene (PCTFE), ethylene tetrafluoroethylene (ETFE), and fluorinated ethylene propylene (FEP))
- High-density polyethylene (HDPE) and silicone materials are acceptable for sample collection, as they do not contain fluorinated compounds. However, samples may not be stored in containers made of low-density polyethylene (LDPE) materials because PFAS can stick to LDPE and bias sample results low.
- Wood will use peristaltic pumps for groundwater sample collection at depths shallower than 25 feet. Wood will use ProActive SS Pumps with polyvinyl chloride (PVC) leads or Geotech SS Geosub pumps for groundwater sample collection at depths greater than 25 feet. These pumps are constructed with stainless steel and will minimize the introduction of PFAS in the sample. However, for groundwater sample depths greater than 150 feet, a Grundfos RediFlo pump (or similar) may be used due to the pumping limitations of stainless steel pumps.

- When using liners to collect soil samples during direct-push technology or during conventional drilling and sampling methodologies, acetate liners are to be used.
- Field reports will be documented on loose paper secured on masonite or aluminum clipboards (i.e., plastic clipboards, binders, or spiral hardcover notebooks are not acceptable) using a pen or pencil. Fine and ultra-fine tipped Sharpies®/markers may also be used to label the sample bottle while in the staging area provided the lid is on the sample bottle and gloves are changed following sample bottle labeling. Regular/thick tipped Sharpies® or otherwise must be avoided. Rite in the Rain products may be used in the staging area and gloves must be changed after note taking. To avoid plastic coating or glue materials, do not use other brands of waterproof field books.
- **Post-It Notes are not allowed** on project sites.
- **Do not use markers other than fine or ultra-fine tipped Sharpies®markers.** Pens will be used when documenting field activities in the field log and on-field forms, and when labeling sample containers and preparing the Chain of Custody.
- Preprinted standard (non-weatherproof) Avery sample labels provided by the Wood quality assurance team will be used on sample containers. Sample labels will be placed on containers after sampling is complete, and container lids are in place to prevent possible cross-contamination.
- **Do not use chemical (blue) ice packs** during the sampling program. This includes the use of ice packs for the storage of food and/or samples.

Field Clothing and Personal Protective Equipment

- **Do not wear water-resistant, waterproof, or stain-treated clothing** during the field program. Field clothing made of synthetic and natural fibers (preferably cotton) are acceptable. Field clothing should be laundered without the use of fabric softener. Preferably, field gear should be cotton construction and well laundered (i.e., washed a minimum of 6 times prior to use after purchase). New clothing may contain PFAS related treatments. **Do not use new clothing** while sampling or sample handling.
- **Do not wear clothing or boots containing Gore-Tex™** during the sampling program as it contains a PFAS membrane.
- Safety footwear will consist of steel-toed boots made with polyurethane and PVC, untreated leather boots, or well-worn leather boots. Newer leather boots may be worn if they are covered with polypropylene, polyurethane, or PVC boot covers.
- Disposable, powder-free nitrile gloves must be worn at all times. Further, a new pair of nitrile gloves shall be donned prior to the following activities at each sample location:
    - Decontamination of re-usable sampling equipment

- Prior to contact with sample bottles or water containers
- Insertion of anything into the well (e.g., HDPE tubing, HydraSleeve bailer, etc.)
- Insertion of silicone tubing into the peristaltic pump
- Completion of monitor well purging, prior to sample collection
- Handling of any quality assurance/quality control samples including field blanks and equipment blanks
- After the handling of any non-dedicated sampling equipment, contact with non-decontaminated surfaces, or when judged necessary by field personnel

Sample Containers

- Different laboratories may supply sample collection containers of varying sizes depending on the type of media to be sampled (e.g., soil, groundwater, etc.). All samples should be collected in polypropylene or HDPE bottles. The screw cap will be made of polypropylene or HDPE and may be lined or unlined. However, if lined, the liner may not be made of Teflon® or contain PFAS.
- Container labels will be completed using a pen or fine, and ultra-fine tipped Sharpies®/markers after the caps have been placed back on each bottle.
- Glass sample containers are not to be used due to potential loss of analyte through adsorption.
- Samples must be chilled during storage and shipment and must not exceed 50 ^{o}F (10 ^{o}C) during the first 48 hours after collection of the sample.

Wet Weather

- Field sampling occurring during wet weather (e.g., rainfall and snowfall) should be conducted while wearing appropriate clothing that will not pose a risk for cross-contamination. Teams will avoid synthetic gear that has been treated with water-repellant finishes containing PFAS. Use rain gear made from polyurethane, vinyl, and wax or rubber-coated materials.
- Teams should consider the use of a gazebo tent, which can be erected over the top of the sample location and provide shelter from the rain. It should be noted that the canopy material is likely a treated surface and should be handled as such; therefore, gloves should be worn when setting up and moving the tent, changed immediately afterward and further contact with the tent should be avoided until all sampling activities have been finished and the team is ready to move on to the next sample location.

Equipment Decontamination

- Laboratory supplied PFAS-free deionized water is preferred for decontamination.

- Field sampling equipment, including oil/water interface meters and water level indicators, and other downhole equipment used at each sample location, will require decontamination between uses. Alconox® and Liquinox® soap are acceptable for use since the Safety Data Sheets do not list fluoro-surfactants as an ingredient. However, Decon 90® will not be used during decontamination activities. Decontamination of sampling equipment will be a triple rinse with laboratory-certified “PFAS-free” water or deionized water or municipal water, if verified to be PFAS-free.
- For larger equipment (e.g., drill rig and large downhole drilling and sampling equipment), decontamination will be conducted with potable water using a high-pressure washer and then rinsed using potable water.

Personnel Hygiene

- Field personnel will not use cosmetics, moisturizers, hand cream, or other related products as part of their personal cleaning/showering routine on the morning of a sampling event unless the products are applied to a part of the body that will be covered by clothing. These products may contain surfactants and represent a potential source of PFAS.
- Many manufactured sunblock and insect repellants contain PFAS and should not be brought or used on-site. A list of acceptable sunscreens and insect repellents is provided in Table 1.
- For washroom breaks, field personnel will leave the exclusion zone and then remove gloves and overalls. Field personnel should wash as normal with extra time for rinsing with water after soap use. When finished washing, the use of a mechanical dryer is preferred, and the use of paper towel for drying is to be avoided (if possible).

Food Considerations

- No food or drink shall be brought on-site, with the exception of bottled water and hydration drinks (i.e., Gatorade® and Powerade®), which will only be allowed to be brought and consumed within the staging area.

Visitors

- Visitors to the investigation area are asked to remain outside of the exclusion zone during sampling activities.

6.0 TIERED APPROACH TO ASSIST WITH FIELD DECISIONS

In evaluating whether products contain PFAS and are suitable for use in the field, the tiered approach presented in Table 2 will be used to assist with field decisions. Any member of the field team should contact the Project Manager, Field Lead, or Project Chemist with questions.

Table 1. Summary of Prohibited and Acceptable Items for PFAS Sampling

Prohibited Items	Acceptable Items
Field Equipment	
Teflon® containing materials (Teflon® synonyms include: Polytetrafluoroethylene; Polyethylene tetrafluoride; Polytetrafluoroethene; Tetrafluoroethene polymer; Tetrafluoroethylene homopolymer; Ethene; tetrafluoro-; and homopolymer. Commercial names include: PTFE; Aflon; Algloflon; Chromosorb T; Fluon; Fluo-kem; Fluoroflex; Fluoroplast 4; Halon G 80; Heydeflon; Polifen; Politef; and Tarflen) LDPE should not be used for any items that will come into direct contact with the sample media.	High-density polyethylene (HDPE). LDPE materials can be used for items not directly in contact with the samples (such as LDPE bags [e.g., Ziploc®]) for sample shipment)
LDPE or glass sample containers	HDPE sample containers and acetate liners
Teflon®, Hostaflon®, Kynar®, Neoflon®, Tefzel®, LDPE tubing, and other field materials	Silicone or HDPE tubing
Waterproof field books not manufactured by Rite in the Rain	Rite in the Rain products (staging area only) or loose-leaf paper (non-waterproof)
Plastic clipboards, binders, or spiral hardcover notebooks	Aluminum field clipboards or with Masonite
Regular or thick tipped Sharpies® markers	Fine or ultra-fine tipped Sharpies®, pens
Post-It Notes	
Chemical (blue) ice packs	Regular ice
Excel Purity Paste TFW Multipurpose Thread Sealant Vibra-Tite Thread Sealant	Gasoils NT Non-PTFE Thread Sealant Bentonite
Equipment with Viton Components (need to be evaluated on a case by case basis, Viton contains PTFE, but may be acceptable if used in gaskets or O-rings that are sealed away and will not come into contact with sample or sampling equipment.)	
Field Clothing and PPE	
New clothing or water-resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of synthetic or natural fibers (preferably cotton)
Clothing laundered using fabric softener	No fabric softener
Boots containing Gore-Tex™	Boots made with polyurethane and PVC, well-worn or untreated leather boots, leather boots with boot covers
Latex gloves	Disposable, powder-free nitrile gloves
Tyvek®	Reflective safety vests, Cotton Clothing, synthetic under clothing, body braces
No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling, unless the products are applied to body parts that will be covered by clothing.	**Sunscreens (SWQCB, 2019)** – • Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30. • Meijer Sunscreen Lotion Broad Spectrum SPF 30.

Prohibited Items	Acceptable Items
	• Neutrogena Ultra-Sheer Dry-Touch Sunscreen Broad Spectrum SPF 30. • Banana Boat for Men Triple Defense Continuous Spray Sunscreen SPF 30 • Banana Boat Sport Performance Coolzone Broad Spectrum SPF 30 • Banana Boat Sport Performance Sunscreen Lotion Broad Spectrum SPF 30 • Banana Boat Sport Performance Sunscreen Stick SPF 50 • Coppertone Sunscreen Lotion Ultra Guard Broad Spectrum SPF 50 • Coppertone Sport High-Performance AccuSpray Sunscreen SPF 30 • Coppertone Sunscreen Stick Kids SPF 55 • L’Oréal Silky Sheer Face Lotion 50+ • Meijer Clear Zinc Sunscreen Lotion Broad Spectrum SPF 15, 30 and 50 • Meijer Wet Skin Kids Sunscreen Continuous Spray Broad Spectrum SPF 70 • Neutrogena Beach Defense Water + Sun Barrier Lotion SPF 70 • Neutrogena Beach Defense Water + Sun Barrier Spray Broad Spectrum SPF 30 • Neutrogena Pure & Free Baby Sunscreen Broad Spectrum SPF 60+ **Insect Repellents (SWQCB, 2019)**– • OFF Deep Woods • Sawyer Permethrin • Jason Natural Quit Bugging Me • Repel Lemon Eucalyptus Insect repellant • Herbal Armor • California Baby Natural Bug Spray
Sample Containers	
LDPE or glass containers	HDPE or polypropylene
Teflon®-lined caps	Lined or unlined HDPE or polypropylene caps
Rain Events	
Waterproof or resistant rain gear	Polyurethane, vinyl, wax, or rubber-coated rain gear. Gazebo tent that is only touched or moved prior to and following sampling activities
Equipment Decontamination	
Decon 90	Alconox®, Citranox®, and/or Liquinox®,
Water from an on-site well	Laboratory provided PFAS free water, potable water from municipal drinking water supply
Food Considerations	
All food and drink, with exceptions noted on the right	Bottled water and hydration drinks (i.e., Gatorade® and Powerade®) to be brought and consumed only in the staging area

Table 2. Tiered Approach

Tier and Description	Action
Tier 1: Products that *will come into direct contact* with field samples include, but are not limited to, drilling grease, sampling equipment, sample containers, and well construction materials	These products will undergo the greatest scrutiny and requires chemist's input to help evaluate the materials as a possible source of contamination[A] and as possible sampling or storage materials or both
Tier 2: Products that *will not come into direct contact* with samples, but could be *reasonably expected to contain PFAS*, such as waterproof or nonstick products	Project team/affected person can review the Safety Data Sheet (SDS)[B], and if it shows PFAS, product should not be used. If product SDS does not indicate PFAS, confirm with chemist before use
Tier 3: Products that *will not come into direct contact* with samples and are *not expected to contain PFAS*, such as ballpoint pens, zipper bags, and body braces	Project team/affected person can review SDS and if no PFAS, then appropriate to use

[A] Tier 1 products will undergo the closest scrutiny. It may be necessary to have Tier 1 products analyzed for PFAS to confirm that a specific batch or lot number does not contain PFAS. Alternate products will need to be evaluated/used if PFAS are identified in the product.

[B] SDS Check: To evaluate product SDS and/or manufacturing specs, check if the product contains anything with "fluoro" in the name or the acronyms TPE, FEP, ETFE, and/or PFA. If fluorinated compounds are not listed in the manufacturing specs and/or on the SDSs, product can be used.

REVIEW AND APPROVAL

QC Manager: Matt Brook

12/21/2020

Matt Brookshire

Date

MMEC Group Quality Control Manager

SOIL SAMPLING
SOP Wood-02 (PFAS)

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the methodology for collecting soil samples in order to document the areal and vertical extent of contaminated soil and to determine the geotechnical, physical, and chemical properties of the soil while conducting per- and polyfluoroalkyl substances (PFAS) investigation sampling.

2.0 SCOPE

This procedure applies to all Wood personnel and subcontractors who collect or otherwise handle samples of surficial or subsurface soil during PFAS investigations. Sample collection will also be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS)*.

3.0 REFERENCES

ASTM International (ASTM), *Standard Practice for Clarification of Soils for Engineering Purposes (Unified Soil Classification System), Method D-2487-11,*

ASTM, 1999, *Standard Method for Penetration Test and Split-Barrel Sampling of Soils*, Method D-1586-99, Philadelphia, Pennsylvania.

ASTM, 1994, *Standard Practice for Thin-Walled Tube Sampling of Soils*, Method D-1587-94, Philadelphia, Pennsylvania. International (ASTM), 1995, *Standard Practice for Ring-Lined Barrel Sampling of Soils*, Method D-3550-84 (1995)e1, Philadelphia, Pennsylvania.

Barth, D.S. and B.J. Mason. 1984. *Soil Sampling Quality Assurance User's Guide.* EPA-600/4-84-043.

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

Environmental Protection Agency. 1984. *Characterization of Hazardous Waste Sites - A Methods Manual, Available Sampling Methods.* Volume II, 2nd Edition. EPA-600/4-84-076.

Mason, B.J. 1983. *Preparation of Soil Sampling Protocol: Techniques and Strategies.* EPA-600/4-83-020.

Hewitt, Alan D., et al. 2007. *Protocols for Collection of Surface Soil Samples at Military Training and Testing Ranges for the Characterization of Energetic Munitions Constituents*. U.S. Army Corps of Engineers. ERDC/CRREL TR-07-10.

4.0 DEFINITIONS

Borehole - Any hole drilled or hydraulically driven into the subsurface for the purpose of identifying lithology, collecting soil samples, and/or installing monitoring wells.

Composite soil sample – a combination of soil aliquots collected at various locations, or at various depths at a single location. Analysis of composite samples yields a value representing an average over the various sampled sites or depths from which individual samples were collected.

Core Sampler – A metal tube (probe rod), generally 4- to 5-feet long by 2.25- to 3.25-inch outer diameter (OD), typically utilized along with drive rods and a polyvinyl chloride (PVC) or acetate or equivalent liner that is used to collect soil cores utilizing a direct-push rig. Inside the probe rods are smaller diameter, center rods affixed with a solid drive tip that seals the lower end of the probe rods during pushing. After reaching the target depth, advancement is halted and the center rods and drive tip are removed, which opens the bottom end of the probe rods. A sample liner is attached to the rod string and is lowered to the bottom of the push rods, and the assembly is then advanced to collect the soil sample within the liner. The center rod string is withdrawn from the probe rods, and the liner is removed to access the recovered soil core. The process of direct-pushing and soil core recovery may be repeated within the same boring until reaching total boring depth.

Discrete soil sample – a discrete aliquot from a distinct sampling interval (of a specific sample size) that is representative of one specific location at a specific point in time.

Drilling Jars – A set pair of linked, heat-treated steel bars. The jars may be attached to a wireline sampling string incorporating a split spoon or other impact sampler. The jars are used to drive the sampler into the soil ahead of the bottom of the borehole

Shelby Tube Sampler – A thin-walled metal tube used to recover relatively undisturbed samples. These tubes are available in various sizes, ranging from 2 to 5 inches OD and 18 to 54 inches in length. A stationary piston device is included in the sampler to reduce sampling disturbance and increase sample recovery.

Split-Spoon Sampler – A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. This device can be driven into resistant (semiconsolidated) materials using a drive weight or drilling jars mounted in the drilling rig. A standard split-spoon sampler (used for performing standard penetration tests) is 2 inches OD and 1-3/8 inches in inside diameter. This standard spoon typically is available in two common lengths, providing either 20-inch or 26-inch internal longitudinal clearance for obtaining 18-inch or 24-inch long samples, respectively. Six-inch long sleeves (tubes) of brass, stainless steel, or plastic are commonly placed inside the sampler to collect and retain soil samples. A five-foot long split-spoon sampler is also available. A California modified split-spoon sampler is also commonly used. The design is similar to the standard split-spoon except the OD is 2 1/2 inches and the inside diameter is 2 inches.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with soil sampling for analysis of PFAS. Proper procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with installation-specific work plans and/or Sampling and Analysis Plans (SAPs). The installation-specific work plans will generally provide the following information:

- Sample collection objectives;
- Locations to be sampled;
- Number and volume of samples to be collected at each location;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control procedures and sampling required;
- Any additional sampling requirements or procedures beyond those covered in this SOP, as necessary; and
- At a minimum, the procedures outlined in this SOP for field sampling will be followed.

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that sample collection activities are conducted in accordance with this SOP, SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS),* and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodic observation of field activities and review of field generated documentation associated with this SOP. The Field Lead is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plan/SAP and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

Field personnel assigned to groundwater sampling 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 procedures to the Project Manager or Field Lead.

5.2 FIELD PROCEDURES/CONSIDERATIONS

Collecting soil samples is an important site characterization activity. Soil samples are used to determine the nature and extent of contamination, to identify hazardous substance source areas, and to determine the geotechnical, hydrogeologic, physical, and chemical properties of a site. Soil sampling strategies will be determined and documented before initiating sampling. Field conditions at the investigation area may preclude collection at one or more predetermined sampling locations. Additional soil sampling may be required if unexpected subsurface conditions are observed during the course of the sampling. Proper sampling techniques, proper selection of sampling equipment, and proper decontamination procedures will eliminate cross-contamination and the introduction of contaminants from external sources. Soil conditions can vary widely at a hazardous waste site. Such variations can affect the rate of contaminant migration through the soil. Therefore, it is important that detailed records be maintained during sampling, particularly with respect to the sample location, depth, color, odor, lithology, hydrogeology, and readings derived from field monitoring equipment. Surface and shallow subsurface soil samples shall be described utilizing the Unified Soil Classification System and / or ASTM guidance D2487 Standard Practices for Classification of Soils for Engineering Purposes (Unified Soil Classification System), unless otherwise specified by the installation-specific work plan.

The following are procedures/considerations to be made during field activities at potential PFAS release areas.

5.2.1 FIELD EQUIPMENT

Equipment and supplies used to collect, document, and package surface or subsurface soil samples may include, but is not limited to, the following items:

- Nitrile gloves;
- Stainless steel spoons/trowels;
- Stainless steel hand auger;
- Stainless steel split spoon, split barrel, or continuous sampler;
- Stainless steel bowls/pans;

- Field tablets, logbooks, and boring logs (Rite in the rain © products are the only waterproof field books that may be used, no other water resistant paper is allowed);
- Pens;
- Paper towels;
- Appropriate decontamination equipment;
- Appropriate personnel protective equipment and safety equipment as specified in the Health and Safety Plan and in other SOPs;
- Sample cooler with ice (no blue ice);
- Sample containers (no LDPE or glass) and labels;
- Bubble wrap;
- Chain-of-Custody forms;
- Munsell Soil Color charts;
- Grain size charts;
- Hand lens;
- Brass sleeves;
- Brass caps;
- Acetate liners;
- Ziplock freezer bags;
- Stainless steel deionized water spraying devices;
- Non PFAS plastic sheeting; and
- Non PFAS tape.

All field equipment and supplies will be considered using the Tiered Approach provided in Table 2 of SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS)* prior to use onsite.

5.2.2 DECONTAMINATION

Downhole drilling and sampling equipment (including but not limited to drill pipe, drive casing, drill rods, bits, tools, non-disposable bailers, etc.) will be thoroughly decontaminated before mobilization to each investigation area and between borings or wells at each investigation area or as required in the installation-specific work plans. Decontamination procedures will be performed in accordance with SOP Wood-10 (PFAS), *Equipment Decontamination*. Before collecting any soil samples, all sampling devices shall be decontaminated. If dedicated or disposable equipment is used, it will be rinsed with PFAS-free deionized (DI) water where applicable. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of sampling equipment shall be decontaminated before initiation of sampling operations and between each sample location and interval. PFAS-free decontamination solutions shall be replenished between sampling locations as needed. Spent decontamination fluids will be containerized, properly labeled and appropriately disposed of according to the investigation derived waste (IDW) plans described in the installation-specific work plan.

5.2.3 SURFACE SOIL SAMPLING

Any surface vegetation will be removed before sampling with a decontaminated shovel or sampling spoon. Surface soil samples may be collected as either discrete or composite samples. Each surface soil sample will be collected using either a stainless steel spoon or trowel. The sampler, wearing clean disposable nitrile gloves, will remove pebbles, roots, etc. from the mixture as the sample is collected. Each sample will be collected by thoroughly homogenizing material from the zero (i.e., zero is considered ground surface where no vegetation is present, and/or the surface directly below where vegetation must be removed) to 6-inch below ground surface depth interval (unless other depth intervals are specified in the work plan). A decontaminated stainless steel scoop or trowel will be used to remove a thin layer of soil from the area that comes into contact with the shovel (if used to gain a specific sampling depth). A second decontaminated stainless steel spoon or trowel will then be used to collect the soil sample.

Each soil sample fraction collected will be thoroughly mixed (i.e., homogenized) using the sampling spoon or trowel. The homogenized material will then be divided among the appropriate sample containers. The sample containers will then be sealed tightly. Care should be taken to ensure the container (bowl, pan, etc.) used for homogenization and the sampling utensils do not interfere with the analytes of interest (e.g., an aluminum pan should not be used for soil samples submitted for inorganic analyses; only stainless steel bowls are allowed).

All personnel who collect or handle the soil samples will wear disposable nitrile gloves to prevent cross-contamination and provide personal protection. New gloves shall be donned for sample collection at each sampling location (i.e., at each new vertical or horizontal position), or whenever gloves are torn or otherwise compromised.

If collecting a composite sample, each aliquot will be collected by placing equal amounts of soil collected from multiple locations into a decontaminated collection container. The aliquots will then be combined (i.e. homogenized) using a spoon or trowel. The homogenized material will then be divided equally among the appropriate sample containers.

5.2.4 SUBSURFACE SOIL SAMPLING

Split-Spoon Sampling

Split-spoon samples for chemical analysis are usually obtained in brass, plastic, or stainless steel sleeves. The type of sleeve to be used if applicable, along with the length and type of sampler, will be stated in the installation-specific work plan and/or SAP. The split-spoon sampler is connected to the drill rod string or a wireline sampling string and is driven by a drive hammer (140 or 340 pound, depending on the size of the sampler) or drilling jars into the undisturbed soil ahead of the bottom of the borehole. The procedure for collecting samples from the split-spoon sampler will be outlined in the installation-specific work plan and/or SAP. The standard procedure is described below.

- Calibrate all field analytical and health and safety monitoring equipment according to the instrument manufacturer’s specifications. Calibration results will be recorded on the appropriate form(s) as specified by the project-specific work plans. Instruments that cannot be calibrated according to the manufacturer’s specifications will be removed from service and tagged.
- Wear the appropriate personal protective equipment as specified in the project work plans and the applicable drilling method SOP.
- Between each sampling location and prior to each sampling run, decontaminate the sampler, sleeves, and other nondisposable sampling equipment as described in SOP Wood-10.
- Advance the borehole to the desired depth or target horizon where the sampling run is to begin.
- When the desired sampling depth or target horizon is reached, remove the drill bit or plug from inside the drive casing or augers.
- Insert the sleeves into the split-spoon sampler (if determined necessary), connect the halves, and screw together the rear threaded collar and front drive shoe. Attach the split-spoon sampler to the bottom end of the drill rod string or wireline sampling string. Set up and attach the specified weight hammer, if used.
- Drive the sampler into the soil at the bottom of the borehole. Record the type of sampler assembly and hammer weight on the Boring Log and/or other appropriate form(s), as specified in the project work plans. To minimize off-gassing of the volatiles, the sampler should not be driven until the sampling team is ready to process the sample.
- Pull the drill rod or wireline sampling string up from the bottom of the borehole and remove the sampler.

- Remove the drive shoe and rear collar from the sampler and open the split barrel.
- If sleeves are used, remove the sleeves one at a time, starting with the sleeve adjoining the drive shoe. Observe and record the amount of sample recovery on the Boring Log. Any observed field problems associated with the sampling attempt (e.g., refusal) or lack of recovery should be noted on the Boring Log.
- If sleeves are used, select sleeve(s) to be submitted for laboratory analysis. Sample sleeve selection should be based on four factors: judgment that the sample represents relatively undisturbed intact material, not slough; proximity to the drive shoe; minimal exposure to air; lithology; and obvious evidence of contamination. The soil core should also be visually recorded on a Boring Log.
- Appropriately label and number each sleeve or soil sample container to be submitted for analysis. The label will contain, at a minimum, the following information:
  - Project number;
  - Location ID;
  - Boring number;
  - Sample number;
  - Bottom depth of sleeve, if applicable;
  - Date and time of sample collection;
  - Parameters for analysis; and,
  - Sampler’s initials.
- Document the sampling event on the Soil Sample Collection Field Sheet or an equivalent form as specified in the installation-specific work plan and/or SAP. At a minimum, this log will contain:
  - Project name and number;
  - Location ID
  - Date and time of the sampling event;
  - Drilling and sampling methods;
  - Sample number;
  - Sample location;
  - Boring number;
  - Sample depth;
  - Sample description;
  - Unusual events; and,
  - Signature or initials of the sampler.

- Appropriately preserve (no blue ice permitted to cool samples), package, handle, and ship the sample in accordance with the procedures outlined in SOP Wood-11 and the installation-specific work plan and/or SAP. The samples shall also be maintained under proper chain of custody. Samples stored on-site will be subject to the provisions of SOP Wood-11.
- Repeat this sampling procedure at the intervals specified in the project work plans until the bottom of the borehole is reached and/or last sample collected.

Core Sampling using Direct Push Technology (DPT)

A core sampler may be used to collect subsurface soil samples. The procedure for collecting soil samples using a core sampler should be outlined in the project work plans. The standard procedure is described below.

- Calibrate all field analytical and health and safety monitoring equipment.
- Wear the appropriate personal protective equipment.
- Between each sampling location and prior to each sampling run, decontaminate the sampler and other sampling equipment as described in SOP Wood-10.
- Advance the probe rods equipped with a solid drive tip to the desired depth or target horizon where the sampling run is to begin. After reaching the target depth, the center rods and drive tip are removed and a new acetate liner is attached to the center rod string.
- Once the liner and center rods are inserted into the probe rods, the assembly is advanced to collect the soil sample within the liner. The assembly is pushed about 4 to 5 feet into the soil with a continuous, rapid motion. At shallow depths and/or in soft soils, the assembly may be advanced without impact from the drive hammer. At greater depths and in harder substrates impact from the drive hammer is likely required to advance the sampling assembly. The liner and center rods are withdrawn from the probe rods, noting which end of the liner is up.
- The DPT contractor will cut the liner and present it to the geologist/engineer for inspection and sample collection. Upon receiving the liner, the field geologist/engineer will observe and record the amount of sample recovery and any associated problems.
- Sample selection should be based on five factors: judgment that the sample represents relatively undisturbed intact material, not slough; proximity to the drive shoe; minimal exposure to air; lithology; and obvious evidence of contamination. The soil core should also be visually recorded on a soil Boring Log.
- Appropriately label and number each soil sample container to be submitted for analysis. The label will contain, at a minimum, the following information:
    - Project number;

- Location ID;
- Boring number;
- Sample number;
- Date and time of sample collection;
- Parameters for analysis; and,
- Sampler's initials.

- Document the sampling event on the soil sample collection field sheet or an equivalent form as specified in the installation-specific work plan and/or SAP. At a minimum, this log will contain:
  - Project name and number;
  - Location ID;
  - Date and time of the sampling event;
  - Drilling and sampling methods;
  - Sample number;
  - Sample location;
  - Boring number;
  - Sample depth;
  - Sample description;
  - Unusual events; and,
  - Signature or initials of the sampler.
- Appropriately preserve (no blue ice permitted to cool samples), package, handle, and ship the sample in accordance with the procedures outlined in SOP Wood-11 and the installation-specific work plan and/or SAP. The samples shall also be maintained under proper chain of custody. Samples stored on-site will be subject to the provisions of SOP Wood-11.
- Repeat this sampling procedure at the intervals specified in the installation-specific work plan and/or SAPuntil the bottom of the borehole is reached and/or last sample collected.

REVIEW AND APPROVAL

QC Manager:

Matt

12/21/2020

Matt Brookshire

MMEC Group Quality Control Manager

Date

GROUNDWATER SAMPLING
SOP Wood-03 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of groundwater samples for chemical analysis. Proper collection procedures are necessary to assure the quality and integrity of all groundwater samples. Additional specific procedures and requirements will be provided in the project-specific work plans and/or Sampling and Analysis Plans (SAPs), as necessary.

2.0 SCOPE

This procedure applies to all Wood personnel and subcontractors who collect or otherwise handle groundwater samples during per- and polyfluoroalkyl substances (PFAS) investigations. Sample collection will also be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS)*.

3.0 REFERENCES

ASTM International, 2019 *Standard Guide for Sampling Ground-Water Monitoring Wells*, D 4448-01.

Barcelona et al, 1985, *Practical Guide for Groundwater Sampling*, Illinois State Water Survey, Champaign, Illinois, ISWS Contract Report 374, November.

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

U.S. Environmental Protection Agency (EPA), 1987, *Compendium of Superfund Field Operations Methods*, EPA 540/P-87/001a, OSWER 9355.0-14, September.

EPA, 1988, *EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA*, Interim Final OSWER Directive 9355.3-01, August.

EPA, 1992, *EPA RCRA Groundwater Monitoring: Draft Technical Guidance*, November.

EPA, 2017, *EPA Region 1 Low Stress (low flow) purging and sampling procedure for the collection of groundwater samples from monitoring wells*, EQASOP-GW4, September.

4.0 DEFINITIONS

Bailer – A bailer is an enclosed cylindrical tube containing a floating ball check-valve at the bottom. Lowering the bailer into water causes the ball to float allowing water to enter the cylinder. Raising the bailer through the water column causes the ball to settle, creating a seal to trap the water so that it can be brought to the surface.

Bladder Pump – A bladder pump is an enclosed cylindrical tube containing a flexible membrane bladder. Well water enters the bladder through a one-way check-valve at the bottom. Gas is forced into the annular space (positive displacement) surrounding the bladder through a gas supply line. The gas displaces the well water through a one-way check-value at the top. The water is brought to the surface through a water discharge line. Gas (air, carbon dioxide, or nitrogen) is provided by compressors or cylinders.

Dedicated Groundwater Monitoring Equipment – Dedicated groundwater monitoring equipment is used to purge and sample only one well. The equipment is commonly installed within, and remains in the well, for the duration of the monitoring program. Dedicated equipment does not need to be decontaminated between sampling events.

Electric Submersible Pump – An electric submersible pump is an enclosed cylindrical tube containing a motor with rotary attachments. Well water enters the cylinder through a one-way check valve. Electrical power to the motor causes rotors or impellers to turn and displace the groundwater.

Peristaltic Pump – A peristaltic pump is a self-priming, low volume pump consisting of a rotor and ball bearing rollers. Tubing placed around the rotors is squeezed by the rotors as they revolve. The squeezing produces a wavelike contractual movement that causes water to be drawn through the tubing. During purging and sampling, only the tubing is placed down the well. All of the mechanical systems of the pump remain above ground during purging and sampling activities. The peristaltic pump is typically limited to sampling at depths of less than 25 feet. Operating two or more peristaltic pumps in parallel can increase operational depths slightly.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with groundwater sampling. Proper groundwater sampling procedures are necessary to ensure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project-specific work plans and/or SAPs. The work plan/SAP will generally provide the following information:

- Sample collection objectives;
- Locations of groundwater samples to be collected;
- Numbers and volumes of samples to be collected;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control (QC) procedures and sampling required;
- Management procedures for groundwater investigation derived waste (IDW); and
- Any additional groundwater sampling requirements or procedures beyond those covered in this SOP, as necessary.
- At a minimum, the procedures outlined in this SOP for groundwater sampling will be followed.

5.1 RESPONSIBILITIES

Compliance with this procedure is the responsibility of project management and field personnel. This SOP and the project-specific work plan/SAP should be reviewed before performing groundwater sampling at the project investigation areas.

Project Manager

The Project Manager is responsible for ensuring that sample collection activities are conducted in accordance with this SOP, SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS),* and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodic observation of field activities and review of field generated documentation associated with this SOP. The Field Lead is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plan/SAP and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

Field personnel assigned to groundwater sampling 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 procedures to the Project Manager or Field Lead.

5.2 FIELD PROCEDURES/CONSIDERATIONS

The following are procedures/considerations to be made during field activities at potential PFAS release areas.

5.2.1 Field Equipment

Purging and sampling equipment is constructed from a variety of materials. The most inert material (e.g., silicone and high-density polyethylene), with respect to known or anticipated contaminants in the well(s), will be used whenever possible. The various types of purging and sampling equipment available and allowable for sampling PFAS in groundwater are described in *ASTM Standard Guide for Sampling Ground-Water Monitoring Wells, D 4448-01* (ASTM, 2019, *Compendium of Superfund Field Operations Methods* (1987) or *PFAS Sampling Guidelines* (SWQCB, 2019).

If non-dedicated sampling equipment is to be used, and the contaminant histories of the wells are known, it is advisable to establish a sampling order starting with the least contaminated well and progressing to the most contaminated well last. All field equipment and supplies will be considered using the Tiered Approach provided in Table 2 of SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS)* prior to use onsite.

5.2.2 Decontamination

Sampling equipment will be thoroughly decontaminated before mobilization to each investigation area and between borings or wells at each investigation area or as required in the project-specific work plan/SAP. Decontamination procedures will be performed in accordance with SOP Wood-10 (PFAS), *Equipment Decontamination*. Before collecting any groundwater samples, all sampling devices shall be decontaminated with laboratory-certified PFAS-free de-ionized (DI) water. If dedicated or disposable equipment is used, it will be rinsed with laboratory-certified PFAS-free DI water, where applicable. Mobile decontamination supplies will be provided so that equipment can be decontaminated in the field. Each piece of sampling equipment shall be decontaminated daily before initiation of sampling operations and between each sample location and interval. Non-PFAS decontamination solutions shall be replenished between sampling locations as needed. Spent decontamination fluids will be containerized, properly labeled and appropriately disposed of according to the IDW plans included in the project-specific work plan/SAP.

5.2.3 Groundwater Purging and Sampling

5.2.3.1 Groundwater Purging and Sampling with a Bladder Pump

Pre-sample purging and sampling should be conducted in accordance with the project-specific work plan/SAP. The standard procedure for purging and sampling using a bladder pump is in agreement with procedures described in the *Compendium of Superfund Field Operations Methods* (EPA, 1987) and will be conducted as described below.

- Inspect the equipment to ensure that it is in good working order.
- Calibrate all field analytical test equipment (e.g., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature) according to the instrument manufacturers' specifications or scope-specific work plan/SAP. Calibration results will be recorded on the appropriate form(s) as specified by the project work plan/SAP. Instruments that cannot be calibrated according to the manufacturers' specifications will be removed from service and tagged.
- An exception to the daily calibration requirements will be made in the case of the water level meters. These instruments will be calibrated at the beginning of the project and then every six months using a steel surveyors tape.
- If non-dedicated equipment is being used, decontaminate the equipment as described in SOP Wood-10. During decontamination, the equipment should again be inspected for damage and, if present, repaired or replaced with undamaged equipment.
- Visually inspect the well to ensure that it is undamaged, properly labeled, and secured. Damage or other conditions that may affect the integrity of the well will be recorded on the Field Log and brought to the attention of the Field Lead.
- Uncap the well and monitor the air space immediately above the open casing per the health and safety plan. Observe if any air is flowing into or out of the casing. In the event

such conditions are observed, they should be noted on the Groundwater Sample Collection Form.

- Obtain a static depth to water level measurement. If the total well depth has not been verified within the past year, obtain a total well depth measurement. Calculate the volume of water in the well (cased well volume) as follows:

$$\pi\left(\frac{d}{2}\right)^2 (h_1 - h_2)\, x\, 7.48 = \text{ cased well volume(in gallons)}$$

Where:

d = inside diameter of well casing (in feet)
h_1 = depth of well from top of casing (in feet)
h_2 = depth to water from top of casing (in feet)

- Record static water level, total well depth, and volume calculations on the sample collection field sheet.
- If using non-dedicated equipment, lower the pump and associated tubing and/or lines into the well. The pump intake should be located near the middle of the saturated portion of the screened interval and the depth of the pump intake will be recorded on the Groundwater Sample Collection Form. For low yielding wells it may be necessary to gently lower the pump during purging to follow the declining water level in the well.
- Attach the compressor or cylinder to the controller and the controller to the gas supply line, making sure that the compressor is downwind of the monitoring well. Attach the sampling tube to the discharge supply line. Adjust the pressure/discharge cycle on the controller.
- Begin purging. Collect and dispose of purge water in accordance with the criteria specified by the project work plan/SAP.
- Physical parameters (i.e., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature) of the purge water will be measured when purging begins, after each well casing volume, and then periodically throughout the purging procedure. These measurements will be recorded on Groundwater Sample Collection Forms. Purging is considered complete when water quality indicator parameters have stabilized (i.e., three consecutive readings are within tolerances specified in Table 4-1) (ASTM, 2019; EPA, 1992 and Barcelona et al, 1985). If stability is not reached within the removal of three well casing volumes, then purging is continued until stability is attained, up to a maximum purging period of one hour. If parameters have not stabilized after the additional hour of purging, the sample may be collected.

Table 4-1

Parameter	Units	Requirement
pH	Standard Units	± 0.1
Specific Conductivity	Micromhos/centimeter (umho/cm, or µS/cm)	± 3 percent
Temperature	Degrees Celcius (°C)	± 0.5 °C
Oxidation-Reduction Potential (ORP)	Millivolts (mV)	± 10 percent
Dissolved Oxygen	Milligrams/liter (mg/L)	± 10 percent
Turbidity	Nephelometric Turbidity Units (NTUs)	Less than 10 NTU or ±10 percent.

- For slowly recharging wells, the parameters may not stabilize before the well casing is emptied, even when using low flow purging rates. In this case, purging will be considered complete when one well volume (i.e., well casing plus filter pack volume) has been purged from the well and the well goes dry.
- The well will then be allowed to recharge, and sampling must be initiated within 24-hours of purging. The depth to the water level in the well will be measured and recorded immediately prior to sample collection. If the volume of water in the recharged well is not sufficient to completely fill all required sample containers, then sample collection may follow multiple well recharge events within 48 hours after completion of purging. All sample containers for a given analytical method (e.g., U.S. EPA 537) must be concurrently and completely filled following a single recharge event. The date and time of each sample collection will be recorded.
- Inspect the sample bottles (obtained from the analytical laboratory prior to the sampling event) to be used to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the project work plan/SAP.
- Turn on the pump and adjust the pressure/discharge cycle on the pump controller so that the water will flow smoothly and without agitation into the sample containers.
- Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the

sample. Completely fill the bottle; however, samples collected for metals and general water chemistry analysis should be filled to the base of the bottleneck.

- The samples should be collected in the order of volatility, collecting the samples for the analysis of the most volatile parameters first, followed by the samples for the least volatile parameters. The samples for volatiles analysis should be collected during one full discharge cycle. Do not partially fill a container for volatile parameter analysis during one cycle and complete the filling during the next cycle.
- Document the sampling event on the Groundwater Sample Collection Form.
- As soon as possible after sample collection, place the sample in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., Ziploc®). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container.
- Handle and ship the sample according to the procedures outlined in SOP Wood-11, following appropriate chain of custody procedures. Samples stored temporarily on-site will be maintained per SOP Wood-10.

5.2.3.2 *Groundwater Purging and Sampling with a Peristaltic Pump*

Purging and sampling will be conducted per the project work plan/SAP. The standard procedure for groundwater purging and sampling using a peristaltic pump is in agreement with procedures described in the *Compendium of Superfund Field Operations Methods* (EPA, 1987) and will be conducted as described below.

- Inspect the equipment to ensure that it is in good working order.
- Calibrate all field analytical test equipment (e.g., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity, and temperature) according to the instrument manufacturers' specifications or project-specific work plan/SAP. Calibration results will be recorded on the appropriate form(s) as specified by the project-specific work plan/SAP. Instruments that cannot be calibrated according to the manufacturers' specifications will be removed from service and tagged.
- An exception to the daily calibration requirements will be made in the case of the water level meters. These instruments will be calibrated at the beginning of the project and then every six months using a steel surveyors tape.
- Conduct equipment decontamination; however, the old silicone tubing used in the pump head should not be decontaminated. New tubing should be used for each well.
- Visually inspect the well to ensure that it is undamaged, properly labeled, and secured. Damage or other conditions that may affect the integrity of the well will be recorded on the Field Log and brought to the attention of the Field Lead.

- Uncap the well and monitor the air space immediately above the open casing per the health and safety plan. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Groundwater Sample Collection Form.
- Obtain a static water level measurement and calculate the cased well volume as described in Section 5.2.3 of this SOP.
- Connect new silicone tubing to the rotor head of the pump motor and tighten until snug.
- Run a short section of the tubing from the discharge side of the pump head to a collection vessel.
- Insert the free end of the influent tubing into the well and lower it to the middle of the saturated portion of the well screen. The depth of the tubing intake will be recorded on the Groundwater Sample Collection Form. For low yielding wells, it may be necessary to gently lower the tubing intake during purging to follow the declining water level in the well.
- Begin purging. Collect and dispose of purge water in accordance with the criteria specified by the project-specific work plan/SAP.
- Physical parameters (i.e., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature) of the purge water will be measured when purging begins, after each well casing volume, and then periodically throughout the purging procedure. These measurements will be recorded on Groundwater Sample Collection Forms. Purging is considered complete when water quality indicator parameters have stabilized (i.e., three consecutive readings are within tolerances specified in Table 4-1) (ASTM, 2007; U.S. EPA, 1992 and Barcelona et al, 1985). If stability is not reached within the removal of three well casing volumes, then purging is continued until stability is attained, up to a maximum purging period of one hour. If parameters have not stabilized after the additional hour of purging, the sample may be collected.
- For slowly recharging wells, the parameters may not stabilize before the well casing is emptied, even when using low flow purging rates. In this case, purging will be considered complete when one well volume (i.e., well casing plus filter pack volume) has been purged from the well and the well goes dry.
- The well will then be allowed to recharge, and sampling must be initiated within 24-hours of purging. The depth to the water level in the well will be measured and recorded immediately prior to sample collection. If the volume of water in the

recharged well is not sufficient to completely fill all required sample containers, then sample collection may follow multiple well recharge events within 48 hours after completion of purging. All sample containers for a given analytical method (e.g., U.S. EPA 537 must be concurrently and completed filled following a single recharge event. The date and time of each sample collection will be recorded.

- Inspect the sample bottles (obtained from the analytical laboratory prior to the sampling event) to be used to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the project-specific work plan/SAP.
- Turn on and adjust the rotor speed of the pump so that the water will flow smoothly and without agitation into the sample containers.
- Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample. Completely fill the bottle; however, samples collected for metals and general water chemistry analyses should be filled to the base of the bottleneck.
- If collecting samples for other than PFAS analysis, in addition to PFAS, the samples should be collected in the order of volatility, collecting the samples for the analysis of the most volatile parameters first, followed by the samples for the least volatile parameters. The samples for volatiles analysis should be collected during one full discharge cycle. Do not partially fill a container for volatile parameter analysis during one cycle and complete the filling during the next cycle.
- Document the sampling event on the Groundwater Sample Collection Form.
- As soon as possible after sample collection, place the sample in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., Ziploc®). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container.
- Handle and ship the sample according to the procedures outlined in SOP Wood-11 following appropriate chain of custody procedures. Samples stored temporarily on-site will be maintained per SOP Wood-10.

5.2.3.3 *Groundwater* Purging and Sampling with an Electric Submersible Pump

Purging and sampling will be conducted in accordance with the project-specific work plan/SAP. The standard procedure for purging and sampling using a submersible pump is in agreement with procedures described in the *Compendium of Superfund Field Operations Methods* (EPA, 1987) and is described below.

- Inspect the equipment to ensure that it is in good working order.
- Calibrate all field analytical test equipment (e.g., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature) according to the instrument manufacturers' specifications or project-specific work plan/SAP. Calibration results will be recorded on the appropriate form(s) as specified by the project-specific work plan/SAP. Instruments that cannot be calibrated according to the manufacturers' specifications will be removed from service and tagged.
- An exception to the daily calibration requirements will be made in the case of the water level meters. These instruments will be calibrated at the beginning of the project and then every six months using a steel surveyors tape.
- If non-dedicated equipment is being used, decontaminate the equipment as described in SOP Wood-10. During decontamination, the equipment should again be inspected for damage and, if present, repaired or replaced with undamaged equipment.
- Visually inspect the well to ensure that it is undamaged, properly labeled, and secured. Damage or other conditions that may affect the integrity of the well will be recorded on the Field Log and brought to the attention of the Field Lead.
- Uncap the well and monitor the air space immediately above the open casing per the health and safety plan. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Groundwater Sample Collection Form.
- Obtain a static water level measurement and calculate the cased well volume as described in Section 5.2.3.1 of this SOP.
- If using non-dedicated equipment, lower the pump and associated lines into the well. The pump intake should be located near the middle of the saturated portion of the screened interval and the depth of the pump intake will be recorded on the field form. For low yielding wells it may be necessary to gently lower the pump during purging to follow the declining water level in the well.
- Place the generator downwind of the well. Start the generator, and then plug the pump into the generator.
- Begin purging. Collect and dispose of purge water in accordance with the criteria specified by the project-specific work plan/SAP.
- Physical parameters (i.e., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity, and temperature) of the purge water will be measured when purging begins, after each well casing volume, and then periodically throughout the purging procedure. These measurements will be recorded on Groundwater Sample

Collection Forms. Purging is considered complete when water quality indicator parameters have stabilized (i.e., three consecutive readings are within tolerances specified in Table 4-1) (ASTM, 2019; U.S. EPA, 1992 and Barcelona et al, 1985). If stability is not reached within the removal of three well casing volumes, then purging is continued until stability is attained, up to a maximum purging period of one hour. If parameters have not stabilized after the additional hour of purging, the sample may be collected.

- For slowly recharging wells, the parameters may not stabilize before the well casing is emptied, even when using low flow purging rates. In this case, purging will be considered complete when one well volume (i.e., well casing plus filter pack volume) has been purged from the well and the well goes dry.
- The well will then be allowed to recharge, and sampling must be initiated within 24-hours of purging. The depth to the water level in the well will be measured and recorded immediately prior to sample collection. If the volume of water in the recharged well is not sufficient to completely fill all required sample containers, then sample collection may follow multiple well recharge events within 48 hours after completion of purging. All sample containers for a given analytical method (e.g., U.S. EPA 537) must be concurrently and completely filled following a single recharge event. The date and time of each sample collection will be recorded.
- Inspect the sampling bottles (obtained from the analytical laboratory prior to the sampling event) to be used to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the project-specific work plan/SAP.
- Turn on and adjust the flow rate of the pump by using the check-valve on the discharge line so that the water will flow smoothly and without agitation into the sample bottles.
- Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample. Completely fill the bottle; however, samples collected for metals and general water chemistry analyses should be filled to the base of the bottleneck.
- The samples should be collected in the order of volatility, collecting the samples for the analysis of the most volatile parameters first, followed by the samples for the least volatile parameters. The samples for volatiles analysis should be collected during one full discharge cycle. Do not partially fill a container for volatile parameter analysis during one cycle and complete the filling during the next cycle.

- Document the sampling event on the Groundwater Sample Collection Form.
- As soon as possible after sample collection, place the sample in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., Ziploc®). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container.
- Handle and ship the sample according to the procedures outlined in SOP Wood-11, following appropriate chain of custody procedures. Samples stored temporarily on-site will be maintained per SOP Wood-10.

5.2.3.4 *Groundwater Purging and Sampling with a Bailer*

Purging and sampling will be conducted in accordance with the project-specific work plan/SAP. The standard procedure for purging and sampling with a bailer is in agreement with procedures described in the *Compendium of Superfund Field Operations Methods* (U.S. EPA, 1987) and is described below.

- Inspect the equipment to ensure that it is in good working order.
- Calibrate all field analytical test equipment (e.g., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature) according to the instrument manufacturers' specifications or project-specific work plan/SAP. Calibration results will be recorded on the appropriate form(s) as specified by the project-specific work plan/SAP. Instruments that cannot be calibrated according to the manufacturers' specifications will be removed from service and tagged.
- An exception to the daily calibration requirements will be made in the case of the water level meters. These instruments will be calibrated at the beginning of the project and then every six months using a steel surveyors tape.
- If non-dedicated equipment is being used, decontaminate the equipment as described in SOP Wood-10. During decontamination, the equipment should again be inspected for damage and, if present, repaired or replaced with undamaged equipment.
- Visually inspect the well to ensure that it is undamaged, properly labeled, and secured. Damage or other conditions that may affect the integrity of the well will be recorded on the Field Activity Daily Log and brought to the attention of the Field Lead.
- Uncap the well and monitor the air space immediately above the open casing per the health and safety plan. Observe if any air is flowing into or out of the casing. In the event such conditions are observed, they should be noted on the Groundwater Sample Collection Form.
- Obtain a static water level measurement and calculate the cased well volume as described in Section 4.2.2 of this SOP.

- Secure the bailer to a five-foot length of stainless bailer wire with a bowline knot or clip. Attach the bailer wire to bailing line or chain.
- Begin purging by slowly lowering the bailer into the groundwater. Allow the floating ball valve to seat, and slowly retrieve the bailer. Repeat this procedure to purge the well. Collect, transport, and dispose of purge water in accordance with the criteria specified in the project-specific work plan/SAP.
- During purging, the descent of the bailer should be controlled to prevent freefall inside the well. In the event the bailer encounters an obstruction inside the well, no attempts should be made to push the bailer beyond the obstruction. If the bailer becomes lodged in the well, the line should not be pulled with such force that it would part from the bailer. Such conditions should also be noted on the Groundwater Sampling Form and brought to the immediate attention of the Field Lead.
- The well will then be allowed to recharge, and sampling must be initiated within 24-hours of purging. The depth to the water level in the well will be measured and recorded immediately prior to sample collection. If the volume of water in the recharged well is not sufficient to completely fill all required sample containers, then sample collection may follow multiple well recharge events within 48 hours after completion of purging. All sample containers for a given analytical method (e.g., U.S. EPA 537) must be concurrently and completed filled following a single recharge event. The date and time of each sample collection will be recorded.
- Inspect the sampling bottles (obtained from the analytical laboratory prior to the sampling event) to be used to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the project-specific work plan/SAP.
- Lower the sample collection bailer and submerge into the water column as above. Retrieve the bailer and insert a bottom-emptying device into the bailer so that the water will flow smoothly and without agitation into the sample bottles.
- Collect the sample water directly into the provided sample bottles (containers), allowing the discharge to flow gently down the inside of the bottles, minimizing aeration of the sample. Completely fill the bottles; however, samples collected for metals and general water chemistry analyses should be filled to the base of the bottleneck.
- Document the sampling event on the Groundwater Sample Collection Form.

- As soon as possible after sample collection, place the sample in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., Ziploc®). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container.
- Handle and ship the sample according to the procedures outlined in SOP Wood-11, following appropriate chain of custody procedures. Samples stored temporarily on-site will be maintained per SOP Wood-10.

5.2.3.5 ***Groundwater Sampling using Inflatable Packers***

Inflatable Packers are used to isolate portions of an open-hole bedrock well for sampling or other hydrogeological assessment purposes. Expandable rubber bladders are positioned one above the other on a metal pipe. Their configuration permits discharge and power supply lines to pass through the packers with a pump sandwiched in between. The packers are inflated with compressed air to hydraulically isolate water-bearing fractures identified through borehole geophysical logging or core samples.

Pumping of water from within a packed interval can be used to estimate yield of the selected zone, and for the analysis of samples collected from a targeted zone, facilitating the assessment of the vertical extent of groundwater contamination. If samples are to be collected for field screening or laboratory analysis, low-flow sampling techniques would be employed before sample collection. The resolution of the groundwater quantity and quality within the borehole is based on the length of the bedrock borehole interval tested and usually does not exceed 20 feet in length. The steps for collecting groundwater samples using inflatable packers are outlined below:

- If packers are not seated properly, water will leak around the system during the sampling event. To determine if leakage around the packer is occurring, the water level above the top packer is monitored to see if the level drops while the target interval is being pumped. If the water level drops, the packers will be re-seated by deflating and re-inflating the packers. A dropping water level does not necessarily mean the packers have a poor seal. Another possibility is that there are vertical fractures that connect fractures within the sampling zone to fractures above the top packer.
- Packers are assembled at the surface with the selected pump sandwiched between individual bladders.
- Assembled unit is lowered to a predetermined depth.
- Bladders are inflated from air-lines originating at the surface. Bladder pressures are determined accordingly:

G = Inflation pressure at gauge (PSI)

DP = Depth to top of packer (feet)

DW = Depth to static water level in well (feet)

Sp = Unconfined packer pressure rating for the well size (PSI)

PP = Injection pump pressure (PSI)

To calculate Packer Inflation Pressure for sampling (i.e., pump out):

$$G = [\ (DP - DW) \times .43\ ] + Sp + [\ (DP - DW) \times .43 \times .2\ ]$$

- Inspect the sampling bottles (obtained from the analytical laboratory prior to the sampling event) to be used to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the project-specific work plan/SAP.
- Turn on and adjust the flow rate of the pump so that the water will flow smoothly and without agitation into the sample bottles.
- Collect the sample directly into the provided sample bottle (container), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample. Completely fill the bottle; however, samples collected for metals and general water chemistry analyses should be filled to the base of the bottleneck.
- The samples should be collected in the order of volatility, collecting the samples for the analysis of the most volatile parameters first, followed by the samples for the least volatile parameters. The samples for volatiles analysis should be collected during one full discharge cycle. Do not partially fill a container for volatile parameter analysis during one cycle and complete the filling during the next cycle.
- Document the sampling event on the Groundwater Sample Collection Form.
- As soon as possible after sample collection, place the sample in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., Ziploc®). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container.
- Handle and ship the sample according to the procedures outlined in SOP Wood-11, following appropriate chain of custody procedures. Samples stored temporarily on-site will be maintained per SOP Wood-10.

REVIEW AND APPROVAL

QC Manager: Matt Broo

12/21/2020

Matt Brookshire

MMEC Group Quality Control Manager

Date

MONITORING WELL INSTALLATION

SOP Wood-04 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) provides procedures and requirements for the installation of monitoring wells using various drilling techniques, including but not limited to, direct push technology (DPT), hollow-stem auger, rotary, sonic, or dual-tube percussion. The details within this SOP should be used in conjunction with project-specific work plans.

2.0 SCOPE

These procedures apply to all Wood personnel and subcontractors who perform monitoring well installation activities during per- and polyfluoroalkyl substances (PFAS) investigations. Installation activities will be compliant with guidelines outlined in *Per- and Polyfluoroaklyl substances (PFAS) Sampling Guidelines* (SWQCB, 2019)

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

U.S. Environmental Protection Agency (EPA), 1986. *Resource Conservation and Recovery Act (RCRA) Ground Water Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, U.S. Government Printing Office, Washington D.C.

EPA, 1987, *A Compendium of Superfund Field Operations Methods*, EPA-500/P-87/001, U.S. Government Printing Office, Washington D.C.

4.0 DEFINITIONS

Air Rotary Casing Hammer Drilling – A drilling method using a non-rotating drive casing that is advanced simultaneously with a slightly smaller diameter rotary bit attached to a string of drill pipe. The drive casing is a heavy-walled threaded pipe that allows for pass-through of the rotary drill bit inside the center of the casing. Air is forced down through the center drill pipe to the bit, and then upward through the space between the drive casing and the drill pipe. The upward return stream of air removes cuttings from the bottom of the borehole.

Annular Space – The space between:

- Concentric drill pipes;

- An inner drill pipe and outer drive casing;
- Drill pipe or drive casing and the borehole wall; or
- Well screen or casing and the borehole wall.

Borehole – Any hole drilled into the subsurface for the purpose of identifying lithology, collecting soil or rock samples, and/or installing groundwater wells.

Cuttings – Pieces of soil, sediment, or rock cut by a bit in the process of drilling borings.

Direct Push Drilling – For the purposes of this monitoring well installation SOP, the term “direct push drilling” refers to using DPT to push or drive hollow rods into the ground for the purpose of installing monitoring wells with a maximum inside diameter of 1 inch when using 2.625 inches inside diameter DPT rods. Direct push drilling uses an expendable drive point that is fitted to the lower end of a string of drive rods that are advanced into the ground using percussive hammering. No cuttings are brought to the surface during drilling, although soil cores may be retrieved using various sampling tools.

Dual-Tube Percussion Drilling – A drilling method using non-rotating drive casing with a bit on the bottom of the casing string. A smaller diameter tube or drill pipe is positioned inside the drive casing. The drive casing is advanced by the use of a percussion hammer, thereby causing the bit to cut or break up the sediment or soil at the bottom of the boring. Air is forced down the annular space between the drive casing and inner drill pipe, and cuttings are forced upward with the return stream of air within the center of the inner drill pipe.

Filter Pack – Granular filter material (sand, gravel, etc.) placed in the annular space between the well screen and the borehole wall to increase the effective diameter of the well and to minimize the movement of fine-grained material into the well.

Grout – For the purposes of this SOP, the term “grout” consists of a neat cement grout mixture generally containing five to six gallons of clean water mixed with each 94-pound bag of Portland cement. The grout is emplaced within a borehole as a slurry, and once properly set and cured, is capable of restricting movement of water.

Hollow-Stem Auger Drilling – A drilling method using augers with open centers. The augers are advanced with a screwing or rotating motion into the ground. Cuttings are brought to the surface by the rotating action of the augers, thereby clearing the borehole.

Monitoring Well – A well that provides for the collection of representative groundwater samples, the detection and collection of representative light and dense non-aqueous phase organic liquids, the measurement of fluid levels, and the assessment of hydrogeologic characteristics of saturated materials in the vicinity of the well.

Mud Rotary Drilling – For the purposes of this monitoring well installation SOP, the term “mud rotary drilling” refers to direct circulation (as opposed to reverse circulation) mud rotary drilling. Mud rotary drilling uses a rotating drill bit, which is attached to the lower end of a string of drill pipe. Drilling mud is pumped down through the inside of the drill pipe and out through the bit. The mud then flows upward in the annular space between the borehole and the drill pipe, carrying the cuttings in suspension, within the drilling mud, to the surface.

Sonic Drilling – Sonic drilling uses a combination of rotary motion, oscillation/vibration, and hydraulic downward force to advance a drill bit and drive casing. Soil or rock cores are retrieved using a core barrel as the drive casing is advanced.

Tremie – A tubular device or pipe used to place grout, bentonite, or filter pack in the annular space of a borehole.

Well Screen – A commercially available, factory-perforated, wire wound, continuous wrap, or slotted casing segment used in a well to maximize the entry of groundwater from the producing zone and to minimize the entrance of sand.

5.0 PROCEDURES

This section contains both the main project team responsibilities and the procedures for monitoring well installation activities. The procedures described herein are applicable as requirements for monitoring well installations using DPT, hollow-stem auger, mud rotary, air rotary, air rotary casing hammer, sonic, or dual-tube percussion drilling techniques. Site-specific factors need to be considered in the selection of well construction and completion materials, specification of well designs, and choosing borehole drilling methods. These factors will be incorporated into project planning activities and the compilation of project-specific work plans. The project-specific work plans will contain the following information related to monitoring well installation:

- Objectives of the monitoring well
- Specific location of the well to be installed
- Zone or depth well is to be installed
- Drilling method(s) to be used
- Well construction materials to be used

- Specification of well design(s) including Well Construction Diagrams
- Additional procedures or requirements beyond the scope of this SOP

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that all monitoring well installation activities are conducted and documented in accordance with this SOP, *SOP Wood-01 (PFAS) Field Sampling Protocols to Avoid Cross-Contamination of Per- And Polyfluoroalkyl Substances (PFAS)*, and any other appropriate procedures, which will be accomplished through staff training and quality assurance/quality control (QA/QC) monitoring activities.

Field Lead

The Field Lead is responsible for periodic observation of well installation activities to assure the implementation of this SOP. The Field Lead is also responsible for the review and approval of corrective action (i.e., retraining personnel, additional review of the project-specific work plans and SOPs, variances to monitoring well installation requirements, issuing nonconformances, etc.) identified during the performance of these activities.

Field Personnel

Field personnel assigned to monitoring well installation activities are responsible for completing their tasks according to specifications outlined in this SOP and other appropriate procedures. Field staff are responsible for reporting deviations from the procedures to the Project Manager or the Field Lead.

All personnel are responsible for carefully reviewing this SOP and the project-specific work plan/SAPs before performing activities at the project investigation area.

5.2 FIELD PROCEDURES/CONSIDERATIONS

The following are procedures/considerations to be made during field activities at potential PFAS release areas. All materials should be compliant with guidelines outlined in SWQCB guidance (2019).

5.2.1 FIELD PREPARATION

Before mobilization of a rig to the site, field personnel should ensure that the monitoring well location has been appropriately cleared of all underground utilities, buried objects, and overhead utilities; and that drill permits (e.g., project-specific dig/drill permits, federal, state, city permits, county permits, etc.) have been issued per the project-specific work plans. Review all forms and diagrams documenting the location of the cleared monitoring well site and the location of any identified underground utility lines, other buried objects, and overheard utilities.

Downhole drilling, sampling, well construction, and development equipment (including but not limited to drill pipe, drive casing, drill rods, bits, tools, tremie pipe, non-disposable bailers, etc.) will be thoroughly decontaminated before mobilization to each investigation area and between borings or wells at each investigation area or as required in the project-specific work plans. Decontamination procedures will be performed in accordance with SOP Wood-10 (PFAS), *Equipment Decontamination*.

Clear the work area of brush and minor obstructions and then mobilize the rig to the planned monitoring well location. The responsible field personnel (e.g., rig geologist or engineer) should then review with the driller the proposed borehole, well design, and the details of the monitoring well installation plan, including any potential drilling or completion problems.

Calibrate field equipment according to the instrument manufacturer’s specifications. Document the calibration results on the appropriate form(s). Instruments that cannot be calibrated according to the manufacturer’s specifications will be removed from service and tagged.

Workers will be provided the appropriate personal protective equipment that must be worn as specified by the project-specific work plans and compliant with SWQCB guidance (2019). Typically, the minimum personal protection will include a hard hat, safety glasses, reflective safety vests, gloves, and boots.

All field equipment and supplies will be considered using the Tiered Approach provided in Table 2 of SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS)* prior to use onsite.

5.2.2 BOREHOLE DRILLING

Commence drilling and advance the borehole while conducting health and safety air monitoring according to the project-specific work plans. Perform air monitoring as often as necessary to ensure the safety of workers. Record all measurements in the field log and/or other appropriate form(s) as specified in the project-specific work plans. Record other pertinent information (date, investigation area, well or boring number, and location) in the field log and/or on other appropriate form(s) as specified by the project-specific work plans. In addition, note and record observed field conditions, any unusual circumstances, and weather conditions.

During drilling, collect representative cutting and/or soil samples as required by the project-specific work plans. Compile a Boring Log or lithologic log from the cuttings and samples.

At total depth, remove soil cuttings through circulation or by rapidly spinning the augers as applicable, prior to constructing the well. Review logs and notes with the driller for any zones or depths exhibiting drilling problems that may affect the planned well installation. Condition the hole or take other actions mutually agreed upon by the rig geologist (or engineer), lead technical personnel, and the driller to ensure or aid in the well development.

Remove the drill pipe and bit if using sonic or rotary techniques, remove the center bit plug if using the hollow-stem auger technique, or disengage the expendable drive point if using DPT. The well construction materials will then be installed inside the open borehole or through the center of the drive casing or augers.

Measure the total depth of the completed boring using a weighted sounding line. The borehole depth is checked to assure that formation material has not collapsed or heaved to fill the borehole. If heaving has taken place or the borehole has collapsed, options for cleaning, re-drilling, or installation in the open section of the boring should be discussed with lead technical personnel.

In the event that the borehole was over-drilled, bentonite pellets, or bentonite chips (as specified in the project-specific work plans) may be added to the boring to raise the bottom of the borehole to the desired depth. The bentonite should be installed through a tremie pipe to fill the borehole from the bottom of the boring upward. During installation, the tremie pipe should be submerged below the top of the bentonite column in the borehole to prevent free-fall and bridging. Bentonite should be added gradually to the borehole to prevent bridging. Bentonite addition will stop when its level has reached approximately one foot below the desired base of the well string (i.e., casing, screen, end plug or sump, etc.). The bentonite plug will be hydrated for at least one hour before the installation of a well string and filter pack.

5.2.3 WELL INSTALLATION

Calculate volumes of filter pack, bentonite pellets/slurry, and grout required, based on borehole and well casing dimensions. If required by the project-specific work plans, determine the filter pack and well screen slot size for the monitoring well. For most monitoring well installations, the filter pack and well screen slot size will be determined prior to the start of the installation activities.

For most monitoring well installations, the filter pack and well screen slot size will be determined prior to the start of the installation activities. In general, Schedule 40 PVC well casing will be used. A consideration for specification of casing materials is the depth of the monitoring well. Well installations greater than 150 feet deep require casing materials of greater structural strength. In the case of PVC casing, Schedule 80 PVC rather than Schedule 40 may be required to prevent over-stressing of the casing couplings. Some thermo-plastic materials may be adversely affected by the build-up of heat during grout setup. For well casings, only flush-threaded couplings are to be used. Flush-threaded couplings ensure that no screws, mechanical adaptors, glues, or solvents are necessary to join individual sections. The inner diameter (ID) of the casing shall be 4 inches or greater to allow better access to the well. Wells greater than 150 feet in depth may require diameters larger than 4 inches to ensure that development and sampling equipment can easily be moved through the well. The borehole in which the well is to be installed shall be a minimum of 4 inches larger in diameter than the outer diameter (OD) of the well casing (i.e., 2-in. annular space around the well).

Inspect the casing, screen, and any other well construction materials prior to installation to assure that no damage has occurred during shipment and decontamination activities. Measure and record the length of each section of well screen, blank casing, and the end cap in order to determine the actual total length of well string and screen interval and to calculate desired stickup.

Connect and carefully lower the well string through the open borehole, drive rods or casing, or inside of the augers until the well string is at the desired depth. The well string should be suspended by the installation rig and should not rest on the bottom of the boring. In the event the well string was dropped, lowered abruptly, or for any other reason suspected of being damaged during placement, the string should be removed from the boring and inspected. In certain instances, the well string may rise after being placed in the borehole due to heaving sands. If this occurs, the driller must not place any drilling equipment on the well string (drill pipe, hammers, etc.) to prevent the casing from rising. The amount of rise should be noted by the rig geologist or engineer who should then consult lead technical personnel for an appropriate course of action.

Record, at a minimum, the following information on the appropriate forms per the project-specific work plans:

- Total length of well string
- Actual calculated length between top of blank casing and top of screen interval
- Total measured length of screen interval

- Total measured length between bottom of screen interval and end cap or sump
- Total depth of boring
- Depth from ground surface to top of grout or bentonite backfill in bottom of borehole (if present)
- Installed depth to base of well string (i.e., bottom of end cap or sump)
- Installed depth to top and bottom of well screen

When using the mud rotary drilling technique, tremie the filter pack into the annular space around the screen. Clean, potable water may be used to assist with the filter pack tremie operation. For all other drilling techniques, the filter pack may be allowed to free-fall or be tremied per the project-specific work plans. If using DPT rods, drive casing, or augers, the drive rods, casing, or augers should be pulled slowly during filter pack installation in increments no greater than 5 feet. For DPT-installed wells, a pre-pack filter may be attached to or fitted around the screen and placed concurrently with the well string.

Filter pack settlement should be monitored by initially measuring the sand level before beginning to withdraw the drive casing/augers. In addition, depth soundings using a weighted tape shall be taken repeatedly to monitor the level of the sand continually. The top of the well casing shall also be monitored to detect any movement due to settlement or from drive casing/auger removal. If the top of the well casing moves upwards at any time during the well installation process, the driller should not be allowed to set drilling equipment (e.g., downhole hammers, drill pipe, etc.) on the top of the casing to prevent further movement.

Filter pack should be added until its height is approximately 2 feet above the top of the screen (unless otherwise specified in the project-specific work plans), and verification of its placement (by sounding) should be conducted. The filter pack should then be gently surged using a surge block or swab in order to settle the pack material and reduce the possibility of bridging. Surging is completed by lowering a surge block or swab into the well casing and alternately lowering and raising it within the saturated portion of the screen.

The height of the filter pack will then be re-sounded and additional filter pack placed as necessary. Once the placement of the filter pack is completed, the depth to the top of the pack is measured and recorded on the appropriate forms per the project-specific work plans.

A 3-foot thick (unless otherwise specified in the project-specific work plans) bentonite seal is then installed on top of the filter pack. If pellets or chips are used, they should be added gradually to avoid bridging. Repeated depth readings will be taken using a weighted tape to ascertain the top of the bentonite seal. Bentonite chips and pellets will not hydrate properly if they are not continually submerged in water and must be allowed to hydrate for a minimum of 12 hours prior to grout installation. Granular bentonite must be used if the seal is to be placed above the water table.

After hydration of the bentonite seal, grout (or cement bentonite grout, as specified in the project-specific work plans) is then pumped through a side-discharging tremie pipe and filled from the top of the bentonite seal upward. The bottom of the tremie pipe should be maintained below the top of the grout column to prevent free-fall and bridging. When using drive casing or hollow-stem auger techniques, the drive casing/augers should be raised in incremental intervals, keeping the bottom of the drive casing/augers below the top of the grout. Grouting will cease when the grout level has risen to within approximately 1 to 2 feet of the ground surface, depending on the surface completion type (flush mount or aboveground). Grout levels should be monitored to assure that grout taken into the formation is replaced by additional grout. If settling of the grout occurs, additional topping off of the grout may be necessary.

Record, at a minimum, the following information on the appropriate forms per the project-specific work plans:

- Type and total volume of filter pack material installed
- Total surging time and amount of settlement
- Final measured depth to top of filter pack
- Type and total volume of bentonite seal material installed
- Amount of water added to hydrate bentonite seal
- Amount of time bentonite seal hydrated
- Final measured depth to top of bentonite seal
- Type and mixture of grout material(s) used
- Total volume of grout installed
- Total number of lifts used to install grout
- Final measured depth to top of grout seal
- Final top of casing measurement after installation completion (feet below ground surface or feet above ground surface)
- Type of well cap (lockable hinged or expansion plug) used to secure well

- Type and diameter of well casing materials used.

5.2.4 SURFACE COMPLETION

For aboveground completions, the protective steel casing will be centered on the well casing and inserted into the grouted annulus. Prior to installation, a 2-inch deep temporary spacer shall be placed between the polyvinyl chloride (PVC) well cap and the bottom of the protective casing cover to keep the protective casing from settling onto the well cap. After the protective casing has set, a drainage hole may be drilled into the protective casing if required by the project-specific work plans. The drainage hole is positioned approximately 2 inches above ground surface. The protective casing will be painted with a rust-preventive colored paint. The well head will be labeled to identify, at a minimum, the well identification, total depth, and date of installation. A minimum of 24 hours after grouting should elapse before installation of the concrete pad and steel guard posts for aboveground completions, or street boxes or vaults for flush mount completions.

For aboveground completions, a concrete pad, a minimum of 2-foot by 2-foot by 4-inch thick, is constructed at ground surface around the protective steel casing. The concrete pad is sloped away from the protective casing to promote surface drainage from the well. If traffic conditions warrant extra protection, three steel bucking posts will be embedded to a depth approximately 2 feet below the top of the concrete pad. The posts will be installed in concrete-filled post holes spaced equally around the well at a distance of approximately 2 feet from the protective steel casing. Where removal of bucking posts is required for well access, mounting sleeves should be embedded into the concrete.

For flush mount (or subgrade) completions, a street box or vault is set and cemented in position. The top of the street box or vault will be raised slightly above grade, and the cement sloped to grade to promote surface drainage away from the well.

Record, at a minimum, the following information on the appropriate forms per the project-specific work plans:

- Type and dimensions of surface completion installed
- Dimensions of concrete pad installed (for above ground completions)
- Number and position of steel bucking posts (if applicable)
- Number, type, and size of bolts (for flush mount completions)

5.2.5 DEMOBILIZATION

Following well completion and demobilization of the rig, the site should be cleared of all debris and trash and restored to a neat and clean appearance per the project-specific work plans. All investigation-derived waste generated at the site should be appropriately contained and managed per the project-specific work plans.

REVIEW AND APPROVAL

QC Manager: Matt Broo 12/21/2020

Matt Brookshire

MMEC Group Quality Control Manager

Date

MONITORING WELL DEVELOPMENT
SOP Wood-05 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes general guidelines for developing new groundwater monitoring wells and redeveloping existing monitoring wells. Additional site-specific well development procedures and requirements may be provided in the project-specific work plans.

2.0 SCOPE

These procedures apply to all Wood personnel and subcontractors who perform monitoring well development activities during per- and polyfluoroalkyl substances (PFAS) investigations. Development activities will be compliant with guidelines outlined in *Per- and Polyfluoroaklyl substances (PFAS) Sampling Guidelines* (SWQCB, 2019).

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

U.S. Environmental Protection Agency (EPA), 1992, *Monitoring Well Development Guidelines For Superfund Project Managers*, OSWER-9950.1, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Ground Water Forum, April.

4.0 DEFINITIONS

Surge Block – A plunger-like tool, consisting of leather or rubber discs sandwiched between steel or wooden disks that may be solid or valved, that is used in well development.

Surging – A well development technique where the surge block is alternately lifted and dropped within the well casing above or adjacent to the screen to create a strong inward and outward movement of water through the well intake.

Well Development – The act of stressing the formation around the well screen so that mobile artifact particulates are removed from the well, filter pack, and formation in the immediate vicinity of the monitoring well. The purpose of development is to try to ensure proper hydraulic connection between the well and the geologic materials in the vicinity of the well, produce a well capable of yielding groundwater samples of acceptably low turbidity, and of obtaining groundwater samples as similar as possible to in situ conditions.

5.0 PROCEDURES

This section contains both the main project team responsibilities and the procedures for monitoring well development activities. The procedures described herein are applicable as requirements for monitoring well development methods, including surging and bailing, surging and pumping, or combinations of these processes. Site-specific factors need to be considered in the selection of well development methods. These factors will be incorporated into project planning activities and the compilation of project-specific work plans. The standard procedure for field personnel to use in assessing and documenting well development is described below and is intended only for development methods listed above.

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that monitoring wells are properly developed and that the development process is properly documented. This will be accomplished by staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodic inspections and review of field generated documentation associated with well development. If deviations from project requirements occur, the Field Lead is also responsible for issuing nonconformance reports and requests for corrective action.

Field Personnel

Field personnel are responsible for conducting monitoring during well development and documentation in accordance with the specifications outlined in this SOP and with the project-specific work plans. All field staff are responsible for reporting deviations from procedures to the Project Manager or Field Lead.

5.2 FIELD PROCEDURES/CONSIDERATIONS

The following are procedures/considerations to be made during field activities at potential PFAS release areas.

5.2.1 FIELD PREPARATION

Decontaminate the rig and development equipment. For a newly installed monitoring well, allow the grout to cure for a minimum of 24 hours prior to development.

Calibrate all field analytical test equipment (e.g., pH, temperature, conductivity, oxidation/ reduction potential, and turbidity) according to the instrument manufacturer's specifications and the project-specific work plan or sampling and analysis plan (SAP). Specific test equipment to be used should be identified in the project-specific work plans and SAP. Instruments that cannot be calibrated according to the manufacturer's specifications will be removed from service and tagged.

An exception to the daily calibration requirements will be made in the case of the water level meters. The tape of these instruments will be checked prior to the beginning of the project, and each succeeding six months, using a steel surveyor's tape.

Field personnel will be provided with the appropriate personal protective equipment that must be worn as specified by the project-specific work plans and compliant with SWQCB guidance (2019). Typically, the minimum personal protection will include a hard hat, safety glasses, reflective safety vests, gloves, and boots.

5.2.2 WELL DEVELOPMENT/REDEVELOPMENT

Visually inspect the well to ensure that it is undamaged, properly labeled, and secured. Any observed problems with the well head should be noted in the field log and reported to the Field Lead.

Unlock the well and obtain a depth to water level measurement. Calculate the volume of water in the well (cased well volume) as follows:

$$\pi\left(\frac{d}{2}\right)^2 (h_1 - h_2)\times 7.48 = \text{gallons per cased well volume}$$

Where:

d = inside diameter of well casing, ft
h_1 = depth of well from top of casing, ft
h_2 = depth to water from top of casing, ft.

The depth to the bottom of the well should be measured and then compared to the well completion form or diagram for the well. If sand or sediment is present inside the well, it should first be removed by bailing. Do not insert bailers, pumps, or surge blocks into the well if obstructions, parting of the casing, or other damage to the well is suspected. Report such conditions to the Field Lead and obtain approval to continue or cease well development activities.

Begin development by first gently surging the well with a surge block, followed by bailing or pumping. This is then continued with alternate surging and bailing or pumping. At no time should the surge block be forced down the well if excessive resistance is encountered. During development, the surge block or bailer should not be allowed to free-fall or descend rapidly such that it becomes lodged in the casing or damages the end cap or sediment trap at the bottom of the well.

Use of a surge block may not be required in the development of certain wells, particularly small diameter wells (i.e., 2-inches or less). Equipment typically used to develop small diameter wells (e.g., bladder pumps, electric submersible pumps, bailers, and tubing with check valve), may be raised and lowered in the water column to surge the well during the development process effectively.

While developing, take periodic water level measurements (at least once every five minutes) to determine if drawdown is occurring, and record the measurements on the well development record. If a well is pumped or bailed to dryness, then development will cease and not resume until the water level in the well recovers to approximately 80 percent of static, pre-development water level conditions.

While developing, calculate the rate at which water is being removed from the well. Record the volume on the Well Development From.

While developing, water is also periodically collected and readings taken of the indicator parameters: pH, specific conductance, oxidation/reduction potential, dissolved oxygen, turbidity, and temperature. Development is considered complete when the indicator parameters have stabilized (i.e., three consecutive pH, specific conductance, and temperature readings are within tolerances specified in the project-specific work plans or SAP, or within 10% if not otherwise specified) and the maximum turbidity is 50 nephelometric turbidity units (NTUs) or less, or the well develops dry. Additionally, three times the amount of water used during drilling and well installation activities will be removed during development of newly installed wells. In certain instances, for slow recharging wells or small-diameter wells, the parameters may not stabilize. In this case, well development is considered complete upon the removal of three times the amount of water used during drilling and well installation activities (if used) or when the best achievable water quality has been attained (i.e., no further improvement observed) using a combination of surging and pumping as described above.

Obtain a water level and turbidity measurement at the completion of development.

Complete documentation of the well development event on the Well Development Form. At a minimum, this record must contain:

- Project name and number;
- Well identification number;
- Well depth, casing size, and completion date;
- Method of development;
- Volume of water removed;
- Water levels (including the time of measurement);
- Physical description of the water (e.g., discoloration, turbidity, odor, etc.) and solids removed from the well;
- Test equipment readings for pH, conductivity, temperature, and turbidity (including the time of collection); and,
- Signature of the well development observer.

Collect and appropriately dispose of water removed from the well in accordance with criteria listed in the project-specific work plans and regulatory requirements.

Allow the well to recover for at least 24 hours prior to sampling, or the duration necessitated by geological and hydrogeological characteristics of the screened formation, or per applicable regulatory guidance.

REVIEW AND APPROVAL

QC Manager: Matt Brook 12/21/2020

Matt Brookshire

MMEC Group Quality Control Manager

Date

BOREHOLE ABANDONMENT

SOP Wood-06 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for field personnel to use in the supervision of borehole or soil boring abandonment and groundwater monitoring well abandonment activities. Additional specific borehole and well abandonment procedures and requirements will be provided in the projectspecific work plans.

2.0 SCOPE

These procedures apply to all Wood personnel and subcontractors who perform soil boring or monitoring well abandonment activities during per- and polyfluoroalkyl substances (PFAS) investigations. Procedures will also be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS)*. Installation activities will be compliant with guidelines outlined in *Per- and Polyfluoroaklyl substances (PFAS) Sampling Guidelines* (SWQCB, 2019).

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

U.S. Environmental Protection Agency (EPA), 1991. *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells,* EPA/600/4-89/034, U.S. Environmental Protection Agency, Office of Research and Development, March.

4.0 DEFINITIONS

Borehole Abandonment – The process whereby boreholes or soil borings are grouted or sealed following completion of drilling, sampling, and/or logging.

5.0 PROCEDURES

This section contains responsibilities, procedures, and requirements for borehole abandonment. Abandonment procedures to be used at a particular investigation area must incorporate project-specific regulatory requirements. Consequently, the project-specific work plans will identify the following:

- Abandonment objectives
- Boreholes to be abandoned
- Specific procedures for borehole abandonment beyond those covered in this SOP (e.g., state-specific procedures)
- Applicable site-specific regulatory requirements for borehole abandonment

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that sample collection activities are conducted in accordance with this SOP, SOP Wood-01 (PFAS) *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS),* and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodically observing field activities, and review of field generated documentation associated with this SOP. The Field Lead is also responsible for the implementation of corrective action (i.e., retraining personnel, additional review of the project-specific work plans and SOPs, variances to the abandonment requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

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 Project Manager or Field Lead.

5.2 FIELD PROCEDURES/CONSIDERATIONS

After drilling, logging, and/or sampling, boreholes should be backfilled by the method required by the applicable regulatory agency and described in the project-specific work plans. This typically consists of backfilling to the surface with bentonite chips, pellets, or bentonite-cement grout. If bentonite chips or pellets are used, they should be added to the borehole in 2-foot lifts and hydrated with water from a potable water supply. This process should be repeated until the entire borehole is plugged using no less than 5 gallons of water per ten feet of borehole. If bentonite grout is used, the following guidelines should be followed:

- Bentonite should be thoroughly mixed into the grout and within the percentage range specified in the project-specific work plans. If not otherwise specified in the project-specific work plans, the cement-bentonite grout mixture should be of the following proportions: 94 pounds of Portland cement, 5 pounds of powdered bentonite, and a maximum of 8 gallons of water. The grout is usually tremied into the hole; however, for selected boreholes (e.g., shallow borings well above the water table) at certain sites, the grout may be allowed to free-fall. In either case, care must be taken to ensure the grout does not bridge, forming gaps or voids in the grout column.

- The volume of the borehole prior to sealing should be calculated and compared to the grout volume used during abandonment to aid in verifying that bridging did not occur.

- When using a tremie pipe to place grout in the borehole, the bottom of the tremie should be submerged into the grout column and withdrawn slowly as the hole fills with grout. If allowing the grout to free-fall (and not using a tremie), the grout should be poured slowly into the boring. The rise of the grout column should also be visually monitored or sounded with a weighted tape.

- If the method used to drill the boring utilized a drive casing, the casing should be slowly extracted during grouting so that the bottom of the casing does not come above the top of the grout column.

- During the grouting process, the drilling hands performing the task should be supervised to assure that potentially contaminating material (oil, grease, or fuels from gloves, pumps, hoses, et al.) does not enter the grout mix and that personnel are properly wearing personal protective equipment as specified in the project Health and Safety Plan.

- Following grouting, barriers should be placed over grouted boreholes as the grout is likely to settle in time, creating a physical hazard. Grouted boreholes will typically require at least a second visit to “top off” the hole.
- The surface hole condition should match the pre-drilling condition (asphalt, concrete, or smoothed flush with native surface) unless otherwise specified in the project-specific work plans.

REVIEW AND APPROVAL

QC Manager: Matt Brook

12/21/2020

Matt Brookshire

Date

MMEC Group Quality Control Manager

SEDIMENT SAMPLING
SOP Wood-07 (PFAS)

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to describe the methodology for collecting sediment samples in order to document the horizontal and vertical extent of contaminated sediment and to determine the geotechnical, physical, and chemical properties of the sediment while conducting per- and polyfluoroalkyl substances (PFAS) investigation sampling.

2.0 SCOPE

This procedure applies to all Wood personnel and subcontractors who collect or otherwise handle sediment sampling during PFAS investigations. Sample collection will also be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS)*.

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

Environmental Protection Agency. 1984. Characterization of Hazardous Waste Sites - A Methods Manual, Available Sampling Methods. Volume II, 2nd Edition. EPA-600/4-84-076.

Southern California Coastal Water Research Project (SCCWRP). 2014. Sediment Quality Assessment Technical Support Manual. Technical Report 777. January.

4.0 DEFINITIONS

Composite Samples – Composite samples are a combination of sediment aliquots collected at various locations, or at various depths at a single location. Analysis of composite samples yields a value representing an average over the various sampled sites or depths from which individual samples were collected.

Discrete sample – Discrete samples are a discrete aliquot from a distinct sampling interval (of a specific sample size) that is representative of one specific location at a specific point in time**.**

Davit – A davit is a small crane on board the survey vessel used to lower and retriever sampling equipment.

Survey Vessel – The survey vessel is the ship, boat, or barge used to stage on water sediment sampling.

Van Veen Grab Sampler – A Van Veen Grab Sampler is a 0.1 square meter clamshell bucket used to sample the sediment surface in aquatic environments.

Vibracore – The vibracore unit includes the vibracore head (encased counter-rotating concentric vibrators), aluminum core barrel with HDPE liner, and the stainless steel core cutter. Vibracores are used to collect subsurface samples of unconsolidated sediment in aquatic environments by using high-frequency vibrations to cause liquefaction of the sediment in contact with the core barrel. This greatly reduces the friction between the core barrel and sediment and allows the vibracore to penetrate below the surface.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with sediment sampling for analysis of PFAS. Proper procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with installation-specific work plans and/or SAPs. The installation-specific work plans and/or SAPs will generally provide the following information:

- Sample collection objectives;
- Approximate locations and depths of sediment samples to be collected;
- Numbers and volumes of sediment samples to be collected;
- Types of analyses to be conducted for the samples;
- Specific quality control procedures required;
- Any additional sediment sampling requirements or procedures beyond those covered in this SOP, as necessary; and,
- At a minimum, the procedures outlined in this SOP for field sampling will be followed.

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that sample collection activities are conducted in accordance with this SOP, SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS),* and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodic observation of field activities and review of field generated documentation associated with this SOP. The Field Lead is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plan/SAP and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

Field personnel assigned to groundwater sampling 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 procedures to the Project Manager or Field Lead.

5.2 FIELD PROCEDURES/CONSIDERATIONS

Collecting sediment samples is an important site characterization activity. Sediment samples are used to determine the nature and extent of contamination, to identify hazardous substance source areas, and to determine the geotechnical, hydrogeologic, physical, and chemical properties of a site. Sediment sampling strategies will be determined and documented before initiating sampling. Field conditions at the investigation area may preclude collection at one or more predetermined sampling locations. Additional sediment sampling or relocation of sampling locations may be required if unexpected surface or subsurface conditions are encountered during the sampling which result in refusal for the sampling device(s). Proper sampling techniques, proper selection of sampling equipment, and proper decontamination procedures will eliminate cross-contamination and the introduction of contaminants from external sources. Sediment conditions can vary widely across a site. Such variations can affect the rate of contaminant migration through the sediment. Therefore, it is important that detailed records be maintained during sampling, particularly with respect to the sample location, depth, color, odor, lithology, and readings derived from field monitoring equipment. Surface and subsurface sediment samples shall be described utilizing the Unified Soil Classification System and / or ASTM guidance D2487 Standard Practices for Classification of Soils for Engineering Purposes (Unified Soil Classification System), unless otherwise specified by the installation-specific work plan.

The following are procedures/considerations to be made during field activities at potential PFAS release areas.

5.2.1 FIELD EQUIPMENT

Equipment and supplies used to collect, document, and package surface and subsurface sediment samples may include, but is not limited to, the following items:

- Nitrile gloves;
- Stainless steel spoons;
- Stainless steel Van Veen grab sampler;
- Vibracore with aluminum core barrel, stainless steel core cutter, and HDPE liner
- Stainless steel bowls/pans;
- Field tablets, logbooks, and core logs (Rite in the rain © products are the only waterproof field books that may be used, no other water resistant paper is allowed);
- Pens;
- Paper towels;
- Appropriate decontamination equipment;
- Appropriate personnel protective equipment and safety equipment as specified in the
- Health and Safety Plan and in other SOPs;
- Sample cooler with ice (no blue ice);
- Sample containers (no LDPE or glass) and labels;
- Bubble wrap;
- Chain-of-Custody forms;
- Munsell Color charts;
- Grain size charts;
- HDPE core liners;
- Ziplock freezer bags;
- Stainless steel deionized water spraying devices;
- Non PFAS plastic sheeting; and
- Non PFAS tape.

All field equipment and supplies will be considered using the Tiered Approach provided in Table 2 of SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS)* prior to use onsite.

5.2.2 SURFACE SEDIMENT SAMPLING

Van Veen Sampling

Surface sediment samples will be collected with a 0.1 square meter Van Veen grab sampler as either discrete or composite samples. The Van Veen will be deployed and retrieved from the survey vessel by winch and davit at each sampling location. Each surface sediment sample will be collected using a stainless steel spoon. Sediment in contact with the sampler walls will not be collected due to possible disturbance or contamination. The sampler, wearing clean disposable nitrile gloves, will remove pebbles, macrophytes, etc. from the mixture as the sample is collected and transferred to sample containers.

Each sediment sample fraction will be thoroughly mixed (i.e., homogenized) using the sampling spoon. The homogenized material will then be divided among the appropriate sample containers. The sample containers will then be sealed tightly. Care should be taken to ensure the container (bowl, pan, etc.) used for homogenization and the sampling utensils do not interfere with the analytes of interest (e.g., an aluminum pan should not be used for samples submitted for inorganic analyses; only stainless steel bowls are allowed).

All personnel who collect or handle the sediment samples will wear disposable nitrile gloves to prevent cross-contamination and provide personal protection. New gloves shall be donned for sample collection at each sampling location (i.e., at each new vertical or horizontal position), or whenever gloves are torn or otherwise compromised.

If collecting a composite sample, each aliquot will be collected by placing equal amounts of soil collected from multiple locations into a decontaminated collection container. The aliquots will then be combined (i.e. homogenized) using a spoon or trowel. The homogenized material will then be divided equally among the appropriate sample containers.

5.2.3 SUBSURFACE SEDIMENT SAMPLING

Vibracore Sampling

A vibracore sampler will be used to collect subsurface sediment samples. The procedure for collecting sediment samples using a vibracore should be outlined in the project work plans. The standard procedure is described below.

- Calibrate all field analytical and health and safety monitoring equipment.
- Wear the appropriate personal protective equipment.
- Between each sampling location and prior to each sampling run, decontaminate the sampler and other sampling equipment as described in SOP Wood-10.
- The vibrating unit of the vibracore will be attached to a 4-inch diameter aluminum core barrel with a stainless steel core cutter. To prevent cross contamination between the core barrel and each core attempt, the core barrel will be lined with a non-contaminating HDPE liner. After removing the core cutter and extracting the core from the core barrel, the vibracore technician will decontaminate the core barrel and core cutter, insert a new HDPE liner into the core barrel, and reattached the core cutter using rivets.
- Once the liner is inserted into core barrel and the core cutter attached, the vibracore unit will then be lowered by a hydraulic winch and vibrated until penetration to the desired depth. Vibracore penetration accuracy will be ±0.5 feet, and the target

penetration to the project design depth will be corrected for the tidal elevation at each coring location. NOAA charts or recent bathymetric data will be used to assess water depth, which will be verified using the survey vessel's fathometer and a weighted fiberglass tape. The penetration depth will be determined using a measuring tape attached with a shackle to the vibracore head. First, the length of the vibracore (vibracore head + core barrel + core cutter) will be measured. This length will then be subtracted from the water depth so that the vibracore may be lowered to the SWI before being engaged. Once at the SWI, the vibracore is activated using a control box on deck, and the vibracore is lowered using a hydraulic winch. The length of the measuring tape that is submerged once the vibracore begins penetrating the substrate indicates penetration depth.

- Once recovered and onboard the survey vessel, the actual length of the sediment extracted from the barrel is measured to determine the amount of sediment recovered. Field personnel will then immediately begin processing of the core on a polyvinyl chloride tray. Processing includes photography of each core as well as inspections for unique strata, color, odors, etc., as well as transcribing relevant information onto sediment core logs.
- Appropriately label and number each sediment sample container to be submitted for analysis.
- The label will contain, at a minimum, the following information:
  - Project number;
  - Sample ID;
  - Core attempt number;
  - Date and time of sample collection;
  - Parameters for analysis; and,
  - Sampler's initials.
- Document the sampling event on the sediment sample collection field sheet or an equivalent form as specified in the installation-specific work plan and/or SAP. The Field Manager will maintain a complete record of field activities, including the following information:
  - Date and time of collection;
  - Sample ID;
  - Sampling location (latitude and longitude);
  - Water depth(+0.1 ft);
  - Mudline elevation;
  - Tidal stage and currents;
  - Weather conditions;

  - Sampling method and any problems encountered (e.g., debris);
  - Sampler penetration;
  - Sample length;
  - Sample depth below mudline,
  - Description of the material type obtained in the samples;
  - Description of any vertical stratification in each core;
  - Description of sediment subsampling methods; and
  - Photograph of each core.

- Appropriately preserve (no blue ice permitted to cool samples), package, handle, and ship the sample in accordance with the procedures outlined in SOP Wood-11 and the installation-specific work plan and/or SAP. The samples shall also be maintained under proper chain of custody. Samples stored on-site will be subject to the provisions of SOP Wood-11.

- Repeat this sampling procedure at the intervals specified in the installation-specific work plan and/or SAP until the last sample is collected and processed.

REVIEW AND APPROVAL

QC Manager: Matt Brook

________________________________ 10/11/2021

Matt Brookshire Date

Quality Control Manager

SURFACE WATER SAMPLING

SOP Wood-08 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of surface water samples for laboratory analyses and water quality measurements. Proper collection procedures are necessary to assure the quality and integrity of all surface water samples. Additional specific procedures and requirements will be provided in the project-specific work plan and/or Sampling and Analysis Plans (SAP), as necessary.

2.0 SCOPE

This procedure applies to all Wood personnel and subcontractors with the responsibility for determining water quality in the field and for the collection, preparation, preservation, and submittal of surface water samples for laboratory analyses. Sample collection will also be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS)*. Sampling activities will be compliant with guidelines outlined in Per- and Polyfluoroaklyl substances (PFAS) Sampling Guidelines (SWQCB, 2019).

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

U.S. Environmental Protection Agency (U.S. EPA), 1987, *Compendium of Superfund Field Operations Methods*, EPA 540/P-87/001a, OSWER 9355.0-14, September.

U.S. EPA, 1988, *EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA*, Interim Final OSWER Directive 9355.3-01, August.

De Vera, E.R., B.P. Simians, R.D. Stephens, and D.L. Storm. 1990. *Samplers and Sampling Procedures for Hazardous Waste Streams*. EPA-600/2-80-018.

Korte, N. and P. Kearl. 1984. *Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells*. U.S. Department of Energy, Grand Junction, Colorado.

4.0 DEFINITIONS

Surface water – Includes all water on the surface of the ground directly exposed to the atmosphere, including, but not limited to, lakes, ponds, reservoirs, artificial impoundments, streams, rivers, springs, seeps, and wetlands.

Vernal pool – Temporary small, shallow bodies of freshwater that support communities of amphibians and invertebrates.

5.0 PROCEDURES

This section contains both the team member responsibilities and procedures involved with surface water sampling. Proper surface water sampling procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project-specific work plans/SAPs. The project-specific work plan/SAP will generally provide the following information:

- Sample collection objectives;
- Approximate locations and depths of surface water samples to be collected;
- Numbers and volumes of surface water samples to be collected;
- Types of analyses to be conducted for the samples;
- Specific quality control procedures required; and,
- Any additional surface water sampling requirements or procedures beyond those covered in this SOP, as necessary.

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that sample collection activities are conducted in accordance with this SOP, SOP Wood-01 (PFAS) *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS)*, and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodic observation of field activities and review of field generated documentation associated with this SOP. The Field Lead is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of project-specific work plans/SAPs and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

Field personnel assigned to surface water sampling 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 procedures to the Project Manager or the Field Lead.

5.2 FIELD PROCEDURES/CONSIDERATIONS

The following are procedures/considerations to be made during field activities at potential PFAS release areas.

5.2.1 EQUIPMENT SELECTION

For most investigation areas, a decontaminated bottle sampler attached to a pole (e.g., PVC pipe) can be used as the sampling device, or the sample container itself can serve as the sampling device.

There are several more sophisticated sampling devices that can be used to collect water at discrete depths in deep bodies of water (e.g., Van Dorn and Kemmerer samplers). However, for most routine area investigations of shallow lakes, ponds, and streams, this equipment is not necessary.

The following equipment will typically be used during surface water sampling events, compliant with SWQCB 2019 guidance:

- Water Quality Meter;
- Laboratory-provided sample containers;
- Self-adhesive sample bottle labels;
- High-density polyethylene (HDPE), stainless-steel, or glass beakers, dippers, bailers or other sampling device;
- Appropriate health and safety equipment specified in the Health and Safety Plan;
- Field notes and data sheets (e.g., sample collection form and Chain of Custody);
- Pen;
- Plastic bags (LDPE only);

- Cooler with ice (no blue ice); and,
- GPS receiver.

Laboratory-provided sample containers will be used to directly collect water samples if sample containers do not contain preservatives. Where required by site conditions, remote sampling into sample containers will be allowed by clamping the container onto the end of a clean extension rod. The extension rod must be made of material that does not include contaminants of interest (SWQCB, 2019).

Beakers or dippers (i.e., transfer containers) made of high-density polyethylene (HDPE) or polypropylene, which may be attached to extension rods, may be used if sample containers have preservatives or remote sampling site conditions prevent sampling by direct sample container immersion. The beakers or dippers will be obtained from a scientific instrument supplier so that the material composition of such a sampling container may be documented. The selected type of transfer device, the composition of this device, and the volume of the device will be recorded on the sample log. Bailers may be used if direct access to the sampling point can be reached. Sample transfer containers must be disposable or decontaminated prior to each use. Discrete depth sampling devices may be used when the project-specific work plan/SAP directs that specific depth intervals be sampled.

All field equipment and supplies will be considered using the Tiered Approach provided in Table 2 of SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS)* prior to use onsite. Sampling equipment will be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the project polyp-specific work plans/SAPs. Decontamination procedures will be performed in accordance with SOP Wood-10 (PFAS), *Equipment Decontamination*.

5.2.2 FIELD PREPARATION

Pre-Sample Planning

In general, surface water sample locations may include shallow or deep lakes, ponds and other types of impoundments, creeks and streams, ditches, low-lying areas, and intermittently wet drainage areas. These bodies of water may receive contaminant input from surface runoff; groundwater; or from direct discharge through a sluice, ditch, or pipe.

If up-to-date information is not available, conduct a reconnaissance of all planned surface water sample locations to determine accessibility to the water body, depth of water, dangerous conditions (e.g., strong currents, boggy bottoms, log jams or beaver dams, waterfalls, steep banks, thick vegetation, etc.), and sampling and personal protection equipment selection criteria. Access to water bodies such as streams may be hampered by thick vegetation, and lakes and ponds that will require the use of a boat may not be accessible by road. Therefore, the logistics of getting sampling equipment and containers to and from the investigation areas must be considered before attempting to sample.

As a general rule, samples should not be collected after heavy rains or during storm events because they will not be representative samples reflecting normal (i.e., baseline) conditions.

When surface water samples are collected at sediment sample locations, the surface water sample should be collected prior to the sediment sample (i.e., the sediment sample will suspend the fines), and the surface water sample should be collected no less than 1 foot above the sediment, unless samples are to be collected in a stratified water column. If samples are to be collected in a stratified water column, the sample depths will be specified in the project- specific work plans/SAPs.

The number of sample points, and the specific analytes to be measured, are provided in the project-specific work plans/SAPs. Sample locations and the number of samples collected will vary with the size of the water body and the nature of the source input.

Streams, Tributaries, and Creeks

In moving water bodies such as streams, tributaries, and creeks, sample points should be located where the water is homogeneous both horizontally and vertically. Samples should be taken far enough downstream from the source input for the discharge to be completely mixed. Locations immediately below riffle areas will be vertically mixed and narrow channel areas promote horizontal or cross-channel mixing. Sampling should take place downstream of riffle areas and narrow channel areas where low flow and minimal turbulence conditions are present. The selection of strategically located sample sites may depend on several factors, such as homogeneity, accessibility, intake points for water supplies, stream velocity, and geomorphology.

In general, a single grab sample collected at mid-depth in the center of the channel is adequate to represent the entire mixed cross-section of small streams less than 20 feet wide. The project-specific work plan/SAP will designate whether a single mid-point sample, vertical profile samples, or discrete depth samples are required. If vertical profile samples are specified in the project-specific work plan/SAP for larger and deeper streams or creeks, these samples should be taken from mid-stream just below the surface, at mid-depth, and just above the bottom and composited. If discrete depth samples are specified by the project-specific work plan/SAP, these samples should be taken at the desired depths, if possible. The pH, temperature, specific conductivity, oxidation-reduction potential, and dissolved oxygen should be measured for each sample point when vertical composite samples are collected. The number of vertical composites and the depths sampled are determined in the project-specific work plan/SAP. Water depth can either be measured with a graduated staff (e.g., yardstick) at shallow depths or with one of various manual or electronic devices available for deeper depths.

Stagnated areas or pools in a stream or creek could contain different contaminant concentrations than those from the flowing areas, depending on the physical and chemical properties of the contaminant and the proximity of these areas to the source. A sample may be taken at mid- depth to determine if these areas represent contaminant sinks.

Lakes, Lagoons, Ponds, and Impoundments

The selection of representative sample points in standing bodies of water depends on the size, shape, and depth of the basin, and will be specified in the project-specific work plan/SAP. Samples can be collected along a vertical transect and/or horizontal grid. The project-specific work plan/SAP will designate whether a single mid-point sample, vertical profile samples, or discrete depth samples are required. In larger basins, stratification may inhibit uniform vertical mixing. In these instances, discrete depth samples may be collected at each stratification layer. In smaller basins, such as ponds, lagoons, and impoundments, the entire water column is generally uniformly mixed and one sample at the deepest point may be adequate. The deepest point is usually in the center of small ponds and other containment catch basins. For impoundments with a dam, the deepest point is generally near the base of the dam. Water depth can either be measured with a graduated staff (e.g., yardstick) at shallow depths or with one of various manual or electronic devices for deeper depths.

Wading into the water body to collect samples is not recommended in shallow lakes and ponds. Wading will disturb bottom sediments, which may contaminate the water column resulting in a false positive parameter result. Therefore, a boat is typically used to collect representative water samples in lakes, lagoons, ponds, and impoundments.

Equipment Decontamination

Before sampling begins, sampling devices (e.g., bailers, beakers, dippers, etc.) shall be decontaminated. Mobile decontamination supplies may be utilized so that equipment can be decontaminated on-site. Each piece of sampling equipment shall be decontaminated before sampling operations and between sampling locations. Decontamination of field equipment will be performed in accordance with SOP Wood-10 (PFAS).

5.2.3 GENERAL SAMPLING PROCEDURES

- Samples will be collected first from areas that are suspected of being the least contaminated to minimize the risk of sample cross-contamination. In flowing water bodies, sampling shall progress from downstream to upstream to avoid sediment disturbance affecting subsequent samples.
- Prior to sampling, the water body characteristics (e.g., size and depth) should be observed
- and described in the field logbook.
- Collect X-Y coordinates of the sample location using a portable GPS instrument. If a GPS is ineffective due to the terrain or tree canopy, mark the location in the field with a stake or flag after sampling is complete.
- Don a clean pair of powderless nitrile gloves.
- Surface debris (i.e., sticks, leaves, vegetation) will be cleared from the sample location prior to sample collection, taking care not to disturb bottom or attached sediments.
- Measure water quality parameters (pH, dissolved oxygen, specific conductivity, oxidation-reduction potential, and temperature) at each sample location prior to collecting a water sample. Samples for water quality parameters will be collected in a separate container at a like location and depth as the samples for laboratory analysis.
- Collect the sample in accordance with the appropriate method-specific procedures in Section 5.2.4.
- Document the sampling event on the sample collection form. As soon as possible after sample collection, place the sample in a separate, appropriately sized, airtight, seam sealing, polyethylene bag (i.e., Ziploc®). Seal the bag, removing any excess air. Place the bagged sample inside the shipping container. Handle and ship the sample according to the procedures outlined in SOP Wood-11 (PFAS), following appropriate chain of custody procedures. Samples stored temporarily on-site will be maintained per SOP Wood-10 (PFAS).

Note: Collection of surface water samples in deep-water areas may require the use of a boat. The Project Manager and Health and Safety Manager shall be consulted for additional health and safety requirements.

5.2.4 METHOD SPECIFIC SAMPLE COLLECTION PROCEDURES

Samples Collected by Container Immersion

Surface water sample collection by container immersion will be done in accordance with the following procedures:

- The outside of all capped sample containers shall be triple rinsed with the surface water being sampled before filling the containers with the sample to be analyzed.
- Submerge the sample container or transfer container below the water surface with minimal surface disturbance and with the open end pointed upstream.
- If possible, the sample container or transfer container will be lowered no closer than 3 to 6 inches above the bottom sediments.

Samples Collected by Bailer

Surface water sample collection with a bailer will be done in accordance with the following procedures:

- A disposable HDPE bailer or equivalent will be used;
- Depth of water at each sampling site will be measured and the bailer will be lowered to the appropriate sampling location in accordance with the sampling plan;
- If possible, the bailer will be lowered no closer than 3 to 6 inches above the bottom
- sediments;
- The bailer will be inserted facing downstream and withdrawn very slowly and carefully to avoid agitation of the bottom sediments; and,
- Transfer the sample from the bailer directly into the sample container. Minimize aeration of the sample as much as possible.

Samples Collected by Discrete Depth Sampling Devices

Surface water sample collection with a discrete depth sampling device will be done in accordance with the following procedure:

- A Van Dorn® sampler, Kemmerer® sampler, or equivalent will be used.
- Depth of water at each sampling site will be measured and the sampling device will be lowered to the appropriate sampling depth in accordance with the project-specific work plan/SAP.
- If possible, the sampling device will be lowered no closer than 3 to 6 inches above the bottom sediments.
- The sampling device will be lowered facing upstream and opened once at the desired sampling depth. The device will be withdrawn very slowly and carefully to avoid agitation of the bottom sediments.

- Transfer the sample from the device directly into the sample container. Minimize aeration of the sample as much as possible.

6.0 RECORDS

Field notes shall be recorded on the Daily Field Record and Surface Water Sampling Form. The following information is required according to the sampling method performed:

- GPS coordinates, or distance to two fixed objects, or distance and compass bearing from at least one fixed object;
- Distance of sample collection point from right or left edge of water;
- Water depth;
- Estimate of surface area of water body;
- Sample depth interval;
- Sample collection method (grab, discrete);
- Surface water and investigation area conditions (e.g., floating oil or debris, gassing, etc.);
- Location of any discharge pipes, sewers, or tributaries;
- Instrument calibration;
- Required investigation area maps (If a staff gauge is measured and not co-located with surface water location it must be included in the investigation area map).; and,
- Weather observations (e.g., wind speed, is it sunny or cloudy, and approximate wave height).

REVIEW AND APPROVAL

QC Manager: Matt Brook

Matt Brookshire
MMEC Group Quality Control Manager

12/21/2020
Date

GROUNDWATER TREATMENT SYSTEM INFLUENT AND EFFLUENT SAMPLING
SOP Wood-09 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the collection and documentation of the collection of, influent and effluent samples from groundwater treatment systems for per- and polyfluoroalkyl substances (PFAS) chemical analysis. Proper collection procedures are necessary to assure the quality and integrity of all samples. Additional investigation area specific information or procedures and applicable area and system specific requirements will be provided in the installation-specific work plans, as necessary.

2.0 SCOPE

This procedure applies to all Wood personnel involved in the sampling of groundwater treatment systems. Sample collection will also be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of per- and polyfluoroalkyl substances (PFAS)*. Construction and operation of systems will vary; therefore, this SOP may not be applicable to all situations.

This procedure has been developed to serve as management-approved professional guidance for the Wood Program. As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment to accommodate unforeseen circumstances. Deviation from this procedure in planning or in the execution of planned activities must be approved by the Project Manager.

3.0 REFERENCES

Barcelona et al, 1985, *Practical Guide for Groundwater Sampling, Illinois State Water Survey, Champaign, Illinois, ISWS Contract Report 374*, November.

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. *Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines*. September.

U.S. Environmental Protection Agency (EPA), 1987, *Compendium of Superfund Field Operations, Methods*, EPA 540/P-87/001a, OSWER 9355.0-14, September.

EPA, 1988, *EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA, Interim Final OSWER Directive 9355.3-01*, August.

EPA, 1992, *EPA RCRA Groundwater Monitoring: Draft Technical Guidance*, November.

4.0 DEFINITIONS

Effluent – Treated groundwater exiting a groundwater treatment system.

Influent - Un-treated groundwater entering into a groundwater treatment system.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with groundwater treatment system sampling. Proper groundwater treatment system sampling procedures are necessary to ensure the quality and integrity of the samples. The details within this SOP should be used in conjunction with installation-specific work plan and or Sampling and Analysis Plan (SAP). The installation-specific work plan and/or SAP will generally provide the following information:

- Sample collection objectives;
- Locations of groundwater treatment system samples to be collected;
- Numbers and volumes of samples to be collected;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control (QC) procedures and sampling required;
- Any additional groundwater treatment system sampling requirements or procedures beyond those covered in this SOP, as necessary; and,
- At a minimum, the procedures outlined in this SOP for groundwater treatment system sampling will be followed.

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that sample collection activities are conducted in accordance with this SOP, SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS),* and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodic observation of field activities and review of field generated documentation associated with this SOP. The Field Lead is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plan/SAP and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

Field personnel assigned to groundwater sampling 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 procedures to the Project Manager or Field Lead.

5.2 METHOD SUMMARY

The basic procedures for sampling groundwater treatment systems are similar to those for sampling of groundwater monitoring wells, as specified in Groundwater Sampling SOP Wood-03 PFAS), and sampling of private and public supply wells, as specified in Private and Public Water Supply Well Sampling SOP Wood-13 (PFAS). The procedure can be summarized as follows.

- Sampling equipment will be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the installation-specific work plans. Decontamination procedures will be performed in accordance with SOP Wood-10 (PFAS), *Equipment Decontamination*. Purge water until specific parameters have stabilized, toward ensuring formation water (as opposed to stagnant well water) will be sampled;
- Collect samples in laboratory-supplied containers; and
- Follow standard sample handling and custody procedures to contain and transport samples to the off-site laboratory.

5.3 FIELD PROCEDURES

Field procedures will incorporate other applicable project-specific SOPs, particularly SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross-Contamination of per- and polyfluoroalkyl substances (PFAS)*. All field equipment and supplies will be considered using the Tiered Approach provided in Table 2 of SOP Wood-01 (PFAS) prior to use onsite.

Treatment Plant Access

Contact treatment plant personnel prior to sampling to procure access and to confirm applicable site specific and system specific health and safety requirements.

Influent and Effluent Sampling Considerations

Upon arriving at treatment plant, the treatment plant operator will inform the sampler if the treatment system is operating or if it is off. The operator will also show the sampler the location of the sampling ports. A design drawing of the treatment system should be obtained to identify the source of wastewater from sampling ports and determine the appropriate sampling location. If the treatment system is off, the sampler will wait until the operator starts the system. Once the system is operating, sampling will be performed as described below. If the treatment plant is operating upon arrival, perform the minimum one minute purge and sample as described below.

- Inspect the laboratory provided sampling bottles prior to sampling to ensure that they are appropriate for the samples being collected, are undamaged, and have had the appropriate types and volumes of preservatives added. The types of sample containers to be used and sample preservation requirements will be provided in the installation specific work plan addendums.
- Open the sampling port.
- Purge for a minimum of 1 minute, a high flow volume into a bucket to flush the sampling port tube.
    - During the purge, collect one set of physical parameters (i.e., pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature).

Table 4-1

Parameter	Units
pH	Standard Units
Specific Conductivity	Micromhos/centimeter (umho/cm, or µS/cm)
Temperature	Degrees Celcius (˚C)
Oxidation-Reduction Potential (ORP)	Millivolts (mV)
Dissolved Oxygen	Milligrams/liter (mg/L)
Turbidity	Nephelometric Turbidity Units (NTUs)

- Upon completion of the one minute purge, adjust the flow rate downward prior to filling the laboratory supplied sample bottles.

- Collect the sample directly into the approved sample bottle(s), allowing the discharge to flow gently down the inside of the bottle, minimizing aeration of the sample.
- Document the sampling event on the Groundwater Sample Collection Form, or equivalent.
- Document the sampling location/sample port on the system drawing and take a photograph of the sample location for project records. Ensure that the sample location (influent/effluent) is recorded in the sample notes and description.
- Appropriately seal, store, handle, and ship the samples per SOP Wood-11.
- Sample both the effluent and influent ports following the same procedures.
- Upon completion of sampling, empty the purge water from the bucket into a location determined by the treatment plant operator.

As the sample is collected directly into the laboratory provided container and directly from the system itself, there is no decontamination required, though fresh gloves should be donned prior to each sampling event at each port.

REVIEW AND APPROVAL

QC Manager:

Matt Brook

12/21/2020

Matt Brookshire

MMEC Group Quality Control Manager

Date

EQUIPMENT DECONTAMINATION
SOP Wood-10 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines for use by field personnel in the decontamination of drilling, sampling, development, and heavy equipment. The details within this SOP are applicable as general requirements for drilling and heavy equipment decontamination and should also be used in conjunction with project-specific work plan and/or Sampling and Analysis Plan (SAP).

2.0 SCOPE

These procedures apply to all Wood personnel and subcontractors who prepare equipment for use during investigation at potential per- and polyfluoroalkyl substances (PFAS) release areas. This SOP should be reviewed by all on-site personnel prior to implementation of field activities. Decontamination activities will be compliant with guidelines outlined in *Per- and Polyfluoroaklyl substances (PFAS) Sampling Guidelines* (SWQCB, 2019)

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines. September.

U.S. Environmental Protection Agency (U.S. EPA), 1987, *Compendium of Superfund Field Operations Methods*, EPA 540/P-87/001a, OSWER 9355.0-14, September.

U.S. EPA, 1988, *EPA Guidelines for Conducting Remedial Investigation and Feasibility Studies under CERCLA*, Interim Final OSWER Directive 9355.3-01, August.

U.S. EPA, 1991, *Management of Investigation Derived Wastes During Site Inspections*, EPA 540/G-191/009, May.

4.0 DEFINITIONS

Heavy Equipment – Drill rigs, excavators, dozers, back-hoes, trucks, or other similar type machinery used to drill soil borings, install groundwater monitoring wells, break concrete, excavate soil or other similar type activity.

Laboratory Grade Detergent – A standard brand of laboratory-grade detergent, such as “Alconox” or “Liquinox.”

Potable Water – Water dispensed from a municipal water system or a water supply well used and approved for drinking.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with equipment decontamination. Proper decontamination procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with project-specific work plan/SAP. The work plan/SAP will generally provide the following information:

- Sample collection objectives;
- Specific quality control (QC) procedures and sampling required; and
- Management procedures for investigation derived waste (IDW).

At a minimum, the procedures outlined in this SOP for equipment decontamination and the *SOP Wood-01 (PFAS) Field Sampling Protocols to Avoid Cross-Contamination of Per- And Polyfluoroalkyl Substances (PFAS)* will be followed.

5.1 RESPONSIBILITIES

Compliance with this procedure is the responsibility of project management and field personnel. This SOP and the project-specific work plan/SAP should be reviewed before implementing drilling, sampling, development, and heavy equipment decontamination at the project investigation area.

Project Manager

The Project Manager is responsible for ensuring that decontamination of drilling, sampling, development and heavy equipment is conducted in accordance with this SOP and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead has the responsibility for periodic review of procedures and documentation associated with the decontamination of equipment. The Field Lead is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of project-specific work plan/SAP and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

Field personnel assigned to monitor the subject decontamination activities are responsible for ensuring these tasks are completed according to specifications outlined in this SOP and other appropriate procedures. All staff are responsible for reporting deviations from procedures to the Project Manager or the Field Lead.

5.2 GENERAL

This section provides requirements for the construction of a temporary decontamination facility for drilling, development, and heavy equipment and the decontamination procedures to be followed. The project-specific work plan/SAP will provide detailed information regarding:

- Types of equipment requiring decontamination under this SOP;
- Location of the decontamination station;
- Types and/or specifications on materials to be used in the fabrication of the decontamination station; and,
- Types of materials and additional details on the procedures to be used in the decontamination process.

Field personnel associated with construction of the decontamination station or decontamination of drilling or heavy equipment must read both this SOP and the project-specific work plan/SAP prior to implementation of related decontamination activities.

5.3 DECONTAMINATION FACILITY

A decontamination facility will be set up in an area exclusively for decontamination of drilling, sampling, well development, and/or heavy equipment. Decontamination of equipment will be conducted within the station.

At a minimum, the station will be constructed such that all rinsates, liquid spray, soil, debris, and other decontamination wastes are fully contained and may be collected for appropriate waste management and disposal. The facility may be as simple as a bermed pad lined with polyethylene sheeting with an impermeable sump for collecting rinse water. More sophisticated designs involving self-contained metal decontamination pads in combination with bermed polyethylene sheeting may also be used, depending on project-specific requirements. These requirements along with specific equipment and construction specifications for the decontamination facility will be provided in the project-specific work plan/SAP.

5.4 DECONTAMINATION PROCEDURES

Each piece of drilling and sampling equipment shall be decontaminated daily before initiation of sampling operations and between each sample location and interval. Decontamination solutions shall be replenished between sampling locations as needed. Spent decontamination fluids will be containerized, properly labeled and appropriately disposed of according to the investigation derived waste (IDW) plan addressed in the project-specific work plan/SAP.

5.4.1 DOWNHOLE EQUIPMENT

Downhole drilling, sampling, and development equipment (including but not limited to drill pipe, drive casing, drill rods, bits, tools, non-disposable bailers, etc.) will be thoroughly decontaminated before mobilization to each investigation area and between borings or wells at each investigation area or as required in the project-specific work plan/SAP. The standard procedure will be performed as described below.

- Appropriate personal protective equipment (as specified in the project-specific work plan/SAP) must be worn by all personnel involved with the subject task to limit personal exposure.
- Equipment caked with drill cuttings, soil, or other material will initially be scraped or brushed. The scrapings will be containerized and appropriately disposed.
- Equipment will then be sprayed with potable water using a high-pressure washer.

- Washed equipment will then have a final rinse with laboratory provided certified PFAS-free deionized (DI) water as defined in SOP Wood-12 (PFAS).
- Decontaminated downhole equipment (e.g., drill pipe, drive casing, bits, tools, bailers, etc.) will be placed on clean plastic sheeting to prevent contact with contaminated soil and allowed to air dry. If equipment is not used immediately, it will be covered or wrapped in plastic sheeting to minimize airborne contamination (i.e., dust).
- Field sampling equipment and other downhole equipment used multiple times at each sample location will require cleaning between uses utilizing a four-stage decontamination process. The equipment will first be rinsed in a bucket containing a mixture of potable water and soap. Alconox® and Liquinox® soap is acceptable for use since the Safety Data Sheets do not list fluoro-surfactants as an ingredient. The equipment will then be rinsed in each of two buckets of clean potable water. Decontamination of sampling equipment will bed triple-rinsed with laboratory-provided certified PFAS-free DI water as defined in SOP Wood-12 (PFAS), or DI or municipal water that has been documented as PFAS-free.
- Decontamination activities will be documented by the Field Lead or other field personnel in the field log and/or appropriate form(s), as specified in the project-specific work plan/SAP.

5.4.2 HEAVY EQUIPMENT

Heavy equipment (e.g., drill rigs, development rigs, backhoes, trucks, and other earthmoving equipment) will be decontaminated between drilling locations and at the decontamination facility upon entering and prior to leaving the installation. Decontamination will be performed in accordance with the project-specific work plan/SAP. The standard procedure will be performed as described below.

- Appropriate personal protective equipment will be worn by all personnel involved in the task, in order to limit personal exposure.
- Heavy equipment caked with drill cuttings, soil, or other material will be initially scraped or brushed to remove bulk soil and containerized in accordance with the project-specific work plan/SAP.
- Heavy equipment will then be moved to the decontamination pad and sprayed with potable water using a high-pressure washer.
- Heavy equipment will then be rinsed with laboratory provided certified PFAS-free DI water as defined in SOP Wood-12 (PFAS).

- During the decontamination effort, fluid collection and containment systems should be inspected for any leaks or problems, which might potentially result in an inadvertent release at the investigation area, thereby contributing to the volume of waste or contamination. Any identified problems should be immediately repaired and documented.
- Decontamination activities will be documented in the field log and/or appropriate form(s), as specified in the project-specific work plan/SAP.
- Between boreholes at the same location the back-end of the drilling rigs will be washed with potable water until surfaces are visibly free of soil buildup.

REVIEW AND APPROVAL

QC Manager: Matt Brook

12/21/2020

Matt Brookshire

Date

MMEC Group Quality Control Manager

SAMPLE HANDLING AND CUSTODY
SOP Wood-11 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures for use by field personnel in the handling and custody procedures for environmental samples. Proper sample handling and collection procedures are necessary to assure the quality and integrity of media samples. Additional specific procedures and requirements will be provided in the project-specific work plan and/or Sampling and Analysis Plan (SAP), as necessary.

2.0 SCOPE

This procedure applies to all Wood personnel and subcontractors collecting environmental per- and polyfluoroalkyl substances (PFAS) samples.

3.0 REFERENCES

U.S. Environmental Protection Agency (U.S. EPA), Office of Emergency and Remedial Response, EPA/540/R-96/0, Dec 96 -*Sampler's Guide to the Contract Laboratory Program.*

U.S. EPA, Office of Emergency and Remedial Response, EPA/540/R-941/013, Feb 94 - *User's Guide to the Contract Laboratory Program.*

United States Department of Defense (DoD), *Quality Systems Manual for Environmental Laboratories, Version 5.3*, May.

American Society for Testing and Materials. 2018. *Standard Guide for Sampling Chain-of-Custody Procedures*. D 4840-99.

4.0 DEFINITIONS

Chain-of-Custody Record – legal documentation of custody of sample materials and instructions for analytical laboratory.

Custody – physical possession or control. A sample is under custody if it is in possession or under control so as to prevent tampering or alteration of its characteristics.

Sample Label – a record attached to samples to ensure legal documentation of traceability.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with sample handling and chain of custody. An essential part of the sampling activities of any environmental project is assuring the integrity of the sample from collection to data reporting. Sample labels and chain-of-custody forms are used to document identification and handling of samples from the time of collection through the completion of chemical analysis. In some projects, analytical data may be used in litigation. Accountability of the history of a sample must be available to demonstrate that the data are a true representation of the media sampled. The chain-of-custody record is used as evidence in legal proceedings to demonstrate that a sample was not tampered with or altered in any way that may bias the analytical accuracy of the laboratory results. It is extremely important that chain-of-custody records be complete, accurate and consistent. At a minimum, the procedures outlined in this SOP for sample handling and chain of custody will be followed.

5.1 RESPONSIBILITIES

Compliance with this procedure is the responsibility of project management and field personnel. This SOP and the project-specific work plan/SAP should be reviewed before sample handling at the project investigation area.

Project Manager

The Project Manager is responsible for ensuring that sample handling and custody activities are conducted in accordance with this SOP and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead shall ensure that the samples are correctly collected, labeled, tracked by chain-of-custody, and stored until they are delivered directly to the shipper or laboratory (i.e., on-site or off-site).

Field Personnel

Sample Collector

The Sample Collector shall ensure the samples are correctly collected compliant with SWQCB guidance (2019), labeled, tracked by chain-of-custody, and stored until they are delivered directly to the Sample Shipper or laboratory (i.e. on-site or off-site). The Sample Collector shall maintain custody of the samples until they are relinquished to the Sample Shipper or laboratory. The Sample Collector shall be responsible for informing the Sample Shipper of sampling conditions and if any of the samples are potentially hazardous. Note: The Sample Collector and Sample

Shipper can be the same person.

Sample Shipper

The Sample Shipper shall pack the sample shipping coolers, ensure that the chain-of-custody forms are correct, and ship and/or deliver the samples to the laboratory. The Sample Shipper shall determine which samples are potentially hazardous and ship them accordingly.

5.2 SAMPLE CUSTODY

Sample custody procedures are designed to ensure that sample integrity is maintained from collection to final disposition. A critical aspect of sound sample collection and analysis protocols is the maintenance of strict chain-of-custody procedures as described in this technical procedure. Chain-of-custody procedures include tracking and documentation during sample collection, shipment, and laboratory processing. A sample is considered to be in an individual's custody if it is: (1) in the physical possession of the responsible party; (2) in view of the responsible party after being in their possession (3) secured to prevent tampering; or (4) placed in a designated, secure area that is controlled and restricted by the responsible party.

Custody will be documented throughout all sampling activities on the chain-of-custody record for each day of sampling. This record will accompany the samples from the investigation area to the laboratory. All personnel with sample custody are required to sign, date, and note on the record the time when receiving and relinquishing samples from their immediate custody. Any discrepancies will be noted at this time. Samples will be shipped to subcontract laboratories via overnight air courier, ground shipping or received by a laboratory provided courier. Bills of lading will be used as custody documentation during this time and will be retained as part of the permanent sample custody documentation. In some cases, samples may be hand delivered to the laboratory by the Sample Collector and/or Sample Shipper; hand delivery will be noted on the chain-of-custody form. The subcontractor laboratory is responsible for sample custody once samples are received.

5.3 SAMPLE LABELS

A label will be attached to all sample containers at the time of sample collection. The label will contain the following information:

- Unique chain-of-custody control number;
- Sample identification (ID)
- Analyses requested; and,

- Preservative used, if applicable.

When sample collection is complete; the Sample Collector fills in the following information in ink:

- Date and time of sample collection; and,
- Sampler’s initials.

5.4 CHAIN-OF-CUSTODY RECORDS

Chain-of-custody forms will be used to document the integrity of all samples to maintain a record of sample collection, transfer of samples between personnel, shipment of samples, and receipt of samples at the laboratory. Each sample/analysis at each sampling location will be logged onto a chain-of-custody form. The chain-of-custody forms shall include the following information:

- Project name and project number, if applicable;
- Name and address of laboratory to receive the samples;
- Chain-of-custody control number;
- Sample type, sample method;
- Location ID, sample ID;
- Matrix code;
- Analyses requested;
- Field QC for matrix spike (MS)/matrix spike duplicate (MSD), if applicable;
- Container type, size and number;
- Preservatives used, if applicable;
- Turn-around-time for laboratory analysis; and,
- Comments to Laboratory or Sample Collector, if applicable.

The Sample Collector will enter the following information using black or blue ink:

- Sampler’s initials;
- Date of collection;
- Time of collection (24-hour format);
- Depths, if applicable;
- Pump/equipment number, if applicable; and,
- Void reason, if applicable.

The Sample Collector shall verify the chain-of-custody record is complete, accurate in all aspects, and consistent with all other sample documentation (e.g. number of samples, sample labels, field logs). The Sample Collector will sign the "Sampled By” and “Relinquished By" fields on the chain-of-custody record, marking the date and time custody is transferred to the Sample Shipper or other authorized person.

The Sample Shipper will perform the following duties:

- Obtain the signature of the Sample Collector, on the chain-of-custody form, to transfer sample custody;
- Record the carrier service and any shipment airbill or tracking numbers on the chain-of-custody;
- Sign and enter the date and time relinquished to the shipper; and,
- Prepare the samples for shipment from the field to the laboratory.

The Sample Shipper will sign the "Received By" box, marking the date and time of receipt of the samples from the Sample Collector or other sample custodian. Every transfer of physical custody shall be documented on the chain-of-custody record.

Any corrections to the chain-of-custody form entries will be made by a single-line strike mark through the incorrect item, and then entering the correct entry adjacent to the strikeout item. Corrections will be initialed and dated by the person making the change. After the form has been inspected and determined to be complete, the sample shipper will sign, date, and note the time of transfer and will reference a shipper tracking number on the form. The chain-of-custody form will be placed inside the cooler after the sample packer has detached or made an appropriate copy of the form. Field copies of the completed chain of custody forms maintained in project files.

5.5 SAMPLE STORAGE

In some cases, samples that cannot be shipped immediately to a laboratory must be temporarily stored in a Wood controlled sample refrigerator until arrangements can be made for delivery. The Sample Collector or Shipper shall place samples and signed chain of custody record(s) in the refrigerator and secure the refrigerator with a unique, keyed lock, restricting access to one field personnel at a time. A temperature blank must accompany all samples.

Samples temporarily stored in the refrigerator must be received by the field personnel that placed them in storage, and in turn, may be “relinquished to” the appropriate laboratory, the Sample Shipper or another sample custodian. Each transfer of custody shall be recorded on the appropriate chain-of-custody form(s).

6.0 RECORDS

Distribution of the chain-of-custody record:

- Original form sealed in a plastic bag and taped inside the top of the shipping container for laboratory receipt; and,
- Copies to the Project Manager.

REVIEW AND APPROVAL

QC Manager: Matt Br

12/21/2020

Matt Brookshire

MMEC Group Quality Control Manager

Date

PROTOCOL TO PROVIDE WATER FREE OF PER- AND POLYFLUOROALKYL SUBSTANCES FOR COLLECTION OF FIELD BLANKS AND EQUIPMENT BLANKS

SOP Wood-12 (PFAS)

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and limit trace per- and polyfluoroalkyl substances (PFAS) detections introduced through low-level PFAS contamination in the laboratory-supplied water used for field blanks, equipment blanks, and decontamination of sampling equipment; ambient PFAS contamination from atmospheric conditions or sample containers; or decontamination procedures. The following procedures will be used to provide traceable PFAS-free water for equipment decontamination, field blanks, and equipment blanks.

2.0 SCOPE

This procedure applies to all Wood personnel and subcontractors who use or provide PFAS-free water for field blanks, equipment blanks, and equipment decontamination.

3.0 REFERENCE

Department of Defense (DoD, 2019. *Quality Systems Manual for Environmental Laboratories, Version 5.3*. July.

United States Environmental Protection Agency (U.S. EPA), 2014. SW-846 Update V *Compendium Chapter 1 Quality Control*, Revision 2. July.

4.0 DEFINITIONS

Per the U.S. EPA definition (2014), water will be defined as being PFAS-free if there are no target analyte detections at concentrations greater than ½ the LOQ (as defined by DoD 2019) or 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater. Target analyte detections in the equipment blanks that exceed the performance criteria at or greater than half the LOQ will disqualify all the water in the associated batch from being used for equipment decontamination, field blanks, or equipment blanks.

5.0 GENERAL

Given the low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFAS, laboratory and field personnel are advised to act on the side of caution by strictly following these protocols. All field work will be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS)*.

6.0 RESPONSIBILITIES

Analytical Laboratories

The analytical laboratories will be responsible for providing Wood with certified PFAS-free deionized (DI) water to use for field and equipment blanks. The laboratories must certify that each batch of deionized water is PFAS-free following the procedures specified below before shipment to the field. Procedures to be used for certification of the PFAS-free water are:

1) If the laboratory provides water from its internal ultrapure water system, that water must be used for the routine preparation of method blanks for PFAS analysis, and the laboratory must provide documentation, upon request, that their water used is certified PFAS-free:

2) If the laboratory provides purchased ultra pure water to Wood for equipment decontamination and blanks, the laboratory must analyze an aliquot of each manufacturer's batch before the water is shipped to Wood. If target analytes are detected in the water at concentrations equal to or greater than half the LOQs specified in **the project-specific work plan (WP)/sampling and analysis plan (SAP)** the water must be considered contaminated, and it will not be shipped to Wood. The manufacturer name and batch or lot number will be used for purposes of maintaining traceability of purchased water.

If target analytes are not detected at concentrations equal to or greater than half the LOQs specified in **the project-specific WP/SAP**, the water is suitable to be shipped to Wood. The laboratory must provide a certificate of analysis with results for the water batch to the Wood's Project Chemist, or designee, before the water is shipped to the field. Each batch of PFAS-free water must be clearly marked with a unique batch identification number. Currently no guidance exists regarding an official expiration date for the certified PFAS-free DI water, however industry leaders suggest not using a batch past 6 months of the certification date.

Wood

Prior to use, the field crew will confirm that the lab has provided certified PFAS-free water by analyzing an aliquot of the water before shipment. If the source water comes from outside a lab, an aliquot must be taken and analyzed to confirm that the water is PFAS-free before using it. Before sample collection, field crews will decontaminate the equipment with potable water as specified in the SOP Wood-10 and will use the PFAS-free water as a final rinse. During sampling, field crews will collect equipment blanks at a frequency of 1 per day of sampling when using non-dedicated sampling equipment.

Wood field crews will clearly associate field blanks and equipment blanks with the associated field samples on daily field forms and/or in an electronic sample tracker. The Wood Chemist will maintain records of the source water, equipment blank, and field blank analytical data. Wood will periodically evaluate the data to identify any trends or anomalies that warrant a change of this or other field sampling procedures.

7.0 EVALUATION

This procedure will provide documentation that the source water used for equipment rinsing and blanks is PFAS-free, with PFAS levels less than less than half the LOQ. Wood will track analyte concentrations in the water from shipment from the laboratories to the field, and ultimately to the water's use to rinse sampling equipment. This will eliminate concern about the PFAS-free water itself as a source of contamination and facilitate evaluation and identification of sources or actions that contribute to cross-contamination, so that the project team can adjust procedures if needed. The blanks dataset will be used as part of Wood's overall quality control assessment of ambient sources of PFAs contamination relative to sample concentrations.

REVIEW AND APPROVAL

QC Manager: Matt Brook

12/21/2020

Matt Brookshire

MMEC Group Quality Control Manager

Date

PRIVATE AND PUBLIC WATER SUPPLY WELL SAMPLING

SOP Wood-13 (PFAS)

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes guidelines and procedures by which Wood personnel should conduct groundwater sampling at private and public water supply wells that may contain per- and polyfluoroalkyl substances (PFAS). Proper procedures are necessary to assure the quality and integrity of analytical results. Additional specific procedures and requirements will be provided in installation-specific work plan, Sampling and Analysis Plan (SAP), and/or field work notifications, as applicable.

2.0 SCOPE

This procedure applies to all Wood personnel involved in the sampling of private and/or public water supply wells. Sample collection will also be conducted in accordance with SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of per- and polyfluoroalkyl substances (PFAS)*. Sample collection will also be conducted in accordance with the project-spcefiifc Accident Prevention Plan and Site Safety and Health Plan. Construction and operation of water supply wells will vary; therefore, this SOP may not be applicable to all situations.

This procedure has been developed to serve as management-approved professional guidance for the Wood Program. As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment to accommodate unforeseen circumstances. Deviation from this procedure in planning or in the execution of planned activities must be approved by the Project Manager.

3.0 REFERENCES

California State Water Quality Control Board- Division of Water Quality (SWQCB), 2020. *Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines*. September.

U.S. Environmental Protection Agency (EPA), 2013. *Science and Ecosystem Support Division (SESD) Operating Procedure: Potable Water Supply Sampling. SESDPROC-305-R3.* Effective date May 30, 2013.

EPA, 1998. Safe Drinking Water Act: *Definition of a Public Water System. Section 1401(4). Amended by the 1996 Safe Drinking Water Act Amendments.* Effective date August 6, 1998.

4.0 DEFINITIONS

Potable Water – Water that meets the standards for drinking purposes of the State or local authority having jurisdiction, or water that meets the standards prescribed by the EPA's National Primary Drinking Water Regulations (40 CFR 141).

Private Water Supply Well – A well that can serve as a private drinking water system, has fewer than 15 individual connections, or regularly serves an average of less than 25 individuals for less than 60 days out of the year.

Public Water Supply Well – A well and distribution system that has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year. The term includes (1) any collection, treatment, storage, and distribution facilities under control of the supplier of water and used primarily in connection with the system; and (2) any collection (including wells) or pretreatment storage facilities not under the control of the supplier which are used primarily in connection with the system.

Note: The definitions provided for private and public water supply wells are generally accepted industry-wide. However, the definitions should be confirmed with the local and state regulatory authorities where the work is being conducted. Site-specific definitions should be included in the installation-specific work plans.

5.0 PROCEDURES

This section contains both the responsibilities and procedures involved with sampling private and public supply wells. Proper procedures are necessary to insure the quality and integrity of the samples. The details within this SOP should be used in conjunction with installation-specific work plans. The installation-specific work plan and/or SAP will generally provide the following information:

- Sample collection objectives;
- Water well locations to be sampled;
- Number and volume of samples to be collected at each well;
- Types of chemical analyses to be conducted for the samples;
- Specific quality control procedures and sampling required;
- Any additional sampling requirements or procedures beyond those covered in this SOP, as necessary; and
- At a minimum, the procedures outlined in this SOP for water supply well sampling will be followed.

5.1 RESPONSIBILITIES

Project Manager

The Project Manager is responsible for ensuring that sample collection activities are conducted in accordance with this SOP, SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS),* and with any other appropriate procedures. This will be accomplished through staff training and by maintaining quality assurance/quality control (QA/QC).

Field Lead

The Field Lead is responsible for periodic observation of field activities and review of field generated documentation associated with this SOP. The Field Lead is also responsible for implementation of corrective action (i.e., retraining personnel, additional review of work plan/SAP and SOPs, variances to QC sampling requirements, issuing nonconformances, etc.) if problems occur.

Field Personnel

Field personnel assigned to groundwater sampling 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 procedures to the Project Manager or Field Lead.

5.2 METHOD SUMMARY

The basic procedures for sampling private and public water supply wells are similar to those for sampling of groundwater monitoring wells, as specified in Groundwater Sampling SOP Wood-03 (PFAS), and sampling of water at a treatment system, as specified in Groundwater Treatment System Influent and Effluent Sampling SOP Wood-09 (PFAS). The main difference is how or where the well water is accessed. Wells with in-place plumbing are commonly found at residences, and water supply wells may or may not have sampling ports at the well head. The procedure can be summarized as follows.

- Sampling equipment will be thoroughly decontaminated before mobilization to each investigation area and between sample locations at each investigation area or as required in the installation-specific work plan and/or SAP. Decontamination procedures will be performed in accordance with SOP Wood-10 (PFAS), *Equipment Decontamination*. Purge water until specific parameters have stabilized, toward ensuring formation water (as opposed to stagnant well water) will be sampled;
- Collect samples in laboratory-supplied containers; and
- Follow standard sample handling and custody procedures to contain and transport samples to the off-site laboratory.

5.3 FIELD PROCEDURES

Field procedures will incorporate other applicable project-specific SOPs, particularly SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross-Contamination of Per- and Polyfluoroalkyl Substances (PFAS) Sites*. All field equipment and supplies will be considered using the Tiered Approach provided in Table 2 of SOP Wood-01 (PFAS), *Field Sampling Protocols to Avoid Cross Contamination of Per- and Polyfluoroalkyl Substances (PFAS)* prior to use onsite.

5.3.1 PREPARATION

Office Procedures

- Contact the well owner with the proposed schedule for sampling, and coordinate with the well owner on timing; obtain information on the pumping rate and frequency during the last several weeks, if available.
- Review the installation-specific work plan and/or SAP and the procedure including well construction, development, and sampling information on the wells to be tested, if available.
- Check out and ensure the proper operation of all field equipment.
- Assemble a sufficient number of field forms to complete the field assignment (do not use waterproof paper).
- Assemble appropriate testing equipment.

Equipment Selection and Sampling Considerations

This SOP assumes that private or public water supply wells are equipped with operational mechanical systems to collect samples. If the mechanical systems for supply wells are not operational, then the sampling should be conducted as described in SOP Wood-03 (PFAS) for Groundwater Sampling and the details provided in the installation-specific work plan and/or SAP. In addition, all federal, state, and local guidelines must be followed in relation to sampling private and public wells.

The following should be considered when choosing the location to collect a potable water sample from a private and/or public water supply well (EPA, 2013):

- Taps selected for sample collection should be supplied with water from a service pipe connected directly to a water main in the segment of interest.
- Whenever possible, choose the tap closest to the water source, and prior to the water lines entering the residence, office, building, etc., and also prior to any holding or pressurization tanks. If the tap closest to the water source is located in a crawl space or

other confined space, the technician will make note of the confined space condition, and identify the next closest tap for sample collection. If sampling in a confined space is deemed necessary, it will be conducted only by a trained sampling team in possession of a confined space entry permit in accordance with the General Health and Safety Plan.

- The sampling tap must be protected from exterior contamination associated with being too close to a sink bottom or to the ground. Contaminated water or soil from the faucet exterior may enter the bottle during the collection procedure because it is difficult to place a bottle under a low tap without grazing the neck interior against the outside faucet surface. If the tap is too close to the ground for direct collection into the appropriate sample container, it is acceptable to use a smaller container to transfer sample to a larger container. The smaller container should be made of high-density polyethylene (HDPE) or polypropylene, and should be decontaminated as specified in SOP Wood-10 (PFAS).
- Containers used for aqueous samples from treated water systems (potentially containing chlrorine) will contain preservative, either trizma (U.S. EPA Method 537) or ammonium acetate (U.S. EPA Method 533). Caution should be used when handling the preserved bottles and the chemicals should be included in the project safety plan.
- When filling any sample container, care should be taken that splashing drops of water from the ground or sink do not enter into either the bottle or cap.
- Leaking taps that allow water to discharge from around the valve stem handle and down the outside of the faucet, or taps in which water tends to run up on the outside of the lip, are to be avoided as sampling locations.
- Disconnect any hoses, filters, or aerators attached to the tap before sampling. These devices can harbor a bacterial population if they are not routinely cleaned or replaced when worn or cracked.
- Taps where the water flow is not constant should be avoided because temporary fluctuation in line pressure may cause clumps of microbial growth that are lodged in a pipe section or faucet connection to break loose. A smooth flowing water stream at moderate pressure without splashing should be used. The sample should be collected without changing the water flow.

Data Form

The Private and Public Water Supply Well Sample Collection Log form, or equivalent, shall be used to record sampling information and observations. All entries shall be made in indelible ink.

5.3.2 PERFORMING THE SAMPLING

Private and public water supply well samples will be collected by filling sample containers from sample ports at each designated location. Ideally, the sample should be collected from a tap or spigot located at or near the well head or pump house and before the water supply is introduced into any storage tanks or treatment units. If the sample must be collected at a point in the water line beyond a tank, a sufficient volume of water should be purged to provide a complete exchange of fresh water into the tank and the tap or spigot. If the sample is collected from a tap or spigot located just before a storage tank, spigots located downstream of the tank should be turned on to prevent any backflow from the tank to the tap or spigot. Several spigots may be opened to provide for a rapid exchange of water.

The following general procedures will be used. These procedures may be modified to reflect investigation area-specific conditions.

- Don personal protective equipment (PPE) appropriate for the task, in accordance with the site-specific Health and Safety Plan and Activity Hazard Analysis, as applicable.
- Sample wells from least contaminated to most contaminated, if possible.
- The sample port for a private water supply well will be opened and allowed to flush for at least 15 minutes, when possible. The sample port for a public water supply well will be allowed to flush for at least three minutes. Flow rate will be measured and recorded in order to calculate the approximate total purge volume.
- During flushing activities, collect a minimum of three sets of physical parameters (i.e. pH, specific conductance, dissolved oxygen, oxidation-reduction potential, turbidity and temperature). An adequate purge is achieved when the pH and specific conductance of the potable water have stabilized and the turbidity has either stabilized or is below 10 Nephelometric Turbidity Units (NTUs). Stabilization occurs when, for at least three consecutive measurements, the pH remains constant within 0.1 Standard Unit (SU) and the specific conductance varies no more than approximately 10 percent.
- If, after 15 minutes, the physical parameters have not stabilized according to the above criteria, use professional judgement to determine whether or not to collect a sample or to continue purging.
- If routinely sampled locations have shown consistency in physical parameters readings, collection of parameters during subsequent sampling events may be discontinued at the direction of the Project Manager and/or Field Lead. If physical parameters are not collected, purge volume is relied upon to ensure stagnant well and system water is not sampled.
- The samples will then be collected directly from the sample port into the laboratory-supplied container. Samples should be collected with as little agitation or disturbance as possible.
- SOP Wood-09 (PFAS), *Groundwater System Influent and Effluent Sampling*, will be used to collect groundwater samples from distribution points.

Note: According to the EPA (2013), "[a] well with an intermittently run pump should, in all respects, be treated like a well without a pump. In these cases, parameters are measured and the well is sampled from the pump discharge after parameter conditions have been met. Generally, under these conditions, 15 to 30 minutes will be adequate."

REVIEW AND APPROVAL

QC Manager:	Matt Brool	*12/21/2020*
	Matt Brookshire MMEC Group Quality Control Manager	Date

xylem
Let's Solve Water

USER MANUAL
ITEM# 626973-01REF
REVISION H

ProDIGITAL User Manual

PROFESSIONAL SERIES DIGITAL HANDHELD METERS

YSI
a xylem brand

ProD·I·G·I·T·A·L

The information contained in this manual is subject to change without notice.

Effort has been made to make the information in this manual complete, accurate, and current.

The manufacturer shall not be held responsible for errors or omissions in this manual.

Consult ***YSI.com*** *for the most up-to-date version of this manual.*

Thank you for purchasing a YSI Professional Series Digital handheld meter. This manual covers setup, operation, and functionality of the ProDIGITAL handhelds which include the ProDSS, ProSwap and ProSolo.

ProDIGITAL Handheld features include:

- Digital smart probes that are automatically recognized by the instrument when connected
- Waterproof (IP-67) case
- Long-life rechargeable lithium-ion battery pack
- Color display and backlit keypad
- User-selectable cable options
- USB connectivity
- Global Positioning System (GPS) (optional on ProDSS and ProSwap)
- Depth sensor (optional on 1-port and 4-port cables)
- Large memory with extensive site list capabilities
- Rugged enclosure with rubber over-molded case and miltary-spec (MS) connectors
- KorDSS data management software included with each instrument (Please see Installation Instructions)

Safety Information

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all precautionary statements. Failure to do so could result in serious injury to the operator or damage to the equipment. Do not use or install this equipment in any manner other than that specified in this manual.

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is solely responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Precautionary Symbols

NOTE: *Information that requires special emphasis*

NOTICE: Indicates a situation which, if not avoided, may cause damage to the instrument

⚠ **CAUTION:** Indicates a potentially hazardous situation that may result in minor or moderate injury

⚠ **WARNING:** Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury

Product Components

Carefully unpack the instrument and accessories and inspect for damage. If any parts or materials are damaged, contact YSI Customer Service at 800-897-4151 (+1 937 767-7241) or the authorized YSI distributor from whom the instrument was purchased.

TABLE OF CONTENTS

1. Introduction
- **1.1** Battery Use and Battery Life
- **1.2** Charging the Battery Pack
- **1.3** Battery Replacement
- **1.4** Connect the Handheld to the Cable Assembly
- **1.5** Cable Assemblies with Integrated Sensors
- **1.6** Cable Assemblies with 1 or 4 Ports

2. Operation
- **2.1** Keypad and Navigation
- **2.2** Startup
- **2.3** Navigation
- **2.4** Main Display Description
- **2.5** System Menu
- **2.6** Sensor Menu
- **2.7** Calibration Menu
- **2.8** Files Menu
- **2.9** Taking Measurements

3. Calibration
- **3.1** Calibration Setup
- **3.2** Depth
- **3.3** Conductivity
- **3.4** Barometer
- **3.5** Dissolved Oxygen
- **3.6** Turbidity
- **3.7** Total Algae
- **3.8** pH/ORP
- **3.9** ISEs

4. Maintenance and Storage
- **4.1** ProDIGITAL Handheld
- **4.2** 1-Port and 4-Port Bulkhead
- **4.3** Sensor Guard
- **4.4** Depth Sensor
- **4.5** Temperature Sensor
- **4.6** Conductivity Sensor
- **4.7** Optical Dissolved Oxygen Sensor
- **4.8** Turbidity & Total Algae Sensors
- **4.9** pH/ORP Sensor
- **4.10** ISE Sensor
- **4.11** ProDSS Sensor Module Replacement

5. KorDSS Software
- **5.1** Introduction
- **5.2** Installing the Driver and Software

6. Accessories
- **6.1** Ordering

7. Safety and Support
- **7.1** Rechargeable Lithium-Ion Battery Pack
- **7.2** Service Information
- **7.3** Technical Support
- **7.4** Declarations of Conformity
- **7.5** Warranty

8. Appendices
- **8.1** Appendix A - DO% Calibration Values
- **8.2** Appendix B - Oxygen Solubility Table

THIS IS AN
INTERACTIVE DOCUMENT

When viewing this document as an Adobe™ PDF, hovering your cursor over certain phrases will bring up the finger-point icon. Clicking elements of the Table of Contents, website URLs, or references to certain sections will take you automatically to those locations.

1. Introduction

1.1 Battery Use and Battery Life

ProSeries Digital handhelds use a rechargeable lithium-ion (Li-Ion) battery pack as a power source. The battery comes pre-installed in the handheld and ships at less than 50% full capacity. Battery life depends on use, enabled parameters, LCD brightness, and GPS use.

A new battery, that has been fully charged, is expected to last for the following durations at 25°C, with Sampling set to Auto, Backlight set to Auto, and GPS enabled:

- ProDIGITAL handheld only - 48 hours
- ProDSS with fully loaded 4-port cable assembly and 25% LCD brightness - 20 hours

To increase battery life, enable manual sampling mode (Sampling). Manual sampling mode powers the sensor(s) on to take a measurement and then powers down to conserve battery life.

As with all lithium-ion batteires, battery life will decline over time and use. This decay should be expected. For the long-term health of the battery, a larger discharge is better than a small dishcarge between recharges.

1.2 Charging the Battery Pack

A USB cable is included with the handheld to charge the instrument battery pack and connect the instrument to a PC. The battery pack can be charged from the AC power adapter, directly from a computer USB connection or from an external, portable USB battery pack (sold separately, see Accessories).

Plug the USB connector into the AC power adapter, computer USB connector or external USB battery pack, then plug the micro USB connector into the handheld (Figure 1).

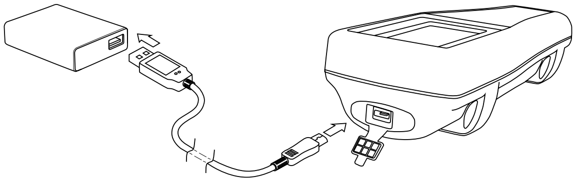


Figure 1 Connecting the handheld to AC power supply

⚠ **WARNING:** Charge the battery pack in an open area away from flammable materials, liquids, and surfaces. Do not charge or handle a battery pack that is hot to the touch. Failure to follow the safety warnings and precautions can result in personal injury and/or instrument damage not covered under warranty. Read Rechargeable Lithium-Ion battery pack safety warnings and precautions.

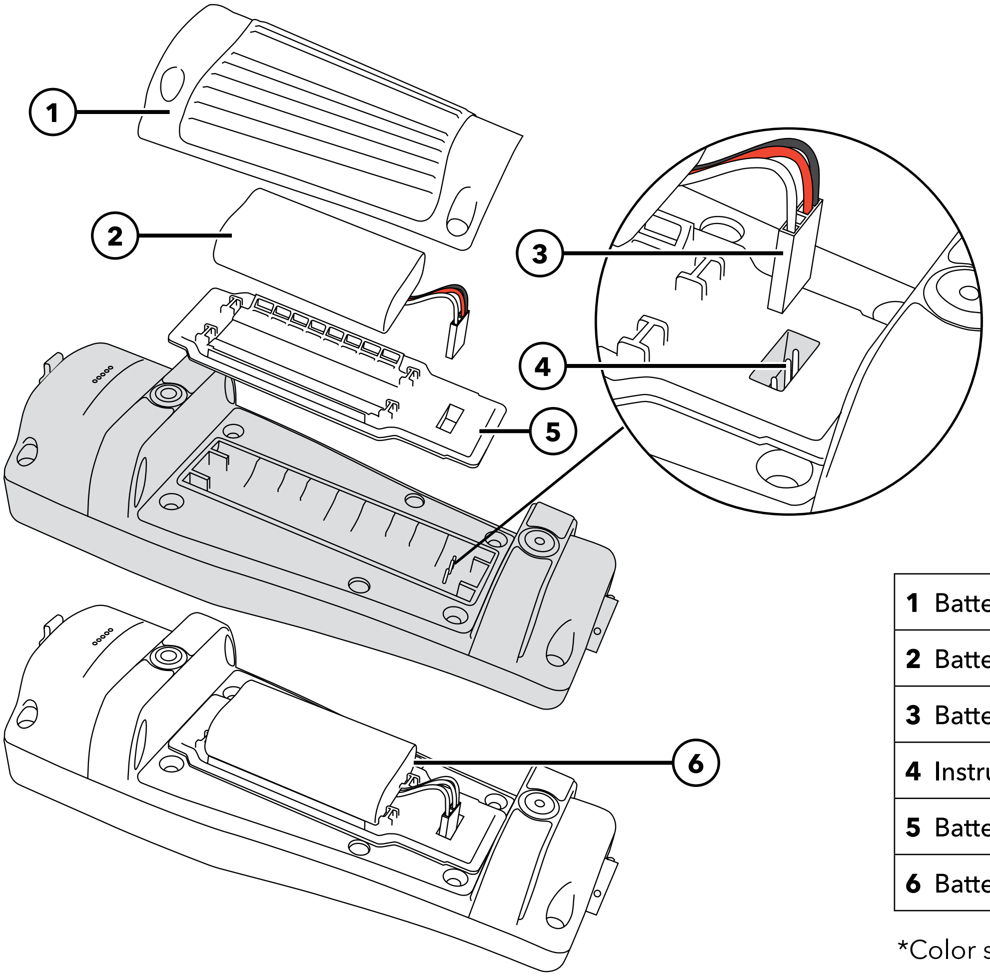
For the handheld to recognize that it is using AC power, you must start charging the handheld while it is turned on. After the instrument recognizes it is being charged, it can be turned off to finish charging.

AC Charging	DC Charging
9 hr	14 hr

1.3 Battery Replacement

1. Remove the battery pack cover by unscrewing (counter-clockwise) the four screws with a flat or Phillips head screwdriver (Figure 2). The retaining screws are captured into the battery pack cover and are not removable.
2. If replacing an existing battery pack, remove the Li-Ion battery pack and rubber battery pack cradle. With two fingers, grasp the battery pack connector and pull the connector straight up to disconnect and remove. Properly dispose of the old battery pack (See Battery Disposal).
3. Inspect the replacement battery pack and battery pack cradle for damage. Contact YSI technical support if there is any damage.
4. Correctly align and seat the battery pack cradle and battery pack into the instrument.
5. Align the battery pack connector wire terminals with the three instrument pins, then connect the battery pack to the instrument. Make sure that the three wire terminal connectors and three instrument pins are correctly aligned before connecting the battery pack connector. Incorrect installation can damage the battery pack connectors or instrument pins.
6. Install the battery pack cover, then hand tighten the cover screws with a screwdriver. DO NOT use any power tools. Make sure that the cover sealing surface is correctly aligned and free of any contamination or damage.

NOTICE: The battery cover does NOT need to make a compressed seal. Overtightening the cover screws can damage the battery cover and the handheld.



1	Battery pack cover
2	Battery pack
3	Battery pack connector*
4	Instrument pin connectors
5	Battery pack cradle
6	Battery pack cradle installed

*Color shown for reference

Figure 2 Battery replacement

1.4 Connect the Handheld to the Cable Assembly

The cable connectors are keyed for positive mating and to prevent connector damage (Figure 3). The handheld retains its IP-67 waterproof rating when the cable is disconnected. However, the connectors are not wet-mateable and should be clean and dry before connecting.

Align the keys on the cable connector with the slots on the handheld connector. Push together firmly, then twist the outer ring clockwise until it locks into place.

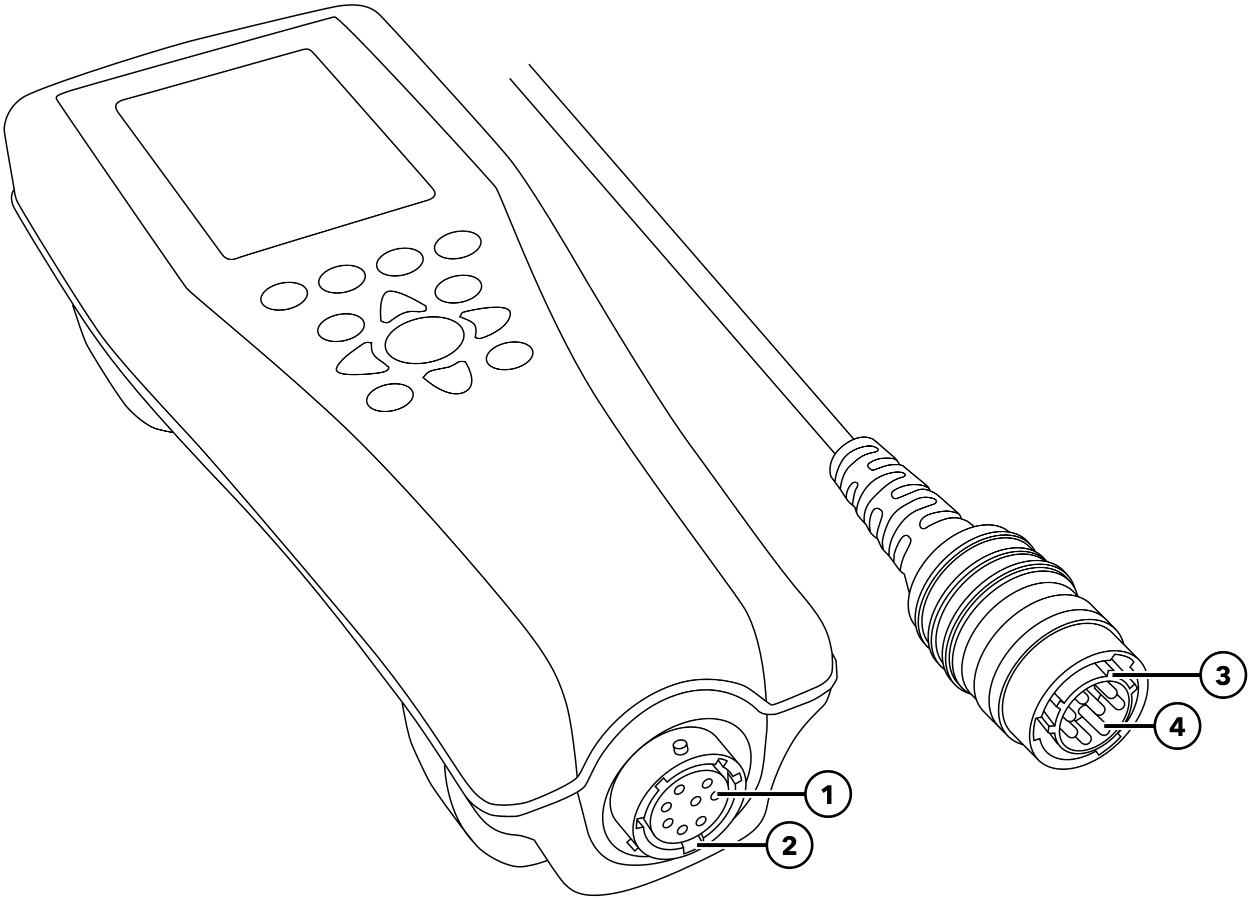


Figure 3 Keyed connectors

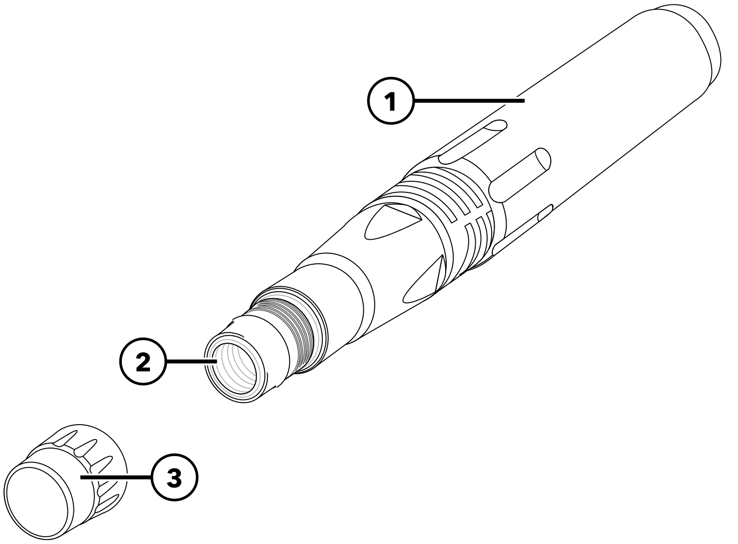
1 Handheld female connector	**3** Keyed area of connector
2 Slotted area of connector	**4** Cable male connector

1.5 Cable Assemblies with Integrated Sensors

Probe assemblies like the **ODO/CT**, **ODO/T**, and **ProOBOD** feature integral sensors – this means that these sensors cannot be removed from the probe and cable. Sensor caps on the ODO/CT and ODO/T are user-replaceable and need to be changed out about once per year.

NOTE: *Each ODO cable assembly and sensor cap includes an instruction sheet with important information unique and specific to each individual sensing cap. These are important because they include calibration coefficients needed for proper setup.*

NOTE: *A new cable/probe assembly already has a sensor cap installed and the sensor cap coefficients are preloaded into the probe at the factory.*



1	Probe
2	Sensor
3	Sensor Cap

Figure 4 ODO probe and cable assembly

Preparing the Probe and Sensor

1. Remove the metal probe guard from the probe by turning it counterclockwise.
2. Remove the red storage cap which, contains a moist sponge, from the end of the probe by pulling it straight off the sensor. Save this to use later for long-term storage.
3. Reinstall the probe guard by sliding it carefully over the sensor and then threading it onto the cable assembly with a clockwise rotation.

⚠ **CAUTION:** It is important to always store your sensor in a moist environment so the sensor cap does not dry out. A grey calibration/storage sleeve is shipped with your cable assembly for an easy storage option. Simply moisten the sponge with a small amount of clean water and slide the sleeve over the probe guard to create a moist atmosphere for the sensor.

1.6 Cable Assemblies with 1 or 4 Ports

ProSwap 1-port cables support user-replaceable sensors. The single port is universal and will allow any ProDSS smart sensor to be connected. These cables include a built-in thermistor which eliminates the need to always connect a conductivity/temperature sensor.

ProDSS 4-port cables feature user-replaceable sensors. The ports on the bulkhead are universal, meaning that you can install any sensor into any port. A conductivity/temperature sensor must be installed for accurate measurement of all parameters except turbidity and TSS.

Bulkhead ports are numbered (Figure 5), so if multiple sensors of the same type are installed, the port number will be added to the Run screen display to clarify the measurement value of each sensor.

NOTICE: The bulkhead ports and sensor connectors are not wet-mateable. Make sure that the sensor connectors and bulkhead ports are clean and dry before sensor installation.

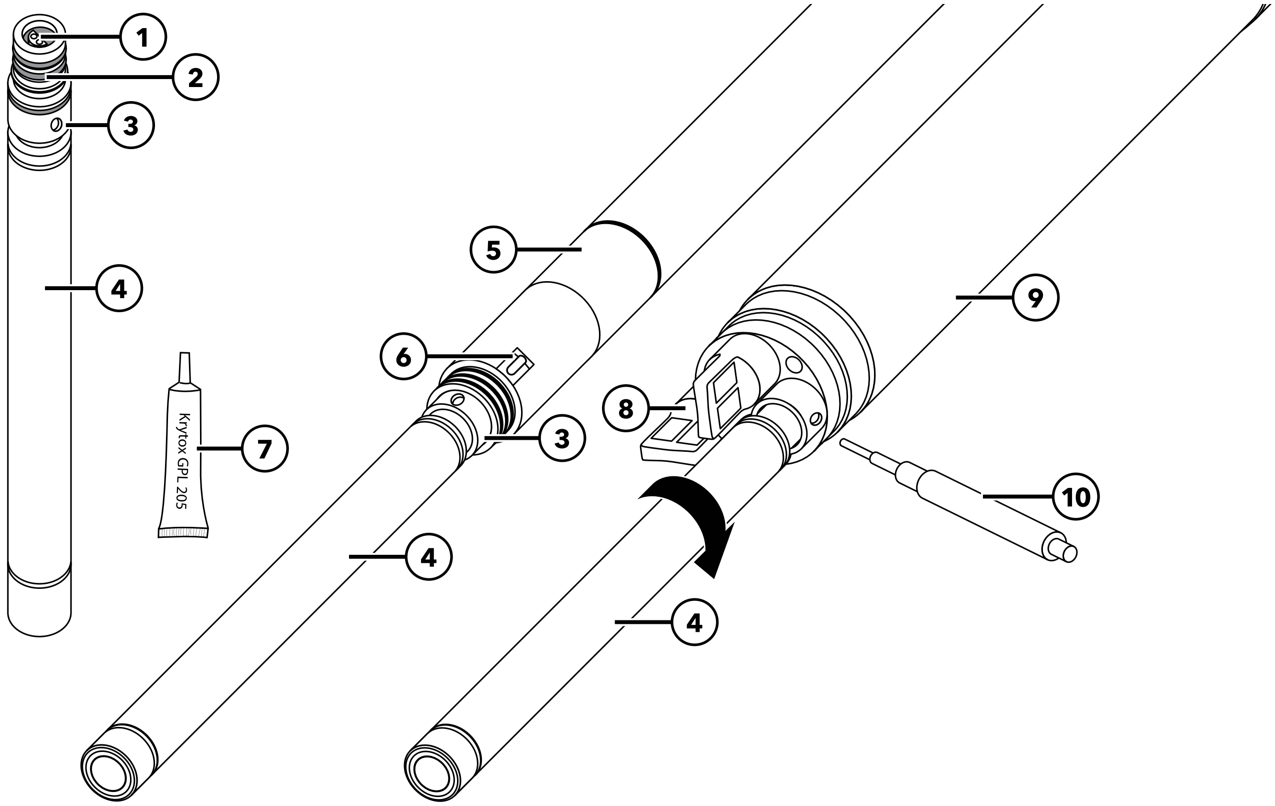


Figure 5 Sensor installation (1- and 4-port cables)

1 Sensor port	**6** Thermistor
2 O-ring	**7** O-ring lubricant
3 Sensor retaining nut	**8** Port plug
4 Sensor	**9** 4-port bulkhead
5 1-port bulkhead	**10** Sensor installation/removal tool

Sensor Installation

1. Remove the port cover shipped with the cable. This cover can be kept to protect the bulkhead ports from contamination during long-term storage.
2. Inspect each bulkhead port for contamination. If the port is dirty or wet, clean it with compressed air.
3. Apply a thin coat of o-ring lubricant to the sensor o-rings. Wipe off excess o-ring grease with a lint-free cloth.
4. Carefully align the sensor and bulkhead connectors by inserting the sensor into the port then gently rotating the sensor until the connectors align. Once aligned, push the sensor toward the bulkhead until the sensor seats in the port.
5. Carefully finger-tighten the retaining nut clockwise. If any resistance is felt, loosen the retaining nut completely to prevent cross-threading.
6. Use the sensor installation/removal tool to tighten the retaining nut clockwise until snug, about a ¼ to ½ additional turn of the retaining nut. Be careful not to over-tighten the retaining nut.

NOTICE: Incorrect installation or over-tightening can cause damage to the sensor or bulkhead that is not covered by the warranty.

Sensor Removal

To remove a sensor, insert the sensor installation/removal tool into the retaining nut, then rotate the retaining nut counterclockwise to loosen. After the retaining nut has been completely unscrewed from the bulkhead, pull the sensor straight out of the port and place it on a clean surface. Install a port plug if not reinstalling a sensor in the exposed port. Exposure to water can cause damage or corrosion to the bulkhead connectors not covered by the warranty.

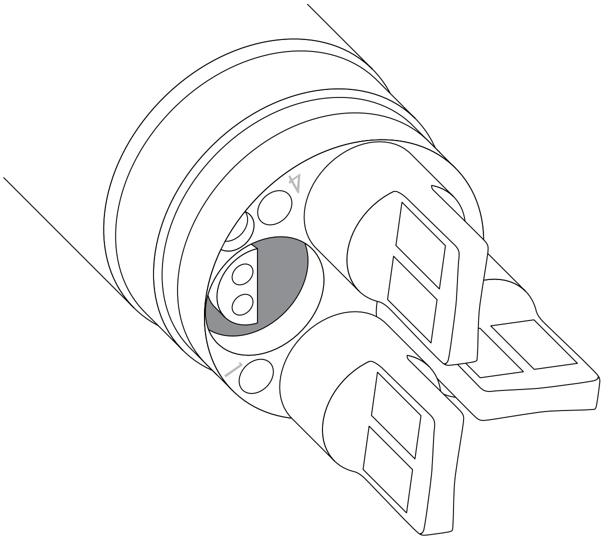


Figure 6 Sensor port plugs and port numbering (4-port cables)

Port plugs

Port plugs and a tube of o-ring lubricant are included in the maintenance kit that ships with all 1-port and 4-port cables.

Installation

1. Apply a thin coat of o-ring lubricant to the o-rings on the plug port.
2. Remove any excess lubricant from the o-rings and port plug with a lint-free cloth.
3. Insert the port plug into the empty port and press until firmly seated.
4. Finger-tighten the port plug clockwise to install. If necessary, use the sensor installation tool to make sure that the plug is fully seated into the port. The o-rings will not be visible if a port plug is correctly installed. Do not over-tighten the port plug.

NOTICE: Do not submerge the bulkhead without a sensor or port plug installed in all ports.

Sensor Guard and Weight Installation

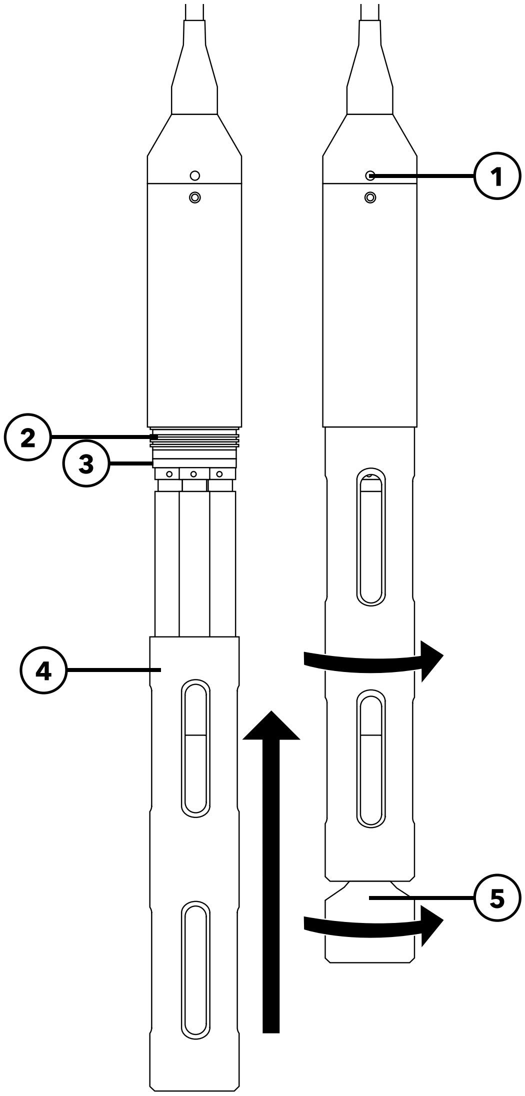


Figure 7 Sensor guard and weight installation on a 4-port cable assembly

1. Carefully slide the sensor guard over the bulkhead and attached sensors/port plugs. Push the sensor guard toward the bulkhead until the sensor guard threads align with the bulkhead threads.
2. Carefully hand-tighten the sensor guard clockwise. If any resistance is felt, loosen the sensor guard completely to prevent cross-threading. Incorrect installation may cause damage to the sensor guard or bulkhead that is not covered by the warranty.

1	Depth sensor (if equipped)
2	Bulkhead threads
3	Bulkhead
4	Sensor guard
5	Weight

Sensor Guard Weights

To help stabilize the sensors when profiling at deeper depths, a sensor guard weight is supplied with 1-port and 4-port assemblies 10 meters and longer. To attach the weight, carefully hand-tighten it clockwise on to the bottom of the sensor guard (Figure 7). If any resistance is felt, loosen the sensor guard weight completely to prevent cross-threading.

The bottom of the weight is threaded so that additional weights can be added if needed. YSI recommends installing no more than 5 lbs of weight on ProDIGITAL cables. See Accessories.

NOTE: *Do not have any weights installed on the sensor guard when calibrating using the calibration cup.*

2. Operation

2.1 Keypad and Navigation

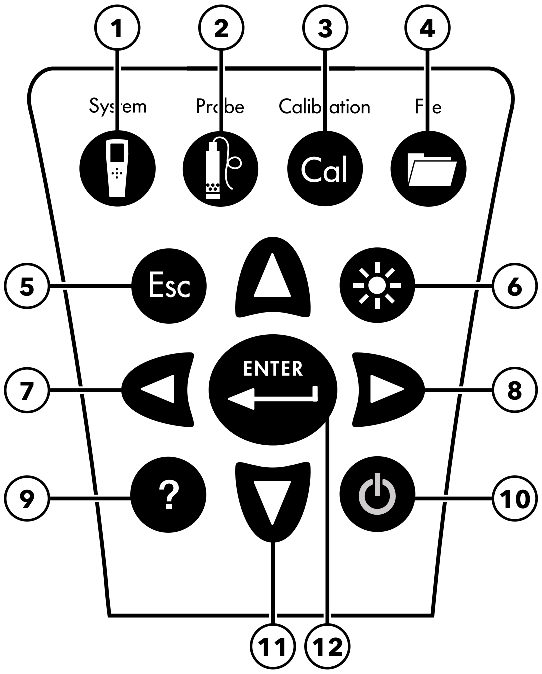


Figure 8 Keypad description

1	**System:** Opens the system menu. Use to adjust system settings.	7	**Left arrow key:** Navigate left in an alpha/numeric entry screen. Push to return to previous menu in all screens except alpha/numeric entry. On the Run screen, push to show graphical representations of the displayed measurements.
2	**Probe:** Opens the sensor menu. Use to setup sensors, change the units shown, select the sensor averaging mode, and turn on/off Auto Stable and GPS.	8	**Right arrow key:** Navigate right in an alpha/numeric entry screen. On the Run screen, push to show graphical representations of the displayed measurements. In the View Data screen, push to view additional parameters in the data set.
3	**Calibrate:** Opens the calibration menu. Use to calibrate sensors or restore default calibration.	9	**Help:** Shows context sensitive help.
4	**File:** Opens the file menu. Use to view logged data and calibration files, backup data to a USB stick, and delete data.	10	**ON/OFF:** Turn on or turn off the instrument.
5	**Exit/Escape key:** Exits to the Run screen. When in an alpha/numeric entry screen, returns to previous menu.	11	**Up/Down arrow keys:** Scroll through menus or enter numbers and letters.
6	**Backlight:** Turns the keypad backlight on or off for use in low light conditions.	12	**Enter key:** Push to confirm selections. On the Run screen, push to log a single data point or start continuous data logging.

2.2 Startup

Push the On/Off (⏻) key to turn on the handheld. If the handheld does not turn on, make sure that the battery is charged. Push and hold the ⏻ key for 1.5 seconds to turn the handheld off.

2.3 Navigation

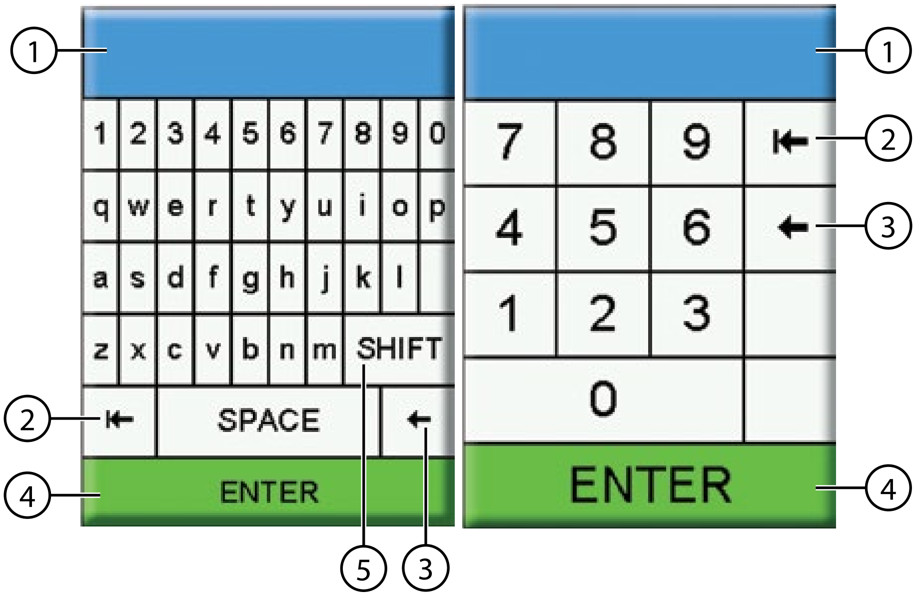
The handheld contains menus to change user-defined options, functions, and parameters. Use the arrow keys (▲ and ▼) to highlight different options within menus and sub-menus, then push the Enter (ENTER ↵) key to select the option. Push the left arrow (◀) key to return to the previous menu.

Push the Exit/Escape (Esc) key to return to the Run screen. To enable or disable an option, highlight the option, then push the ENTER ↵ key. Enabled functions appear as a circle with a dot (◉) or a box with a check mark (☑). Disabled functions appear as a circle only (○) or an empty box (☐).

Alpha/Numeric Entry

When required, an alpha/numeric entry screen will be shown. Use the arrow keys to highlight a specific character and push the ENTER ↵ key to select it for entry. When finished entering information, highlight **ENTER**, then push the ENTER ↵ key to save the entry (Figure 9).

> ***NOTE:*** *When in an alpha/numeric screen, the ◀ key is for alpha/numeric navigation only. Push the Esc key to cancel and return to the previous menu.*



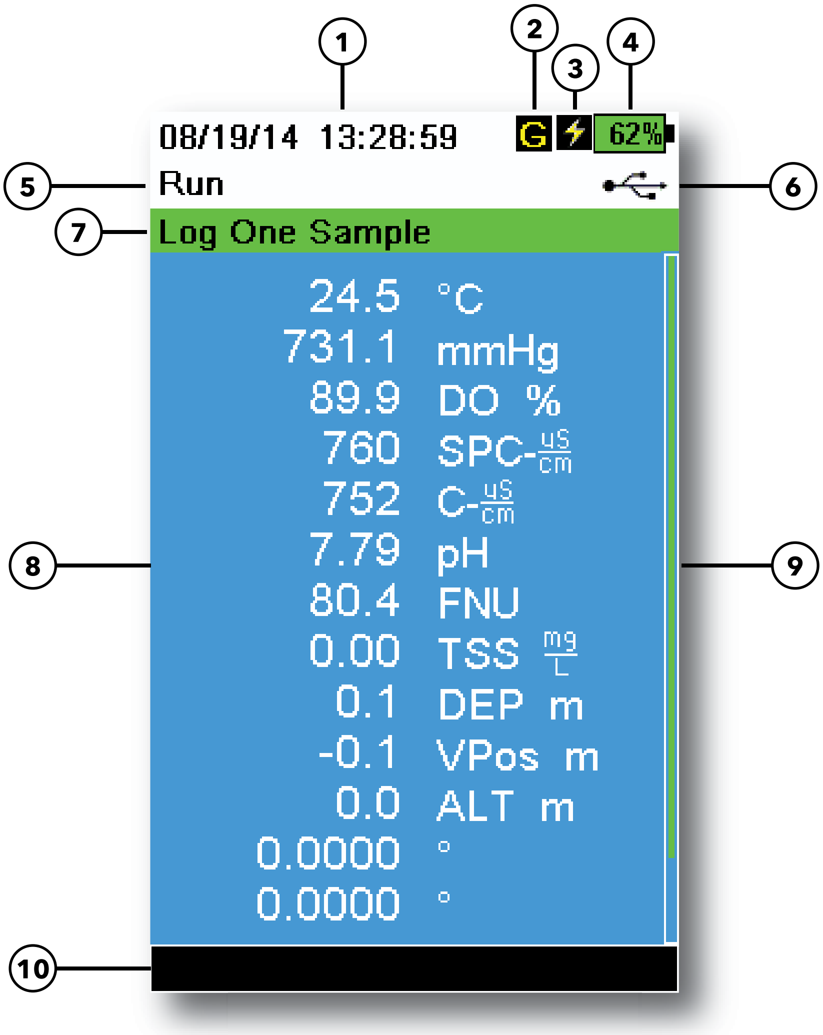
1	User entry field
2	Delete entire entry
3	Backspace
4	Enter (highlighted selection)
5	Upper/lowercase

Figure 9 Alpha/numeric and numeric entry screens

2.4 Main Display Description

The main display (Run screen) shows the current measurements and units as defined in the Sensor Display menu. If more measurements are selected than can be displayed on the Run screen, a scroll bar will be shown. Use the ▲ and ▼ arrow keys to view the additional measurements (Figure 10).

The message area shows status messages, error messages, and information about selected functions.



```
08/19/14  13:28:59        62%
Run
Log One Sample
   24.5  °C
  731.1  mmHg
   89.9  DO  %
    760  SPC-uS/cm
    752  C-uS/cm
   7.79  pH
   80.4  FNU
   0.00  TSS mg/L
    0.1  DEP  m
   -0.1  VPos  m
    0.0  ALT  m
 0.0000  °
 0.0000  °
```

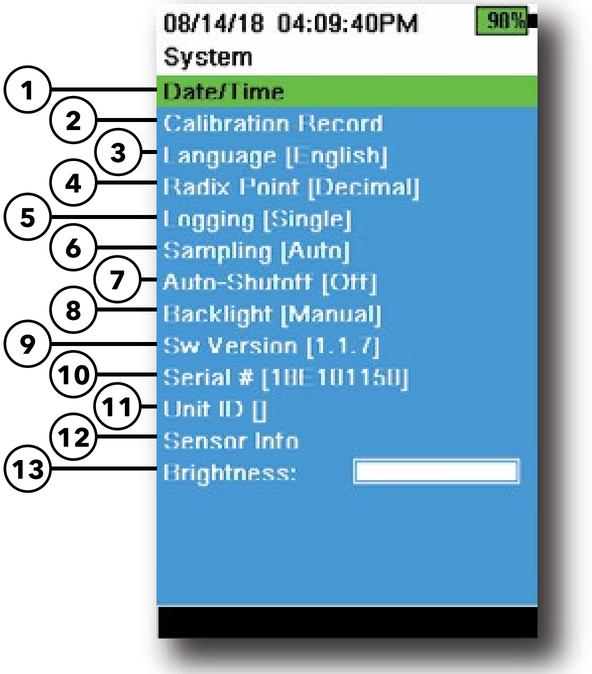
Figure 10 Main display example

1	Date/Time	**6**	USB/PC connection indicator
2	GPS signal indicator	**7**	Log or sampling (update measurements) prompt on Run screen (single or continuous)
3	Battery charging indicator	**8**	Displayed measurements
4	Battery charge %	**9**	Scroll bar
5	Current screen/menu	**10**	Message area

2.5 System Menu

Push the System (▮) key to view and adjust instrument settings. Highlight a sub-menu then push the ENTER key to view the sub-menu options (Figure 11).

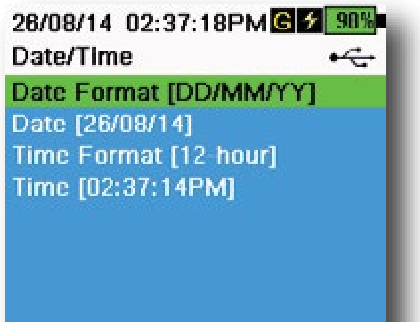
Pre-defined or user-selected options are noted within brackets (**[ ]**).



08/14/18 04:09:40PM
System
Date/Time
Calibration Record
Language [English]
Radix Point [Decimal]
Logging [Single]
Sampling [Auto]
Auto-Shutoff [Off]
Backlight [Manual]
Sw Version [1.1.7]
Serial # [18E101150]
Unit ID []
Sensor Info
Brightness:

Figure 11 System menu

1	Set the Date and Time
2	Change the user-defined Calibration Options
3	Change the instrument Language settings
4	Change the Radix Point
5	Change the Logging options
6	Change the Sampling options
7	Set the handheld Auto-Shutoff time
8	Set the Backlight mode
9	View the Software Version
10	View the handheld Serial Number
11	View and adjust the Unit ID
12	View the Sensor specific information
13	Adjust the display Brightness



26/08/14 02:37:18PM
Date/Time
Date Format [DD/MM/YY]
Date [26/08/14]
Time Format [12-hour]
Time [02:37:14PM]

Figure 12 Date/Time

Date/Time

▮ → **Date/Time**

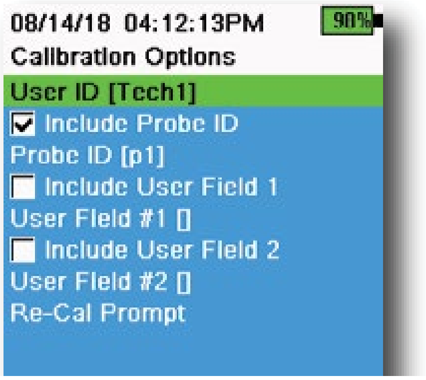
For accurate logging and calibration data, correctly set the date and time options (Figure 12). Select any of the following options to set the Date/Time.

Date/Time options:

- Set YY/MM/DD, MM/DD/YY, DD/MM/YY or YY/DD/MM date format
- Set the correct date
- Select 12 or 24 hour time format
- Set the correct time

Calibration Record

Detailed sensor calibration information is stored for later review. The instrument's internal memory can save up to 400 individual calibration records. After 400 records, the instrument will overwrite previously stored calibration records, starting with the oldest. To prevent the permanent loss of calibration records, periodically download the calibration files to a computer using the KorDSS software.



08/14/18 04:12:13PM 90%
Calibration Options
User ID [Tech1]
☑ Include Probe ID
Probe ID [p1]
☐ Include User Field 1
User Field #1 []
☐ Include User Field 2
User Field #2 []
Re-Cal Prompt

Figure 13 Calibration Options

Calibration Options

→ **Calibration Record** → **Options**

User ID, Probe ID, or User Field #1 or 2 can be user-defined for positive calibration file identification of:

- The person calibrating the instrument
- The sensor/cable serial number used during calibration (or other, user-defined Probe ID)
- Other user-specific identification (User Field #1 and #2) (Figure 13)

NOTE: *User Field can be used to describe the condition of the probe. For example, new sensor or new ODO cap.*

08/24/18 10:37:46AM 100%
Re-Cal Prompts
ODO [7 Days]
Conductivity [0 Days]
pH [7 Days]
ORP [0 Days]
NH4 [0 Days]
NO3 [0 Days]
Cl [0 Days]
Turbidity [0 Days]
Depth [0 Days]
Barometer [0 Days]

Figure 14 Re-Cal Prompts

Re-Cal Prompts

→ **Calibration Record** → **Options** → **Re-Cal Prompts**

Re-Cal Prompts provide a reminder to recalibrate a probe in the user-defined number of days (Figure 14). Select the desired sensor Re-Cal prompt, then enter the desired number of days before the Re-Cal prompt occurs. This reminder will be provided when the instrument is powered on and will reoccur every day until the sensor is re-calibrated.

Set the sensor value to zero (0) days (default) to turn off Re-Cal prompts.

Calibration Security

→ **Calibration Record** → **Security**

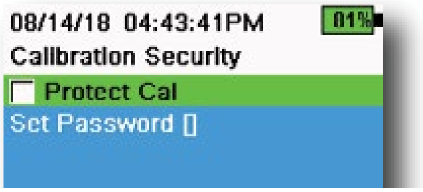


Figure 15 Calibration Security

The Calibration menu can be password protected to prevent accidental or unauthorized sensor calibration (Figure 15).

1. From the Calibration Record menu, select **Security**, then enter the default password "ysi123".
2. Select **Set Password** [ ] and change the default password.
3. Select the **Protect Cal** check box to password protect the Calibration menu.

NOTE: *Write down and keep the password in a safe place. Contact YSI Technical Support if you lose the password (Technical support).*

Language

→ **Language**

Figure 16 Language

The instrument is shipped with English enabled. If a different language is desired and selected, the handheld will take approximately 10 to 20 seconds to enable the new language (during the first installation only).

Optional languages:

- Spanish
- French
- German
- Italian
- Portuguese
- Norwegian
- Japanese
- Simplified Chinese
- Traditional Chinese
- Korean
- Thai

Radix Point

→ **Radix Point**

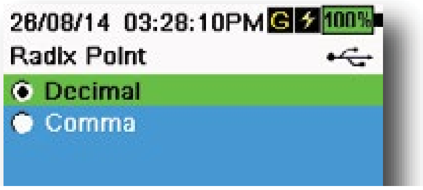


Figure 17 Radix Point

The radix point can be changed to display a comma or a decimal in numeric displays (*e.g.* 1.00 becomes 1,00 when Comma is selected) (Figure 17).

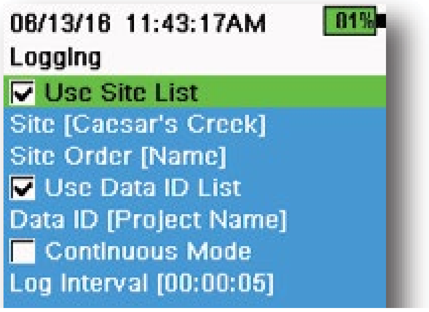
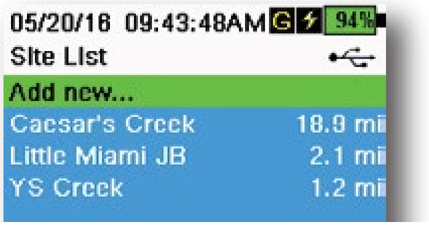

06/13/18 11:43:17AM 01%
Logging
☑ Use Site List
Site [Caesar's Creek]
Site Order [Name]
☑ Use Data ID List
Data ID [Project Name]
☐ Continuous Mode
Log Interval [00:00:05]

Figure 18 Logging


05/20/18 09:43:48AM G ⚡ 94%
Site List
Add new...

Caesar's Creek	18.9 mi
Little Miami JB	2.1 mi
YS Creek	1.2 mi

Figure 19 Site List


05/20/18 09:48:06AM G ⚡ 94%
Site
Select [Caesar's Creek]
Edit [Caesar's Creek]
Delete [Caesar's Creek]

Figure 20 Site

Logging

→ **Logging**

The handheld can add a user-defined Site and/or Data ID to a data record if these functions are enabled under the Logging menu. A check mark in the box next to these features indicates they are enabled (Figure 17).

After selecting **Site** [ ] or **Data ID** [ ], the Site List or Data ID List will be shown (Figure 19). New entries can be created by choosing **Add new...**

If the handheld has a GPS signal, the current GPS coordinates will be auto-populated when creating a new site. If the handheld does not have a built-in GPS, the coordinates and altitude can be entered manually.

Sites can be listed in order of Name (*i.e.* alphanumeric order) or Distance from the current position (Figure 19).

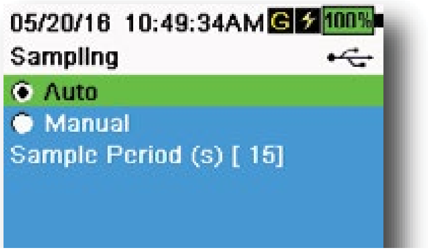
Choose an entry from the Site List or Data ID List to **Select**, **Edit**, or **Delete** (Figure 20). When selected, data recorded will be tagged with the specific site and/or data ID.

> ***NOTE:*** *The Manage Sites menu in KorDSS Software can be used to send a picture of the Site to the instrument.*

Continuous Mode (Interval logging): Select the Continuous Mode check box and enter the user-defined Log Interval (in hours:minutes:seconds) to log samples continuously at the specified time interval. The Run screen will display **Start Logging...** when in Continuous Mode. Press ENTER to begin logging.

One sample logging: Clear the Continuous Mode check box. The Run screen will display **Log One Sample**. A sample will be logged each time the ENTER key is pushed when in the Run screen.

> ***NOTE:*** *An option to change Site and/or Data ID (if enabled) appears once* ENTER *is pressed to begin logging.*



05/20/18 10:49:34AM G ⚡ 100%
Sampling
● Auto
○ Manual
Sample Period (s) [15]

Figure 21 Sampling

Sampling

▮ → **Sampling**

Auto sampling mode continuously updates measurements on the display (Figure 21).

When in Manual mode, the instrument will take measurements for the duration of the user-defined Sample Period (in seconds) then "lock" or hold the readings on the display. The default sample period is 50 seconds, and can be adjusted from 15 to 60 seconds. Manual mode helps conserve battery power.

Once the measurements are locked, push the ENTER ⟵ key to log the held data, or the Esc key and then the ENTER ⟵ key to take a new measurement.

> ***NOTE:*** *When both Continuous Logging Mode and Manual Sampling mode are enabled, the handheld will power the sensors on and take measurements for 15 seconds before logging a data set.*

Auto-Shutoff

▮ → **Auto-Shutoff**

To conserve battery power, auto-shutoff powers off the instrument after a user-defined time period (in minutes). The auto-shutoff time can be adjusted from 1 to 255 minutes. Set to 0 (zero) to disable Auto-Shutoff.

Backlight

▮ → **Backlight**

In Automatic mode, the instrument display will dim 60 seconds after the last key was pushed. Once any key is pushed, the instrument display will return to the user-defined brightness setting and the keypad backlight will turn on. The screen will dim and the keypad backlight will turn off after another 60 seconds of inactivity.

In manual mode, the instrument display remains at the user-defined brightness and the keypad backlight is turned on and off by the Backlight key. Setting the backlight to manual mode is recommended for bright conditions.

Software (Sw) Version

▮ → **Sw Version**

Sw Version shows the instrument's software version number. The latest instrument software and update instructions are available at YSI.com. Instrument software can be updated through the KorDSS Software under the **Instrument and Sensors** tab.

Serial

▮ → **Serial #**

Serial # shows the serial number of the handheld instrument. Note the serial number when contacting YSI support.

Unit ID

▮ → **Unit ID**

Users can set a custom Unit ID. The Unit ID identifies the instrument in KorDSS Software.

Sensor Info

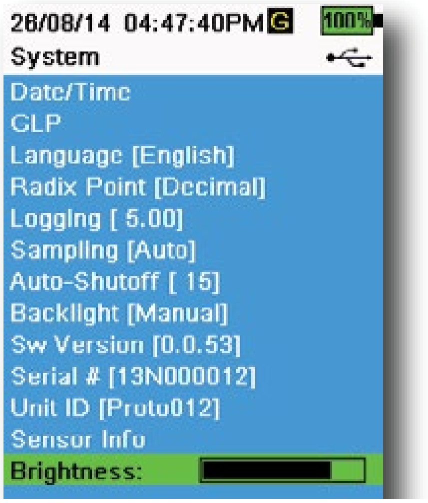
▮ → **Sensor Info**

Sensor info shows measurement data, and hardware/software information for each component of the system: instrument, sensor, and bulkhead. Use the ▲ and ▼ arrow keys to scroll through the components.

Brightness

▮ → **Brightness**

The screen brightness can be adjusted to accommodate lighting conditions and to conserve battery power (Figure 22). Use the ◀ and ▶ arrow keys to adjust the screen brightness.



28/08/14 04:47:40PM G 100%
System
Date/Time
GLP
Language [English]
Radix Point [Decimal]
Logging [5.00]
Sampling [Auto]
Auto-Shutoff [15]
Backlight [Manual]
Sw Version [0.0.53]
Serial # [13N000012]
Unit ID [Proto012]
Sensor Info
Brightness:

Figure 22 Display Brightness

2.6 Sensor Menu

Use the Probe ( ) key to access the Sensor menu and change sensor settings (if applicable), enable the measurement units displayed on the Run screen, set Auto Stable parameters, change the sensor averaging mode, and if equipped, turn on/off GPS.

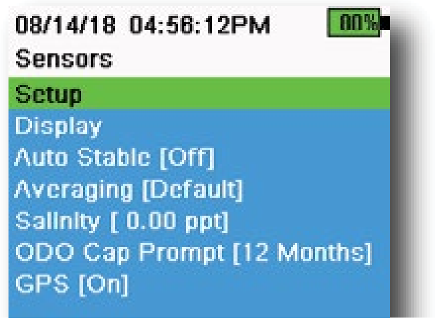

08/14/18 04:56:12PM 00%
Sensors
Setup
Display
Auto Stable [Off]
Averaging [Default]
Salinity [0.00 ppt]
ODO Cap Prompt [12 Months]
GPS [On]

Figure 23 Probe (Sensor) menu

Push the key to access the sensor menu (Figure 23). Highlight a sub-menu then push the ENTER key to view sub-menu options.

Pre-defined or user-selected sensor settings are noted within brackets (**[]**).

Sensor Setup

→ **Setup**

The Sensor Setup menu will show all sensors connected to the instrument (Figure 24). If a sensor is connected but is not listed on the Sensor Setup menu (**<None>** displayed), check the sensor and cable connections.

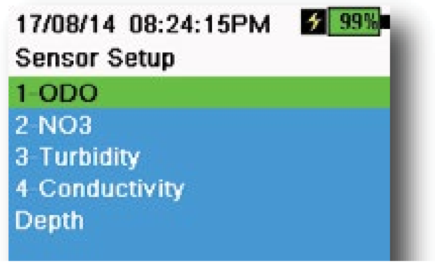

17/08/14 08:24:15PM 99%
Sensor Setup
1 ODO
2 NO3
3 Turbidity
4 Conductivity
Depth

Figure 24 Sensor Setup

Setup ODO

→ **Setup** → **ODO**

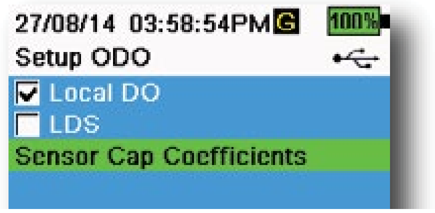

27/08/14 03:58:54PM G 100%
Setup ODO
☑ Local DO
☐ LDS
Sensor Cap Coefficients

Figure 25 Setup ODO

Local DO: Enable or disable localized DO% measurements. When enabled, the calibration value is set to 100% regardless of altitude or barometric pressure. When enabled, an L will be shown next to DO% on the run screen. DO mg/L measurements are unaffected when Local DO is enabled (Figure 25).

LDS: Last Digit Supression (LDS) rounds the DO value to the nearest tenth, *e.g.* 8.27 mg/L becomes 8.3 mg/L.

Sensor Cap Coefficients: The sensor cap coefficients must be updated after sensor cap replacement. Update the sensor cap coefficients using the coefficient sheet provided with the new sensor cap. Once updated, the coefficients are saved to the ODO sensor and do not need to be re-entered.

> ***NOTE:*** *The coefficients stay with the sensor even when used with different handheld meters.*

Setup Turbidity

→ **Setup** → **Turbidity**


02/09/14 01:32:58PM 96%
TSS Coefficients
C1 [0.000000]
C2 [0.000000]
C3 [0.000000]
C4 [0.000000]
C5 [0.000000]
C6 [0.000000]
Update Coefficients

Figure 26 TSS coefficients

TSS Coefficients: Total Suspended Solids (TSS) can be measured if correlation coefficients are calculated in KorDSS.

To obtain these coefficients, collect turbidity data at the sampling site with corresponding grab samples. Analyze the samples in a lab to determine a true TSS measurement (mg/L). At least 2 and up to 6 value pairs of turbidity and TSS measurements can be used.

Correlation data must be collected for each unique sampling site, as this correlation is site-specific.

In KorDSS Software, enter the field-obtained turbidity measurements and the corresponding lab-obtained TSS measurements in the Instrument and Sensors menu. Coefficients can then calculated with KorDSS and sent to the sensor.

> ***NOTE:*** *Although correlation coefficients can be entered directly into the handheld (Figure 26), only KorDSS Software can calculate the coefficients.*

Setup pH

→ **Setup** → **pH**

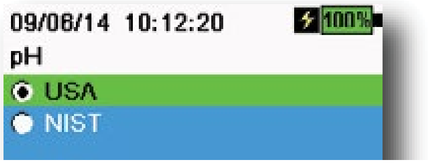

09/06/14 10:12:20 100%
pH
● USA
○ NIST

Figure 27 Setup pH

Select USA auto-buffer recognition (4.00, 7.00, and 10.00) or NIST auto-buffer recognition (4.01, 6.86, and 9.18) (Figure 27). Calibration values are automatically compensated for temperature for both buffer sets.

Setup Conductivity

→ **Setup** → **Conductivity**


10/13/14 08:50:57AM 75%
Setup Conductivity
Temp Ref [25.0]
%/°C [1.9100]
TDS Constant [0.650]

Figure 28 Setup Conductivity

Temp Ref: Reference temperature is used to calculate temperature compensated specific conductance. All specific conductance values are compensated to the Temp Ref temperature. The default value is 25°C (Figure 28). Enter a new value between 15.00°C and 25.00°C.

%/°C (Percent per degree Celsius): The temperature coefficient is used to calculate temperature compensated specific conductance. The default is 1.91% based on KCl standards. Enter a new value between 0 and 4%.

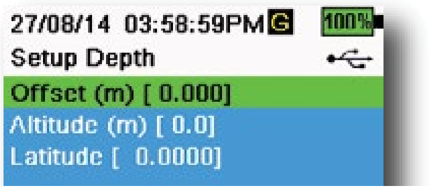
TDS Constant: This is a multiplier used to calculate an estimated Total Dissolved Solids (TDS) value from conductivity. The multiplier is used to convert specific conductance in mS/cm to TDS in g/L. The default value is 0.65. Enter a new value between 0 and 0.99.

Setup Conductivity *(continued)*

The TDS multiplier is highly dependent on the nature of the ionic species present in the water sample. To be assured of moderate accuracy for the conversion, you must determine a multiplier for the water at your sampling site. Use the following procedure to determine the multiplier for a specific sample:

1. Determine the specific conductance of a water sample from the site.
2. Filter a portion of water from the site.
3. Carefully measure a volume of the filtered water. Completely evaporate to yield a dry solid.
4. Accurately weigh the remaining solid.
5. Divide the weight of the solid (in grams) by the volume of water used (in liters) to yield the TDS value in g/L for the site.
6. Divide the TDS value in g/L by the specific conductance of the water in mS/cm to yield the conversion multiplier.

NOTE: *If the nature of the ionic species at the site changes between sampling studies, the TDS values will be in error. TDS cannot be calculated accurately from specific conductance unless the make-up of the chemical species in the water remains constant.*



27/08/14 03:58:59PM G 100%
Setup Depth
Offset (m) [0.000]
Altitude (m) [0.0]
Latitude [0.0000]

Figure 28 Setup Depth

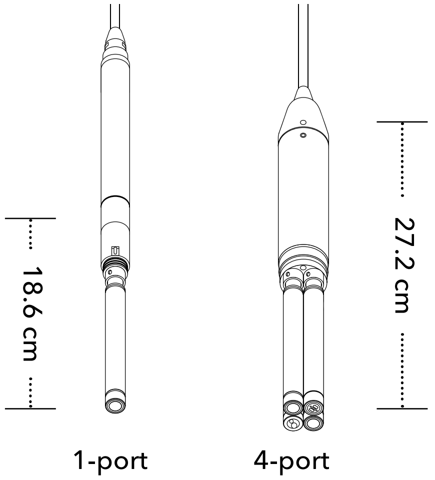


Figure 30 Distance of depth sensor to WQ sensors

Setup Depth

→ **Setup** → **Depth**

Cable assemblies with a depth sensor in the bulkhead can measure virtual vented depth. The virtual vented depth measurement allows for real time compensation for atmospheric pressure using the handheld's barometer.

Depth offset: Depth offset can be used if referencing water elevation against a known value. If a depth offset is entered (in meters), the output value will shift by the value of the offset (Figure 29).

A common offset entered by the user is the depth sensor location relative to the rest of the WQ sensors. This value is 18.6 cm on the 1-port cable and 27.2 cm on the 4-port cable. (Figure 30).

Altitude/Latitude: To compensate for atmospheric pressure based on elevation and gravitational pull, enter the local altitude in meters relative to sea level and latitude in degrees where the instrument is sampling.

Latitude effect: Varying latitudes can cause up to a 200 mm change in depth from equator to pole.

Altitude effect: A 100 m change in altitutde causes a 1.08 mm of change to the depth readings.

Sensor Display

→ **Display** (Figure 31)

The Sensor Display menu determines the parameters and units that are shown on the Run screen (Figure 10). The Run screen will only show measurements for sensors that are attached to the cable bulkhead.

If more measurements are selected than can be displayed on one screen, a scroll bar will be shown. Use the ▲ and ▼ keys to scroll through the measurements.

> ***NOTE:*** *For depth profiling, enable Vertical Position under Depth Display to view the real-time position of the depth sensor in the water column. This is helpful in profiling applications to ensure the depth sensor is lowered to the desired depth without waiting for the depth data to stabilize.*

02/15/18 01:55:12PM 05%
Sensor Display
Temperature
ODO
Conductivity
ISE
Turbidity
TAL
Depth
Barometer
GPS Lat/Long
GPS Altitude

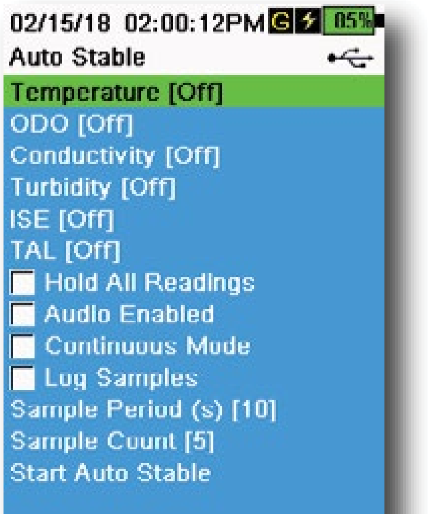
Figure 31 Sensor Display

Auto Stable

→ **Auto Stable**

Auto Stable indicates when a measurement is stable. Sensors with Auto Stable enabled will have $\overset{A}{S}$ flash beside the measurement on the Run screen.
$\overset{A}{S}$ will flash green when the measurement is stable.

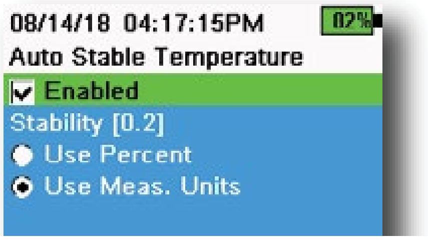
Select a sensor to enable or disable Auto Stable (Figure 32). Then set the stability threshold parameters.



02/15/18 02:00:12PM 05%
Auto Stable
Temperature [Off]
ODO [Off]
Conductivity [Off]
Turbidity [Off]
ISE [Off]
TAL [Off]
☐ Hold All Readings
☐ Audio Enabled
☐ Continuous Mode
☐ Log Samples
Sample Period (s) [10]
Sample Count [5]
Start Auto Stable

Figure 32 Auto Stable

The Auto Stable stability threshold can be set by percent of measurement or in the units of measurement selected in the Sensor Display menu. Enter the stability value, then select **Use Percent** or **Use Meas. Units** (Figure 33).



08/14/18 04:17:15PM 02%
Auto Stable Temperature
☑ Enabled
Stability [0.2]
○ Use Percent
● Use Meas. Units

Figure 33 Auto Stable stability threshold

This threshold is used to compare the last reading with the previous. The smaller the number entered in % or units, the longer it will take for the instrument to reach the auto stable criteria.

Example: For temperature in °C, if Measurement Units threshold is set to 0.2 and the temperature reading changes by more than 0.2 degrees, $\overset{A}{S}$ will continue to be red until the reading does not change by more than 0.2°C over the defined sample period and sample count.

Hold All Readings: After all sensors have reached their stability criteria, the measurements will be held or 'locked' on the display. If disabled, the sensor measurements will continue to change in real time.

Audio Enabled: An audio alert will sound when stability is reached.

Auto Stable *(continued)*

Continuous Mode: The handheld will continuously check sensor values against the stability criteria even after the sample period and sample count have been met.

Log Samples: Logs the sample/s defined by the Sample Period to memory.

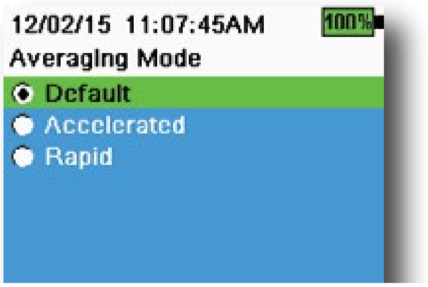
Sample Period: Time interval between samples that are used to determine stability. Set the interval in seconds (1 to 900).

Sample Count: Number of consecutive samples required for stability (1 to 10).

Select Start Auto Stable to enable.

Averaging

→ **Averaging** (Figure 34)



12/02/15 11:07:45AM 100%

Averaging Mode

● Default

○ Accelerated

○ Rapid

Figure 34 Averaging

The averaging mode determines how the handheld will filter data. A smaller time frame for the rolling average window allows changes in the sensor's measurements to be more quickly observed, while a larger rolling window provides more stable measurement readings and a smooth result. Each averaging mode will decrease the time span of the rolling window if a large change in the sensor measurement is detected, allowing the handheld to adapt when an event occurs.

The **Default** mode provides optimum averaging for all sensors. This mode has up to 40 seconds of averaging on the sensors to curb spikes and outliers, resulting in more stable data.

In **Accelerated** mode, changes in sensor measurements are more quickly observed than default (approximately 10 seconds of averaging). This mode is recommended when the sensors are moving through the water, such as during profiling studies and most spot sampling applications.

> ***NOTE:*** *For profiling applications, enable Vertical Position under Depth Display to view unfiltered depth measurements. This helps to ensure the depth sensor is lowered to the desired depth without waiting for the averaged measurement.*

In **Rapid** mode, sensor response is very fast (approximately 2 seconds of averaging), but the instrument will never settle on a single steady number. This mode is recommended when the sensors are moving quickly through the water, such as rapid profiling and towed applications.

Salinity

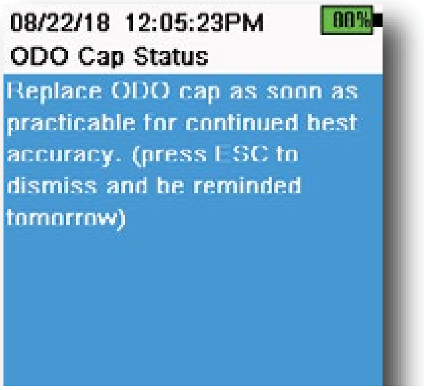
→ **Salinity**

Salinity is determined by calculations derived from the conductivity and temperature sensors.

When a conductivity sensor is installed, the instrument will automatically use the salinity measurement for DO and "As Measured" will be displayed. If no conductivity sensor is installed (*e.g.* ODO/T cable assembly used), the salinity value will be user-selectable.

ODO Cap Prompt

→ **ODO Cap Prompt**



ODO Cap Status

Replace ODO cap as soon as practicable for continued best accuracy. (press ESC to dismiss and be reminded tomorrow)

Figure 35 ODO Cap Status

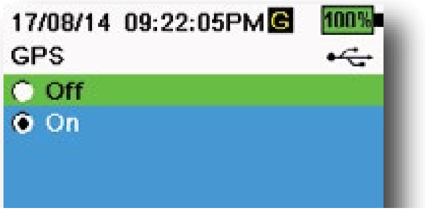
The handheld can remind users when it is time to replace the ODO Cap based on a user-defined interval (Figure 35). To set the reminder, select ODO Cap Prompt and **input a number in months**. YSI recommends enabling this setting to match the warranty period of the ODO Cap:

- ProDSS ODO Sensor Cap [SKU: 626890] = **12** months
- ODO Extended Warranty Sensor Cap [SKU: 627180] = **24** months

The handheld will automatically recognize the last time the ODO Sensor Cap coefficients were updated and alert the user when the Cap is due for replacement. To disable the prompt, simply enter **0** for the number of months.

GPS (Optional)

→ **GPS**



GPS

○ Off

● On

Figure 36 GPS

Some handhelds feature a built-in GPS. GPS turns the handheld Global Positioning System On or Off. The G symbol is shown when a GPS signal is received (Figure 36).

When enabled, the GPS coordinates will be saved with the Calibration Record and logged data. Note that the battery will drain more rapidly when GPS is enabled than when it is not enabled.

NOTE: *GPS data will be most accurate when there is a clear line of sight to satellites. It may be difficult for the handheld to receive a good GPS signal when under canopy or indoors.*

2.7 Calibration Menu

Push the Calibrate (Cal) key to access the Calibration menu (Figure 37). Highlight a sub-menu then push the ENTER key to view sub-menu options. Pre-defined or user-selected parameters are noted within brackets (**[ ]**). Refer to the Calibration section for sensor specific calibration procedures.

NOTE: *User ID, Probe ID, and User Field #1 and #2 can be enabled in the* ***Calibration Settings*** *under the System menu.*

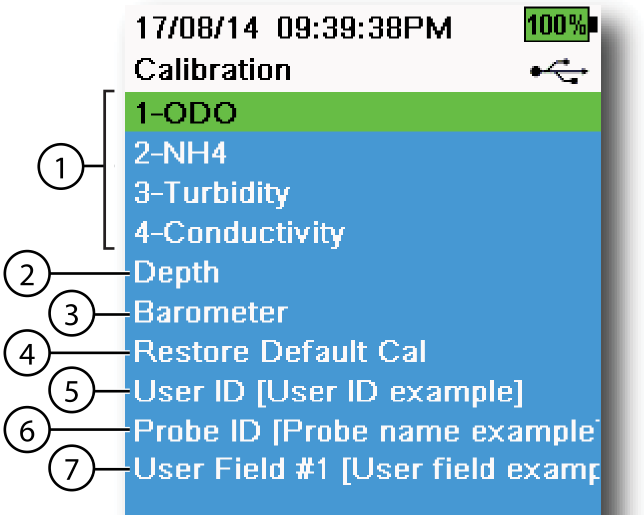


Figure 37 Calibration menu

1 Sensors connected	**5** User ID
2 Optional Depth sensor calibration	**6** Probe ID
3 Barometer calibration	**7** User Field #1
4 Restore Default Calibration - restores specified sensor to factory default	

2.8 Files Menu

Push the File (🗁) key to access the Files menu (Figure 38). Highlight a sub-menu then push the ENTER key to view sub-menu options.

Use the Files menu to view, delete or backup logged data or the calibration file. Data can be filtered by a specific date and time range and by user-created Site and Data ID lists.

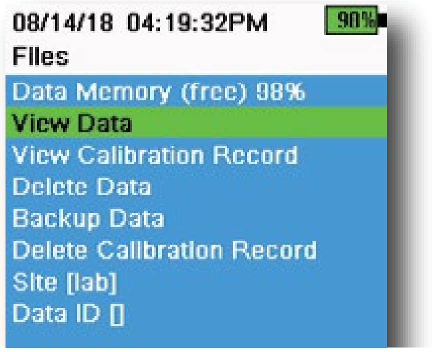
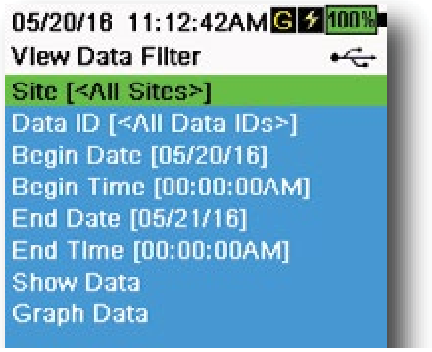


Figure 38 Files menu

Data Memory: (free) % shows the remaining memory available. Download or delete data to free available internal memory.

The Site List and/or Data ID List can be seen by selecting **Site [ ]** or **Data ID [ ]**. To enable the use of Site and/or Data ID when logging data, select **Logging** under the System menu.



05/20/16 11:12:42AM G ⚡ 100%

View Data Filter

Site [<All Sites>]

Data ID [<All Data IDs>]

Begin Date [05/20/16]

Begin Time [00:00:00AM]

End Date [05/21/16]

End Time [00:00:00AM]

Figure 39 View Data Filter

View Data Filter

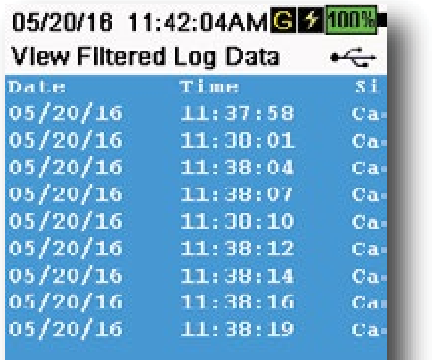
🗁 → **View Data**

Enter the desired filter criteria, then select **Show Data** or **Graph Data** to view the tabular or graphical data. If necessary, use the arrow keys to scroll through the data (Figure 39 and Figure 40).

Site: View data from one site or all sites.

Data ID: View data from one ID or all IDs.

Begin/End: View data within specific date and time ranges.



```
05/20/16 11:42:04AM G ⚡ 100%
View Filtered Log Data
Date        Time        Si
05/20/16    11:37:58    Ca
05/20/16    11:38:01    Ca
05/20/16    11:38:04    Ca
05/20/16    11:38:07    Ca
05/20/16    11:38:10    Ca
05/20/16    11:38:12    Ca
05/20/16    11:38:14    Ca
05/20/16    11:38:16    Ca
05/20/16    11:38:19    Ca
```

Figure 40 View Filtered Log Data

View Calibration Record


08/14/18 04:20:18PM 90%
View Calibration Record
Calibrate ODO
Date: [MM/DD/YY] 08/12/18
Time: 02:00:25PM
Sensor Type: ODO/T
Sensor: 18N000001
Sw Version: 3.1.2
Method: DO Air Cal
Cal Value: 96.6 DO %
Pre Cal Value: 93.3 DO %
Sensor Value: 90.2
ODO Gain: 1.035855
Barometer: 734.5 mmHg
Temperature: 22.7 Ref °C
User ID:
Probe ID:
Calibrate Status: Calibrated

Figure 41 View GLP

→ **View Calibration Record**

Select **View Calibration Record** to show the stored sensor calibrations (Figure 41).

Use the arrow keys to scroll through the calibration file data.

Calibration Information

Information in each calibration record:

- Sensor calibrated
- Date/time stamp
- Sensor ID
- Sensor serial #
- Sensor software version
- User ID (optional)
- Probe ID (optional)
- User Fields #1 and #2 (optional)
- Calibration status
- Calibration value
- Temperature

Depending on the parameter, a calibration record may include additional information such as the Conductivity cell constant, ODO gain, ORP offset, and pH slope.

Delete Data

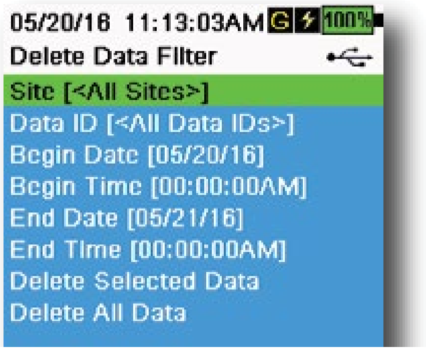

05/20/16 11:13:03AM G 100%
Delete Data Filter
Site [<All Sites>]
Data ID [<All Data IDs>]
Begin Date [05/20/16]
Begin Time [00:00:00AM]
End Date [05/21/16]
End Time [00:00:00AM]
Delete Selected Data
Delete All Data

Figure 42 Delete Data Filter

→ **Delete Data**

Enter the desired filter criteria, then select **Delete Selected Data** to *permanently* delete the data (Figure 42).

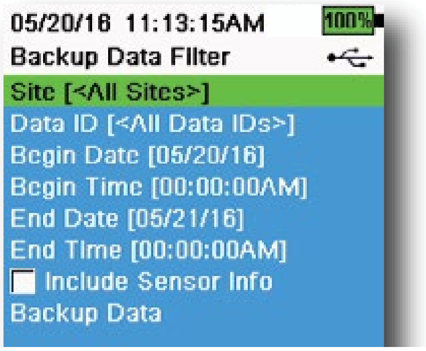
Select **Delete All Data** to permanently delete all logged data from the handheld.

Backup Data

→ **Backup Data**

This function allows you to backup logged data to a flash drive based on Site, Data ID, and log date (Figure 43). A USB female to micro USB male adapter is included with new instruments for this data backup.

> ***NOTE:*** *The USB storage device must be formatted as FAT32, not NTFS or exFAT. The handheld will only support FAT32.*



05/20/16 11:13:15AM 100%
Backup Data Filter
Site [<All Sites>]
Data ID [<All Data IDs>]
Begin Date [05/20/16]
Begin Time [00:00:00AM]
End Date [05/21/16]
End Time [00:00:00AM]
☐ Include Sensor Info
Backup Data

Figure 43 Backup Data

If the box next to "**Include Sensor Info**" is checked, each data set will be sent to a flash drive as a separate file with sensor serial number and sensor software information included. If the box is not checked (default), all data sets will be sent in a single backup file with no sensor serial number or sensor software information.

> ***NOTE:*** *It is suggested to send data to the USB flash drive as a single file (i.e. box is not checked) unless this sensor information is needed. This makes importing the data much faster and easier.*

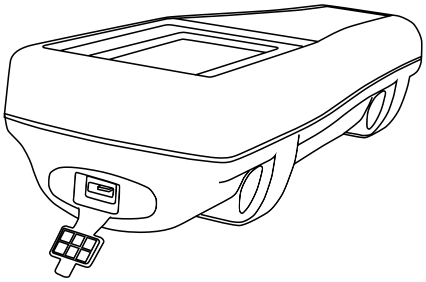


Figure 44 Micro USB female connector

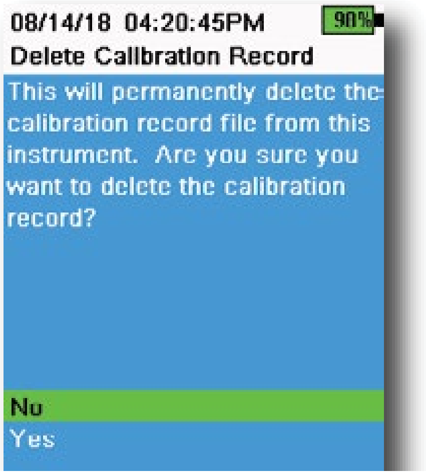
Once the filter settings are configured, select **Backup Data** to send the data to a flash drive. The data is exported in a CSV file.

If the data backup is not successful, ensure the correct filter criteria are selected and the USB connection indicator can be seen at the top of the screen (Figure 10).

Delete Calibration Record

→ **Delete Calibration Record**

To permanently delete the Calibration Record file from the instrument, select **Yes**, then push the ENTER key (Figure 45).



08/14/18 04:20:45PM 90%
Delete Calibration Record
This will permanently delete the calibration record file from this instrument. Are you sure you want to delete the calibration record?
No
Yes

Figure 45 Delete Calibration Record

2.9 Taking Measurements

For the highest accuracy, calibrate the sensor(s) before taking measurements.

1. Create Site and Data ID lists for logged data (if applicable).
2. Set the logging method (single or interval).
3. Set the Auto Stable parameters (if applicable).
4. Verify that the sensors and/or port plugs are correctly installed in all bulkhead ports.
5. Install the probe guard.
6. Insert the probe into the sample. Make sure the probe is fully submerged.
7. Move the probe in the sample to release any air bubbles and to provide a fresh sample to the sensors.
8. Wait for the sensor/s to stabilize in the sample.
9. On the main run screen, press ENTER to begin logging (single or interval) (See Logging).

   NOTE: *An option to change Site and/or Data ID (if enabled) appears once* ENTER *is pressed to begin logging.*
10. To stop continuous logging, simply press ENTER key again.

3. Calibration

ProDIGITAL sensors (except temperature) require periodic calibration. Calibration procedures follow the same basic steps with variations for specific parameters. Before calibration, adjust *Calibration Record* settings under the **System** menu if applicable to user requirements. Set up sensor options, settings, and coefficients as applicable.

3.1 Calibration Setup

Make sure the calibration cup, sensor guard, and all sensors are clean. YSI strongly recommends installing the sensor guard before placing the sensors into the calibration cup.

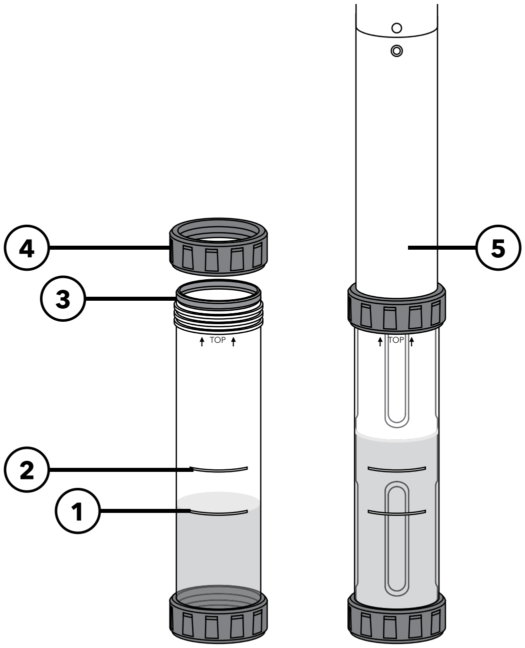
For highest data accuracy, thoroughly rinse the calibration cup and sensors with a small amount of the calibration standard for the sensor to be calibrated. Discard the rinse standard, and proceed with a fresh standard.

Be careful to avoid cross-contamination with other standards between calibrations by thoroughly rinsing with DI water and drying the calibration cup and sensors.

Ensure the calibration cup gasket is correctly seated. Loosely install the retaining nut on the cup. Slide the calibration cup over the sensors and sensor guard and tighten the retaining nut (Figure 46).

For cables and probes without dedicated calibration cups, please use the included graduated cylinder or a clean conatainer large enough to submerge the sensors. When calibrating the 1-port cable assembly, please ensure the built-in thermistor is fully submerged in the calibration solution.

Calibration Cup Installation for 4-Port Cable Assemblies

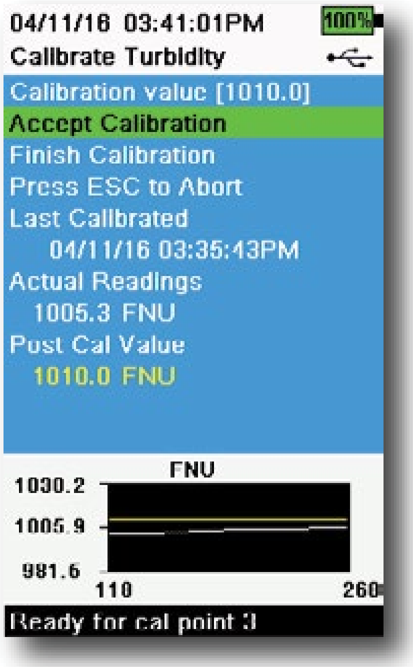


1 Fill line one (for all calibration solutions except for conductivity)	
2 Fill line two (for conductivity calibration solution)	
3 Gasket	
4 Retaining nut	
5 Calibration cup installed	

It takes 170 mL of solution to fill the calibration cup to line 1, while it takes 225 mL to fill to line 2.

Figure 46 Calibration cup standard volume (4-port cable)

Calibration Setup *(continued)*



04/11/16 03:41:01PM
Calibrate Turbidity
Calibration value [1010.0]
Accept Calibration
Finish Calibration
Press ESC to Abort
Last Calibrated
04/11/16 03:35:43PM
Actual Readings
1005.3 FNU
Post Cal Value
1010.0 FNU

Figure 47 Layout of calibration screen

Calibration Screen Layout

The calibration screen has the same basic layout for each parameter (Figure 47).

Calibration value: This is the value the sensor will be calibrated to. The Yellow Line on the graph corresponds to this value.

Accept Calibration: Select this to calibrate the sensor to the calibration value.

Finish Calibration: This option is only available with multi-point calibrations (*i.e.* pH, ISE, turbidity, PC, PE, and chlorophyll). Finishes the calibration by applying previously accepted points.

Press ESC to Abort: Press the ESC key to leave the calibration. The sensor will not be calibrated to any points. The last successful calibration will be used.

Last Calibrated: View the date and time of the last successful sensor calibration.

Actual Readings: This shows the current measurement value on the Run screen. The White Line on the graph corresponds to this value. Observe the White Line to ensure the measurement is stable before choosing Accept Calibration.

Post Cal Value: This is the same as the calibration value. This will be the measurement value in the current solution after the calibration is finished.

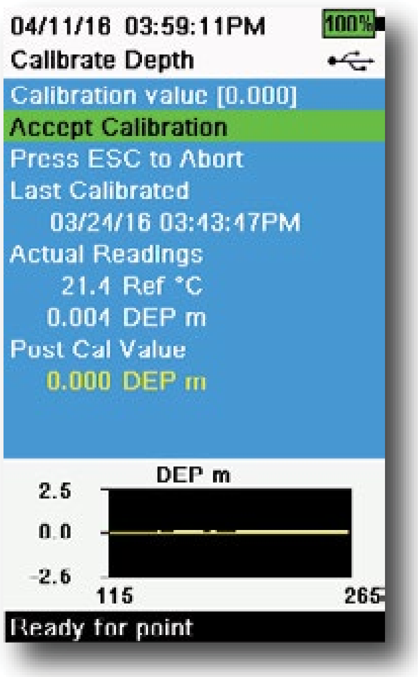
3.2 Depth

NOTE: *This calibration option is available only if your bulkhead is equipped with a depth sensor.*

Depth is calculated from the pressure exerted by the water column minus atmospheric pressure. Factors influencing depth measurement include barometric pressure, water density, and temperature. Calibration in the atmosphere "zeros" the sensor with respect to the local barometric pressure.

YSI recommends calibrating depth at the location of measurement. A change in barometric pressure will result in a zero shift unless the transducer is recalibrated to the new pressure.

If applicable, enter the depth offset to set the depth measurement to something other than zero. Enter the altitude and latitude of your sampling location to increase the accuracy of your depth measurement.



04/11/16 03:59:11PM 100%
Calibrate Depth
Calibration value [0.000]
Accept Calibration
Press ESC to Abort
Last Calibrated
03/24/16 03:43:47PM
Actual Readings
21.4 Ref °C
0.004 DEP m
Post Cal Value
0.000 DEP m

Ready for point

Figure 48 Calibrate Depth

Depth Calibration

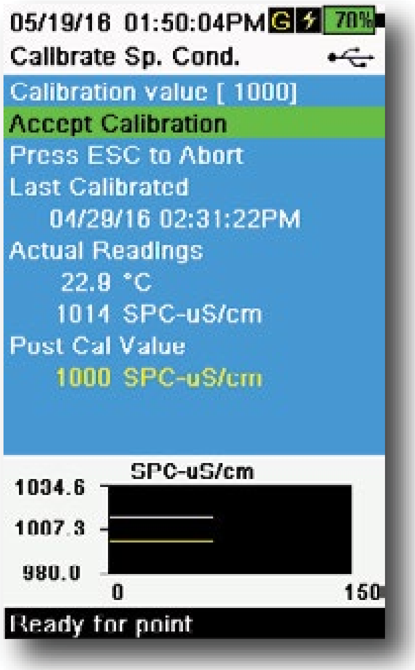
1. Make sure that the depth sensor is clean and dry in air, not immersed in any solution. For best results, keep the bulkhead still and in one position while calibrating.
2. Push the Cal key, then select **Depth**. The **Calibration Value** is set to 0.000 and should not be changed for air calibrations, even if using an offset.
3. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), then select **Accept Calibration** (Figure 48).

If the depth offset is used, the depth measurement will be adjusted after calibration.

3.3 Conductivity

The conductivity/temperature sensor can measure and calculate conductivity, specific conductance (temperature compensated conductivity), salinity, non-linear function (nLF) conductivity, TDS, resistivity, and density. Calibration is only available for specific conductance, conductivity, and salinity. Calibrating one of these options automatically calibrates the other conductivity/temperature parameters listed above. For both ease of use and accuracy, YSI recommends calibrating specific conductance.

Select the appropriate calibration standard for the conductivity of the sampling environment. Standards at least 1 mS/cm (1000 µs/cm) are recommended for the greatest stability. For fresh water applications, calibrate to 1,000. For salt water applications, calibrate to 50,000 µS.



05/19/16 01:50:04PM G ⚡ 70%
Calibrate Sp. Cond.
Calibration value [1000]
Accept Calibration
Press ESC to Abort
Last Calibrated
04/28/16 02:31:22PM
Actual Readings
22.9 °C
1014 SPC-uS/cm
Post Cal Value
1000 SPC-uS/cm

Ready for point

Figure 49 Calibrate specific conductance

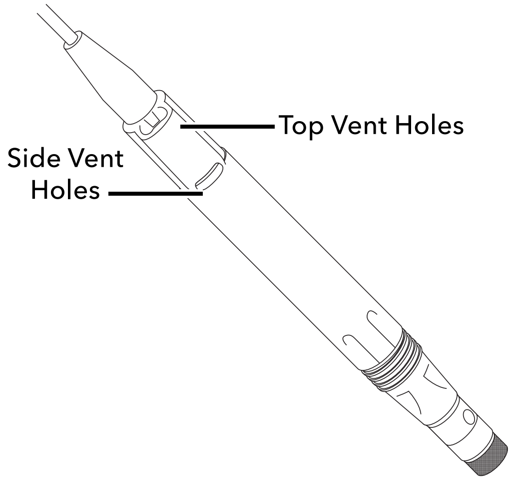


Figure 50 ODO/CT Cable Assembly

Conductivity Calibration

1. Make sure the conductivity sensor is clean prior to calibration. If necessary, clean the conductivity cell with the supplied soft brush.
2. Place the correct amount of conductivity standard into a clean and dry or pre-rinsed calibration cup.
3. Carefully immerse the sensors into the solution. Make sure the solution is above the vent holes on the side of the conductivity sensor.

   If using the ODO/CT assembly, ensure the vent holes at the top of the sensor are completely immersed and the solution level is at least 1 cm higher than the top vent holes (Figure 50). A graduated cylinder is included with ODO/CT cable assemblies for the purpose of calibrating conductivity.

   For 4-port cable assemblies, fill the calibration cup to the second line with fresh calibration standard. It takes 225 mL of solution to fill to line 2.
4. Gently rotate and/or move the sensor up and down to remove any bubbles from the conductivity cell. Allow at least 40 seconds for temperature equilibration before proceeding.
5. Push the Cal key, select **Conductivity**, then select **Specific Conductance**.
6. Select **Calibration value** then enter the calibration value of the standard used. Note the measurement units the instrument is reporting and calibrating and be sure to enter in the correct calibration value for the units being used. For example, 10,000 µS = 10 mS. Make sure that the units are correct and match the units displayed on the handheld.
7. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), then select **Accept Calibration** (Figure 49). "Calibration successful!" will be displayed in the message area.

(continued on next page)

Conductivity Calibration *(continued)*

8. Rinse the sensor in clean water then dry.

NOTE: *If the data is not stabilized after 40 seconds, gently rotate the sensor or remove/reinstall the calibration cup to make sure that no air bubbles are in the conductivity cell.*

If you get calibration error messages, check for proper sensor immersion, verify the calibration solutions is fresh, the correct value has been entered into the handheld, and/or try cleaning the sensor.

3.4 Barometer

The barometer is factory calibrated and should rarely need to be recalibrated. The barometer is used for DO calibration, %Local measurements, and for virtual vented depth measurements. Verify that the barometer is accurately reading "true" barometric pressure and recalibrate as necessary.

Laboratory barometer readings are usually "true" (uncorrected) values of air pressure and can be used "as is" for barometer calibration. Weather service readings are usually not "true", *i.e.* they are corrected to sea level and cannot be used until they are "uncorrected". Use this approximate formula:

True BP in mmHg=[Corrected BP in mmHg] - [2.5* (Local altitude in ft. above sea level/100)]
Example:
Corrected BP = 759 mmHg
Local altitude above sea level = 978 ft
True BP = 759 mmHg - [2.5*(978ft/100)] = 734.55 mmHg


04/11/16 04:00:49PM
Calibrate Barometer
Calibration value [732.0]
Accept Calibration
Press ESC to Abort
Last Calibrated
01/11/16 08:44:53AM
Actual Readings
21.7 °C
732.0 mmHg
Post Cal Value
732.0 mmHg

Ready for point

Figure 51 Calibrate Barometer

Barometer Calibration

1. Push the Cal key, then select **Barometer**.
2. Select **Calibration value** then enter the correct "true" barometric pressure.

NOTE: *The measurement units during calibration are dictated by what is enabled in the sensor setup menu. Be sure to enter in the correct units.*

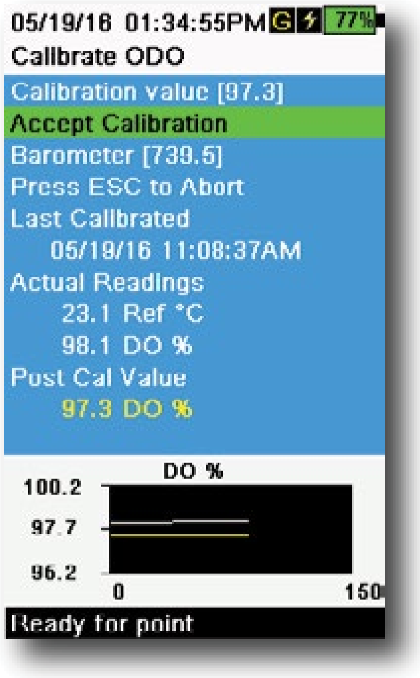
- BP in mmHg=25.4 x BP inHg
- BP in mmHg=0.750062 x BP mb
- BP in mmHg=51.7149 x BP psi
- BP in mmHg=7.50062 x BP kPa
- BP in mmHg=760 x BP atm

3. Select **Accept Calibration** (Figure 51). "Calibration successful!" will be displayed in the message area.

3.5 Dissolved Oxygen

ODO calibration requires the current “true” barometric pressure. Make sure that the barometer is reading accurately prior to ODO calibration.

Calibrating in DO% or DO% local automatically calibrates the mg/L and ppm measurement. There is no reason to calibrate both parameters. For both ease of use and accuracy, we recommend that you calibrate DO% or DO% Local and not mg/L.



05/19/16 01:34:55PM G ⚡ 77%
Calibrate ODO
Calibration value [97.3]
Accept Calibration
Barometer [739.5]
Press ESC to Abort
Last Calibrated
05/19/16 11:08:37AM
Actual Readings
23.1 Ref °C
98.1 DO %
Post Cal Value
97.3 DO %

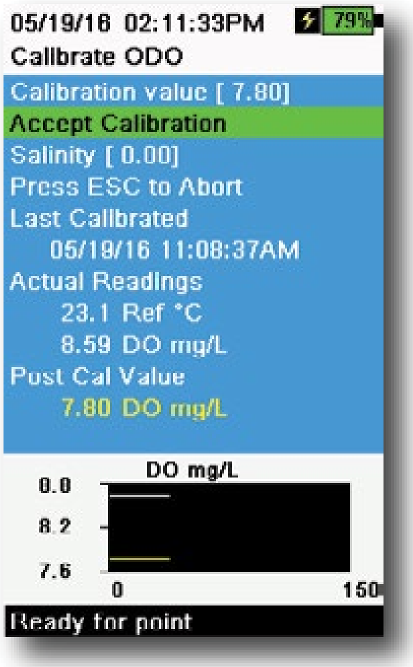
Ready for point

Figure 52 Calibrate ODO %

ODO% and ODO% Local - Water Saturated Air Calibration

1. Place a small amount of clean water (5 mL) in the calibration cup or a wet sponge into the calibration sleeve (for ODO/T and ODO/CT probes and 1-port cable assemblies).
2. Make sure there are no water droplets on the ODO sensor cap or temperature sensor.
3. Attach the probe guard and carefully slide into the calibration cup. Make sure a seal is not created around the probe. Atmospheric venting is required for accurate calibration.
4. Turn the instrument on and wait approximately 5 to 15 minutes for the air in the storage container to be completely saturated with water.
5. Push the Cal key, then select **ODO.** Select **DO%**.
6. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), then select **Accept Calibration** (Figure 52). “Calibration successful!” will be displayed in the message area.

NOTE: *If you see a calibration error message, verify the barometer reading and inspect the sensor cap. Clean and/or replace the sensor cap as needed.*



05/19/16 02:11:33PM 79%

Calibrate ODO

Calibration value [7.80]

Accept Calibration

Salinity [0.00]

Press ESC to Abort

Last Calibrated

05/19/16 11:08:37AM

Actual Readings

23.1 Ref °C

8.59 DO mg/L

Post Cal Value

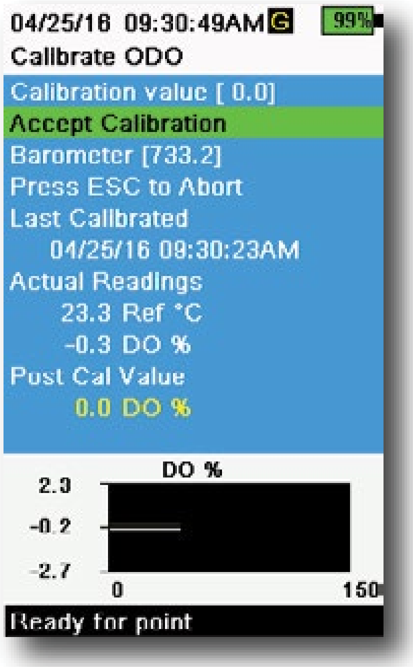
7.80 DO mg/L

Ready for point

Figure 53 Calibrate ODO mg/L

ODO mg/L Calibration

1. Place the ODO and conductivity/temperature sensor into a water sample that has been titrated by the Winkler method to determine the dissolved oxygen concentration in mg/L.
2. Push the Cal key, then select **ODO**. Select **DO mg/L**.
3. Select **Calibration value.**
4. Enter the dissolved oxygen concentration of the sample in mg/L.
5. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), then select **Accept Calibration** (Figure 53). “Calibration successful!” will be displayed in the message area.
6. Rinse the bulkhead and sensors in clean water then dry.



04/25/16 09:30:49AM G 99%

Calibrate ODO

Calibration value [0.0]

Accept Calibration

Barometer [733.2]

Press ESC to Abort

Last Calibrated

04/25/16 09:30:23AM

Actual Readings

23.3 Ref °C

-0.3 DO %

Post Cal Value

0.0 DO %

Ready for point

Figure 54 Calibrate ODO zero point

ODO Zero Point Calibration

1. Place the ODO and Conductivity/Temperature sensors in a solution of zero DO.

   NOTE: *A zero DO solution can be made by dissolving approximately 8-10 grams of sodium sulfite into 500 mL of tap water. Mix the solution thoroughly. It may take the solution 60 minutes to be oxygen-free.*

2. Push the Cal key, then select **ODO**. Select **Zero**.
3. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), then select **Accept Calibration** (Figure 54). “Calibration successful!” will be displayed in the message area.
4. Thoroughly rinse the bulkhead and sensors in clean water then dry.
5. Perform a ODO % water-saturated air calibration after performing a zero point calibration.

3.6 Turbidity

Standards

For best results, YSI recommends the following standards for turbidity calibration:

Calibration Point	Standard Value
1	0 FNU [SKU: 608000]
2	12.4 FNU [SKU: 607200] or 124 FNU [SKU: 607300]
3	1010 FNU [SKU: 607400]

Other standards may be acceptable as long as they have been prepared according to details in Standard Methods for the Treatment of Water and Wastewater (Section 2130 B). These standards include:

- YSI Certified AMCO-AEPA polymer-based standards (see above)
- Hach StablCal™ standards in various NTU denominations
- Dilutions of 4000 NTU formazin concentrate purchased from Hach
- Other formazin standards prepared according to the Standard Methods

The use of standards other than those mentioned above will result in calibration errors and inaccurate field readings. It is important to use the same type of standard for all calibration points; do not mix formazin and polymer-based standards for different points in a multi-point calibration.

When using an alternative standard (non-YSI), calibration can be completed using the following limits:

	Min	Max	Unit
1st Calibration Point	0.0	1.0	FNU or NTU
2nd Calibration Point	5.0	200	FNU or NTU
3rd Calibration Point	400	4000	FNU or NTU

04/11/16 03:39:31PM
Calibrate Turbidity
Calibration value [124.0]
Last Calibrated
04/11/16 03:35:43PM
Actual Readings
123.8 FNU
Post Cal Value
124.0 FNU
Ready for cal point 2

Figure 55 Calibrate Turbidity

Turbidity Calibration 2-Point

Turbidity calibrations, more than most other paramters, are susceptible to interference from contamination. It is critical for calibrations to be performed with very clean sensors, guards, and cups.

NOTE: *Calibration standards should not be re-used.*

1. Fill the calibration cup to the appropriate level with 0 FNU standard (deionized water may be used as a substitute). The sensor guard must be installed to ensure an accurate calibration. Make sure the guard is intalled and immerse the probe in the zero standard.
2. Push the Cal key, then select **Turbidity**.
3. Select **Calibration Value** and enter 0.00.
4. Make sure there are no air bubbles on the turbidity sensor lens. If present, lightly tap the guard against the cup to dislodge any bubbles. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), and then select **Accept Calibration**. “Ready for cal point 2” will be displayed in the message area.
5. Discard the used standard, and rinse the probe, guard, and calibration cup with a small amount of the next calibration point standard. Discard the rinse standard.
6. Fill the calibration cup to the appropriate level with fresh standard for the second calibration point. Immerse the probe in the standard.
7. Select **Calibration Value** and enter the value of the second calibration standard.
8. Make sure there are no air bubbles on the turbidity sensor lens. Observe the actual measurement readings for stability, and then select **Accept Calibration** (Figure 55). “Ready for cal point 3” will be displayed in the message area.
9. Select **Finish Calibration** to complete a 2-point calibration or continue for the 3-point calibration.

Repeat steps 5 through 8 for a 3-point calibration. “Calibration successful!” will be displayed in the message area. After calibration, rinse with water and dry the probe.

3.7 Total Algae

TAL Sensors

YSI offers two Total Algae (TAL) sensor options. Both are dual-channel fluorescence sensors.

The channels on the TAL-PC sensor refer to two independent data sets: one results from a blue excitation beam that excites the chlorophyll a (Chl) molecule and the second results from an orange excitation beam that excites the phycocyanin (PC) accessory pigment. TAL-PC sensors are typically selected for monitoring freshwater cyanobacteria.

The TAL-PE sensor is similar in having a chlorophyll channel, but utilizes a slightly blueshifted beam that excites the pigment phycoerythrin (PE). TAL-PE sensors are typically selected for monitoring marine cyanobacteria.

TAL Units

The TAL sensors report data in RFU and µg/L of pigment (Chl, PC or PE) units. YSI recommends reporting in Relative Fluorescence Units (RFU).

RFU is used to set sensor output relative to a stable secondary standard, Rhodamine WT dye. This allows users to calibrate sensors identically so that results from sensor to sensor can be compared. Calibration with Rhodamine WT also enables users to monitor for sensor drift and external factors such as biofouling or declining sensor optical performance over time as the LEDs age.

The excellent linearity of RFU, once the channels are calibrated with Rhodamine WT, translates to the best accuracy of measurements. For example, a chlorophyll reading of 100 units will represent twice the pigment detected by the sensor than with a chlorophyll reading of 50 units. This high linearity (R2>0.9999) doesn't always hold for µg/L of pigment since that unit was derived from laboratory monocultures, and an environmental algal population can behave quite differently. This is also why the TAL sensors and in situ monitoring should not be regarded as a perfect replacement for other methods such as pigment extractions and cell counting.

The µg/L output generates an estimate of pigment concentration that is based upon correlations built with sensor outputs and extractions of pigments from laboratory-grown blue-green algae. Synonymous with parts per billion (ppb), µg/L is still commonly used by regulatory agencies, but has the drawback that it is very dependent upon the composition of the algal population, the time of day, the physiological health of the algae, and a number of other environmental factors. Thus, users are advised to do their own check of our correlation with a population of algae relevant to their own sites, as described below.

A 2-point RFU calibration is advised to be performed first. Next, with samples collected from the site of interest, measure both RFU and µg/L with the sensor(s). Observing careful handling and preservation of the samples, as soon as possible extract the pigments from the samples, using standardized methods to determine the µg/L in each sample. The extraction data may be used to assess how RFU and µg/L delivered by the sensor compare with the µg/L of pigment that would be predicted by RFU from the sensor. The user's requirements can guide the decision as to whether RFU or µg/L is the best unit to read from the sensor for any specific application.

TAL Raw values can only be seen under Sensor info in the System menu and are unaffected by user calibrations. These values range from 0-100, representing the percent of full scale that the sensor detects in a sample, and are used for diagnostic purposes.

Rhodamine WT Dye Solution Preparation

Rhodamine WT dye solution must be used when completing a 2-point calibration. Purchase Rhodamine WT as a 2.5% solution to follow the procedure below. Kingscote Chemicals (Miamisburg, OH, 1-800-394-0678) has historically had a 2.5% solution (item #106023) that works well with this procedure. Note that there are many types of Rhodamine—make sure Rhodamine **WT** is selected. If a 2.5% solution cannot be obtained commercially, prepare it from a solid or from another concentration of a liquid solution to a 2.5% final concentration, or adjust the dilutions below accordingly. It should be stored in the refrigerator when not in use.

For PC and chlorophyll channel calibrations, a 0.625 mg/L solution of Rhodamine WT should be prepared. For PE channel calibration, a 0.025 mg/L solution of Rhodamine WT should be prepared. The steps below describe one procedure to prepare these solutions.

1. *For any TAL sensor calibration, prepare a 125 mg/L solution of Rhodamine WT.* Transfer 5.0 mL of the 2.5% Rhodamine WT solution into a 1000 mL volumetric flask. Fill the flask to the volumetric mark with deionized or distilled water and mix well to produce a solution that is approximately 125 mg/L of Rhodamine WT. Transfer to a storage bottle and retain it for future use.

   *This solution can be stored in the refrigerator (4°C). Its degradation will depend upon light exposure and repeated warming cycles, but solutions used 1-2 times a year can be stored for up to two years. Users should implement their own procedures to safeguard against degradation.

2. *For PC and chlorophyll channel calibrations, prepare a 0.625 mg/L solution of Rhodamine WT.* Transfer 5.0 mL of the 125 mg/L solution prepared in step one into a 1000 mL volumetric flask. Fill the flask to the volumetric mark with deionized or distilled water. Mix well to obtain a solution that is 0.625 mg/L of Rhodamine WT. Use this solution within 24 hours of preparation and discard it after use.
3. *For PE channel calibration, prepare a 0.025 mg/L solution of Rhodamine WT.* Transfer 0.2 mL of the 125 mg/L solution prepared in step one into a 1000 mL volumetric flask. Fill the flask to the volumetric mark with deionized or distilled water. Mix well to obtain a solution that is 0.025 mg/L of Rhodamine WT. Use this solution within 24 hours of preparation and discard it after use.

In addition to preparing the Rhodamine solution(s), it is also necessary to determine temperature-compensated calibration values for solutions. In general, fluorescence is inversely related with temperature. Measure the temperature of the Rhodamine solution(s) and use the temperature of the solution at the time of calibration to select the compensated solution concentrations, in either RFU (recommended) or µg/L pigment equivalents, from the table below.

As an example, assume that you will calibrate the chlorophyll channel in RFU, and that the temperature measured in the 0.625 mg/L Rhodamine WT solution is 22°C. The first standard value entered will be 0, and the second standard value will be 16.4 (see table on page 41). Likewise, if you intend to use the default µg/L unit when calibrating chlorophyll, the second standard value would be 66 in this example. Using the same 0.625 mg/L Rhodamine WT solution to calibrate the PC channel will yield a second standard value of 16.0 RFU or 16 µg/L. These values will be entered when performing a 2-point calibration.

Rhodamine WT Dye Solution Preparation *(continued)*

	Chlorophyll		Phycocyanin		Phycoerythrin	
Temp (°C)	RFU	µg/L	RFU	µg/L	RFU	µg/L
30	14.0	56.5	11.4	11.4	37.3	104.0
28	14.6	58.7	13.1	13.1	39.1	109.0
26	15.2	61.3	14.1	14.1	41.0	115.0
24	15.8	63.5	15.0	15.0	43.0	120.0
22	16.4	66	16.0	16.0	45.0	126.0
20	17.0	68.4	17.1	17.1	47.0	132.0
18	17.6	70.8	17.5	17.5	49.2	138.0
16	18.3	73.5	19.1	19.1	51.4	144.0
14	18.9	76	20.1	20.1	53.6	150.0
12	19.5	78.6	21.2	21.2	55.9	157.0
10	20.2	81.2	22.2	22.2	58.2	163.0
8	20.8	83.8	22.6	22.6	60.6	170.0

TAL Calibration

A 1- or 2-point calibration can be completed for all channels on the TAL-PC and TAL-PE sensors.

A 1-point calibration, typically completed in clear deionized or distilled water, is simply a re-zeroing of the sensor. This calibration does not reset the second point entered during the previous 2-point calibration. The consequence is that error will be alleviated at and near zero, but more error can accumulate in the measurement the farther away from zero the measured value is. The amount of error is dependent upon how much the second point drifts, which is not always equivalent to how much the zero point drifts.

For many users, especially those with sites where pigment is rarely detected and values are at or near zero most of the time, the far-from-zero accumulation of error is a non-issue. For others, it is best to perform a 2-point calibration using a Rhodamine WT solution.

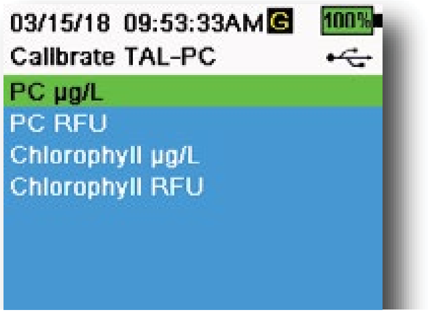


Figure 56 TAL-PC Calibration Options

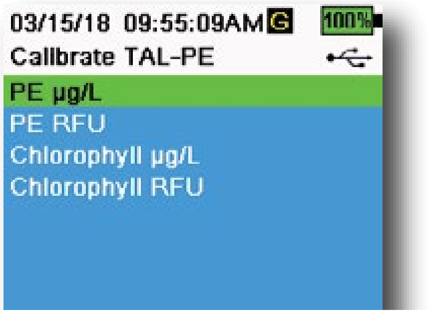
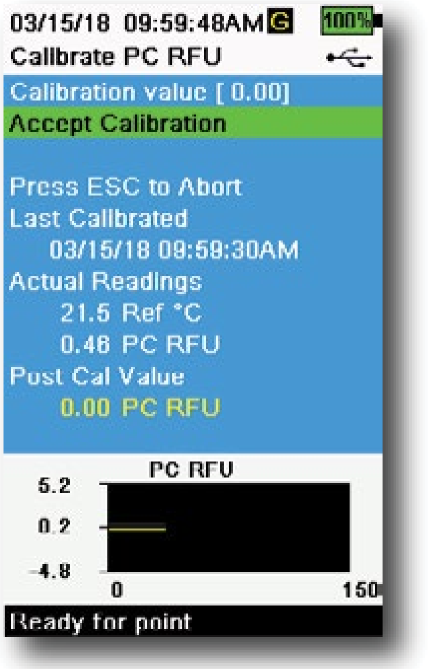


Figure 57 TAL-PE Calibration Options



Calibration value [0.00]

Press ESC to Abort

Last Calibrated
03/15/18 09:58:30AM

Actual Readings
21.5 Ref °C
0.46 PC RFU

Post Cal Value
0.00 PC RFU

Ready for point

Figure 58 Calibrate PC RFU

PE, PC and Chlorophyll Calibration 2-Point

Each channel of the sensor must be calibrated independently. Calibration of the chlorophyll channel does not set the calibration for the PC channel or the PE channel. In addition, calibrating in RFU for a channel does not automatically calibrate the µg/L measurement for the same channel. The following calibration procedure must be performed for each channel and each unit the user would like to display.

1. Fill the calibration cup to the appropriate level with deionized water (0 standard). Immerse the probe in the standard. Make sure the sensor guard is installed.
2. Push the Cal key, then select either **TAL-PC** or **TAL-PE**, depending on the sensor to be calibrated.
3. Select the channel and units to be calibrated. Options for the TAL-PC sensor are shown in Figure 56, while options for the TAL-PE sensor are shown in Figure 57.
4. Select **Calibration Value** and enter 0.00.
5. Make sure there are no air bubbles on the sensor lens. If present, lightly tap the guard against the cup to dislodge any bubbles. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), and then select **Accept Calibration**. "Ready for cal point 2" will be displayed in the message area.
6. Discard the used water, and rinse the probe, guard, and calibration cup with a small amount of the standard for calibration point #2. Discard the rinse standard.

   NOTE: *For standard #2, use the 0.625 mg/L Rhodamine WT solution when calibrating chlorophyll (RFU or µg/L) on either TAL sensor, or when completing a PC (RFU or µg/L) calibration on a TAL-PC sensor. Use the 0.025 mg/L Rhodamine WT solution when completing a PE (RFU or µg/L) calibration on a TAL-PE sensor.*

7. Fill the calibration cup to the appropriate level with fresh standard #2. Immerse the sensors in the second calibration standard.
8. Observe the temperature reading on the calibration display (Figure 58). Use the table in the Rhodamine WT dye solution preparation section to identify the appropriate value for the calibration standard.
9. Select **Calibration Value** and enter the value of the second calibration standard.
10. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), then select **Accept Calibration**. The procedure will automatically finish after calibrating using the second standard.

3.8 pH/ORP

Observe the pH mV readings during calibration to understand the condition and response of the pH sensor. In buffer 7, pH mVs should be between -50 and +50. In pH4 buffer, the mV reading should be 165 to 180 mV higher than the reading in pH 7 buffer. In pH 10 buffer, the mV reading should be 165 to 180 mV lower than the reading in pH 7 buffer. The theoretically ideal slope is -59 mV/pH unit.

1-Point

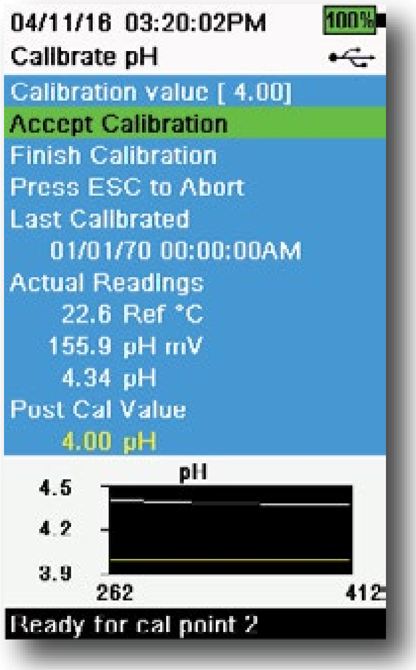
While a 1-point pH calibration is possible, this calibration procedure adjusts only the pH offset and leaves the previously determined slope unaltered. This should only be performed if you are adjusting a previous 2-point or 3-point calibration.

2-point

Perform a 2-point pH calibration if the pH of the media to be monitored is known to be either basic or acidic. In this procedure, the pH sensor is calibrated with a pH 7 buffer and a pH 10 or pH 4 buffer depending upon the pH range you anticipate for your water to be sampled.

3-point

Perform a 3-point pH calibration to assure maximum accuracy when the pH of the environmental water cannot be anticipated or fluctuates above and below pH 7. In this procedure, the pH sensor is calibrated with pH 7, pH 10, and pH 4 buffer solutions.



04/11/16 03:20:02PM 100%
Calibrate pH
Calibration value [4.00]
Accept Calibration
Finish Calibration
Press ESC to Abort
Last Calibrated
01/01/70 00:00:00AM
Actual Readings
22.6 Ref °C
155.9 pH mV
4.34 pH
Post Cal Value
4.00 pH

Ready for cal point 2

Figure 59 Calibrate pH 2- or 3-point

pH Calibration 3-Point

1. Always start the calibration with pH 7 buffer. Fill the calibration cup to the appropriate level with pH 7 buffer solution.
2. With the probe guard installed, carefully immerse the probe into the buffer solution. Make sure both the pH sensor and temperature sensor are submerged.
3. Push the Cal key; then select **pH** or **pH/ORP**.
4. The **Calibration value** will automatically be adjusted based on the selected buffer and temperature. Alternatively, the Calibration value can be manually entered..
5. Wait for the pH mV and temperature readings to stabilize; the white line on the graph should be flat for about 40 seconds.
6. Select **Accept Calibration** and press the ENTER key. "Ready for cal point 2" will be displayed in the message area.
7. Rinse the probe and calibration cup. Fill to the appropriate level with either pH 10 or pH 4 buffer solution; it doesn't matter which one comes next.
8. Immerse the probe into the buffer solution. The **Calibration value** will automatically be adjusted based on the selected buffer and temperature.
9. Wait for the pH mV and temperature readings to stabilize; the white line on the graph should be flat for about 40 seconds.
10. Select **Accept Calibration** and press the ENTER key. "Ready for cal point 3" will be displayed in the message area.

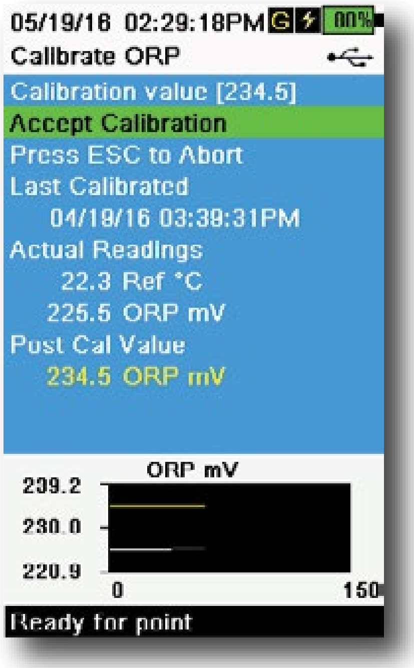
pH Calibration 3-Point *(continued)*

NOTE: *For 2-Point calibrations, select Accept Calibration before selecting Finish Calibration.*

11. Rinse the probe and calibration cup. Fill to the appropriate level with the final buffer solution.
12. Immerse the probe into the buffer solution. The **Calibration value** will automatically be adjusted based on the selected buffer and temperature.
13. Wait for the pH mV and temperature readings to stabilize; the white line on the graph should be flat for about 40 seconds.
14. Select **Accept Calibration** and press the ENTER key. The procedure will automatically finish after calibrating the third point.

ORP Calibration

1. Obtain a premixed standard solution that is approved for use with Ag/AgCl ORP sensors or prepare a standard with a known oxidation reduction potential (ORP) value. Zobell solution is recommended.
2. With the probe guard installed, carefully immerse the probe into the standard solution. Make sure both the ORP sensor and temperature sensor are submerged.
3. Push the Cal key, then select **pH/ORP**, then **ORP**.
4. If using YSI Zobell solution, the **Calibration value** will automatically be adjusted based on the temperature. Otherwise, refer to the table included with the standard solution and enter the mV value that corresponds to the temperature of the solution.
5. Wait for the ORP mV and temperature readings to stabilize; the white line on the graph should be flat for about 40 seconds.
6. Select **Accept Calibration** and press the ENTER key. "Calibration successful!" will be displayed in the message area.



05/19/16 02:29:18PM G 00%
Calibrate ORP
Calibration value [234.5]
Accept Calibration
Press ESC to Abort
Last Calibrated
04/18/16 03:38:31PM
Actual Readings
22.3 Ref °C
225.5 ORP mV
Post Cal Value
234.5 ORP mV

Ready for point

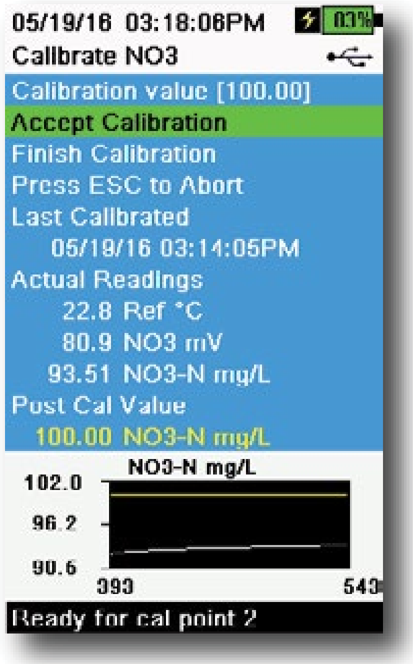
Figure 60 Calibrate ORP

3.9 ISEs

Ammonium, Nitrate, & Chloride

YSI recommends a 2-point calibration for ISEs. For best results, use standards that differ by 2 orders of magnitude:

- 1 mg/L and 100 mg/L for Ammonium and Nitrate
- 10 mg/L and 1,000 mg/L for Chloride



05/19/16 03:18:06PM
Calibrate NO3
Last Calibrated
05/19/16 03:14:05PM
Actual Readings
22.8 Ref °C
80.9 NO3 mV
93.51 NO3-N mg/L
Post Cal Value
100.00 NO3-N mg/L
Ready for cal point 2

Figure 61 Calibrate ISE

ISE Calibration

1. Fill the calibration cup to the appropriate level standard for calibration point #1. Immerse the probe in the standard.
2. Push the Cal key, then select the applicable ISE sensor.
3. Select **Calibration value** and enter the value that corresponds to the first calibration standard.
4. Observe the actual measurement readings for stability (white line on graph shows no significant change for 40 seconds), then select **Accept Calibration**. "Ready for cal point 2" will be displayed in the message area.
5. Discard the used standard and rinse the probe and calibration cup with a small amount of the next calibration point standard. Discard the rinse standard.
6. Fill the calibration cup to the appropriate level with fresh standard for the second calibration point. Immerse the probe in the standard.
7. Select **Calibration value** and enter the value of the second calibration standard.
8. Observe the actual measurement readings for stability, and then select **Accept Calibration** (Figure 61). "Ready for cal point 3" will be displayed in the message area.
9. Select **Finish Calibration** to complete a 2-point calibration.

Optimal mV for ISE calibration

Ammonium mV values

- NH_4 1 mg/L = 0 mV +/- 20 mV (new sensor only)
- NH_4 100 mg/L = 90 to 130 mV greater than the mV reading in the 1 mg/L standard
- The mV span between 1 mg/L and 100 mg/L values should be approximately 90 to 130 mV. The slope should be 45 to 65 mV per decade of ammonium concentration in mg/L

Nitrate mV values

- NO_3 1 mg/L = 200 mV +/- 20 mV (new sensor only)
- NO_3 100 mg/L = 90 to 130 mV less than the mV reading in the 1 mg/L mV standard
- The mV span between 1 mg/L and 100 mg/L values should be approximately 90 to 130 mV. The slope should be -45 to -65 mV per decade of nitrate concentration in mg/L

Chloride mV values

- Cl 10 mg/L = 225 mV +/- 20 mV (new sensor only)
- Cl 1,000 mg/L = 80 to 130 mV < 10 mg/L mV value
- The mV span between 10 mg/L and 1000 mg/L values should be approximately 80 to 130 mV. The slope should be -40 to -65 mV per decade of chloride concentration in mg/L

Chilled Third Calibration Point

The chilled 3-point calibration is recommended if there is a large temperature variation during sampling or when the temperature of the media cannot be anticipated. The highest concentration solution and one of the lower concentration solutions should be at ambient temperature. The other lower concentration solution should be chilled to less than 10°C to prior calibration point.

1. Discard the used standard and rinse the probe and calibration cup with a small amount of the next calibration point standard. Discard the rinse standard.
2. Fill the calibration cup to the appropriate level with fresh standard for the third calibration point. Immerse the probe in the standard.
3. Select **Calibration value** and enter the value of the third calibration standard.
4. Observe the actual measurement readings for stability, and then select **Accept Calibration**. "Calibration successful!" will be displayed in the message area.

Preparing Standards

We recommend using YSI calibration solutions whenever possible. However, qualified users can follow these recipes to prepare their own standards.

⚠ **CAUTION:** Some of the chemicals required for these solutions could be hazardous under some conditions; therefore, the standards should only be prepared by qualified chemists in laboratories where proper safety precautions are possible. It is the responsibility of the user to obtain and study the MSDS for each chemical and to follow the required instructions with regard to handling and disposal of these chemicals.

Ammonium Standards

You will need:

- Solid ammonium chloride or a certified 100 mg/L NH_4^+-N from a supplier
- Lithium acetate dihydrate
- Concentrated hydrochloric acid
- High purity water
- A good quality analytical balance
- A 1000 mL volumetric flask
- Accurate volumetric measuring devices for 100 mL and 10 mL of solution
- And a 1000 mL glass or plastic storage vessels

⚠ **CAUTION:** Hydrochloric acid is highly corrosive and toxic and should therefore be handled with extreme care in a well-ventilated fume hood. The equivalent amount of a less-hazardous, more dilute sample of the acid may be used if preferred.

100 mg/L Standard

1. Accurately weigh 0.3817 g of ammonium chloride and transfer quantitatively into a 1000 mL volumetric flask. Add 2.6 g of lithium acetate dihydrate to the flask.
2. Add approximately 500 mL of distilled or deionized water to the flask. Swirl to dissolve all of the reagents and then dilute to the volumetric mark with distilled or deionized water.
3. Mix well by repeated inversion and then transfer the 100 mg/L standard to a storage bottle.
4. Add 3 drops of concentrated hydrochloric acid to the bottle, then seal and agitate to assure homogeneity. Alternatively, 100 mL of certified 100 mg/L NH_4^+-N standard can be used in place of the solid ammonium chloride.

Ammonium Standards *(continued)*

1 mg/L Standard

1. Accurately measure 10.0 mL of the above 100 mg/L standard solution into a 1000 mL volumetric flask. Add 2.6 g of lithium acetate dihydrate to the flask.
2. Add approximately 500 mL of distilled or deionized water. Swirl to dissolve the solid reagents and then dilute to the volumetric mark with water.
3. Mix well by repeated inversion and then transfer the 1 mg/L standard to a storage bottle.
4. Add 3 drops of concentrated hydrochloric acid to the bottle, then seal and agitate to assure homogeneity.

Other concentrations can be made by altering the amount of ammonium chloride. All other ingredient concentrations should remain unchanged.

Nitrate Standards

You will need:

- Solid potassium nitrate or a certified 1000 mg/l NO_3-N from a supplier
- Magnesium sulfate, high purity water
- A good quality analytical balance
- 1000 mL volumetric flask
- Accurate volumetric measuring devices for 100 mL, 10 mL and 1 mL of solution
- And 1000 mL glass or plastic storage vessels

100 mg/L standard

1. Accurately weigh 0.7222 g of anhydrous potassium nitrate and transfer quantitatively into a 1000 mL volumetric flask. Add 1.0 g of anhydrous magnesium sulfate to the flask.
2. Add approximately 500 mL of water to the flask. Swirl to dissolve all of the reagents, and then dilute to the volumetric mark with distilled or deionized water.
3. Mix well by repeated inversion and then transfer the 100 mg/L standard to a storage bottle.
4. Rinse the flask extensively with water prior to its use in the preparation of the 1 mg/l standard. Alternatively, 100 mL of certified 1000 mg/L NO_3-N standard can be used in place of the solid potassium nitrate.

1 mg/L standard

1. Accurately measure 10.0 mL of the above 100 mg/L standard solution into a 1000 mL volumetric flask. Add 1.0 g of anhydrous magnesium sulfate to the flask.
2. Add approximately 500 mL of distilled or deionized water. Swirl to dissolve the solid reagents, and then dilute to the volumetric mark with water.
3. Mix well by repeated inversion and then transfer the 1 mg/L standard to a storage bottle.

Other concentrations can be made by altering the amount of potassium nitrate. All other ingredient concentrations should remain unchanged.

Chloride Standards

You will need:

- Solid sodium chloride or a certified 1000 mg/L chloride solution from a supplier
- Magnesium sulfate
- High-purity water
- A good quality analytical balance
- 1000 mL volumetric flask
- An accurate 10 mL measuring devices
- And 1000 mL glass or plastic storage vessels

1000 mg/L Standard

1. Accurately weigh 1.655 grams of anhydrous sodium chloride and transfer into a 1000 mL volumetric flask.
2. Add 0.5 grams of anhydrous magnesium sulfate to the flask.
3. Add 500 mL of water to the flask, swirl to dissolve all of the reagents, then dilute to the volumetric mark with water.
4. Mix well by repeated inversion, then transfer the 1000 mg/L standard to a storage bottle.
5. Rinse the flask extensively with water prior to its use in the preparation of the 10 mg/L standard. Alternatively, simply add 0.5 grams of magnesium sulfate to a liter of a 1000 mg/L chloride standard from a certified supplier.

10 mg/L Standard

1. Accurately measure 10 mL of the above 1000 mg/L standard solution into a 1000 mL volumetric flask.
2. Add 0.5 grams of anhydrous magnesium sulfate to the flask.
3. Add 500 mL of water, swirl to dissolve the solid reagents, then dilute to the volumetric mark with water.
4. Mix well by repeated inversion, then transfer the 10 mg/L standard to a storage bottle.

4. Maintenance and Storage

Follow all maintenance and storage procedures in this section. Incorrect or unapproved maintenance and/or storage can cause handheld, sensor or cable damage not covered by the warranty.

Storage terms are defined as follows:

Short-term Storage = Less than 4 weeks

Short-term storage is appropriate when the handheld, cables, and sensors will be used at regular intervals (daily, weekly, etc.).

Long-term Storage = More than 4 weeks

During long periods of inactivity, such as the "off-season" for environmental monitoring, the instrument, sensors, and cables should be placed in long-term storage.

YSI recommends cleaning and maintenance before long-term storage.

4.1 ProDIGITAL Handheld

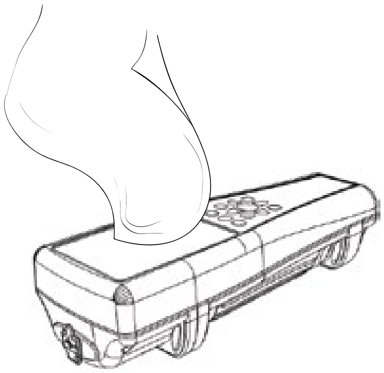


Figure 62 Handheld cleaning

Wipe the keypad, screen, and case with a cloth dampened with a mild solution of clean water and dish soap (Figure 62). Optimal storage temperature of the handheld instrument is 0-45°C. The battery pack permanently loses capacity at a faster rate when above 45°C.

Short-term Storage:

Assure that the handheld instrument is powered off, and store it in a temperature-controlled, secure location. Ideally all ports should be covered to prevent dust, water, or other contamination.

Long-term Storage:

In addition ot the short-term storage guidelines above, remove the battery pack to prevent any damage from possible battery leaks. Reinstall the battery cover. Store the battery pack in a dry place ideally around 25°C.

4.2 1-Port and 4-Port Bulkheads

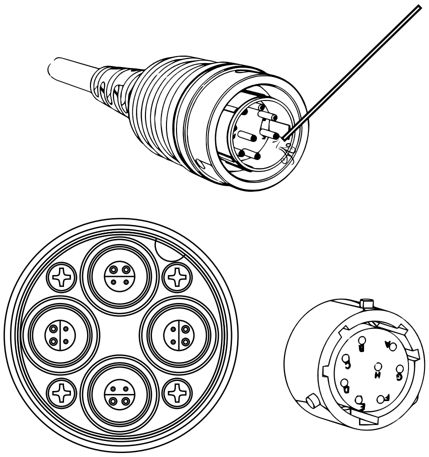


Figure 63 Cable, bulkhead, connector maintenance

Wipe the cable and bulkhead with a cloth dampened with a mild solution of clean water and dish soap. Make sure sensors or port plugs are installed so the bulkhead ports do not get wet when cleaning. Exposure to water can cause damage or corrosion to the bulkhead connectors not covered by the warranty.

For short-term storage, YSI recommends leaving the sensors installed on the bulkhead. The ODO, pH, and pH/ORP sensors must be kept in a moist air environment; therefore, place a small amount of water (5-10 mL) in the calibration cup and tighten the retaining nut to seal the storage chamber.

For long-term storage, YSI recommends uninstalling the sensors from the bulkhead and following each sensor's respective long-term storage instructions. Inspect the bulkhead ports and cable connectors for contamination. If dirty or wet, clean it with compressed air (Figure 63). Install the cap that protected the bulkhead during initial shipment. Alternatively, install the bulkhead port plugs.

4.3 Sensor Guard

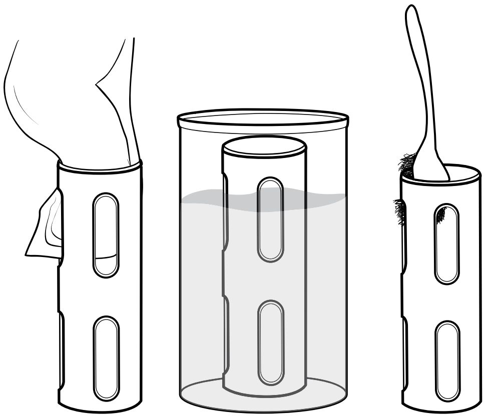


Figure 64 Sensor guard maintenance

Remove light bio-fouling with a cloth soaked in a mild solution of clean water and dish soap. Soak in vinegar to remove hard growth and deposits. Use a plastic scrub brush to remove any remaining bio-fouling. Rinse the sensor guard with clean water (Figure 64).

NOTICE: Do not sand or polish the guard. Removal of the guard coating can affect some sensor readings.

4.4 Depth Sensor

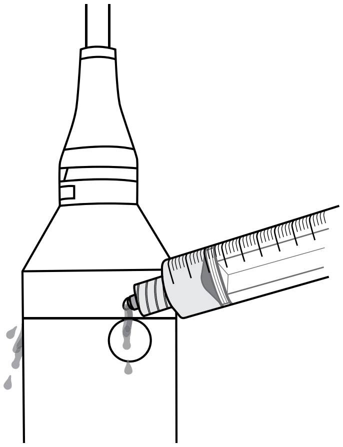


Figure 65 Depth sensor flush

The depth sensor should be flushed after each use. Fill the syringe (included with the maintenance kit) with clean water and gently push water through the ports located on the bulkhead. Flush until clean water flows from the opposite depth port (Figure 65).

The sensor can be stored wet or dry. For long-term storage, YSI recommends storing the sensor dry.

NOTICE: Do not insert objects into the depth ports. Damage to the depth transducer from incorrect cleaning is not covered by the warranty.

4.5 Temperature Sensor

To ensure optimal performance, it is important to keep the temperature sensor free of any deposits. Rinse the thermistor after each use. If deposits have formed, use mild soapy water and a soft bristle cleaning brush. The ProDSS smart sensor can be stored wet or dry.

However, if you're using the **ODO/T** or **ODO/CT** cable assembly, the sensor must be stored in a moist enviornment. A grey storage sleeve is shipped with the cable for an easy storage option. Simply moisten the sponge with a small amount of clean water and slide the sleeve over the probe guard to create a moist atmosphere for the sensor.

4.6 Conductivity Sensor

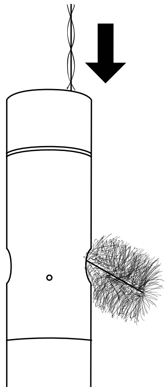


Figure 66 Channel brush

The conductivity channels should be cleaned after each use. Dip the sensor's cleaning brush (included with the maintenance kit) in clean water, insert the brush at the top of the channels, and sweep the channels 15 to 20 times (Figure 66).

If deposits have formed on the electrodes, use a mild solution of dish soap and water to brush the channels. For heavy deposits, soak the sensor in white vinegar, then scrub with the cleaning brush. Rinse the channels with clean water following the sweepings or soak.

The ProDSS sensor can be stored wet or dry. For long-term storage, YSI recommends storing the sensor dry.

However, if you're using the **ODO/CT** cable assembly, the sensor must be stored in a moist enviornment.

4.7 Optical Dissolved Oxygen Sensor

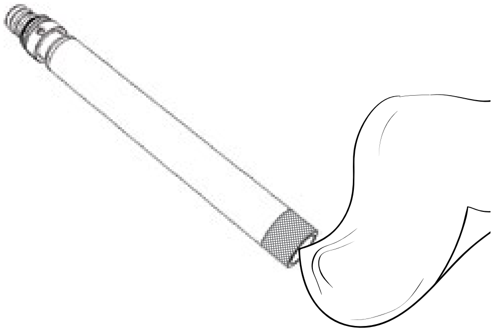


Figure 67 Wiping the ODO sensor window

The ODO sensor should be kept clean since some types of fouling may consume oxygen which could affect the dissolved oxygen measurements.

To clean the sensor cap, gently wipe away any fouling with a lens cleaning tissue that has been moistened with water to prevent scratches (Figure 67). Do not clean the ODO sensor with organic solvents as they may damage the cap.

To minimize sensor drift, always store the ODO sensor in a wet or water-saturated air environment.

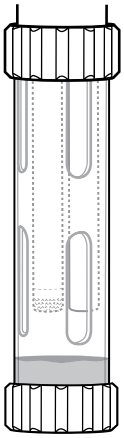


Figure 68 ODO short-term storage

Short-term Storage:

Store the ODO sensor in a moist air environment. A storage sleeve with a wet sponge or the calibration cup with a small amount of water is recommended (Figure 68).

This is true for both ProDSS sensors and the ODO cables assemblies.

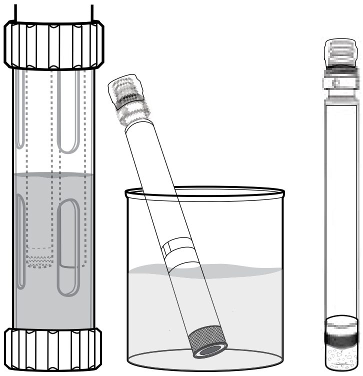


Figure 69 ODO long-term storage

Long-term Storage:

- **Method 1:** Submerge the sensing end of the sensor in a container of distilled or deionized water. Periodically check the level of the water to make sure that it does not evaporate.
- **Method 2:** Wet the sponge located in the cap originally included with the ODO sensor, then install on sensing end of the ODO sensor. Replace the sponge if it becomes dirty.

For ProDSS ODO sensors, the sensor can be left on the 4-port bulkhead or removed for long-term storage (Figure 69).

For ODO cable assemblies, the sensor must be stored in a moist enviornment. A grey storage sleeve is shipped with the cable for an easy storage option. Simply moisten the sponge with a small amount of clean water and slide the sleeve over the probe guard to create a moist atmosphere for the sensor.

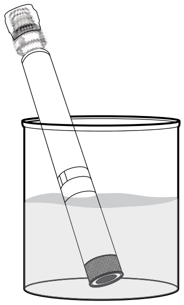


Figure 70 ODO rehydration

ODO Sensor Rehydration

If the ODO sensor has accidentally been left dry for longer than 8 hours, it must be rehydrated. To rehydrate, soak the ODO sensor in room temperature tap water for approximately 24 hours. After the soak, calibrate the sensor (Figure 70).

ODO Sensor Cap

Optical DO sensor caps are warrantied for either 12 or 24 months depending on the model:

- ProDSS ODO Sensor Cap [SKU: 626890] = **12** months
- ODO Extended Warranty Sensor Cap [SKU: 627180] = **24** months

Depending on usage and storage practices, the cap may last longer than its warranty period.

As the ODO sensor caps ages, deterioration of the dye layer can reduce measurement stability and response time. Periodically inspect the sensor cap for damage and large scratches in the dye layer. Replace the cap when readings become unstable and cleaning the cap and DO recalibration do not remedy the symptoms.

ODO Sensor Cap Replacement

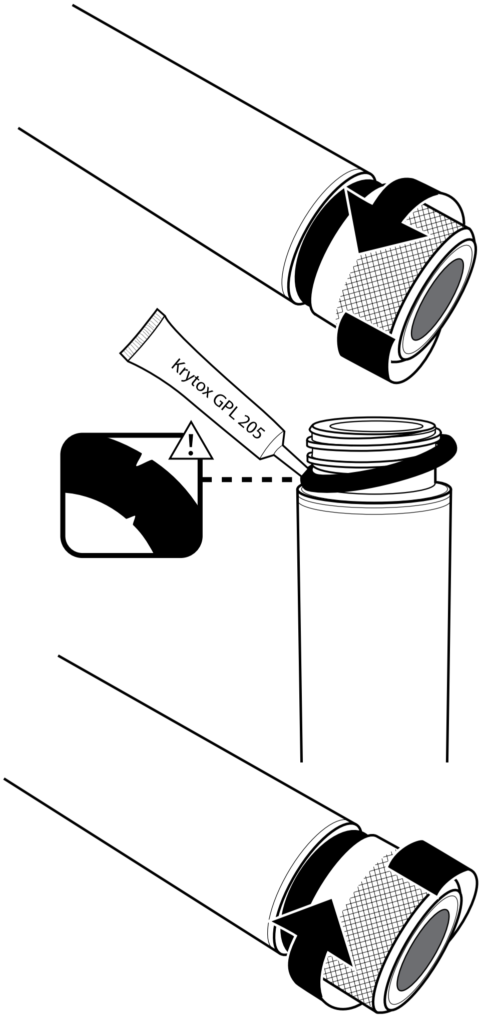


Figure 71 ODO cap replacement

The instruction sheet shipped with the replacement ODO sensor cap includes the calibration coefficients specific to that sensor cap. Make sure to save the ODO sensor cap instruction sheet in case you need to reload the calibration coefficients.

1. Remove the old sensor cap assembly from the probe by grasping the probe body with one hand and rotating the sensor cap counterclockwise until it is completely free. Do not use any tools for this procedure.
2. Carefully remove the o-ring by pinching it with your fingers and rolling it up. Do not use any tools to remove the o-ring. Clean the area of any debris with a lens cleaning tissue.
3. Install the new o-ring that is included with the replacement sensor cap.
4. Apply a thin coat of o-ring lubricant (included with the new cap) to the installed o-ring. Remove any excess o-ring lubricant with a lens cleaning tissue. Be careful to avoid contact with the sensor lens.
5. Inspect the sensor lens for any moisture or debris. If necessary, wipe the lens carefully with a non-abrasive, lint-free cloth to prevent scratches. Do not use organic solvents to clean the ODO sensor lens.
6. Remove the new sensor cap from its hydrated container and dry the inside cavity of the sensor cap with lens cleaning tissue. Make sure the cavity is completely dry before proceeding with the installation.
7. Using clockwise motion, thread the new sensor cap onto the probe assembly until it is finger-tight. The o-ring should be compressed between the sensor cap and probe. Do not over-tighten the sensor cap and do not use any tools for the installation process.
8. After installing the new sensor cap, store the sensor in either water or in the water-saturated air storage chamber.

NOTE: *Be sure to update the ODO Sensor Cap Coefficients after replacement.*

Updating the ODO Sensor Cap Coefficients

After installing a new sensor cap, connect the probe to the handheld and turn the instrument on. Locate the Calibration Code Label on the ODO Sensor Cap Instruction Sheet. This contains the calibration codes for this particular sensor cap. Follow the procedures below to enter the new calibration coefficients into the instrument.

1. Push the key to access the Sensor menu, then select **Setup**, then **ODO**.
2. Select **Sensor Cap Coefficients**.
3. Highlight each coefficient in turn (K1 through KC) and use the numeric entry screen to enter the corresponding new coefficient from the Calibration Code Label. Push the ENTER key after each entry and then proceed to the next K selection.
4. After all the new coefficients have been entered, select **Update Sensor Cap Coefficients**.
5. A message will appear warning that you will be overwriting the current sensor cap coefficients and you should confirm that you wish to carry out this action. Select **Yes** to confirm the new coefficients.

After updating the Coefficients, the Serial # in the Sensor Cap menu will be updated automatically based on your entries.

If errors are made in entering the Sensor Cap Coefficients, the instrument will block the update and an error message will appear on the display. If you see this error message, re-enter the coefficients and check them carefully.

NOTE: *After entering the sensor cap coefficients, the ODO sensor must be calibrated.*

4.8 Turbidity & Total Algae Sensors

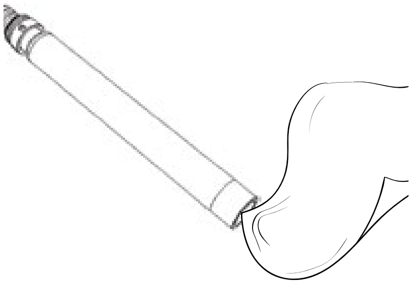


Figure 72 Wiping the sensor window

Clean the sensing window with a non-abrasive, lint-free cloth (Figure 72). If necessary, use mild soapy water.

The sensor can be stored wet or dry. For long-term storage, YSI recommends storing the sensor dry. Install the shipping cap or sensor guard to prevent scratches or damage to the optical sensing window.

4.9 pH/ORP Sensor

The pH and pH/ORP sensors are shipped with their tips in a storage bottle containing potassium chloride (KCl) solution. Keep this bottle for long-term storage.

Periodic maintenance is necessary to clear contamination from the sensing elements. Contaminants on the bulb and/or junction can slow sensor response time. Clean the sensors when deposits, bio-fouling or other contamination appears on the glass or when the sensor response time is noticeably slow. There are several methods to clean and restore the sensor depending on the severity of fouling or contamination.

Cleaning Methods

Standard Rinse

Rinse the sensor with tap water each time it is brought in from the field. This is generally recommended for most sensors and use cases to clear mild contamination.

If contaminants remain or the sensor exhibits a slow response time, continue with advanced cleaning.

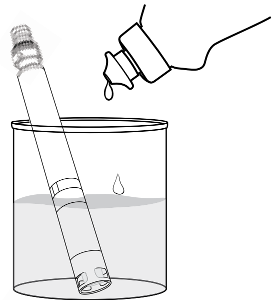


Figure 73 Cleaning the pH and pH/ORP sensor with dish soap

Advanced Cleaning

For moderate contamination or slow response after advanced rinsing, remove the sensor from the bulkhead and perform the following steps:

1. Remove any foreign matter from the sensor tip. If necessary, use a moistened cotton swab to carefully remove foreign material from the glass bulb and junction. Be careful to avoid direct contact with the glass bulb. The bulbs are fragile and will break if pressed with sufficient force.
2. Soak for 10 minutes in a mild solution of clean water and dish soap (Figure 73). Rinse the sensor with tap water and inspect.

If contaminants are removed, attach the sensor to the bulkhead and test the response time.

If contaminants remain or response time does not improve, continue to the hydrochloric acid (HCl) soak.

pH/ORP Sensor Maintenance and Storage *(continued)*

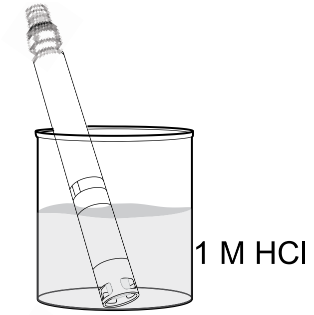


Figure 74 Cleaning the pH and pH/ORP sensor with hydrochloric acid

Acid Soak

For heavy contamination or slow response after advanced cleaning, remove the sensor from the bulkhead and perform the following steps:

1. Soak the sensor for 30 to 60 minutes in one molar (1 M) HCl (Figure 74). HCl reagent can be purchased from most chemical or laboratory distributors. To prevent injury, carefully follow the HCl manufacturer's instructions. If HCl is not available, soak in white vinegar.
2. After soaking, thoroughly rinse the sensor with tap water. Then soak the sensor in clean tap water for 60 minutes, stirring occasionally. Finally, rinse the sensor once again with tap water.

Attach the sensor to the bulkhead and test the response time. If response time does not improve or biological contamination of the reference junction is suspected, continue to the chlorine bleach soak.

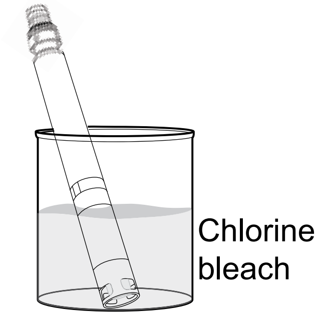


Figure 75 Cleaning the pH and pH/ORP sensor with chlorine bleach

Bleach Cleanse

If biological contamination of the reference junction is suspected or if good response is not restored by the previous methods, remove the sensor from the bulkhead and perform the following steps:

1. Soak the sensor for 60 minutes in a 1:1 dilution of chlorine bleach and tap water.
2. After soaking, thoroughly rinse the sensor with tap water. Then soak the sensor in clean tap water for 60 minutes. Finally, rinse the sensor once again with tap water.

Attach the sensor to the bulkhead and test the response time. If response time does not improve the sensor may be nearing the end of its useful life.

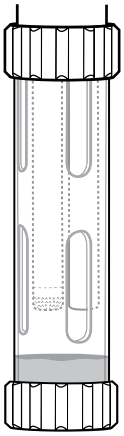


Figure 76 pH and pH/ORP short-term storage

Short-term Storage:

When in regular field use, the pH-pH/ORP sensors should remain on the bulkhead with the calibration/storage cup installed. Place a small amount of tap or surface water in the cup prior to storage or transport. The probes should be kept in this water-saturated air chamber between uses; not submerged (Figure 76). Make sure the storage cup makes a tight connection to prevent evaporation.

pH/ORP Sensor Maintenance and Storage *(continued)*

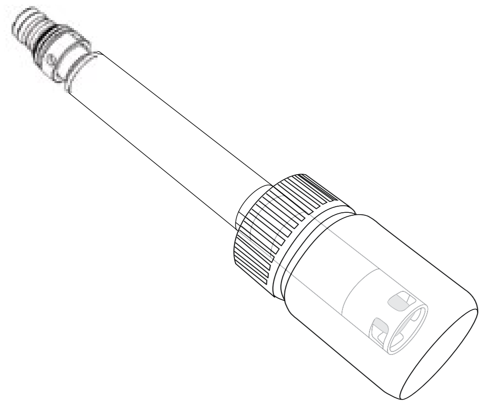


Figure 77 pH and pH/ORP long-term storage

Long-term Storage:

Remove the sensor from the bulkhead and plug the bulkhead port. Insert the sensor tip into the storage bottle and solution that were originally supplied with the sensor (Figure 77). The storage bottle features an open cap and o-ring to form a tight seal around the sensor tip; the solution contains KCl with potassium phthalate and a preservative. If this original solution is not available, one can prepare a 2 M KCl solution or use pH 4 buffer as an alternative, though these solutions should be monitored for microbial growth and replaced if growth is apparent. Other sensors and system components should not be stored in or exposed to these pH buffers for long periods of time.

NOTICE: Do NOT let the sensor dry out. Do NOT store the sensor in distilled or deionized water. Either of these will radically shorten the lifespan of the sensor module and void its warranty.

Sensor Module

The pH and pH/ORP sensors feature user-replaceable sensor modules. These modules contain a reference solution that depletes over time. The warranty period for both of these modules is 12 months:

- Replacement pH Module [SKU: 626963] = **12** months
- Replacement pH/ORP Module [SKU: 626964] = **12** months

Depending on usage and storage practices, the module may last longer than its warranty period. Replace the module if the sensor exhibits a slow response time after trying all the cleaning methods listed above.

4.10 ISE Sensor

ISE sensors are shipped with their tips in a storage bottle. Keep this bottle for long-term storage.

Do not let the ISE sensor reference electrode junctions dry out. Clean the sensors when deposits, bio-fouling or other contamination appears on the membrane.

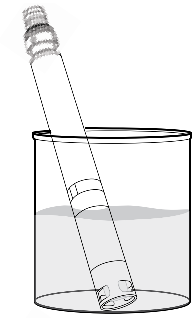


Figure 78 Soaking the ammonium or nitrate ISE sensor

Ammonium and Nitrate Sensor Maintenance

1. Carefully clean the ammonium or nitrate sensor by rinsing with DI water followed by soaking in the high standard calibration solution.
2. Carefully dab the sensor dry with a clean, lint-free cloth.

NOTICE: The ion-selective membranes are very fragile. Do not use coarse material (*e.g.* paper towels) to clean the membranes or permanent damage to the sensor can occur. The only exception is fine emery cloth on the chloride sensor.

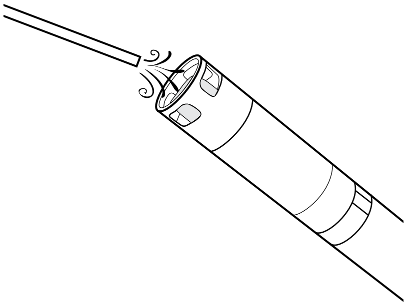


Figure 79 Rinsing the chloride sensor

Chloride Sensor Maintenance

1. Carefully clean the chloride sensor by carefully polishing with fine emery paper in a circular motion to remove deposits or discoloration.
2. Carefully rinse with DI water to remove any debris.

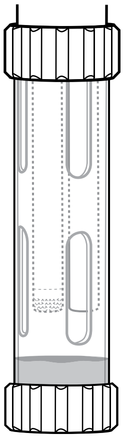


Figure 80 ISE short-term storage

Short-term Storage:

When in regular field use, ISEs should remain on the bulkhead with the calibration/storage cup installed. Place a small amount of tap or surface water in the cup prior to storage or transport. The probes should be kept in this water-saturated air chamber between uses; not submerged. Make sure the storage cup makes a tight connection to prevent evaporation (Figure 80).

ISE Sensor Maintenance and Storage *(continued)*

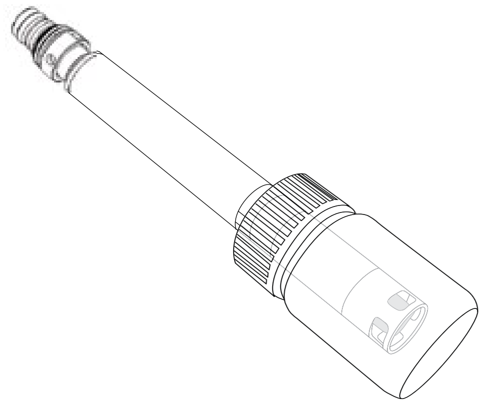


Figure 81 ISE long-term storage

Long-term Storage:

Remove the sensor from the bulkhead and plug the bulkhead port. Insert the sensor tip into the storage bottle with a small amount of high-calibration solution or tap water. The sensor tip should not be submerged. The storage bottle features an open cap and o-ring to form a tight seal around the sensor tip (Figure 81).

NOTICE: Do NOT let the sensor dry out. Do NOT store the ISE sensor in conductivity standard, pH buffer, or salt water. Either of these will radically shorten the lifespan or kill the sensor module and void its warranty.

Rehydrating the Reference Junction

If an ISE module has been allowed to dry, soak the sensor for several hours (preferably overnight) in the sensor's high-calibration solution. If the sensor is irreparably damaged, the sensor module must be replaced.

Sensor Module

Ammonium, chloride and nitrate sensors feature user-replaceable sensor modules. These modules contain a reference solution that depletes over time. The warranty period for ISE modules is 6 months:

- Replacement Nitrate Module [SKU: 626965] = **6** months
- Replacement Ammonium Module [SKU: 626966] = **6** months
- Replacement Chloride Module [SKU: 626967] = **6** months

Depending on usage and storage practices, the module may last longer than its warranty period. When it is time, perform a sensor module replacement in a clean, dry laboratory environment.

4.11 ProDSS Sensor Module Replacement

Sensor modules for pH, pH/ORP, nitrate, ammonium, and chloride all require periodic replacement. Perform a sensor module replacement in a clean, dry laboratory environment. Remove the sensor from the bulkhead and perform the following steps:

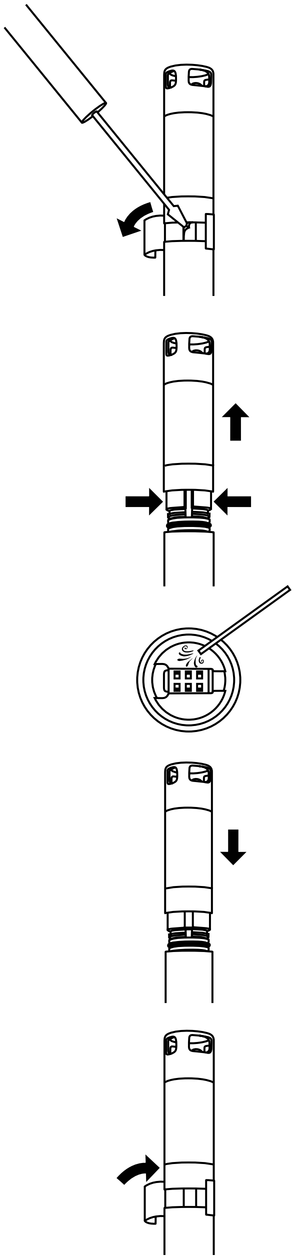


Figure 82 Sensor module replacement

Module Replacement

1. Peel off and discard the sticker that covers the junction of the sensor body and the module (Figure 82).
2. With a small, flat-blade screwdriver, carefully remove the square rubber plug from the gap in the hard plastic ring at the base of the sensor module.
3. Using two fingers, squeeze the sensor module's hard plastic ring so that it compresses the gap left by the rubber plug.
4. While squeezing, steadily pull the sensor module straight from the sensor body, rocking slightly if necessary. Do not keep the used o-rings as they are unusable after removal from the sensor body. Discard the old sensor module.
5. Inspect the sensor connector port for debris or moisture. If detected, remove it with lint-free cloth or a light blast of compressed air.
6. The new sensor module comes with two o-rings installed and pre-lubricated. Visually inspect the o-rings for nicks, tears, contaminants or particles. Replace any damaged o-rings.

   NOTICE: If a sensor module is removed for any reason, the o-rings must be replaced.

7. Align the prongs on the base of the sensor module with the slots in the sensor body. The sensor module is keyed to insert in only one orientation. Push the sensor module firmly into position until it clicks. Wipe any excess o-ring lubricant from the assembled components.
8. Wrap the junction of the sensor module and sensor body with the new sticker included in the sensor module kit. The sticker helps keep the sensor module junction clean and retain the rubber plug throughout deployment.
9. Write the replacement date on the sticker.

NOTE: *Be sure to calibrate the sensor after module replacement.*

5. KorDSS Software

5.1 Introduction

KorDSS Software and drivers require permissions for successful installation. Administrative privileges may be necessary for a business or networked PC. Contact your organization's IT department for admin privileges.

System Requirements

Supported 32 bit (x86) and 64 bit (x64) Microsoft Operating Systems:

- Microsoft Windows 7 Home Basic SP1
- Microsoft Windows 7 Home Premium SP1
- Microsoft Windows 7 Professional SP1
- Microsoft Windows 7 Enterprise SP1
- Microsoft Windows 7 Ultimate SP1
- Microsoft Windows 8 Home Basic
- Microsoft Windows 8 Home Premium
- Microsoft Windows 8 Professional
- Microsoft Windows 8 Enterprise
- Microsoft Windows 8.1 Basic
- Microsoft Windows 8.1 Professional
- Microsoft Windows 8.1 Enterprise
- Microsoft Windows 10 Home
- Microsoft Windows 10 Professional
- Microsoft Windows 10 Enterprise
- Microsoft Windows 10 Education

Ram Memory Requirement:

- Minimum of 2 GB of RAM installed

Hard Disk Free Space:

- Minimum of 500 MB of free hard drive space

Internet Access Required to Support:

- Software and device updates, software licensing

5.2 Installing the Driver and Software

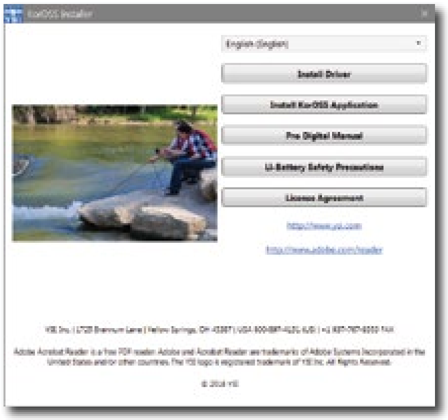


Figure 83 KorDSS Installer

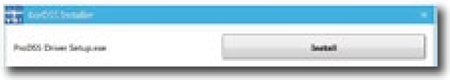
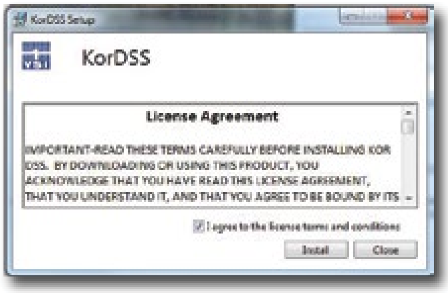


Figure 84 ProDSS Driver Installer

Figure 85 Back button



License Agreement

IMPORTANT-READ THESE TERMS CAREFULLY BEFORE INSTALLING KOR DSS. BY DOWNLOADING OR USING THIS PRODUCT, YOU ACKNOWLEDGE THAT YOU HAVE READ THIS LICENSE AGREEMENT, THAT YOU UNDERSTAND IT, AND THAT YOU AGREE TO BE BOUND BY ITS

☑ I agree to the license terms and conditions

Figure 86 KorDSS license agreement

Setup Successful

Figure 87 Launch KorDSS

Follow these steps to complete the installation process and establish connection to the handheld:

> ***NOTE:*** *Be sure to install the driver* ***before*** *connecting the handheld to your PC for the first time.*

1. Insert the supplied USB flash drive into a USB port on your computer.
2. Depending on the PC operating system and system settings, the KorDSS Installer may appear. If it does not appear, open the flash drive in Windows Explorer and double-click **Start.exe** to start the installer. Figure 83 shows how the installer will appear once it starts.
3. On the KorDSS Installer, click **Install Driver**. Then choose to Install the driver on the screens that follow (Figure 84).
4. After the driver has installed, choose to go **Back** to the KorDSS Installer (Figure 85) .
5. On the KorDSS Installer, click **Install KorDSS Application**. A license agreement will appear (Figure 86).
6. You may be asked if you want to allow a program from an unknown publisher to make changes on the computer. If so, select **Yes**.
7. After successful installation of KorDSS, click **Launch** to start the program (Figure 87).
8. Connect the handheld meter to the PC with the supplied USB cable.
9. Power on the handheld and click **Connect** when it appears under the **Instrument Connection Panel**; there may be a short delay before it appears in the software.

6. Accessories

6.1 Ordering

Telephone: 800 897 4151 (USA)
+1 937 767 7241 (Globally) Monday through Friday
8:00 AM to 5:00 ET
Fax: +1 937 767 9353 (orders)
Email: info@ysi.com
Mail: YSI Incorporated 1725 Brannum Lane
Yellow Springs, OH 45387 USA
Web: Visit YSI.com to order replacement parts, accessories, and calibration stolutions.

When placing an order please have the following available:

1. YSI account number (if available)
2. Name and phone number
3. Purchase Order or Credit Card number
4. Model Number or brief description
5. Billing and shipping addresses
6. Quantity

ProDIGITAL Handhelds

YSI Item #	Description
626650	ProSolo handheld, no GPS, not compatible with ProSwap 1-port or ProDSS 4-port cable assemblies
626700-1	ProSwap handheld, no GPS, not compatible with ProDSS 4-port cable assemblies
626700-2	ProSwap handheld with GPS, not compatible with ProDSS 4-port cable assemblies
626870-1	ProDSS handheld, no GPS
626870-2	ProDSS handheld with GPS

ProDIGITAL Probe Assemblies

NOTE: *The ODO and OBOD sensor caps come pre-installed on the following probe assemblies, with calibration coefficients of the sensor cap pre-loaded into the probe at the factory.*

YSI Item #	Description
	Optical Dissolved Oxygen and Temperature Probes
627200-1	ODO/T Probe Assembly, 1m
627200-4	ODO/T Probe Assembly, 4m
627200-10	ODO/T Probe Assembly, 10m
627200-20	ODO/T Probe Assembly, 20m
627200-30	ODO/T Probe Assembly, 30m
627200-50	ODO/T Probe Assembly, 50m
627200-100	ODO/T Probe Assembly, 100m
	Optical Dissolved Oxygen, Conductivity, and Temperature Probes
627150-1	ODO/CT Probe Assembly, 1m
627150-4	ODO/CT Probe Assembly, 4m
627150-10	ODO/CT Probe Assembly, 10m
627150-20	ODO/CT Probe Assembly, 20m
627150-30	ODO/CT Probe Assembly, 30m
627150-50	ODO/CT Probe Assembly, 50m
627150-100	ODO/CT Probe Assembly, 100m
	Self-Stirring Optical Biochemical Oxygen Demand Probes
626400	ProOBOD probe assembly (lab BOD probe); U.S./Japanese version with power supply
626401	ProOBOD probe assembly (lab BOD probe); International version with power supply

ProSwap 1-Port Cable Assemblies (No Sensors Included)

YSI Item #	Description
626750-1	ProSwap 1-port cable assembly with integral temperature sensor, no depth, 1m
626750-4	ProSwap 1-port cable assembly with integral temperature sensor, no depth, 4m
626750-10	ProSwap 1-port cable assembly with integral temperature sensor, no depth, 10m
626750-20	ProSwap 1-port cable assembly with integral temperature sensor, no depth, 20m
626750-30	ProSwap 1-port cable assembly with integral temperature sensor, no depth, 30m
626750-50	ProSwap 1-port cable assembly with integral temperature sensor, no depth, 40m
626750-100	ProSwap 1-port cable assembly with integral temperature sensor, no depth, 100m
626760-1	ProSwap 1-port cable assembly with integral temperature sensor, shallow depth, 1m
626760-4	ProSwap 1-port cable assembly with integral temperature sensor, shallow depth, 4m
626760-10	ProSwap 1-port cable assembly with integral temperature sensor, shallow depth, 10m
626770-20	ProSwap 1-port cable assembly with integral temperature sensor, medium depth, 20m
626770-30	ProSwap 1-port cable assembly with integral temperature sensor, medium depth, 30m
626770-50	ProSwap 1-port cable assembly with integral temperature sensor, medium depth, 50m
626770-100	ProSwap 1-port cable assembly with integral temperature sensor, medium depth, 100m

ProDSS 4-Port Cable Assemblies (No Sensors Included)

YSI Item #	Description
626909-1	ProDSS 4-port cable assembly, no depth, 1m
626909-4	ProDSS 4-port cable assembly, no depth, 4m
626909-10	ProDSS 4-port cable assembly, no depth, 10m
626909-20	ProDSS 4-port cable assembly, no depth, 20
626909-30	ProDSS 4-port cable assembly, no depth, 30m
626909-40	ProDSS 4-port cable assembly, no depth, 40m
626909-50	ProDSS 4-port cable assembly, no depth, 50m
626909-60	ProDSS 4-port cable assembly, no depth, 60m
626909-70	ProDSS 4-port cable assembly, no depth, 70m
626909-80	ProDSS 4-port cable assembly, no depth, 80m
626909-90	ProDSS 4-port cable assembly, no depth, 90m
626909-100	ProDSS 4-port cable assembly, no depth, 100m
626910-1	ProDSS 4-port cable assembly, with depth, 1m
626910-4	ProDSS 4-port cable assembly, with depth, 4m
626910-10	ProDSS 4-port cable assembly, with depth, 10m
626911-20	ProDSS 4-port cable assembly, with depth, 20m
626911-30	ProDSS4-port cable assembly, with depth, 30m
626911-40	ProDSS 4-port cable assembly, with depth, 40m
626911-50	ProDSS 4-port cable assembly, with depth, 50m
626911-60	ProDSS 4-port cable assembly, with depth, 60m
626911-70	ProDSS 4-port cable assembly, with depth, 70m
626911-80	ProDSS 4-port cable assembly, with depth, 80m
626911-90	ProDSS 4-port cable assembly, with depth, 90m
626911-100	ProDSS 4-port cable assembly, with depth, 100m

ProDSS Sensors (for 1-Port and 4-Port Cable Assemblies)

YSI Item #	Description
626900	Optical dissolved oxygen sensor
626902	Conductivity and temperature sensor
626901	Turbidity sensor
626903	pH sensor with module
626904	pH/ORP sensor with module
626906	Ammonium sensor with module
626905	Nitrate sensor with module
626907	Chloride sensor with module
626210	Total algae sensor, PC
626211	Total algae sensor, PE

Replacement Sensor Modules and ODO Sensor Caps

YSI Item #	Description
626890	Replacement ProDSS Optical Dissolved Oxygen sensor cap (for 626900 smart sensor)
626482	Replacement ProOBOD Optical Dissolved Oxygen sensor cap (for 626400 or 626401 lab probes)
627180	Replacement ODO Extended Warranty Sensor Cap (only compatible with ODO/T and ODO/CT probe assemblies)
626963	Replacement ProDSS pH sensor module
626964	Replacement ProDSS pH/ORP sensor module
626966	Replacement ProDSS Ammonium sensor module
626965	Replacement ProDSS Nitrate sensor module
626967	Replacement ProDSS Chloride sensor module

Calibration Standards

YSI Item #	Description
065270	Conductivity standard, 1000 µmhos/cm (quart, glass); ideal for fresh water
065272	Conductivity standard, 10000 µmhos/cm (quart, glass); ideal for brackish water
065274	Conductivity standard, 100000 µmhos/cm (quart, glass); ideal for supersaturated sea water
060907	Conductivity standard, 1000 µmhos/cm (box of 8 individual pints, plastic); ideal for fresh water
060906	Conductivity standard, 1413 µmhos/cm, ±1%, 0.01 M KCl (box of 8 individual pints, plastic)
060911	Conductivity standard, 10000 µmhos/cm (box of 8 individual pints, plastic); ideal for brackish water
060660	Conductivity standard, 50000 µmhos/cm (box of 8 individual pints, plastic); ideal for sea water
061320	ORP (mV) standard, Zobell solution, powder - needs hydrated (125 mL bottle, plastic)
061321	ORP (mV) standard, Zobell solution, powder - needs hydrated (250 mL bottle, plastic)
061322	ORP (mV) standard, Zobell solution, powder - needs hydrated (500 mL bottle, plastic)
003821	pH 4 buffer (box of 6 individual pints, plastic); ideal for storage solution for pH sensor
003822	pH 7 buffer (box of 6 individual pints, plastic)
003823	pH 10 buffer (box of 6 individual pints, plastic)
603824	Assorted case of pH 4, 7, and 10 buffers (2 individual pints of each buffer, plastic)
005580	Confidence solution to verify conductivity, pH and ORP system (box of 6 individual 475 mL bottles, plastic). ***Note:*** *Not for calibration*
003841	Ammonium standard, 1 mg/L (500 mL, plastic)
003842	Ammonium standard, 10 mg/L (500 mL, plastic)
003843	Ammonium standard, 100 mg/L (500 mL, plastic)
003885	Nitrate standard, 1 mg/L (500 mL, plastic)
003886	Nitrate standard, 10 mg/L (500 mL, plastic)
003887	Nitrate standard, 100 mg/L (500 mL, plastic)
608000	Turbidity standard, 0 FNU (1 gallon, plastic)
607200	Turbidity standard, 12.4 FNU (1 gallon, plastic)
607300	Turbidity standard, 124 FNU (1 gallon, plastic)
607400	Turbidity standard, 1010 FNU (1 gallon, plastic)

ProDIGITAL Accessories

YSI Item #	Description
626946	Large, hard-sided carrying case (Fits ProDSS 4-port cables 10, 20, and 30 meters in length, cable management kit, handheld, and accessories)
603075	Large, soft-sided carrying case
626945	Small, hard-sided carrying case (Fits ProDSS 4-port cables 1 and 4 meters in length, handheld, flow cell, and accessories)
599080	Flow cell for ProDSS 4-port cables
603076	Flow cell for ODO/CT cables (requires single port adapter; 603078)
603078	Adapter required for ODO/CT flow cell (603076)
603056	Flow cell mounting spike
063507	Tripod (screws into back of meter)
063517	Ultra clamp (screws into back of meter)
603070	Shoulder strap
603069	Belt clip (screws into back of meter)
626942	USB car charger
626943	Small external Li-Ion rechargeable battery pack (Typical performance: will charge a completely discharged handheld battery to about 50%)
626944	Large external Li-Ion rechargeable battery pack (Typical performance: will charge a completely discharged battery to full charge, plus have power to charge a second battery to 20%)
626940	AC charger (USA). Includes power supply and USB cable (included with handheld)
626941	AC charger (international). Includes power supply, USB cable and outlet adapters (included with handheld)
626846	Replacement Lithium-ion battery pack
626969	USB flash drive (included with handheld)
626991	Cable for charging and PC connection (included as part of 626940 and 626941)
626992	Cable for connection to USB drive (included with handheld)
626990	ProDSS maintenance kit (included with all ProDSS 4-port cables): • 3 port plugs • 1 tube of o-ring lubricant • 1 brush • 1 syringe • 1 sensor installation/removal tool • O-rings (6)
626919	Sensor guard for 4-port ProDSS cable assembly (included with all 4-port cables)
599786	Calibration/storage cup for 4-port ProDSS cable assembly (included with all 4-port ProDSS cables)
627195	Calibration cup for ODO/CT cable assembly (included with all ODO/CT cables)
603062	Cable management kit (included with **ProDSS 4-port cables** 10, 20, and 30-meters long; **ODO/CT cables** 4, 10, 20, and 30-meters long; and **ODO/T cables** 4, 10, 20, and 30-meters long)
626918	1 lb weight (included with ProDSS 4-port cables 10-meters and longer)
605978	4.9 oz weight

7. Safety and Support

7.1

Rechargeable Lithium-Ion Battery Pack

Safety Warnings and Precautions

⚠ **CAUTION:** Failure to follow the safety warnings and precautions can result in fire, personal injury and/or equipment damage not covered under warranty.

⚠ **CAUTION:** If the internal battery fluid comes into contact with skin, wash the affected area(s) with soap and water immediately. If it comes into contact with your eye(s), flush them with generous amounts of water for 15 minutes and seek immediate medical attention.

⚠ **CAUTION:** Always keep batteries away from children.

⚠ **WARNING:** In the unlikely event a lithium-ion battery catches fire, **DO NOT** attempt to put the fire out with water, use a Class A, B or C fire extinguisher.

Do:

- Store the battery pack in a cool, dry, ventilated area.
- Store the battery pack in a non-conductive and fireproof container.
- Store the battery pack at approximately 50% of the capacity.
- Disconnect the battery pack when not in use and for long-term storage.
- Follow applicable laws and regulations for transporting and shipping of batteries.
- *Immediately discontinue* use of the battery pack if, while using, charging or storing the battery pack:
  - Emits an unusual smell
  - Feel hot
  - Changes color
  - Changes shape
  - Appears abnormal in any other way.

Battery Pack General Precautions:

- **DO NOT** put the battery in fire or heat the battery.
- **DO NOT** connect the positive and the negative terminal of the battery to each other with any metal object (*e.g.* wire).
- **DO NOT** carry or store the battery pack with neckaces, hairpins or other metal objects.
- **DO NOT** carry or store the battery pack with hazardous or combustible materials.
- **DO NOT** pierce the battery pack with nails, strike with a hammer, step on or otherwise subject the battery pack to strong impacts or shocks.
- **DO NOT** solder directly onto the battery pack.
- **DO NOT** expose the battery pack to water or salt water or allow it to get wet.
- **DO NOT** disassemble or modify the battery pack. The battery contains safety and protection devices that, if damaged, can cause the battery to generate heat, rupture or ignite.
- **DO NOT** place the battery pack on or near fires, stoves or other high-temperature locations.
- **DO NOT** place the battery pack in direct sunlight or extreme temperatures for extended periods of time or store the battery pack inside cars in hot weather. Doing so may cause the battery pack to generate heat, rupture or ignite. Using the battery pack in this manner may also result in a loss of performance and a shortened life expectancy.
- **DO NOT** place the battery pack in microwave ovens, high-pressure containers or on induction cookware.
- **DO NOT** ship damaged or potentially defective batteries to YSI or any of our authorized service centers unless instructed otherwise. All federal and international shipping laws should be consulted prior to shipping lithium-ion batteries.

Charging/Discharging/Handling the Battery Pack

⚠ **WARNING:** Failure to follow the battery pack charging/discharging instructions can cause the battery to become hot, rupture or ignite and cause serious injury and/or equipment damage.

⚠ **WARNING:** Only charge the battery using charging devices designed specifically for the ProDIGITAL handheld by YSI. Use of unapproved chargers can result in battery failure and potentially serious injury to the user.

If at any time the battery pack becomes damaged, hot or begins to balloon or swell, discontinue charging (or discharging) immediately. Quickly and safely disconnect the charger. Then place the battery pack and/or charger in a safe, open area way from flammable materials. After one hour of observation, remove the battery pack from service. **DO NOT** continue to handle, attempt to use or ship the battery.

Damaged or swollen batteries can be unstable and very hot. **DO NOT** touch batteries until they have cooled. In the event of a fire use a Class A, B, or C fire extinguisher. **DO NOT** use water.

- **DO NOT** attach the battery pack to a power supply plug or directly to a car's cigarette lighter.
- **DO NOT** place the battery pack in or near fire or into direct extended exposure to sunlight. When the battery pack becomes hot, the built-in safety equipment is activated, preventing the battery pack from charging further. Heating the battery pack can destroy the safety equipment and cause additional heating, breaking or ignition.
- **DO NOT** leave the battery pack unattended while charging.

NOTICE: The ambient temperature range over which the battery pack can be discharged is -20°C to 60°C (-4°F to 140°F). Use of the battery pack outside of this temperature range may damage the performance of the battery pack or may reduce its life expectancy.

- **DO NOT** discharge the battery pack using any device except for a ProDIGITAL handheld. When the battery pack is used in other devices it may damage the performance of the battery or reduce its life expectancy. Use of a non-approved device to discharge the battery pack can cause an abnormal current to flow, resulting in the battery pack to become hot, rupture or ignite and cause serious injury.
- **DO NOT** leave the battery pack unattended while discharging.

Battery Disposal

When the battery pack is worn out, insulate the terminals with adhesive tape or similar materials before disposal. Dispose of the battery pack in the manner required by your city, county, state or country. For details on recycling lithium-ion batteries, please contact a government recycling agency, your waste-disposal service or visit reputable online recycling sources such as www.batteryrecycling.com.

This product must not be disposed of with other waste. Instead, it is the user's responsibility to dispose of their waste equipment by handing it over to a designated collection point for the recycling of waste electrical and electronic equipment. The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment.

For more information about where you can drop off your waste equipment for recycling, please contact your local city office, or your local waste disposal service. **DO NOT ship batteries to YSI or a YSI authorized service center unless instructed to do otherwise.**

Contact YSI Technical Support at (937) 767-7241 if you have additional questions.

7.2 Service Information

YSI has authorized service centers throughout the United States and Internationally. For the nearest service center information, please visit ysi.com and click 'Support' or contact YSI Technical Support directly at 800-897-4151 (+1 937-767-7241).

When returning a product for service, include the Product Return form with cleaning certification. The form must be completely filled out for a YSI Service Center to accept the instrument for service. The form may be downloaded from YSI.com.

7.3 Technical Support

Telephone: 800 897 4151 (USA)

+1 937 767 7241 (Globally) Monday through Friday, 8:00 AM to 5:00 ET

Fax: +1 937 767 9353 (orders)

Email: info@ysi.com

Mail: YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA

Internet: YSI.com

7.4 Declaration of Conformity

The undersigned hereby declares on behalf of the named manufacturer under our sole responsibility that the listed product conforms to the requirements for the listed European Council Directive(s) and carries the CE mark accordingly.

Manufacturer:	YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Product Name:	ProDSS, ProSwap, ProSolo
Conforms to the following:	
Directives:	EMC 2004/108/EC RoHS 2011/65/EU WEEE 2012/19/EU
Harmonized Standards:	EN61326-1:2013 (IEC 61326-1:2012) IEC 61000-3-2:2005 +A1:2008+A2:2009 IEC 61000-3-3:2008
Supplementary Information:	All performance met the operation criteria as follows: 1. ESD, IEC 61000-4-2:2008 2. Radiated Immunity, IEC 61000-4-3:2006 +A1:2007+A2:2010 3. Electrical Fast Transient (EFT), IEC 61000-4-4:2004 +A1:2010 4. Immunity to Surge, IEC 61000-4-5:2005 5. Radio Frequency, Continuous Conducted Immunity, IEC61000-4-6:2008 6. IEC 61000-4-8:2009 7. IEC 61000-4-11:2004
Authorized EU Representative	Xylem Analytics UK Ltd Unit 2 Focal Point, Lacerta Court, Works Road Letchworth, Hertfordshire, SG6 1FJ UK

Gregory W. Popp

Signed: Gregory Popp
Title: Quality Manager

Date: March 10, 2020

The undersigned hereby declares on behalf of the named manufacturer under our sole responsibility that the listed product conforms to the requirements for electrical equipment under US FCC Part 15 and ICES-003 for unintentional radiators.

Manufacturer:	YSI Incorporated 1725 Brannum Lane Yellow Springs, OH 45387 USA
Product Name:	Professional Digital Sampling System Instrument
Model Numbers	
Instrument/Accessory:	ProDSS non-GPS (626870-1) / ProDSS GPS (626870-2), ProSwap non-GPS (XXX), ProSwap GPS (XXX), ProSolo (626650)
Probe/Cable Assemblies:	626909-1, 626909-4, 626909-10, 626909-20, 626909-30, 626909-40, 626909-50, 626909-60, 626909-70, 626909-80, 626909-90, 626909-100, 626910-1, 626910-4, 626910-10, 626911-20, 626911-30, 626911-40, 626911-50, 626911-60, 626911-70, 626911-80, 626911-90, 626911-100 626750-1, 626750-4, 626750-10, 626750-20, 626750-30, 626750-50, 626750-100 626760-1, 626760-4, 626760-4 626770-20, 626770-30, 626770-50, 626770-100, 627200-1, 62700-4, 627200-10, 627200-20, 627200-30, 627200-50, 627200-100 627150-1, 627150-4, 627150-10, 627150-20, 627150-30, 627150-50, 627150-100 626250-1, 626250-4, 626250-10, 626250-20, 626250-30, 626250-40, 626250-50, 626250-60, 626250-70, 626250-80, 626250-90, 626250-100 626400, 626401
Sensors:	626900, 626902, 626901, 626903, 626904, 626906, 626905, 626907, 626210, 626211
Conforms to the following:	
Standards:	• FCC 47 CFR Part 15-2008, Subpart B, Class B, Radio Frequency Devices • ICES-003:2004, Digital Apparatus
Supplementary Information:	Tested using ANSI C63.4-2003 (excluding sections 4.1, 5.2, 5.7, 9, and 14)

Gregory W. Popp

Signed: Gregory Popp Date: March 10, 2020
Title: Quality Manager

7.5 Warranty

The YSI Professional Series Digital (ProDIGITAL) handheld meters are warranted for three (3) years from date of purchase by the end user against defects in materials and workmanship. Digital sensors and cables (ProSwap 1-port, ProDSS 4-port, ODO/CT, ODO/T, and ProOBOD) are warranted for two (2) years from date of purchase by the end user against defects in material and workmanship. The ODO Extended Warranty Sensor Cap (627180) for the ODO/T and ODO/CT cable assemblies is warranted for two (2) years from date of purchase by the end user against defects in material and workmanship. ProDSS pH and pH/ORP sensor modules, optical ODO sensor caps (all but the 627180 cap previously mentioned), and Li-Ion battery pack are warranted for one (1) year from date of purchase by the end user against defects in material and workmanship; ProDSS ISE sensor modules (ammonium, nitrate, and chloride) are warranted for 6 months. ProDIGITAL systems (instrument, cables & sensors) are warranted for 1 year (excluding sensor modules) from date of purchase by the end user against defects in material and workmanship when purchased by rental agencies for rental purposes. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio at +1 937 767-7241, 800-897-4151 or visit www.YSI.com (Support tab) for a Product Return Form. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

LIMITATION OF WARRANTY

This Warranty does not apply to any YSI product damage or failure caused by:

1. Failure to install, operate or use the product in accordance with YSI's written instructions;
2. Abuse or misuse of the product;
3. Failure to maintain the product in accordance with YSI's written instructions or standard industry procedure;
4. Any improper repairs to the product;
5. Use by you of defective or improper components or parts in servicing or repairing the product;
6. Modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI's LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

8. Appendices

8.1 Appendix A
DO% Calibration Values

Calibration Value	Pressure			
D.O. %	**in Hg**	**mmHg**	**kPa**	**mbar**
101%	30.22	767.6	102.34	1023.38
100%	29.92	760.0	101.33	1013.25
99%	29.62	752.4	100.31	1003.12
98%	29.32	744.8	99.30	992.99
97%	29.02	737.2	98.29	982.85
96%	28.72	729.6	97.27	972.72
95%	28.43	722.0	96.26	962.59
94%	28.13	714.4	95.25	952.46
93%	27.83	706.8	94.23	942.32
92%	27.53	699.2	93.22	932.19
91%	27.23	691.6	92.21	922.06
90%	26.93	684.0	91.19	911.93
89%	26.63	676.4	90.18	901.79
88%	26.33	668.8	89.17	891.66
87%	26.03	661.2	88.15	881.53
86%	25.73	653.6	87.14	871.40
85%	25.43	646.0	86.13	861.26
84%	25.13	638.4	85.11	851.13
83%	24.83	630.8	84.10	841.00
82%	24.54	623.2	83.09	830.87
81%	24.24	615.6	82.07	820.73
80%	23.94	608.0	81.06	810.60
79%	23.64	600.4	80.05	800.47
78%	23.34	592.8	79.03	790.34
77%	23.04	585.2	78.02	780.20
76%	22.74	577.6	77.01	770.07
75%	22.44	570.0	75.99	759.94
74%	22.14	562.4	74.98	749.81
73%	21.84	554.8	73.97	739.67
72%	21.54	547.2	72.95	729.54

8.2 Appendix B
Oxygen Solubility Table

Solubility of oxygen in mg/L in water exposed to water-xaturated air at 760 mm Hg pressure.

Salinity = Measure of quantity of dissolved salts in water.

Chlorinity = Measure of chloride content, by mass, of water.

S(0/00) = 1.80655 x Chlorinity (0/00)

Temp °C	**Chlorinity : 0** **Salinity: 0**	**5.0 ppt** **9.0 ppt**	**10.0 ppt** **18.1 ppt**	**15.0 ppt** **27.1 ppt**	**20.0 ppt** **36.1 ppt**	**25.0 ppt** **45.2 ppt**
0.0	14.62	13.73	12.89	12.10	11.36	10.66
1.0	14.22	13.36	12.55	11.78	11.07	10.39
2.0	13.83	13.00	12.22	11.48	10.79	10.14
3.0	13.46	12.66	11.91	11.20	10.53	9.90
4.0	13.11	12.34	11.61	10.92	10.27	9.66
5.0	12.77	12.02	11.32	10.66	10.03	9.44
6.0	12.45	11.73	11.05	10.40	9.80	9.23
7.0	12.14	11.44	10.78	10.16	9.58	9.02
8.0	11.84	11.17	10.53	9.93	9.36	8.83
9.0	11.56	10.91	10.29	9.71	9.16	8.64
10.0	11.29	10.66	10.06	9.49	8.96	8.45
11.0	11.03	10.42	9.84	9.29	8.77	8.28
12.0	10.78	10.18	9.62	9.09	8.59	8.11
13.0	10.54	9.96	9.42	8.90	8.41	7.95
14.0	10.31	9.75	9.22	8.72	8.24	7.79
15.0	10.08	9.54	9.03	8.54	8.08	7.64
16.0	9.87	9.34	8.84	8.37	7.92	7.50
17.0	9.67	9.15	8.67	8.21	7.77	7.36
18.0	9.47	8.97	8.50	8.05	7.62	7.22
19.0	9.28	8.79	8.33	7.90	7.48	7.09
20.0	9.09	8.62	8.17	7.75	7.35	6.96
21.0	8.92	8.46	8.02	7.61	7.21	6.84
22.0	8.74	8.30	7.87	7.47	7.09	6.72
23.0	8.58	8.14	7.73	7.34	6.96	6.61
24.0	8.42	7.99	7.59	7.21	6.84	6.50
25.0	8.26	7.85	7.46	7.08	6.72	6.39
26.0	8.11	7.71	7.33	6.96	6.62	6.28
27.0	7.97	7.58	7.20	6.85	6.51	6.18
28.0	7.83	7.44	7.08	6.73	6.40	6.09
29.0	7.69	7.32	6.93	6.62	6.30	5.99
30.0	7.56	7.19	6.85	6.51	6.20	5.90
31.0	7.43	7.07	6.73	6.41	6.10	5.81
32.0	7.31	6.96	6.62	6.31	6.01	5.72

Temp °C	Chlorinity : 0 Salinity: 0	5.0 ppt 9.0 ppt	10.0 ppt 18.1 ppt	15.0 ppt 27.1 ppt	20.0 ppt 36.1 ppt	25.0 ppt 45.2 ppt
33.0	7.18	6.84	6.52	6.21	5.91	5.63
34.0	7.07	6.73	6.42	6.11	5.82	5.55
35.0	6.95	6.62	6.31	6.02	5.73	5.46
36.0	6.84	6.52	6.22	5.93	5.65	5.38
37.0	6.73	6.42	6.12	5.84	5.56	5.31
38.0	6.62	6.32	6.03	5.75	5.48	5.23
39.0	6.52	6.22	5.98	5.66	5.40	5.15
40.0	6.41	6.12	5.84	5.58	5.32	5.08
41.0	6.31	6.03	5.75	5.49	5.24	5.01
42.0	6.21	5.93	5.67	5.41	5.17	4.93
43.0	6.12	5.84	5.58	5.33	5.09	4.86
44.0	6.02	5.75	5.50	5.25	5.02	4.79
45.0	5.93	5.67	5.41	5.17	4.94	4.72

Xylem |ˈzīləm|

1) The tissue in plants that brings water upward from the roots;

2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services settings. Xylem also provides a leading portfolio of smart metering, network technologies and advanced analytics solutions for water, electric and gas utilities. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

For more information on how Xylem can help you, go to www.xylem.com

Who's
Minding
the Planet?®

xylem
Let's Solve Water

YSI, a Xylem brand
1725 Brannum Lane
Yellow Springs, OH 45387
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YSI.com

YSI.com/ProDIGITAL

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Attachment 3
General Data Validation Guidelines, Revision 1 and the Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Version 5.3
Table B-15

(Provided on CD)

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UNITED STATES DEPARTMENT OF DEFENSE

General Data Validation Guidelines

Environmental Data Quality Workgroup

11/04/2019

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

General Data Validation Guidelines

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Date: 2019.11.05 08:01:12 -06'00'

Brian Jordan Date
Army Principal

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Date: 2019.11.04 14:14:51 -06'00'

John S. Gillette, Ph.D. Date
Air Force Principal

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Date: 2019.11.04 14:37:16 -05'00'

Jordan Adelson, Ph.D. Date
Navy Principal, EDQW Chair

General Data Validation Guidelines Change Sheet

1. Global change – All references to DoD Quality Systems Manual (QSM) version 5.1 have been updated to DoD Quality Systems Manual (QSM) version 5.3.

2. Section 2.0 Scope – The following text has been added to the end of the first paragraph:

“Data validation should not be confused with data usability. It is anticipated that project decisions will be supported by data usability determinations aided by the results of data validation.”

3. Section 3.0 Responsibilities – The following text has been added:

“It is anticipated that data validation is performed by a party independent of the laboratory. Project teams may identify a government quality assurance validation as necessary. A government quality assurance validation is defined as being independent of the prime contractor and performed by a government representative or services directly contracted by the government agency independent of the prime contractor.”

4. Section 4.1 Introduction – The following text has been removed from the fourth paragraph:

“Data validation should not be confused with data usability.”

The following text has been added to the fourth paragraph:

“Data validation is distinct from a data usability assessment.”

Contents

1.0 Purpose 1
2.0 Scope 1
3.0 Responsibilities 2
4.0 Validation Steps 2
  4.1 Introduction 2
  4.2 Laboratory Data Deliverables 3
  4.3 Elements of Data Validation 5
  4.4 Staged Data Validation 6
  4.5 Percentage Data Validation in Stages 3 and 4 8
  4.6 Content and Format of the Data Validation Report 10
  4.7 Recommended Recalculations for Stage 3 Data Validation 12
  4.8 Data Validation Qualifiers 20
5.0 Records 20
6.0 References 21
7.0 Attachments 22
Appendix 1: Example Acronyms and Abbreviations 23
Appendix 2: Example Sample Cover Letter 26
Appendix 3: Example Sample Identification Table 28
Appendix 4: Example Data Validation Reports and Checklist 30
Appendix 5: Example Annotated Laboratory Data Sheet 47
Appendix 6: Example Stage 3 Calculation Spreadsheet 49
Appendix 7: Example Qualification Code Reference Table 53

General Data Validation Guidelines

1.0 Purpose

This document provides guidance on the validation of environmental data generated in support of Department of Defense (DoD) projects, primarily from SW-846 methods. The entire DoD data validation guidance will be composed of this document plus analytical technique specific guidelines.

The objectives of the data validation and reporting procedures outlined in this guidance are to:

- Provide a clear understanding of the quality and limitations of the data using documented validation procedures;
- Encourage consistency in the way in which data are validated and reported for DoD projects; and
- Include items for Project Management consideration during the planning stages of a project.

Note: The analytical technique specific data validation guidelines will be published as separate modules.

2.0 Scope

This guidance can be applied to the validation of environmental data generated in support of DoD projects. This guidance applies primarily to chemical analytical data based on the requirements presented in the DoD Quality Systems Manual (QSM) version 5.3 and applicable SW-846 methods. This guidance is specific for data validators responsible for validating data for DoD. Data validation should not be confused with data usability. It is anticipated that project decisions will be supported by data usability determinations aided by the results of data validation.

This document serves as professional guidance for data validation and expands upon the protocols outlined in the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) Manual (DoD/EPA 2005). This document is intended to provide the foundation for the validation process by providing guidance on validation procedures and report content.

Validation requirements as identified in a project-specific QAPP should always supersede the guidance of this document. The data validation guidelines presented in each project QAPP should be appropriate to the Data Quality Objectives (DQOs) of that project. The guidance provided in this document is not intended to obviate the need for professional judgment during the validation process. Professional judgment may be required in areas not fully addressed by this guidance document. Deviations from any validation procedure while planning or executing project activities should be documented in accordance with project requirements.

If the appropriate quality control documentation and information are provided and defined, this guidance may also be useful in labeling the scope and content of verification and validation performed on analytical data generated by less traditional means such as field analytical methods (e.g., X-ray fluorescence, image analysis, immunoassay methods, or direct sensing). Information in this guidance may be utilized in the generation and presentation of the data reporting, data validation, and electronic data deliverable elements of specific Quality Assurance Project Plans (QAPPs). This guidance should be implemented by personnel familiar with the techniques and methodologies contained herein.

Refer to: *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods (SW-846), Update V, Chapter 1* and the *DoD/DOE Quality Systems Manual for Environmental Laboratories, version 5.3* for definitions of applicable terms.

3.0 Responsibilities

Data validation personnel are responsible for implementing these procedures for the validation of data and generation of validation reports. However, it is recognized that planning and proper establishment of validation requirements is necessary during the contracting phase as well as during the writing and approval of the QAPP. Project personnel (e.g., prime contractors, remedial project managers, and project chemists) are responsible for the scope and extent of validation for their projects.

It is anticipated that data validation is performed by a party independent of the laboratory. Project teams may identify a government quality assurance validation as necessary. A government quality assurance validation is defined as being independent of the prime contractor and performed by a government representative or services directly contracted by the government agency independent of the prime contractor.

4.0 Validation Steps

4.1 INTRODUCTION

This document outlines the validation of environmental data obtained under United States (US) DoD projects. The document incorporates other applicable elements of federal policies and guidance as noted in the references section. For example, this document incorporates conventional data validation language such as “stages of validation” previously developed (e.g., the USEPA Superfund program).

Based on the laboratory data deliverables and data validation requirements identified in the project QAPP, the analytical data may undergo “Stage 1” through “Stage 4” data validation or some combination of these. The extent of the data validation performed will be dependent on the project data quality objectives (DQOs) and will be limited by the content of the laboratory data deliverable. This procedure establishes guidance for the content of the validation reports and the validation process. The development of project DQOs is beyond the scope of this guidance.

Data validation should not be confused with compliance monitoring. Data validation is an explanatory process that extends the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set. Data validation informs the user of any limitations on a data set and can identify project noncompliance. However, enforcement of compliance is not within the authority of the data validator.

Data validation is distinct from a data usability assessment. Analytical data validation is the systematic review of laboratory data deliverables and can help identify laboratory and field sample analytical uncertainty. Data usability assessment also encompasses field sampling uncertainty including the overall sampling plan, sampling processes and conditions during sampling. A data validation report can be one element used during an assessment of the overall usability of the data. Data validation is an evaluation of data with respect to the project measurement quality objectives (MQOs), while data usability is an evaluation of the data with respect to the overall goals of the project as outlined in the DQOs.

It should be re-emphasized that it is not the role of data validation to determine if project goals have been met or to provide the decisions to be made. Data validation provides the overall appraisal of a data set and the project team should use this appraisal along with their own judgment when making decisions. It is not the role of data validation to accept or reject data. As such, the conventional R (reject) flag has been removed from this document. The project team should make the decision to accept or reject qualified data during the Data Usability stage, in accordance with the QAPP (for example, using the process described in UFP-QAPP Worksheet #37).

This document may also be used for guidance to indicate basic contractual validation requirements during the generation of project-specific QAPPs. Specifically, this document may be used as guidance to identify the required laboratory data deliverable, the extent of data validation to be performed, and the data validation qualifiers and reason codes to be used. These requirements should be included within the body of the QAPP or as appendices.

4.2 LABORATORY DATA DELIVERABLES

The types of laboratory data deliverables for each stage of data validation are intended to correspond as closely as possible to the stages of data validation outlined in *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (USEPA 2009) and as defined in Appendix A of the *Quality Systems Manual ver. 5.3* (DoD/DOE 2019). The types of laboratory data deliverables per stage are as follows:

A Cover Sheet, Table of Contents, and Laboratory Case Narrative are required for all stages.

Stage 1: Sample results forms, chain of custody and supporting records (such as ground courier documents), laboratory receipt checklist, and field QC records (if separate from chain of custody).

Stage 2A: Includes all of **Stage 1** plus method QC (preparation batch QC) and forms. The following is a non-inclusive list:

- Sample related QC data and QC acceptance criteria linked to corresponding field samples (such as method blanks, matrix duplicates, surrogates, and serial dilutions);

- Requested spike analytes or compounds as appropriate (such as LCS, matrix spike, and surrogate recoveries, and post digestion spikes);
- QC sample frequency checked for appropriateness (for example, one LCS per twenty samples per 24 hours in a preparation batch).

Stage 2B: Includes all of **Stage 2A** plus instrument QC forms and preparation logs. The following is a non-inclusive list:

- Initial calibration summaries detailing the following: calibration type, individual standard concentrations, individual response factors, individual abundances, average response factors, correlation coefficients, and linear dynamic range results;
- Initial and continuing calibration verification summaries along with associated concentrations and percent recoveries or percent differences;
- Method specific forms such as tune and interference check summaries and internal standard summaries;
- All summary forms listed above for second column or detector including percent difference between the two analytical results;
- Preparation logs, including records supporting special techniques applied by the laboratory, such as Incremental Sampling Methodology (ISM) subsampling (included to allow evaluation of applicable quality control checks as detailed in the QAPP).

Stage 3: Includes all of **Stage 2B** plus instrument quantitation forms (raw data) necessary to recalculate sample results, method, and instrumentation QC; and standards traceability logs to include copies of vendor “Certificates of Analysis”.[1]

Stage 4: Includes all of **Stage 3** plus all data (such as instrument chromatograms and spectra) necessary to qualitatively evaluate the results (for example, tentatively identified compound searches, all manual integration summaries with reasons, and evaluation of chromatographic baselines).

The extent of data validation that can be performed will be dependent upon the required type of laboratory data deliverable. For example, a Stage 3 data review cannot be performed without a Stage 3 or Stage 4 data deliverable. Successive stages of data validation require more comprehensive data deliverables from the laboratory. For example, Stage 1 data validation requires the review of sample receipt data from the laboratory, whereas Stage 4 requires all the outputs of the previous stages (Stage 1 through Stage 3) and evaluation of sample chromatograms and mass spectra. Therefore, Stage 4 data validation requires raw

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[1] Standards traceability will allow recalculation of standards derived from primary stock concentration to working stock or spiking concentration and should be included in a Stage 3 data deliverable if the potential exists for legal chain of custody requirements during the project.

data (such as spectra) to evaluate results and cannot be performed on a deliverable containing only sample receipt forms.

4.3 ELEMENTS OF DATA VALIDATION

The process by which analytical data validation should be carried out depends on the stage assigned to that data type in the project QAPP. The assigned stage will be based on the DQOs required. The laboratory data should be delivered in a report that is, at a minimum, the same stage as the assigned stage of validation. The laboratory analytical data deliverable may be a hard copy deliverable, an electronic data deliverable, or a combination of both. The validator may validate the analytical data using entirely manual, entirely electronic, or a combination of both processes.

Data validators should document their findings in a report format that provides clear support and definition for the data qualifiers and reason codes applied. Data validators may also annotate sample result forms and EDDs with appropriate validation qualifiers and reason codes if required by the QAPP. The completed data validation reports may be sent either as a hard copy or an electronic file to the data recipient or customer. Examples of data validation reports and annotated sample result forms may be found in Appendices 4 and 5, respectively.

When the hardcopy of the report is validated, but a project EDD is used as the official data source for archival or storage, the project EDD should be compared to the hardcopy report to confirm that the results match. When performing part or full manual validation on a hardcopy (such as a pdf) report, a minimum of 10% of the sample results per method reported should be cross-checked against any project-required EDD. The data elements to be reviewed should be detailed in the project QAPP.

The steps in the process of staged data validation are outlined below.

(1) The analytical data package should be checked or verified by the data validator for *completeness* to ensure that all data requested are present in the data deliverable. The reporting requirements for the analytical data package should be specified in the QAPP. This is a critical step as analytical data validation may not be possible if any part of the requested laboratory data deliverable is not present. If any required data are missing, the point of contact (such as a remedial project manager or project chemist) should be notified to secure the missing data.

(2) The completeness check in step (1) should be followed by a QAPP *compliance* check to compare the documented sample receipt conditions and analytical QC results in the analytical data package to the requirements in the QAPP. The analytical QC results generally consist of two parts: (1) preparation batch QC, and (2) instrument-related QC. If the check is not in compliance with the QAPP, document this in the appropriate section of the data validation report. The point of contact should be notified about any preparation batch/analytical QC limits that are not consistent with QAPP requirements.

(3) The completeness and QAPP compliance checks may be followed by *recalculation checks*. This step is required only for Stage 3 and Stage 4 data validation and is dependent upon receipt of at least a Stage 3 laboratory data deliverable. The laboratory reported values

(e.g., sample results, instrument calibration result) can be checked by recalculating them using the data from instrument outputs reported by the laboratory. The objective is to ensure that the laboratory used proper calculations and procedures to determine the final reported values. This step may extend to other raw data, such as percent solids/moisture raw measurements from balances to assure dry basis calculations are correct. This step may be done on a fraction or percentage of instrument outputs, which should be specified in the QAPP. The QAPP should also specify that additional results should be recalculated and checked if any issues are noted with the first recalculated values.

(4) The *actual instrument outputs* such as chromatograms or spectra may be checked to ensure that the laboratory reported analytes have been correctly identified and quantitated. This step is required only for Stage 4 data validation and is dependent upon receipt of a Stage 4 laboratory data deliverable. This step also may be done on a fraction or percentage of instrument outputs which should be specified in the QAPP. The QAPP should specify that additional outputs should be checked if any issues are noted with the first fraction or percentage reviewed.

4.4 STAGED DATA VALIDATION

For the purposes of this guidance, the following terminology is recommended for use to describe the stages (extent) and processes used to validate laboratory analytical data packages, whether the validation is performed by a manual process, electronic process, or combination of both.

Note: The following lists of required activities per each stage of validation is not considered an “all inclusive” list or applicable to every method that is validated.

Stage 1: A verification and validation conducted only on completeness and compliance of sample specific information and field QC: field sample IDs and target analytes verified against the chain of custody for completeness; sample conditions upon arrival at laboratory noted; sample preservation was appropriate and verified by the laboratory; holding times were met; concentrations and units for limits of detection and quantitation were appropriate; trip blanks, field blanks, equipment blanks, and field duplicates met project requirements for frequency and field quality control.

Stage 2A: Stage 1 validation plus evaluation of preparatory batch QC results: method blanks, laboratory control samples, matrix spikes, laboratory duplicates (LCSD, MSD, DUP), surrogates (organics), serial dilutions, post digestion spikes (as appropriate to the method), and any preparatory batch cleanup QC to assure project requirements for analyte spike list, frequency, and quality control limits are met.

Stage 2B: Stage 2A validation plus evaluation of instrument-related QC results including Instrument Performance Samples: Tunes, breakdown standard check results, peak tailing factors (if applicable), instrument initial calibration summaries (including response factors and any regression summaries), initial calibration verification and continuing calibration verification summaries, internal standards, initial and continuing calibration blank summaries, confirmation of positive results for second column or detector including percent difference between the two analytical concentrations that are greater than the detection limit, and interference check samples to assure project requirements for frequency and quality control criteria are met.

Stage 3: Stage 2B validation plus re-quantification and recalculation of selected samples (i.e., target analytes quantitated from appropriate internal standards) and instrument QC: Appropriate selection of curve fit type, weighting factors, and with or without forcing through zero, continuing calibration verifications and blanks, and percent ratios of tunes and performance checks including calculation of DDT/Endrin breakdown and column peak tailing, and preparatory batch QC results (such as spike percent recoveries and serial dilution percent differences) from instrument response. Instrument response data are required to perform re-quantification and recalculation.

Stage 4: Stage 3 validation plus qualitative review of non-detected, detected, and tentatively identified compounds (TICs) from instrument outputs: Chromatograms are checked for peak integration (10% of automated integration and 100% of manual integrations (MI) where chromatograms from before and after MI are examined for cause and justification), baseline, and interferences; mass spectra are checked for minimum signal to noise, qualitative ion mass presence, ion abundances; retention times or relative retention times are within method requirements for analyte identification. Raw data quantitation reports, chromatograms, mass spectra, instrument background corrections, and interference corrections are required to perform review of the instrument outputs.

Greater detail on the exact steps and processes to follow during Stages 3 and 4 of validation may be found in the following discussion of percentage data validation and in the validation guidelines for the individual methods/analytical technologies that follow this section of the guidelines.

Note: Using higher stages of data validation does not necessarily result in higher quality data. However, the quality of the analytical data becomes more transparent as more stages of validation are conducted, and the source of problems identified in lower stages of validation may be uncovered. Thus, the usability of the analytical data for its intended use becomes better understood.

Additionally, the generated data validation report should indicate, via use of the label codes listed below, the steps as well as the manner used for laboratory data verification and validation.

Label	**Corresponding Label Code**
Stage_1_Validation_Electronic	S1VE
Stage_1_Validation_Manual	S1VM
Stage_1_Validation_Electronic_and_Manual	S1VEM
Stage_2A_Validation_Electronic	S2AVE
Stage_2A_Validation_Manual	S2AVM

Label	**Corresponding Label Code**
Stage_2A_Validation_Electronic_and_Manual	S2AVEM
Stage_2B_Validation_Electronic	S2BVE
Stage_2B_Validation_Manual	S2BVM
Stage_2B_Validation_Electronic_and_ Manual	S2BVEM
Stage_3_Validation_Electronic	S3VE
Stage_3_Validation_Manual	S3VM
Stage_3_Validation_Electronic_and_Manual	S3VEM
Stage_4_Validation_Electronic	S4VE
Stage_4_Validation_Manual	S4VM
Stage_4_Validation_Electronic_and_ Manual	S4VEM
Not_Validated	NV

4.5 PERCENTAGE DATA VALIDATION IN STAGES 3 AND 4

When a Stage 3 or 4 manual data validation is performed, the requested re-quantifications and recalculations may be performed on a percentage of the samples in a project. The percentage can vary based on project needs to save time and money. When a Stage 3 or Stage 4 EDD is provided, an automated data validation at Stage 3 could be performed on 100% of the samples.

Note: It is understood that Stage 3 or 4 level validation cannot be fully automated with 100% success at this time. However, validators are still encouraged to attempt automated data validation on all their datasets regardless of Stage. The DoD encourages continued innovation in automated data review.

To encourage consistency in the interpretation of the percentage of re-quantifications and recalculations, the following guidelines were established as the minimum that should be performed, if required. If project requirements dictate any recalculation needs, those needs should be clearly defined in the QAPP. In cases where the QAPP defines requirements other than those below, the QAPP shall supersede this guidance.

Re-quantification and recalculation should be performed on the designated percentage of the samples per Sample Delivery Group (or however defined in the QAPP, such as percentage of total project samples) per analytical suite. As a minimum, it is recommended that 10% of the data should be re-quantified and re-calculated unless specific instructions are given in the QAPP.

When choosing samples, preparatory batch QC, and analytes for re-quantification and recalculation, consideration should be given to how samples are processed and analyzed to help assure a representative subsample of recalculations is performed. Additionally, if priority contaminants or contaminants of concern are identified in the QAPP, those analytes should be selected for re-quantification and recalculation. Other circumstances that should be prioritized for re-quantification and recalculation include samples that were diluted, target analytes that had manual integrations, and samples that were re-analyzed.

Initial calibration recalculations should use the raw instrument response for the target analytes and associated internal standards (if applicable) to recreate the calibration curve from the individual calibration standards. If multiple types of calibration curves are employed in an analytical suite, then one analyte per curve type should be recalculated. Re-quantification of instrument QC samples, preparatory batch QC samples, and sample results should use raw instrument response in tandem with the reported calibration factor, response factor, or slope; the preparation information; and percent moisture for solid samples to recreate the reported result. Instrument and preparatory batch QC sample recalculations should include verification of the percent recovery (%R), percent difference (%D), relative percent difference (RPD), or other reported data quality indicators. When a method requires dual column (confirmation) analysis, the same analyte should be recalculated from both columns and the reported RPD between columns verified.

Sample calculations should include the raw instrument result, re-quantified from the instrument response against the calibration function, and the final reported sample result, including any dilution, preparation factor, or percent moisture (if applicable). Surrogate results and recoveries should be re-quantified and recalculated where applicable. When no detects are present in the samples, re-quantification and recalculation of the surrogate (Stage 3) along with review of the chromatogram for absence of any analyte response (Stage 4) serves as verification of the sample quantification.

Any discrepancies or errors that are discovered during recalculation should trigger validators to consult their point of contact for further direction. If possible, the validator should try to determine if the errors are random or systematic. Errors of any sort may trigger more extensive recalculation (Stage 3), increased manual review of the instrument chromatography (Stage 4), and a request for a revised data deliverable from the laboratory. The scope of additional review triggered by errors or discrepancies should be clearly discussed in the data validation report and outcomes described in accordance with QAPP instructions.

Documentation of the Stage 3 for all recalculations performed, whether in the form of a checklist, handwritten calculations, or spreadsheet, should be included in the data validation report. An example of a recalculations spreadsheet is included in Appendix 6. Documentation of the Stage 4 re-interpretations, integrations, or other qualitative identification parameter should include the pages of the laboratory deliverable that were visually reviewed. Documentation of Stage 3 and Stage 4 validation performed via electronic means should include the identification of any automated data review software used and include the output report.

4.6 CONTENT AND FORMAT OF THE DATA VALIDATION REPORT

The data validation report should consist of the following major components. The presentation format of the information below is an example:

4.6.1 Cover Letter

The cover letter should contain the generation date of the cover letter, the address of the project office, the sample delivery group (SDG) number(s), the Project Manager's name or designee, name and address of the laboratory and laboratory contact, data validator's name and contact information, and applicable QAPP citation. The cover letter should list the specific data validation reports being sent with the cover letter. The cover letter may apply to data validation reports from more than one SDG. Appendix 2 is an example of the cover letter. The data validation report should be paginated in a manner such that on each page there is an identification to ensure that the page is recognized as a part of the report and there is a clear identification of the end of the report.

4.6.2 Data Validation Reports by SDG

Each SDG (however named) should be associated with a data validation report. The procedures used to generate the report(s) are discussed in the following sub-sections.

4.6.2.1 COVER PAGE AND INTRODUCTION

The cover page should indicate the SDG number(s) and analysis techniques/methods. The introduction should contain a brief description of the SDG information that is pertinent to data validation. This information includes the SDG title and number, Project Manager, the sample matrices and analyses performed on the samples, the data validation stage for the project, and a brief discussion of the methodologies/stages used for data validation. This section should also contain a Sample Identification Table listing each field sample identification number (as indicated on the field chain of custody) cross-referenced with its associated internal laboratory identification number and the validation stage performed. Each sample should be listed under every analytical method for which data were validated. Appendix 3 is an example of the sample identification table.

4.6.2.2 DATA VALIDATION FINDINGS

This section should present the data validation findings. The findings should be determined based on validation criteria established for each analytical technique as defined by the technique specific validation guidelines.

A discussion of each QC criteria and any applicable non-conformities under each analytical method should be presented in the data validation report for each analytical category.

4.6.2.3 DATA VALIDATION CHECKLISTS

A manual or electronic checklist for each analytical category listed above should be completed and should be included in the data validation report. The checklist may be defined in project planning documents or may be a standard or custom checklist. The checklist should address all QC elements for each analytical method in the report. It is recommended that the checklist be approved or included in the QAPP to ensure that all required aspects are sufficiently addressed during the validation process. Examples of data validation checklists may be found in Appendix 4.

4.6.2.4 DOCUMENTATION OF RECALCULATIONS

Documentation of the recalculations performed during Stages 3 and 4 validation should be included in the data validation report. The documentation may be in the form of hand-written calculations, a verification generated during electronic validation, or a spreadsheet. An example of a calculations spreadsheet may be found in Appendix 6.

Note: All recalculations performed during Stages 3 and 4 validation can be provided in the validation report in the form of an appendix or addendum.

4.6.2.5 LABORATORY REPORTS (FORM ONES, SAMPLE RESULTS FORMS)

Annotated laboratory reports with the appropriate data qualifiers and qualification codes (if applicable), as specified in the data validation procedures, may be submitted as an appendix to the data validation report. Formats may include tabulated excel, word, or other EDD formatted files provided from the laboratory. Alternatively, an annotated data sheet (however named) with handwritten validation qualifiers may be submitted. An example is provided in Appendix 5.

4.6.3 Acronyms and Abbreviations List

This list should present all acronyms and abbreviations used in the individual data validation reports. Appendix 1 is an example of an acronyms and abbreviations list.

4.6.4 Data Qualifier Reference Table

Data qualifiers are applied in cases where the data do not meet the required quality control (QC) criteria or where special consideration by the data user is required. The data qualifiers that are recommended for use with these guidelines are listed in Section 4.8. Project needs may dictate the use of other data qualifiers. The data qualifiers to be used should be listed and defined in the QAPP, as well as, in the data validation report.

4.6.5 Qualification Code Reference Table

Qualification codes explain why data qualifiers have been applied and identify possible limitations and bias of data use. Appendix 7 provides an example of the qualification codes that may be used. Alternate or additional qualification codes may be specified in the project QAPP based on project needs. If required, qualification codes are to be provided by data validation personnel in the body of the data validation report on the annotated “certificates of analysis” provided by the laboratory.

4.6.6 EDDs

The stages of data validation defined in this document coincide with USEPA guidance on Electronic Data Deliverables (EDDs) such as Staged Electronic Data Deliverables (SEDD). Data validation may include a manual review of test reports, electronic data review (with data checkers), or a combination of both. A laboratory’s electronic data output should comply with the EDD data structure as outlined in the QAPP. A generic automated electronic data review checklist for SEDD Stage 2B can be located at the DoD DENIX/EDQW website.

Note: SEDD is used in a generic sense in this document for simplicity. It does not preclude the use of other Component file structures, such as Navy NEDD or Air Force ERPIMS.

4.7 RECOMMENDED RECALCULATIONS FOR STAGE 3 DATA VALIDATION

Calculations are performed in Stage 3 data validation. Stage 4 data validation additionally includes the qualitative evaluation of non-detect, detected, and tentatively identified analytes from instrument outputs. Specific guidance on the qualitative evaluation can be found in the individual analytical technique guidelines. The following manual calculations are included in Stage 3 or higher.

The QAPP may require more extensive recalculations. Requirements in the QAPP will always supersede this guidance.

A minimum of reported quality control calculations should be verified at a frequency of 10% per analytical method, per SDG. If the SDG is analyzed on multiple instruments, then each instrument should be included in the calculations. A minimum of 10% of the laboratory standards (instrument QC), field QC samples, field samples, and batch QC samples, should be undergo re-quantification, per analytical suite, per SDG. Project specific target analyte detects should also undergo re-quantification (minimum 10%) per analytical suite, per SDG. When choosing samples for re-quantification, precedence should be given to priority contaminants, diluted samples, manual integrations, and any samples requiring re-analysis.

When performing re-quantification on samples, instrument QC samples, and preparatory batch QC samples, the calculation should begin with the raw instrument response. Once the calibration curve is verified, as recommended below, the reported calibration factors may be used for re-quantification of other target analytes in the samples, instrument QC samples, and batch QC samples.

These recommendations were based on the National Functional Guidelines, adapted for SW-846 methods, and are not comprehensive for all methods. These recommendations should be adapted for methods that do not fall into one of the categories below.

If errors in the calculations are discovered, the validator should contact the project management team for further direction.

4.7.1 Organic Methods

Note: In this section, the term ‘target analyte’ is considered the same as project specific analytes of concern identified in the project QAPP.

4.7.1.1 GAS AND LIQUID CHROMATOGRAPHY (GC AND LC)

Note: these calculations include SW-846 methods such as: PCBs (8082), pesticides (8141), herbicides (8151), PAHs (8310), and nitroaromatics (8330).

Samples

Re-quantify all the target analyte detects for at least 10% of the samples in each SDG. Include dilution, prep factors, and percent moisture to recalculate the reported result.

Re-quantify all detects found in the field QC blanks (such as field blanks or equipment blanks).

Note: If no samples in the SDG contain detects, the surrogate recalculation may serve as verification of sample results.

If the method requires confirmation of detects on a second detector or analytical column, re-quantify analytical results for both primary and secondary for all detects. Verify both concentrations are greater than the detection limit as directed by the QAPP and both peaks from each column fall within their retention time windows.

Preparatory Batch QC

Laboratory Control Sample (LCS):

Re-quantify the result and recalculate the percent recovery for at least 10% of the target analytes per each LCS.

Surrogates:

Re-quantify the surrogate result and recalculate percent recovery for at least 10% of the samples. If more than one surrogate was used, vary the surrogate compound to have approximately the same number of manually re-quantified concentrations and manual recalculations of percent recoveries per surrogate compound.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) or LCS Duplicate:

Re-quantify the spike result concentration and recalculate percent recovery and relative percent difference (RPD) for at least 10% of the target analytes in each MS/MSD sample pair.

Method Blank:

Re-quantify one or more detects found in the method blank (if applicable), per each SDG.

Instrument QC

GC Column Performance:

Ensure no calculation errors occurred by recalculating 10% of the injection port inertness checks (if applicable) reported on summary forms for DDT or Endrin. Review tailing factors for GC column performance as required by the specific analytical technique or in accordance with QAPP instructions.

Initial Calibration:

Recalculate the initial calibration for at least 10% of the target analytes from each initial calibration proportionally selecting analytes based on calibration curve types used and for each internal standard (if applicable).

Average Relative Response Factor ($\overline{RRF}$):

Recalculate individual RRFs, $\overline{\mathrm{RRF}}$, and the percent relative standard deviation (%RSD) for target analytes selected from each internal standard. Include all second column/detector positive detects.

Average Calibration Factor ($\overline{CF}$):

Recalculate individual CFs, $\overline{CF}$, and the percent relative standard deviation (%RSD).

Linear or Quadratic Regression:

Recalculate the slope, intercept, and correlation coefficient.

<u>Relative Standard Error (RSE):</u>

If the initial calibration included refitting the data back to the model (RSE), then recalculate 10% of the target analytes from each initial calibration for the RSE.

<u>Initial and Continuing Calibration Verification (ICV/CCV):</u>

Re-quantify and recalculate the initial and continuing calibration verifications for at least 10% of the target analytes for every ICV/CCV proportionally selecting analytes based on calibration curve types used in the initial calibration. The target analytes should be based upon on project QAPP analytes of concern.

RRF:

Re-quantify ICV/CCV concentrations to verify reported values on the associated summary forms for target analytes selected from each internal standard.

Recalculate the ICV/CCV RRF and percent difference (%D) from the average RRF for target analytes selected from each internal standard.

CF:

Re-quantify the ICV/CCV concentrations to verify reported values on the associated summary forms.

Recalculate the ICV/CCV CF and percent difference (%D) from the average CF.

Linear or Quadratic Regression:

Re-quantify the ICV/CCV concentrations to verify reported values on the associated summary forms.

Recalculate the ICV/CCV calibration factor and percent drift from the average calibration factor.

4.7.1.2 GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

Note: these calculations include SW-846 methods such as: volatiles (8260), semi-volatiles (8270), and dioxins/furans (8290).

Samples

Re-quantify all the target analyte detects for at least 10% of the samples in each SDG. Include dilution, prep factors, and percent moisture (if applicable) to recalculate the reported result.

Re-quantify all detects found in the field QC blanks (such as trip blanks, field blanks or equipment blanks).

Note: If no samples in the SDG contain detects, the surrogate recalculation may serve as verification of sample results.

Preparatory Batch QC

LCS:

Re-quantify the result and recalculate the percent recovery for at least 10% of the target analytes per each LCS.

Surrogates:

Re-quantify and recalculate percent recoveries for all surrogate results in the 10% of samples and method QC that were originally selected.

MS/MSD (or LCS Duplicate):

Re-quantify the spike result concentration and recalculate percent recovery and relative percent difference (RPD) for at least 10% of the target analytes in each MS/MSD sample pair.

Method Blank:

Re-quantify one or more detects found in the method blank (if applicable), per each SDG.

Instrument QC

GC Column Performance and Injection Port Inertness /Tune:

Ensure no calculation errors occurred by recalculating 10% of the abundance ratios and the percent degradation of DDT in every tune, and recalculate the peak tailing factor (if applicable). Ensure tune criteria specified by the analytical method or QAPP are met.

Initial Calibration:

Recalculate the initial calibration for at least 10% of the target analytes per each internal standard per each initial calibration proportionally selecting analytes based on calibration curve types used.

Average Relative Response Factor ($\overline{RRF}$):

Recalculate individual RRFs and $\overline{\mathrm{RRF}}$ for target analytes from each internal standard.

Recalculate the percent relative standard deviation (%RSD) for these target analytes per each internal standard.

Linear or Quadratic Regression:

Recalculate the slope, intercept, and correlation coefficient.

Initial and Continuing Calibration Verification (ICV/CCV):

Re-quantify and recalculate the initial and continuing calibration verifications for at least 10% of the target analytes proportionally per each internal standard for every ICV/CCV proportionally selecting analytes based on calibration curve types used in the initial calibration.

RRF:

Re-quantify ICV/CCV concentrations to verify reported values on the associated summary forms.

Recalculate the ICV/CCV RRF and percent difference (%D) from the average RRF.

Linear or Quadratic Regression:

Re-quantify the ICV/CCV concentrations to verify reported values on the associated summary forms.

Recalculate the ICV/CCV calibration factor and percent drift from the average calibration factor.

Relative Standard Error (RSE):

If the initial calibration included refitting the data back to the model (RSE), then recalculate 10% of the target analytes from each initial calibration for the RSE.

The following recalculations should be performed in addition to those listed above for GC/MS if High Resolution for dioxins, furans and PCB's are required:

Toxicity Equivalency Quantity/Factor (TEQ/TEF):

Recalculate at least 10% of the TEQ/TEF.

Estimated Detection Limit (EDL)/Estimated Maximum Possible Concentration (EMPC):

Verify at least 10% of the quantitated EDL concentrations.

Include EMPC results in the 10% of target analytes recalculated and re-quantified, if reported.

4.7.2 Inorganic Methods

Note: In this section, the term 'target analyte' is considered the same as project specific analytes of concern identified in the project QAPP.

4.7.2.1 WET CHEMISTRY

Note: these calculations include SW-846 methods such as: mercury (7470/7471), hexavalent chromium (7196/7197/7199), cyanide (9010), and anions (9056).

Samples

Re-quantify all the target analyte detects for at least 10% of the samples in the SDG. Include dilution, preparation factors, and percent moisture to recalculate the reported result.

Re-quantify all detects found in the field QC blanks (such as field blanks or equipment blanks).

Preparatory Batch QC

LCS:

Re-quantify the result and recalculate the percent recovery for at least 10% of the target analytes per each LCS (as applicable).

MS/MSD:

Re-quantify the spike result and recalculate percent recovery and relative percent difference (RPD) for at least 10% of the target analytes in each MS/MSD pair (as applicable).

Laboratory Duplicate:

Recalculate the RPD of all target analyte detects in each laboratory duplicate.

Note: Laboratory duplicates recalculation may not be applicable depending on the method or QAPP QC requirements.

Method Blank:

Re-quantify one or more detects found in the method blank (if applicable), per each SDG.

Instrument QC

Initial Calibration:

Linear or Quadratic Regression:

Recalculate the slope, intercept, and correlation coefficient for at least 10% of the target analytes in each initial calibration.

Initial and Continuing Calibration Verification (ICV/CCV):

Linear or Quadratic Regression:

Re-quantify the ICV/CCV concentrations to verify reported values on the associated summary forms for at least 10% of the target analytes in each calibration verification.

Recalculate the ICV/CCV calibration factor and percent drift from the average calibration factor for at least 10% of the target analytes in each calibration verification.

4.7.2.2 INDUCTIVELY COUPLED PLASMA (ICP-AES) AND MASS SPECTROMETRY (ICP-MS)

Note: these calculations include SW-846 methods such as: metals by ICP-AES (6010) and metals by ICP-MS (6020).

For ICP-AES and ICP-MS instrumentation, the calibration algorithms vary widely among manufacturers. For this reason, the recalculation of ICP-AES and ICP-MS initial calibrations may produce results that do not match those reported by the laboratory. The validator must be provided with the instrument specific algorithm necessary to perform the recalculation. In cases where the algorithm cannot be obtained, the validator must use professional judgment in the evaluation of the calibration curve. The manufacturer of the instrument is expected to comply with SW-846 inorganic method requirements.

Samples

Re-quantify all the target analyte detects for at least 10% of the samples in the SDG. Include dilution, prep factors, and percent moisture to recalculate the reported result.

Re-quantify all detects found in the field QC blanks (such as field blanks or equipment blanks).

Preparatory Batch QC

LCS:

Re-quantify the result and recalculate the percent recovery for at least 10% of the target analytes per each LCS.

MS/MSD:

Re-quantify the spike result and recalculate percent recovery and relative percent difference (RPD) for at least 10% of the target analytes in each MS/MSD pair.

Laboratory Duplicate:

Recalculate the RPD for at least 10% of the target analytes in each laboratory duplicate.

Note: Laboratory duplicates recalculation may not be applicable depending on the method or QAPP QC requirements.

Method Blank:

Re-quantify one or more detects found in the method blank (if applicable), per each SDG.

Serial Dilution:

Recalculate the percent difference for at least one target analyte.

Post Digestion Spike:

Recalculate one post digestion spike per SDG for at least 10% of the target analytes.

Instrument QC

Mass Calibration (ICP-MS Tune):

Ensure no calculation errors occurred by recalculating 10% of the average mass and %RSD for every tune.

Initial Calibration:

Recalculate the initial calibration for at least 10% of the target analytes per each initial calibration, proportionally selecting analytes based on calibration curve types used.

Linear or Weighted-linear Regression:

Recalculate the slope, intercept, and correlation coefficient.

Relative Standard Error (RSE):

If the initial calibration included refitting the data back to the model (RSE), then recalculate 10% of the target analytes from each initial calibration for the RSE.

Initial and Continuing Calibration Verification (ICV/CCV) and Low-Level Calibration Verification (LLCCV):

Re-quantify and recalculate the ICV, CCV, and LLCCV for at least 10% of the target analytes for every ICV, CCV, and LLCCV proportionally selecting analytes based on calibration curve types used in the initial calibration.

RRF:

Re-quantify ICV/CCV concentrations to verify reported values on the associated summary forms for target analytes from each internal standard.

Recalculate the ICV/CCV RRF and percent difference (%D) from the average RRF for these target analytes from each internal standard.

Verify the LLCCV result and recalculate percent recovery.

Linear or Weighted-linear Regression:

Re-quantify the ICV/CCV concentrations to verify reported values on the associated summary forms.

Recalculate the ICV/CCV calibration factor and percent drift from the average calibration factor.

Verify the LLCCV result and recalculate percent recovery.

Interference Check Samples:

Verify the result and recalculate the percent recovery for at least 10% of the target analytes for every interference check standard. Recalculate at least 10% of the reported concentrations of non-spiked metals in each ICS.

4.8 DATA VALIDATION QUALIFIERS

The following provides a brief explanation of the DoD data validation qualifiers assigned to results during the data review process by a data validator. The reviewer should use these qualifiers, as applicable, unless other data qualifiers are specified in a project related document, such as a QAPP. If other qualifiers are used, a complete explanation of those qualifiers should accompany the data validation report.

Qualifier	**Definition**
U	The analyte was not detected and was reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result was an estimated value with an unknown bias.
J+	The result was an estimated quantity, but the result may be biased high.
J-	The result was an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there was presumptive evidence to make a "tentative identification."
NJ	The analyte has been “tentatively identified” or “presumptively” as present and the associated numerical value was the estimated concentration in the sample.
UJ	The analyte was not detected and was reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

Note: R (reject) flag has been removed; see Section 4.1

5.0 Records

Data validation record retention requirements for hard copies and electronic formats should be defined in the QAPP for the project. At a minimum, data validation records should be retained the same length as the original laboratory report (i.e., 5 years or as specified by the QAPP).

6.0 References

The following documents were reviewed in the preparation of the DoD Data Validation Guidelines:

2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. *Final Version 1.* Intergovernmental Data Quality Task Force (IDQTF). DoD: DTIC ADA 427785, EPA-505-B-04-900A. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

2019. *Department of Defense/Department of Energy Consolidated Quality Systems Manual for Environmental Laboratories Version 5.3* DoD Environmental Data Quality Workgroup and DOE Consolidated Audit Program (DOECAP).

2014. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Update V, Revision 2. Environmental Protection Agency, United States (EPA). Office of Solid Waste. July.

2011. *USEPA National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review.* EPA-540-R-11-016. (OSWER 9240.1-53). Office of Superfund Remediation and Technology Innovation (OSRTI). September.

2016. *USEPA National Functional Guidelines for High Resolution Superfund Methods Data Review*. EPA-542-B-16-001. (OLEM 9200.3-115). Office of Superfund Remediation and Technology Innovation (OSRTI). April.

2014. *USEPA National Functional Guidelines for Inorganic Superfund Data Review.* USEPA-540-R-013-001. (OSWER 9355.0-131). Office of Superfund Remediation and Technology Innovation (OSRTI). August.

2014. *USEPA National Functional Guidelines for Superfund Organic Methods Data Review.* USEPA-540-R-014-002. (OSWER 9335.0-132). Office of Superfund Remediation and Technology Innovation. August.

2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.* EPA 540-R-8-005 (OSWER 9200-1-85). Office of Solid Waste and Emergency Response. January.

2005. *Guidance for Evaluating Performance-Based Chemical Data*. EM200-1-10. Department of the Army, US Army Corps of Engineers. June.

2008. *SEDD Specifications Document & Data Element Dictionary Version 5.2.* USEPA Contract Laboratory Program. July.

2013. *SEDD Valid Values Document Version 1.0.* USEPA Contract Laboratory Program. May.

7.0 Attachments

Appendix 1: Example Acronyms and Abbreviations

Appendix 2: Example Sample Cover Letter

Appendix 3: Example Sample Identification Table

Appendix 4: Example Data Validation Reports & Checklists

Appendix 5: Example Annotated Laboratory Data Sheets

Appendix 6: Example Calculations Spreadsheet for Stage 3

Appendix 7: Example Qualification Code Reference Table

Appendix 1: Example Acronyms and Abbreviations

Appendix 1: EXAMPLE ACRONYMS AND ABBREVIATIONS

Following is a list of acronyms and abbreviations that may be used in data validation reports:

%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation
$\overline{CF}$	average calibration factor
$\overline{RRF}$	average relative response factor
CCB	continuing calibration blank
CCV	continuing calibration verification
DL	detection limit
DQO	data quality objective
ICAL	initial calibration
ICB	initial calibration blank
ICS	interference check sample
ICV	initial calibration verification
IS	internal standard
LCS	laboratory control sample
LD	laboratory duplicate
LLCV	low-level calibration verification
LOD	limit of detection
LOQ	limit of quantification
MB	method blank
MS	matrix spike
MSD	matrix spike duplicate
QAPP	quality assurance project plan

RPD	relative percent difference
RT	retention time
SD	sample duplicate
SDG	sample delivery group
TEQ	toxicity equivalency quantity
TIC	tentatively identified compound

Appendix 2: Example Sample Cover Letter

Appendix 2: Example Sample Cover Letter

(Date)
(Project Manager or
Designee) (Company
address)

Dear ( ):

Enclosed is Revision __ of the data validation reports for project (number) from Work Plan/QAPP Title (number) as follows: Semi-volatiles SDG S0221 SDG S0350 by SW-846 Method 8270D, laboratory reports (A and B); Pesticides/PCBs SDG S0201 by SW-846 Methods 8081B/8082, laboratory report (C); and Metals SDG S0221 SDG S0201 by SW-846 Method 6010B, laboratory report (D and E). The SDGs were analyzed by (laboratory name, address). The laboratory project manager is (name, contact info). The specific sample identifications are listed in the Sample Identification Table(s). The data packages were reviewed according to the *DoD General Data Validation Guidelines version1, 2018*.

(List data validation references)

Sincerely,

(Signature)

Data Validation Project Manager (Data Validator)
Contact information

Appendix 3: Example Sample Identification Table

Appendix 3: Example Sample Identification Table

Client Sample ID	Laboratory Sample ID	Matrix	Validation Stage
FB-BS04-E01-D10.0	2720-1	water	S4VEM
FB-BS04-B01-D10.0	2720-2	water	S2BVE
FB-BS04-B02-D10.0	2720-3	water	S2BVE
FB-SS01-S01-D0.5	2720-4	soil	S2BVEM
FB-BS01-S01-D10.0	2720-5	soil	S3VEM
FB-SS02-S01-D0.5	2720-6	soil	S2BVEM
FB-BS02-S01-D10.0	2720-7	soil	S2BVEM
FB-BS02-D01-D10.0	2720-8	soil	S2BVEM
FB-SS03-S01-D0.5	2720-9	soil	S2BVEM
FB-BS03-S01-D10.0	2720-10	soil	S2BVEM

Appendix 4: Example Data Validation Reports and Checklist

Note: The following are just example validation reports and checklists. They may not comply with your specific project and should not be used as specified (for example, “cut and paste” into your documents). It is expected that each validation group will develop their own validation reports and checklists consistent with project objectives.

EXAMPLE Data Validation Report A

Site Name: Site AXA

Collection Date: March 22, 2012

Report Date: March 29, 2012

Matrix: Water

Parameters: Volatiles

Validation Stage: S4VM

ADR Software Identification: N/A

Laboratory and Report Number/Date: Laboratory B, report (X) on March 25, 2012

Sample Delivery Group (SDG): 1203308

Client Sample ID	Laboratory Sample ID
W	1203308-1
X	1203308-2
Y	1203308-3
Z	1203308-6
Trip Blank	1203308-7

Introduction

This data review covers three water samples, one equipment blank, and one trip blank listed above including dilutions and reanalysis as applicable. The analyses were performed by EPA SW 846 Method 8260B for Volatiles applying DoD QSM requirements.

This review follows the Master Quality Assurance Project Plan for Project A and the DoD General Data Validation Guidelines.

A qualification summary table is provided at the end of this report if data have been qualified.

The following are definitions of the data qualifiers (from the QAPP).

Qualifier	**Definition**
U	The analyte was not detected and is reported as less than the LOD or as defined by the customer. The LOD has been adjusted for any dilution or concentration of the sample.
J	The reported result is an estimated value (e.g., matrix interference was observed, or the analyte was detected at a concentration outside the calibration range).
J+	The result is an estimated quantity, but the result may be biased high.
J-	The result is an estimated quantity, but the result may be biased low.
N	The analysis indicates the presence of an analyte for which there is presumptive evidence to make a "tentative identification."
NJ	The analyte has been "tentatively identified" or "presumptively" as present, and the associated numerical value is the estimated concentration in the sample.
UJ	The analyte was not detected and is reported as less than the LOD or as defined by the customer. However, the associated numerical value is approximate.
X	The sample results (including non-detects) were affected by serious deficiencies in the ability to analyze the sample and to meet published method and project quality control criteria. The presence or absence of the analyte cannot be substantiated by the data provided. Acceptance or rejection of the data should be decided by the project team (which should include a project chemist), but exclusion of the data is recommended.

Note: R (reject) flag not used.

Sample Receipt

All sample receipt documentation was complete and correct. No anomalies were noted.

Holding Time/Preservation

The samples were analyzed within the technical holding times and were properly preserved.

GC/MS Instrument Performance Check

The instrument performance check met frequency and ion abundance requirements.

Initial Calibration

The initial calibration was performed using the correct number of standards at appropriate concentrations.

The percent relative standard deviations (%RSDs) were ≤20% with the following exceptions. The coefficients of determination (r^2) were ≥0.995 for all compounds calibrated using linear regression or quadratic regression.

The %RSD for acetone, bromoform and 2-butanone were 22%. All associated sample results were non-detects and were not qualified.

Continuing Calibration

Percent differences (%Ds) between the initial calibration RRFs and the initial calibration verification (ICV) RRFs were ≤20%.

Continuing calibration verification (CCV) analysis was performed at the correct frequency.

Percent differences (%Ds) between the initial calibration RRFs and the CCV RRFs were ≤20%.

The ICV and CCV RRFs met all QC acceptance criteria.

Blanks

The method blank and trip blank met all QC acceptance criteria with the following exception:

Toluene was detected in the trip blank at a concentration > the limit of detection (LOD) but ≤ the limit of quantification (LOQ). All associated sample results were non-detects and were not qualified.

Surrogate Spikes

Surrogates were added to all field and QC samples. All surrogate percent recoveries were within QC acceptance limits.

Matrix Spike (MS)/Matrix Spike Duplicates (MSD)

The MS and MSD analyses met all QC acceptance criteria for percent recovery and relative percent difference (RPD) with the following exceptions:

The percent recoveries for MS (38%) and MSD (41%) for iodomethane were less than the laboratory lower control limit (70%), but ≥10%. The associated sample results were non-detects and were **qualified UJ**.

Laboratory Control Sample (LCS)

The LCS analysis met all QC acceptance criteria.

Internal Standards

The internal standard areas and retention times were within QC acceptance limits.

Target Compound Identification

All target compound identifications were within validation criteria for relative retention times, characteristic ions, and relative ion abundances.

Limits of Detection (LODs), Limits of Quantification (LOQs) and Reporting Limits (RLs)

All LODs, LOQs and RLs met project decision limits. The LODs for the non-detects and the LOQs for the detects were less than the action levels.

Tentatively Identified Compounds (TICs)

TICs were not reported in this SDG.

Field Duplicates

A field duplicate was not performed for this SDG.

Calculation Checks

The calculations for initial and continuing calibration select sample results for the samples noted above, LCS, MS, MSD, surrogate percent recoveries and RPDs, and confirmation RPDs were checked (10% of samples). No discrepancies were noted.

Overall assessment of Data

The overall assessment of data was acceptable. Data qualifiers are summarized in the following table.

Client Sample ID	Analyte	Qualifier	Qualification Code Reference
W	Iodomethane	UJ	M3
X	Iodomethane	UJ	M3
Y	Iodomethane	UJ	M3
Z	Iodomethane	UJ	M3
Trip Blank	Iodomethane	UJ	M3

Example Data Validation Checklist A

SDG: 1203308	**Laboratory Sample ID: 1203308-1, -2, -3, -6, -7**
Method/Batch Number: 8260/VL120326-3	

<u>Note only Outliers.</u> Tune/Instrument Performance Check:

Frequency:√	**Ion Abundances:√**	

ICAL and Blanks:

Analyte	***ICAL RRF (>0.05)**	**ICAL %RSD (≤20%) or r^2(≥0.990)**	**ICV/CCV Frequency (12 hours)**	***(ICV)/CCV RRF (>0.05)**	**(ICV)/CCV %D (≤20%)**	**Method Blank**	**Trip Blank**	**5X (10X) Blank**
Acetone	√	22	√	√	√	√	√	NA
2-Butanone	√	22	√	√	√	√	√	NA
Bromoform	√	22	√	√	√	√	√	NA
Toluene	√	√	√	√	√	√	3.8	(38)

**Comments/Notes ***see Method for minimum RRFs

Sample	**IS percent recovery (-50 to +100%)**	**IS RT +/-30s from ICAL mid-point**	**Sample**	**IS percent recovery (-50 to +100%)**	**IS RT +/-30s from ICAL mid- point**
√	√	√	√	√	√

Batch QC

Analyte	**LCS %R**	**MS %R**	**MSD %R**	**MS/D or LCS/D RPD**	
Iodomethane	√	62	60	√	

Comments/Notes: LCS/MS/MSD laboratory limits. FD RPD 30% for W, 50% for soils.

Sample	**Surr %R**	**Surr %R**	**Sample**	**Surr %R**	**Sample**	**Surr %R**	**Surr %R**
None.	None.	None.	None.	None.	None.	None.	None.

EXAMPLE DATA VALIDATION REPORT AND CHECKLIST B

8260B VOCs

Laboratory SDG:

Chemist/Verifier:

Associated Batches:

Contractor Program Chemist (CPC):

Date Verified:

Date CPC review:

Client:

Project Title:

Laboratory:

Guidance: DoD Guidelines for Data Review and Validation Version 1

Applicable QAPP:

ADR Software Identification: **Company ADR 2, Version 3**

Sample ID #	Sample Date	Date Lab Received	Date Analysis Run	Methods	Validation Label Code
A	3/3/15	3/4/15	3/7/15	8260B	S3VEM
B	3/3/15	3/4/15	3/7/15	8260B	S3VEM
C	3/3/15	3/4/15	3/7/15	8260B	S3VEM
D	3/3/15	3/4/15	3/7/15	8260B	S3VEM
E	3/3/15	3/4/15	3/7/15	8260B	S3VEM

Note: “Yes/No” answers that indicate a possible data quality issue are shaded. If answer falls in the shaded area, an explanation must be provided below each applicable question box. Also include if any discussion occurred with the project chemist for discussion or concurrence.

Laboratory Case Narrative

Verification Criteria	**Yes**	**No**	**N/A**
Were any DoD QSM deviations noted in the laboratory case narrative?		X	
Were DoD QSM corrective actions followed if deviations were noted?			X
Were any issues noted in the cooler receipt form?		X	

Sample Documentation

Verification Criteria	**Yes**	**No**
Were all samples documented correctly on the chain-of-custody (COC)?	X	
Did samples listed on COCs match the sample labels?	X	
Were samples relinquished properly on the COC?	X	
Were all samples properly preserved?	X	
Were all samples analyzed within the specified holding times?		X

Samples X, Y, and Z were received and analyzed beyond the HT but within 2X the HT. All associated sample results that were detects were qualified J and non-detects were qualified UJ.

Instrument Performance Check (Tuning) ([1] list instrument ID, date and time tune was run.) (Manual / Electronic)

Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was instrument tune check completed prior to calibration?	X	
Was instrument tune check completed every 12 hours during sample analysis?	X	
Were ion relative abundance for each target mass within the required intensities limits listed in the Table of SW-846 8260?	X	
Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was instrument tune check completed prior to calibration?	X	
Was instrument tune check completed every 12 hours during sample analysis?	X	
Were ion relative abundance for each target mass within the required intensities limits listed in the Table of SW-846 8260?	X	
Verification Criteria for instrument_______________[1]	**Yes**	**No**
Was instrument tune check completed prior to calibration?	X	
Was instrument tune check completed every 12 hours during sample analysis?	X	
Were ion relative abundance for each target mass within the required intensities limits listed in the Table of SW-846 8260?	X	

Initial Calibration ([1] list instrument ID, date and time tune was run.)

Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was at least a 5-point calibration completed for all analytes prior to sample analysis?	X	
Was lowest standard at or below the LOQ?	X	
Are the average response factors (RFs) above the minimum response factor? ($\geq$0.30 for SPCCs chlorobenzene and 1,1,2,2- tetrachloroethane, $\geq$0.1 for chloromethane, bromoform, and 1,1- dichloroethane.)	X	

Verification Criteria for instrument__________________[1]	**Yes**	**No**
Are the RSDs for RFs for CCCs % (vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene) ≤30% and one option below?	X	
Option 1: RSD for each analyte ≤ 20%?	X	
Option 2: If linear least squares regression was used, was the r ≥ 0.995?	X	
Option 3: If non-linear regression was used, was the coefficient of determination r^2 ≥0.99?	X	
If non-linear regression was used, were 6 points used for second order and 7 points for third order?	X	
Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was at least a 5-point calibration completed for all analytes prior to sample analysis?	X	
Was lowest standard at or below the LOQ?	X	
Are the average response factors (RFs) above the minimum response factor? (≥0.30 for SPCCs chlorobenzene and 1,1,2,2- tetrachloroethane, ≥0.1 for chloromethane, bromoform, and 1,1- dichloroethane.)	X	
Are the RSDs for RFs for CCCs % (vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene) ≤ 30% and one option below?	X	
Option 1: RSD for each analyte ≤ 20%?	X	
Option 2: If linear least squares regression was used, was the r ≥ 0.995?	X	
Option 3: If non-linear regression was used, was the coefficient of determination r^2 ≥0.99?	X	
If non-linear regression was used, were 6 points used for second order and 7 points for third order?	X	
Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was at least a 5-point calibration completed for all analytes prior to sample analysis?	X	
Was lowest standard at or below the LOQ?	X	

Verification Criteria for instrument__________________[1]	**Yes**	**No**
Are the average response factors (RFs) above the minimum response factor? (≥0.30 for SPCCs chlorobenzene and 1,1,2,2- tetrachloroethane, ≥0.1 for chloromethane, bromoform, and 1,1- dichloroethane.)	X	
Are the RSDs for RFs for CCCs % (vinyl chloride, 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, and ethylbenzene) ≤ 30% and one option below?	X	
Option 1: RSD for each analyte ≤ 20%?	X	
Option 2: If linear least squares regression was used, was the r ≥ 0.995?	X	
Option 3: If non-linear regression was used, was the coefficient of determination $r^2 \geq 0.99$?	X	
If non-linear regression was used, were 6 points used for second order and 7 points for third order?	X	

Initial Calibration Verification [(ICV) Second Source] ([1] list instrument ID, date and time tune was run.)

Verification Criteria for instrument_________________[1]	**Yes**	**No**
Was the ICV confirmed as a second source and analyzed after each calibration?	X	
Was the ICV %difference (%D) for all analytes within ±20% of the expected value (initial source)?	X	
Verification Criteria for instrument_________________[1]	**Yes**	**No**
Was the ICV confirmed as a second source and analyzed after each calibration?	X	
Was the ICV %difference (%D) for all analytes within ±20% of the expected value (initial source)?	X	
Verification Criteria for instrument_________________[1]	**Yes**	**No**
Was the ICV confirmed as a second source and analyzed after each calibration?	X	
Was the ICV %difference (%D) for all analytes within ±20% of the expected value (initial source)?	X	

Continuing Calibration Verification (CCV) (^{1} list instrument ID, date and time tune was run.)

Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was the CCV analyzed daily before sample analysis?	X	
Was the CCV analyzed every 12 hours of analysis time and following the last sample?	X	
Are the average response factors (RFs) above the minimum response factor? (VOCs -$\geq$0.30 for SPCCs chlorobenzene and 1,1,2,2- tetrachloroethane, $\geq$0.1 for chloromethane, bromoform, and 1,1- dichloroethane).	X	
Was the CCV %difference (%D) or %Drift for VOCs within $\pm$20% and ±50% for the ending CCV?	X	
Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was the CCV analyzed daily before sample analysis?	X	
Was the CCV analyzed every 12 hours of analysis time and following the last sample?	X	
Are the average response factors (RFs) above the minimum response factor? (VOCs -$\geq$0.30 for SPCCs chlorobenzene and 1,1,2,2- tetrachloroethane, $\geq$0.1 for chloromethane, bromoform, and 1,1-dichloroethane).	X	
Was the CCV %difference (%D) or %Drift for VOCs within $\pm$20% and ±50% for the ending CCV?	X	
Verification Criteria for instrument__________________[1]	**Yes**	**No**
Was the CCV analyzed daily before sample analysis?	X	
Was the CCV analyzed every 12 hours of analysis time and following the last sample?	X	
Are the average response factors (RFs) above the minimum response factor? (VOCs -$\geq$0.30 for SPCCs chlorobenzene and 1,1,2,2- tetrachloroethane, $\geq$0.1 for chloromethane, bromoform, and 1,1- dichloroethane).	X	
Was the CCV %difference (%D) or %Drift for VOCs within $\pm$20% and ±50% for the ending CCV?	X	

Internal Standard (IS) Recoveries

Verification Criteria (Applied to each batch and each instrument)	Yes	No
Were internal standards reported for all samples and standards?	X	
Were internal standard areas within -50% to + 100% of the ICAL midpoint standard area (or daily CCV)?	X	
Were retention time ± 30 seconds (or ±10 seconds for QSM requirements) from the retention time of the midpoint standard of the ICAL (or daily CCV)?	X	

Method Blank

Verification Criteria	Yes	No
Was one method blank run per method batch?	X	
No analytes were detected > 1/2 the LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit or common lab contaminants (methylene chloride, 2-butanone, and acetone) were < the LOQ?	X	
Did blank results affect sample results?	X	

LCS

Verification Criteria	Yes	No
Was a complete target analyte list of LCS including surrogates reported?	X	
Was one LCS run per preparatory batch?	X	
Were all percent recoveries within limits specified in the QAPP?	X	

Matrix Spike and Matrix Spike Duplicate

Verification Criteria	Yes	No
Was one MS and MSD run per preparatory batch per matrix?	X	

Verification Criteria	Yes	No
Were all MS percent recoveries within LCS control limits and also within project specified limits?	X	
Was the RPD between MS and MSD ≤20%?	X	

Surrogates

Verification Criteria	Yes	No
Were surrogates added to all field and QC samples?	X	
Were surrogate recoveries within the laboratory or project specified control limits?	X	

Field QC

Verification Criteria	Yes	No
Was a trip blank shipped with and analyzed with the samples in this SDG?	X	
Was the trip blank clean (No analytes were detected > 1/2 the LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit or common lab contaminants (methylene chloride, 2-butanone, and acetone) were < the LOQ)?	X	
Did blank results affect sample results?	X	
Were other field blanks collected and analyzed with the samples in this SDG?	X	
If so, were they clean (no analytes were detected > 1/2 the LOQ or > 1/10 the amount measured in any sample or 1/10 the regulatory limit or common lab contaminants (methylene chloride, 2-butanone, and acetone) were < the LOQ)?	X	
Did field blank results affect sample results?	X	
Were field duplicates or triplicates analyzed with the samples in this SDG?	X	
If so, did the duplicate (or triplicate) results meet QC acceptance criteria specified by the project (QAPP)?	X	

Sensitivity

Verification Criteria	Yes	No	N/A
Was the laboratory sensitivity consistent with project (QAPP) requirements?	X		
Did all analytes meet sensitivity requirements?	X		

Samples that have quantitation limits that do not meet QAPP requirements, based on dilutions, are listed in the table below.

Field ID	Parameter	Dilution
N/A	N/A	N/A

Target Compound Identification

Verification Criteria	Yes	No	N/A
Were the RRTs for detected compounds within 0.06 RRT units of the daily CCV?	X		
Do the relative intensities of the characteristic ions agree within ±30% of the relative intensities in the reference spectrum?	X		

Tentatively Identified Compounds

Verification Criteria	Yes	No	N/A
Were TICS requested with this SDG?	X		
Were the major ions present in the reference spectrum also present in the sample spectrum?	X		
Did the relative intensities of the major ions in the sample spectrum agree within ±20% of the reference spectrum?	X		

Additional Qualifications

Were additional qualifications applied or professional judgment used?

Field ID	Analyte	New RL	Qualification
None.	None.	None.	None.

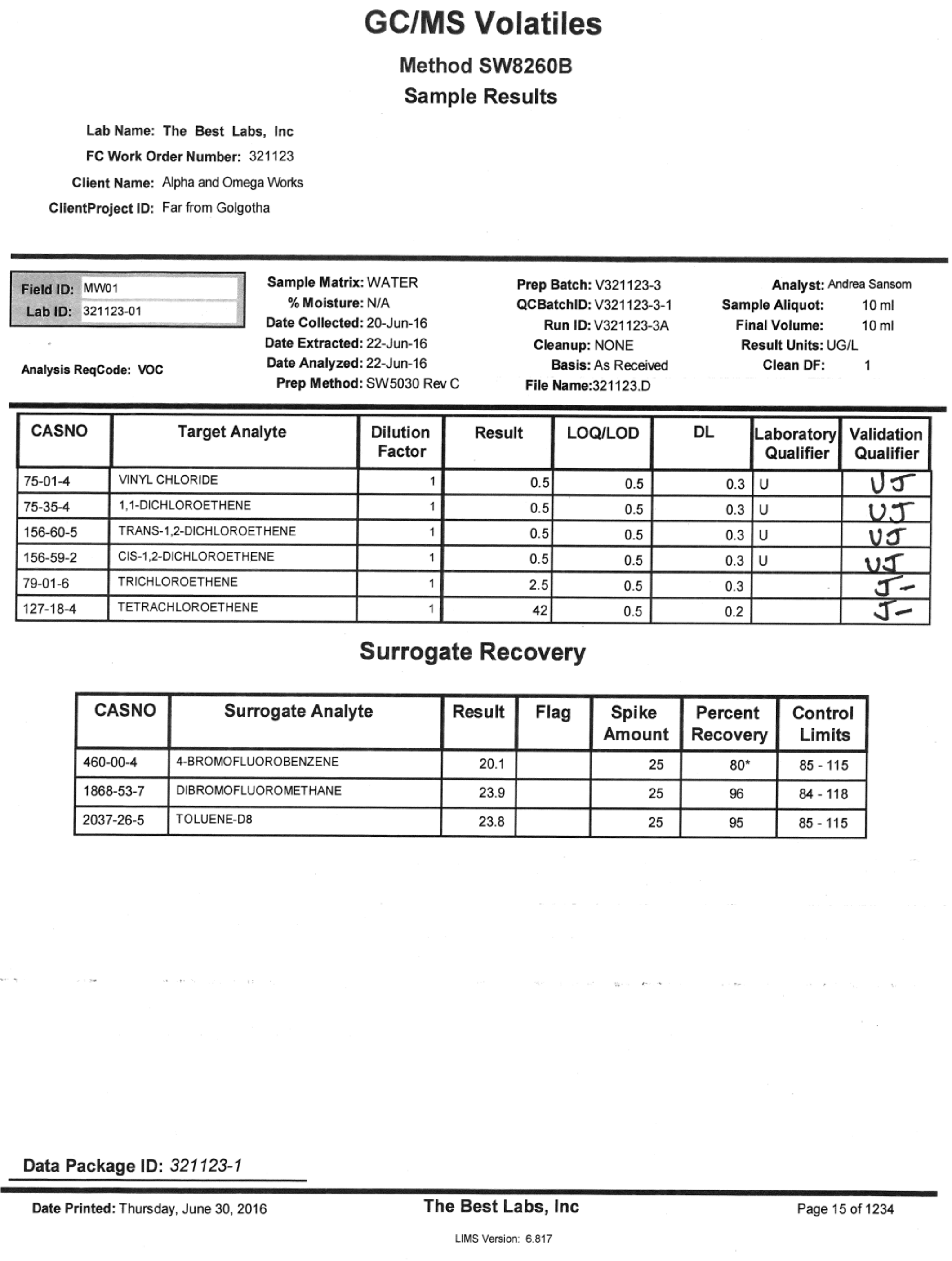
Completeness

Verification Criteria	Yes	No	N/A
Were any data X qualified during the verification process?		X	
Were any samples lost, broken, or in any other manner in not verified?		X	
Were all requested sample analyses requested performed, the correct analyte lists used and correct sample preparation and analyses methods and units utilized?	X		

EXAMPLE C: EXAMPLE AUTOMATED DATA REVIEW CHECKLIST

Data Review QC	Checklist Item	Checklist Item	Yes	No	NA	Comment
2B	1	Did chain of custody information agree with the laboratory report?				
2B	2	Were samples preserved properly and received in good condition?				
2B	3	Were holding times met?				
2B	4	Were all requested target analytes reported?				
2B	5	Was the initial calibration within acceptance criteria?				
2B	6	Were CCVs at the proper frequency and within acceptance criteria?				
2B	7	Was a method blank prepared and analyzed for each batch?				
2B	8	Were target analytes in the method blank less than the LOD?				
2B	9	Were target analytes in the field blank less than the LOD?				
2B	10	Were LCS/LCSD recoveries within project specified limits?				
2B	11	Were MS/MSD recoveries within project specified limits?				
2B	12	Were MS/MSD RPDs within project specified limits?				
2B	13	Were surrogate recoveries within project specified limits?				
2B	14	Did any field duplicates meet the required RPD for the project?				
2B	15	Were project required laboratory PQLs achieved?				
2B	16	Have all Case Narrative findings been addressed?				

Appendix 5: Example Annotated Laboratory Data Sheet



GC/MS Volatiles

Method SW8260B

Sample Results

Lab Name: **The Best Labs, Inc**
FC Work Order Number: 321123
Client Name: Alpha and Omega Works
ClientProject ID: Far from Golgotha

Field ID: MW01	**Sample Matrix:** WATER	**Prep Batch:** V321123-3	**Analyst:** Andrea Sansom
Lab ID: 321123-01	**% Moisture:** N/A	**QCBatchID:** V321123-3-1	**Sample Aliquot:** 10 ml
	Date Collected: 20-Jun-16	**Run ID:** V321123-3A	**Final Volume:** 10 ml
	Date Extracted: 22-Jun-16	**Cleanup:** NONE	**Result Units:** UG/L
Analysis ReqCode: VOC	**Date Analyzed:** 22-Jun-16	**Basis:** As Received	**Clean DF:** 1
	Prep Method: SW5030 Rev C	**File Name:** 321123.D	

CASNO	Target Analyte	Dilution Factor	Result	LOQ/LOD	DL	Laboratory Qualifier	Validation Qualifier
75-01-4	VINYL CHLORIDE	1	0.5	0.5	0.3	U	UJ
75-35-4	1,1-DICHLOROETHENE	1	0.5	0.5	0.3	U	UJ
156-60-5	TRANS-1,2-DICHLOROETHENE	1	0.5	0.5	0.3	U	UJ
156-59-2	CIS-1,2-DICHLOROETHENE	1	0.5	0.5	0.3	U	UJ
79-01-6	TRICHLOROETHENE	1	2.5	0.5	0.3		J-
127-18-4	TETRACHLOROETHENE	1	42	0.5	0.2		J-

Surrogate Recovery

CASNO	Surrogate Analyte	Result	Flag	Spike Amount	Percent Recovery	Control Limits
460-00-4	4-BROMOFLUOROBENZENE	20.1		25	80*	85 - 115
1868-53-7	DIBROMOFLUOROMETHANE	23.9		25	96	84 - 118
2037-26-5	TOLUENE-D8	23.8		25	95	85 - 115

Data Package ID: *321123-1*

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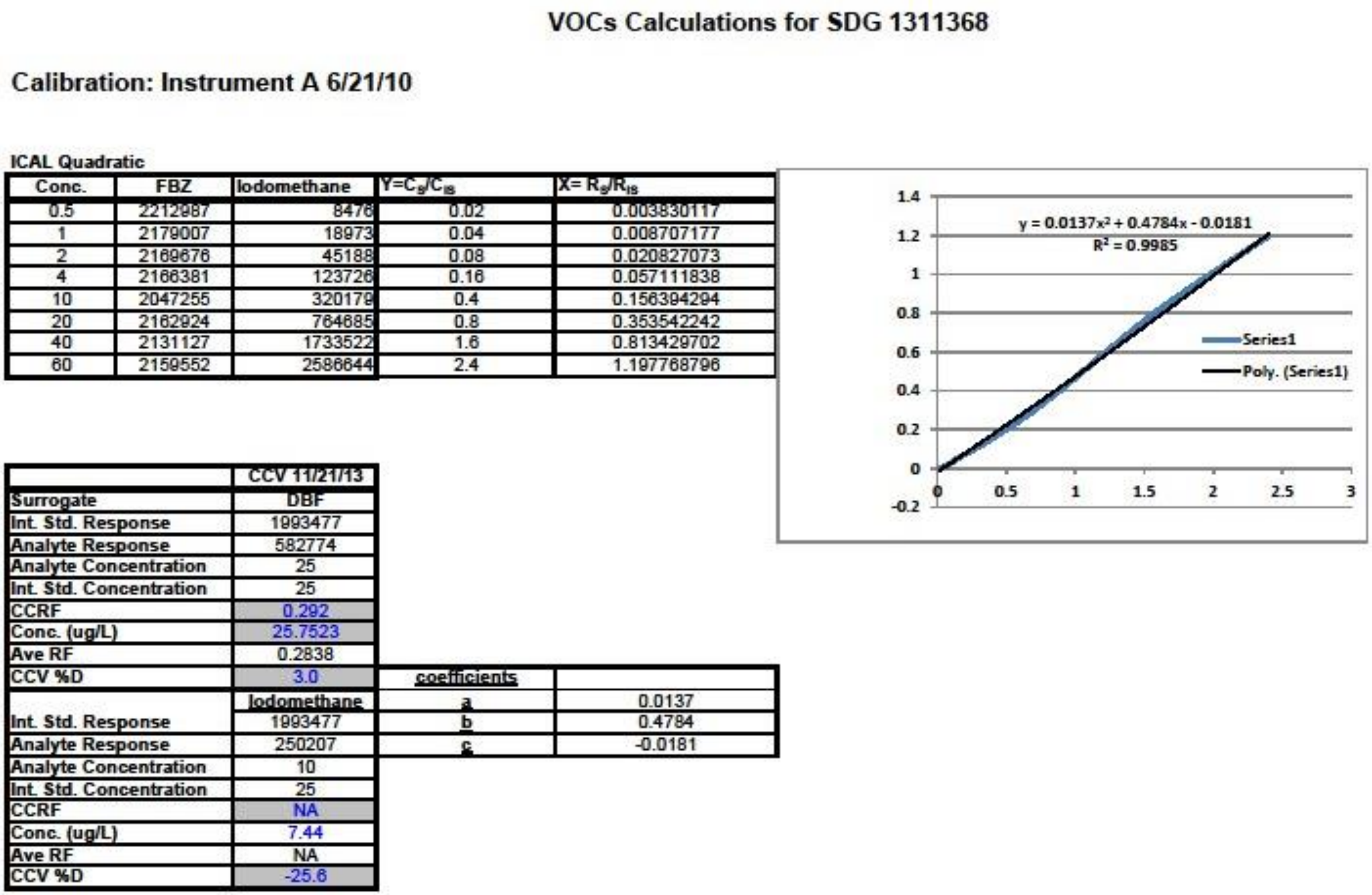
The Best Labs, Inc
Page 15 of 1234
LIMS Version: 6.817

Appendix 6: Example Stage 3 Calculation Spreadsheet

Example



VOCs Calculations for SDG 1311368

Calibration: Instrument A 6/21/10

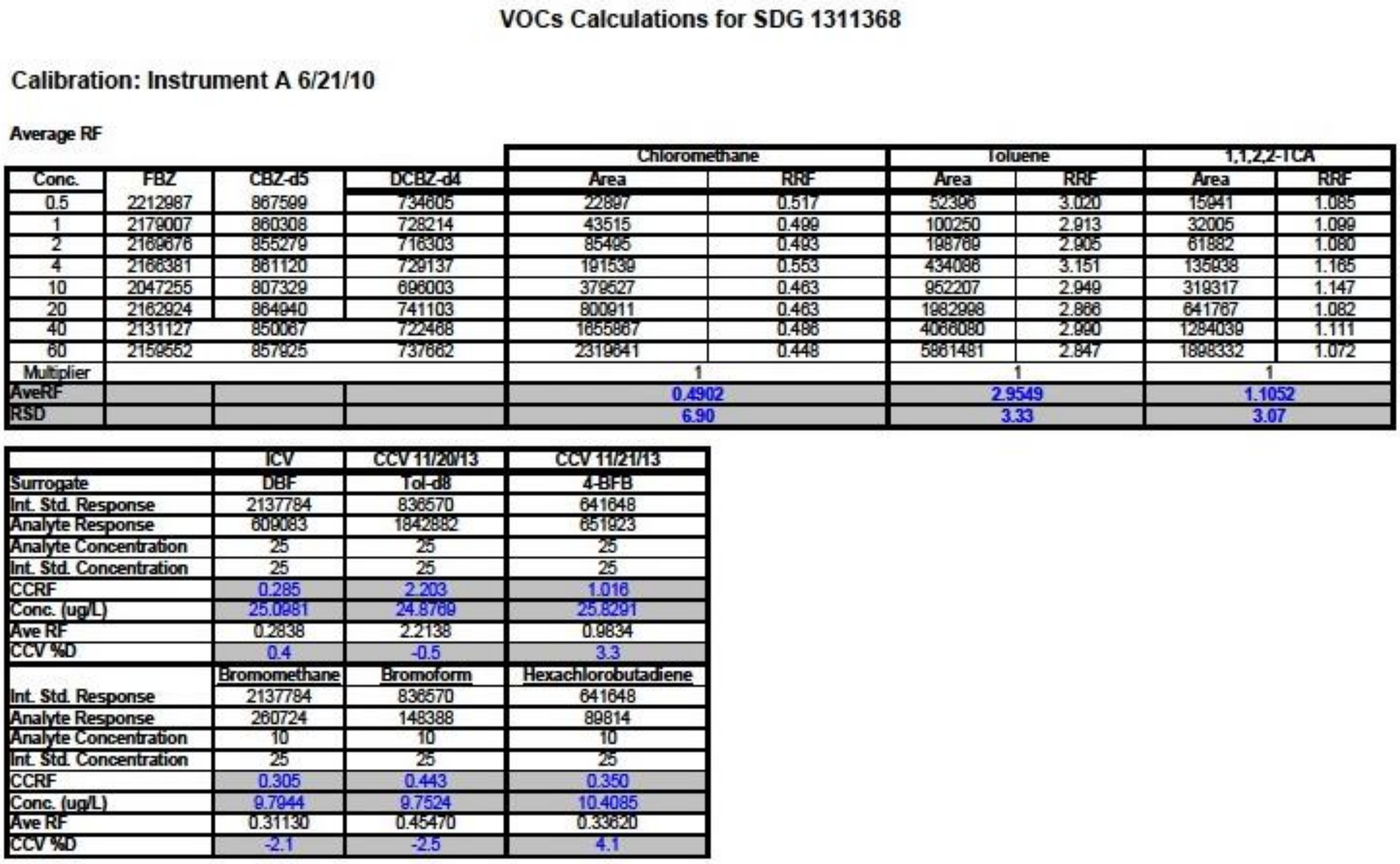
ICAL Quadratic

Conc.	FBZ	Iodomethane	$Y=C_s/C_{IS}$	$X=R_s/R_{IS}$
0.5	2212987	8476	0.02	0.003830117
1	2179007	18973	0.04	0.008707177
2	2169676	45188	0.08	0.020827073
4	2166381	123726	0.16	0.057111838
10	2047255	320179	0.4	0.156394294
20	2162924	764685	0.8	0.353542242
40	2131127	1733522	1.6	0.813429702
60	2159552	2586644	2.4	1.197768796

	CCV 11/21/13
Surrogate	**DBF**
Int. Std. Response	1993477
Analyte Response	582774
Analyte Concentration	25
Int. Std. Concentration	25
CCRF	0.292
Conc. (ug/L)	25.7523
Ave RF	0.2838
CCV %D	3.0
	Iodomethane
Int. Std. Response	1993477
Analyte Response	250207
Analyte Concentration	10
Int. Std. Concentration	25
CCRF	NA
Conc. (ug/L)	7.44
Ave RF	NA
CCV %D	-25.6

coefficients	
a	0.0137
b	0.4784
c	-0.0181

Example



VOCs Calculations for SDG 1311368

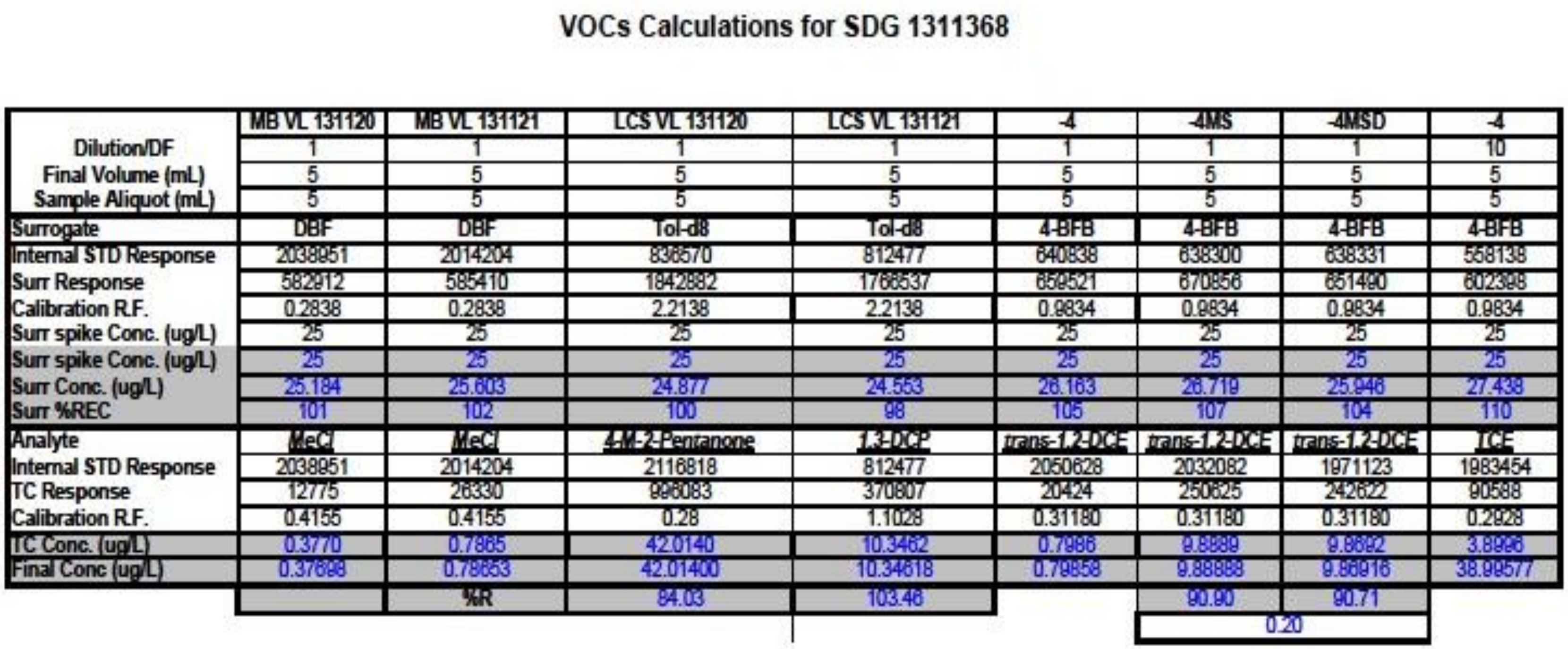
Calibration: Instrument A 6/21/10

Average RF

				Chloromethane		Toluene		1,1,2,2-TCA	
Conc.	FBZ	CBZ-d5	DCBZ-d4	Area	RRF	Area	RRF	Area	RRF
0.5	2212987	867599	734605	22897	0.517	52396	3.020	15941	1.085
1	2179007	860308	728214	43515	0.499	100250	2.913	32005	1.099
2	2169676	855279	716303	85495	0.493	198769	2.905	61882	1.080
4	2166381	861120	729137	191539	0.553	434086	3.151	135938	1.165
10	2047255	807329	696003	379527	0.463	952207	2.949	319317	1.147
20	2162924	864940	741103	800911	0.463	1982998	2.866	641767	1.082
40	2131127	850067	722468	1655867	0.486	4066080	2.990	1284039	1.111
60	2159552	857925	737662	2319641	0.448	5861481	2.847	1898332	1.072
Multiplier				1		1		1	
AveRF				0.4902		2.9549		1.1052	
RSD				6.90		3.33		3.07	

	ICV	CCV 11/20/13	CCV 11/21/13
Surrogate	DBF	Tol-d8	4-BFB
Int. Std. Response	2137784	836570	641648
Analyte Response	609083	1842882	651923
Analyte Concentration	25	25	25
Int. Std. Concentration	25	25	25
CCRF	0.285	2.203	1.016
Conc. (ug/L)	25.0981	24.8769	25.8291
Ave RF	0.2838	2.2138	0.9834
CCV %D	0.4	-0.5	3.3
	Bromomethane	Bromoform	Hexachlorobutadiene
Int. Std. Response	2137784	836570	641648
Analyte Response	260724	148388	89814
Analyte Concentration	10	10	10
Int. Std. Concentration	25	25	25
CCRF	0.305	0.443	0.350
Conc. (ug/L)	9.7944	9.7524	10.4085
Ave RF	0.31130	0.45470	0.33620
CCV %D	-2.1	-2.5	4.1

Example



VOCs Calculations for SDG 1311368

	MB VL 131120	MB VL 131121	LCS VL 131120	LCS VL 131121	-4	-4MS	-4MSD	-4
Dilution/DF	1	1	1	1	1	1	1	10
Final Volume (mL)	5	5	5	5	5	5	5	5
Sample Aliquot (mL)	5	5	5	5	5	5	5	5
Surrogate	DBF	DBF	Tol-d8	Tol-d8	4-BFB	4-BFB	4-BFB	4-BFB
Internal STD Response	2038951	2014204	836570	812477	640838	638300	638331	558138
Surr Response	582912	585410	1842882	1766537	659521	670856	651490	602398
Calibration R.F.	0.2838	0.2838	2.2138	2.2138	0.9834	0.9834	0.9834	0.9834
Surr spike Conc. (ug/L)	25	25	25	25	25	25	25	25
Surr spike Conc. (ug/L)	25	25	25	25	25	25	25	25
Surr Conc. (ug/L)	25.184	25.603	24.877	24.553	26.163	26.719	25.946	27.438
Surr %REC	101	102	100	98	105	107	104	110
Analyte	*MeCl*	*MeCl*	*4-M-2-Pentanone*	*1,3-DCP*	*trans-1,2-DCE*	*trans-1,2-DCE*	*trans-1,2-DCE*	*TCE*
Internal STD Response	2038951	2014204	2116818	812477	2050628	2032082	1971123	1983454
TC Response	12775	26330	996083	370807	20424	250625	242622	90588
Calibration R.F.	0.4155	0.4155	0.28	1.1028	0.31180	0.31180	0.31180	0.2928
TC Conc. (ug/L)	0.3770	0.7865	42.0140	10.3462	0.7986	9.8889	9.8692	3.8996
Final Conc (ug/L)	0.37698	0.78653	42.01400	10.34618	0.79858	9.88888	9.86916	38.99577
		%R	84.03	103.46		90.90	90.71	
						0.20		

Appendix 7: Example Qualification Code Reference Table

Example Qualification Code Reference Table

Explanation of Infraction	**Reason Code**
Chemical Preservation Infraction	P1
Temperature Infraction	T1
Holding Time Infraction, Sampling to Analysis	H1
Holding Time infraction, Sampling to Extraction	H2
Holding Time Infraction, Extraction to Analysis	H3
Performance Evaluation Sample/Tune Infraction	P2
Resolution Check Infraction	R1
Initial Calibration Frequency Infraction	I1
Initial Calibration- Insufficient Number of Standards	I2
Initial Calibration RRF Infraction	I3
Initial Calibration %RSD, r or r^2 Value Infraction	I4
ICV/CCV Frequency Infraction	C1
ICV/CCV RRF Infraction	C2
ICV/CCV Infraction with High Bias	C3
ICV/CCV Infraction with Low Bias	C4
ICB/CCB Frequency Infraction	B1
ICB/CCB Infraction (Qualified Detect)	B2
ICS Frequency Infraction	I5
ICS A Infraction (Qualified Detect)	I6
ICS AB Infraction with High Bias	I7
ICS AB Infraction with Low Bias	I8
Internal Standard Infraction with High Bias	I9
Internal Standard Infraction with Low Bias	I10
Internal Standard RT Infraction	I11
Required Sample Cleanup not Performed	R2
Method Blank Frequency Infraction	B3
Method Blank Infraction (Qualified Detect)	B4
LCS Frequency Infraction	L1
LCS percent recovery Infraction with High Bias	L2
LCS percent recovery Infraction with Low Bias	L3
LCS/LCSD Duplicate precision infraction	L4
MS/MSD Frequency Infraction	M1
MS/MSD percent recovery Infraction with High Bias	M2

Explanation of Infraction	**Reason Code**
MS/MSD percent recovery Infraction with Low Bias	M3
MS/MSD or Duplicate Precision Infraction	M4
Post Digestion Spike infraction	M5
Surrogate percent recovery Infraction with High Bias	S1
Surrogate percent recovery Infraction with Low Bias	S2
Serial Dilution Infraction	S3
Confirmation Analysis not Performed	C5
Confirmation Precision Infraction	C6
Sample RT or RRT Infraction	R3
Spectral Match Infraction	S4
Ion Mass Ratio Criteria Infraction	I12
Result Exceeds Calibration Range	R4
Storage Blank Infraction (Qualified Detect)	B5
Trip Blank Infraction (Qualified Detect)	B6
Field Blank Infraction (Qualified Detect)	B7
Equipment Blank Infraction (Qualified Detect)	B8
Field Duplicate Precision Infraction	D1
Reporting Limit Exceeds Action Level	R5
Professional Judgment (include references to support basis of decision)	P3

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UNITED STATES DEPARTMENT OF DEFENSE

Data Validation Guidelines Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by QSM Table B-15

Environmental Data Quality Workgroup

05/01/2020

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

Data Validation Guidelines
Module 3

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Brian Jordan Date
Army Principal

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Date: 2020.05.07 06:26:52 -05'00'

John Gillette, Ph.D. Date
Air Force Principal

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Date: 2020.05.07 09:57:50 -04'00'

Jordan Adelson, Ph.D. Date
Navy Principal, EDQW Chair

TABLE OF CONTENTS

1.0 Purpose 1
2.0 Procedure 1
  2.1 Introduction 1
  2.2 Deliverables 1
  2.3 Validation Stages 2
3.0 Stage 1 Validation 3
  3.1 Sample Results 3
  3.2 Chain of Custody (CoC) 5
  3.3 Field QC 7
4.0 Stage 2A Validation 10
  4.1 Ion Ratio 11
  4.2 Extracted Internal Standard (EIS) Recovery 11
  4.3 Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD) 13
  4.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD) 14
  4.5 Post Spike Sample 15
  4.6 Method Blanks 16
  4.7 Sample Dilution and Reanalysis 17
5.0 Stage 2B Validation 18
  5.1 Sequence and Preparation Logs 18
  5.2 Instrument Performance Checks 19
  5.3 Initial Calibration 19
  5.4 Initial (Secondary Source), Continuing Calibration Verification, and Instrument Sensitivity Check 23
  5.5 Instrument Blanks 24
6.0 Stage 3 Validation 24
  6.1 Samples and Field QC 25
  6.2 Method QC 26
  6.3 Instrument QC 27
  6.4 Standards Traceability 28
  6.5 Detection/Quantitation Limit Studies (Optional) 29
7.0 Stage 4 Validation 30
  7.1 Target Compound Identification 30
  7.2 Manual Integrations 31
Appendix A: Method QC Tables 33
Appendix B: Formulas used in Stages 3 and 4 Data Validation 39

Module 3: Data Validation Procedure for Per- and Polyfluoroalkyl Substances Analysis by Quality Systems Manual for Environmental Laboratories (QSM) Table B-15

1.0 Purpose

This document provides guidance on the validation of data generated by Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS) analysis for per- and polyfluoroalkyl substances (PFAS) compliant with DoD Quality Systems Manual (DoD QSM) Table B-15 criteria in solid, biota, AFFF, and non-drinking water matrices. The objective of this procedure is to provide the end user with a clear understanding of the quality and limitations of the data through documented validation procedures and to encourage consistency in the validation technique and reporting of data generated for Department of Defense (DoD) projects for PFAS when analyzed on LC/MS/MS.

Project-specific requirements as identified in the Quality Assurance Project Plan (QAPP) (also called Sampling and Analysis Plan (SAP)) should always supersede the requirements of this document.

This document assumes the user is familiar with data validation conventions and qualifiers used in the *DoD General Data Validation Guidelines (2019).* This document is also not intended to obviate the need for professional judgment during the validation process.

This document references the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) Optimized Worksheets (March 2012)*. Other QAPP formats are equally acceptable.

2.0 Procedure

2.1 Introduction

This document was written with primary consideration to Version 5.3 of Table B-15 in the DoD Quality Systems Manual (QSM). Actual validation should proceed using the acceptance criteria for the DoD QSM version specified in the laboratory data deliverable or in the QAPP. Appendix A summarizes the quality control (QC) checks and the required frequency and acceptance criteria for DoD QSM Version 5.3 requirements. This guidance can be applied to PFAS data generated in support of DoD projects that was produced by LC/MS/MS. This guidance should be implemented by personnel familiar with the methodology contained herein.

Data validation personnel are responsible for implementing this procedure for validation of data and generation of data validation reports for LC/MS/MS PFAS contaminant data.

2.2 Deliverables

Laboratory data deliverables consist of a combination of forms and raw data. The manner in which laboratories label their forms is not dictated nor specified. **The labeling convention below is used for simplicity.**

- Cover Sheet
- Table of Contents
- Case Narrative
- Sample Receipt and Conditions Summary
- Sample Results Summary
- Transition Ion Summary
- Sample Transition Ion Ratio Summary
- Extracted Internal Standard Recovery and Retention Time Summary
- Laboratory Control Sample/Laboratory Control Sample Duplicate Recovery and Relative Percent Difference Summary
- Matrix Spike/Matrix Spike Duplicate Recovery and Relative Percent Difference Summary
- Post Spike Recovery Summary
- Method Blank Summary
- Sample Dilution and Reanalysis Summary
- Sequence and Preparation Logs
- Instrument Performance Check Summary (mass calibration verification)
- Initial Calibration Summary
- Initial/Continuing Calibration Verifications and Instrument Sensitivity Check Summary
- Instrument Blank Summary
- Manufacturer provided Certificate of Analysis for Standards
- Raw Data- including quantitative and confirmation transition ion chromatograms, peak areas, and ion ratios

2.3 Validation Stages

The types of laboratory data deliverables, staged data validation, and the relationship between the two are outlined in the *DoD General Data Validation Guidelines*.

Stage 1 data validation consists of a review of sample results forms, associated sample receipt summaries (chain of custody), and field QC data.

Stages 2A and **2B** data validation consist of review of summary forms only.

Stages 3 and **4** data validation require review of both summary forms and all associated raw data.

Both the laboratory deliverable and the stage of validation should be specified in the QAPP or other planning documents. Data review guidelines and how they apply to the different validation stages are indicated in the following sections.

Note: Any required stage of validation that reveals significant deviations from project requirements will require a higher stage of validation to uncover the source. Data validators are encouraged to communicate with their points of contact identified in the project QAPP (such as the UFP-QAPP Worksheet #6) to resolve discrepancies.

3.0 Stage 1 Validation

The following documents should be reviewed for representativeness (compliance with required analytical protocols outlined in the QAPP), completeness, and project sensitivity needs:

- Cover Sheet
- Table of Contents
- Case Narrative
- Sample Results form or equivalent Laboratory Report
- Transition Ion Summary
- Chain of Custody (CoC) forms, Laboratory Receipt Checklists, and other supporting records
- Field QC forms and supporting records

Stage 1 is the validation of investigative and field QC samples**.**

3.1 Sample Results

Examine the Laboratory Report sample results and verify the following information, ensuring that:

- Holding times have been met, as applicable
- All project target analytes have been analyzed and are reported
- All ion transitions used for quantitation and confirmation are identified
- All project target analytes whose quantitation includes branched and linear isomers are identified
- All sample identification labels are unique, and match the chain of custody
- All laboratory reported Detection Limits (DLs), Limits of Detection (LODs), and Limits of Quantitation (LOQs) are equal to or less than QAPP required DLs/LODs/LOQs
- All project required LODs have been met and are lower than the LOQs
- All reported units (e.g., µg/L) are accurate and reflect the requirements of the project and that units are consistent with the type of sample matrix
- All required field QC samples (such as equipment blanks, reagent blanks, and field duplicates) have been included in the Laboratory Report at the frequency specified in the QAPP
- Soil samples have been reported on a dry weight basis, unless specified by the QAPP to report on a wet weight basis
- Each laboratory report has a case narrative that explains all non-conformities with the data

For sample results (assuming no other qualifications due to data quality issues):

Qualification of data is based upon the reporting requirements of the project QAPP.

If the project QAPP changes reporting requirements from that specified in the QSM by reporting data down to the DL, then any detects between the DL and LOQ are qualified as estimated **J.** Values below the DL are considered non-detects and are qualified as **U** at the stated DL.

If the project QAPP changes reporting requirements from that specified in the QSM by reporting data down to the LOD, then any detects between the LOD and below the LOQ are qualified as estimated **J**. Values below the LOD are considered non-detects and are qualified as **U** at the stated LOD.

If the project QAPP changes reporting requirements from that specified in the QSM by reporting data down to the LOQ, then any detects below the LOQ are considered non-detects and are qualified as **U** at the stated LOQ.

Evaluation of the Laboratory Report

Any samples received for analysis that were not analyzed should be noted in the data validation report, along with the reason(s) for failure to analyze the samples, if the reason(s) can be determined; conversely, samples that were analyzed by LC/MS/MS but were not requested should also be noted.

Analytes that have project action levels less than the laboratory's LOQ should be noted in the data validation report as there is greater uncertainty at values less than the LOQ. Errors in reported units and case narrative non-conformities that call into question the quality of the data should also be discussed in the data validation report.

Errors in quantitation limits or missing and misidentified samples may require a higher than Stage 1 validation. Data validators are encouraged to reach out to their point of contact identified in the project QAPP (such as the UFP-QAPP Worksheet #6) and communicate issues when preparing the data validation report.

A minimum of two ion transitions (precursor to quantitative ion and precursor to confirmation ion) should be used for identification of target analytes, when possible. In some cases, such as perfluorobutanoic acid (PFBA),perfluoropentanoic acid (PFPeA), N-methylperfluorooctanesulfonamidoethanol (NMeFOSE), and N-ethylperfluorooctanesulfonamidoethanol (NEtFOSE) only one ion transition is possible. In cases where the DoD QSM has specified a particular ion transition to be used for quantitation (Table I), that ion transition should be the one identified for quantitative purposes. When evaluating the Sample Transition Ion Summary, if the DoD QSM specified ion transitions are not used for quantitation, the technical justification provided in the case narrative should be reviewed. If a technical justification is not provided or the explanation provided does not provide a technical justification for the change, use professional judgment to qualify the data and all affected results must be noted in the data validation report.

Table I: DoD QSM Specified Quantitative Ion Transitions

PFAS Name	CASRN	Transition
Perfluorooctanoic acid (PFOA)	335-67-1	413 → 369
Perfluorooctanesulfonic acid (PFOS)	1763-23-1	499 → 80
Perfluorohexanesulfonic acid (PFHxS)	355-46-4	399 → 80
Perfluorobutanesulfonic acid (PFBS)	375-73-5	299 → 80
1H,1H, 2H, 2H-Perfluorohexane sulfonic acid (4:2 FTS)	757124-72-4	327 → 307
1H,1H, 2H, 2H-Perfluorooctane sulfonic acid (6:2 FTS)	27619-97-2	427 → 407
1H,1H, 2H, 2H-Perfluorodecane sulfonic acid (8:2 FTS)	39108-34-4	527 → 507
N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)	2991-50-6	584 → 419
N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)	2355-31-9	570 → 419

3.2 Chain of Custody (CoC)

Examine the CoC form (some information may be included on Laboratory Receipt Checklists) for legibility and check that all PFAS by LC/MS/MS analyses requested on the CoC have been performed by the laboratory. Ensure that the CoC sample identification on the Laboratory Sample Results form matches the sample identification on the CoC. Ensure the CoC was signed and dated during transfers of custody. Read the laboratory case narrative for additional information.

Evaluation of the CoC

Any discrepancies in sample naming between the CoC and sample results form should be noted in the data validation report with the correct sample name being identified in the report and on the appropriate summary form, if the correct sample name can be determined. These edit corrections should also be verified in any associated electronic data deliverables (EDDs).

If the receiving laboratory transferred the samples to another laboratory for analysis, both the original CoC and transfer CoC should be present. Document in the data validation report if the transfer CoC is not present or if there is missing information (such as location of the laboratory). Make note in the data validation report when signatures of relinquish and receipt of custody were not present.

3.2.1 Sample Preservation, Handling, and Transport

Evaluate sample handling, transport, and laboratory receipt from the CoC and laboratory receipt checklists to ensure that the samples have been properly handled. The project quality assurance project plan (such as UFP-QAPP Worksheet #19) should provide specific preservation requirements. The following are general guidance if project specifications were not stipulated.

- Aqueous, solid, and aqueous film forming foam (AFFF) samples are to be shipped in HDPE containers with an unlined cap
- Samples are shipped in coolers that are maintained at the temperature required by the QAPP

Evaluation of Preservation, Handling, and Transport

If the temperature of receipt is greater than that required by the QAPP, detects should be flagged as estimated **J** and non-detects as estimated **UJ**.

On occasion, the samples may be delivered to the laboratory within a few hours of collection and before the temperature of the cooler can reach the required temperature. For those instances, if cooling has begun, but the temperature is greater than the required temperature, special note should be made but no qualification should be required.

If the temperature of receipt is below that required by the QAPP, special note should be made but no qualification should be required.

If a temperature non-conformance occurs as well as a holding time non-conformance (see next section), apply professional judgment to qualify the sample results.

In the event that both a cooler temperature and a temperature blank were measured, the temperature blank should be evaluated for temperature compliance as it best assimilates the condition of the samples; however, both temperatures shall be noted in the data validation report.

If the temperature upon receipt at the laboratory was not recorded, note this in the data validation report and assume that a temperature non-conformance occurred. Detects should be flagged as estimated **J** and non-detects as estimated **UJ**. Review any log-in check sheets for indication that the samples were at least received on ice and note in the data validation report. If the receiving laboratory transferred the samples to another laboratory for analysis, apply the same temperature criteria to both laboratories.

3.2.2 Holding Times

Holding times for PFAS are measured from the time of collection (as shown on the CoC) to the time of sample extraction and analysis (as shown on the sample results form or extraction log). Based on input from the DoD Environmental Data Quality Workgroup (EDQW), holding time exceedances are calculated as follows:

Total holding time is based on the time frame (i.e., hours, days, or months) of the requirement. The following example gives guidance on how hold time exceedances are measured:

For a test with a recommended maximum holding time measured in **days**, the holding time is tracked by the **day**.

- An exceedance of holding time for a sample with a 14-day holding time will occur when the 15th day is reached. Therefore, a sample with a 14-day holding time collected at 8:30 AM on April 4th must be analyzed or extracted before 12:00 AM April 19th (midnight, the start of the 15th day), or an exceedance has occurred.

The QAPP should specify the holding time requirements.

Evaluation of Holding Times

If the holding time is exceeded, qualify all associated detects as estimated **J** and all associated non-detects as estimated **UJ** and document that holding times were exceeded.

3.3 Field QC

Field QC can consist of various blanks, field duplicates, and field replicates. The purpose of blanks is to identify potential cross-contamination at different stages of sampling and cleaning of equipment for reuse. Duplicates and replicates help a project identify reproducibility among samples at the project site.

3.3.1 Field Blanks

Not every field blank type may be utilized during any given sampling event and there may be more blank types than described in this document. Field blanks may be varied throughout the sampling events of a project. The types of blanks and their collection frequency should be stipulated in the QAPP.

Below are the common types of field blanks utilized.

A **field blank** is a sample of PFAS-free water (as defined by the QAPP) supplied by the laboratory that is transferred from one sample container directly into another sample container in the field. Analytes detected in field blanks indicate the possibility of cross-contamination between the ambient environment and the matrix collected for testing.

If water other than the PFAS-free water supplied by the laboratory is used during sampling, a **source blank** must be collected from each of these sources of water. Due to the ubiquitous presence of PFAS, any source water that has not been verified as PFAS-free (as defined by the QAPP) must be collected as a separate QC sample and analyzed to assess whether the chemical nature of the water used in decontamination may have affected the analytical results of site samples. A source blank is collected once per source prior to sample collection.

An **equipment blank** (also called a **rinse or rinsate blank**) is an aliquot of PFAS-free water, subjected to all aspects of sample collection. Analytes detected in equipment blanks indicate the possibility of cross-contamination between samples due to improper equipment decontamination. Equipment blanks should be collected at a minimum, the frequency specified in the QAPP.

Evaluation of Field Blanks

Determine which field blanks apply to samples in the sample delivery group (SDG) from the CoC. If the applicability of multiple field blanks cannot be determined, communicate with the point of contact identified in the project QAPP to inquire if applicability can be determined.

Note: SDGs can be called different names such as SEDD Lab Reporting Batch, depending on the project.

Ensure that units are correct when applying field blank qualifications.

Note: it may not be appropriate to make a direct quantitative comparison for aqueous field blanks (such as equipment blanks reported as µg/mL) to a solid parent sample (such as a soil sample reported as mg/kg). At best, only a qualitative comparison can be made.

Generally, when multiple blank type contaminations are present, the evaluation should not involve a ‘hierarchy’ of one blank type over another. Each blank is evaluated separately and independently. The final validated result should be assessed on the blank with the highest value (i.e., greatest effect on sample analyte concentration).

Water used for field blanks should be PFAS-free (as defined by the QAPP) and provided with the sample bottle kit by the contracted laboratory performing the analysis. To ensure the origin of the water used, consult with the field sampling team leader via appropriate channels identified in the QAPP (such as UFP-QAPP Worksheet #6). If source water was used during sampling, field blanks using each source water should also be PFAS-free (as defined by the QAPP).

If field blank water is used as equipment blanks and both are contaminated, the affected samples are qualified by either the field blank or equipment blank results, whichever has the higher contaminant concentration. The same applies if source water is used as equipment blanks and both are contaminated.

If analytes (as appropriate) are detected in the field blanks, the procedure for the qualification of associated sample results is summarized below.

Compare the results of each type of blank with the associated sample results. The reviewer should note that the blank analyses may not involve the same units, weights, volumes, percent moistures, or dilution factors as the associated samples. These factors may be taken into consideration when applying the 5X criteria discussed below, such that a comparison of the total amount of contamination is actually made. Care should be taken to factor in the percent moisture or dilution factor when doing comparisons between detects in the sample and the blank.

- If an analyte is detected in the field blank, but not in the associated samples, no action is taken.
- If field blanks were not collected at the proper frequency required by the QAPP, then use professional judgment to qualify the data, and make note of this in the data validation report.
- If an analyte is detected in the field blank (at any concentration) and in the associated samples, the action taken depends on both the blank and sample concentrations (Table II).

Table II: Blank Qualifications

	Blank	Sample		
Row Number	Result	Result	Validated Result	Validation Qualifier
1	≤ DL or LOD	≤ DL or LOD	Report as required by QAPP (at DL or LOD)	None
2	> DL or LOD	≤ DL or LOD	Report at Sample Result	U
3	> DL or LOD	> DL or LOD but ≤ LOQ	Report at Sample Result	U
4	> DL or LOD	> LOQ but ≤ 5x blank	Report at Sample Result	J+
5	> DL or LOD	> LOQ and > 5x blank	Report at Sample Result	None

LOD = Limit of Detection **LOQ** = Limit of Quantitation **DL** = Detection Limit

Note: The laboratory B qualifier is maintained, and the validation qualifier is added in addition to the laboratory qualifier. The QAPP should specify reporting non-detects at either the DL, or the LOD.

In situations where the QAPP requires an LOQ for the sum of a number of PFAS, (e.g., sum of concentrations of PFOA, PFOS, and PFNA) and the sum of the detects in blank exceed this value, use professional judgment to qualify the sample results and note all affected results in the data validation report.

3.3.2 Field Duplicates (Replicates)

Field duplicates consist of collocated samples. Field duplicate results are an indication of both field and laboratory precision; the results may be used to evaluate the consistency of sampling practices.

Evaluation of Field Duplicates

Check to ensure that field duplicates were collected and analyzed as specified in the QAPP. If the sampling frequency is less than the frequency stated in the QAPP, no qualification of the associated sample results is necessary, but the incident should be discussed in the data validation report.

For field duplicate results, if the Relative Percent Differences (RPDs or absolute differences are greater than those stated in the QAPP, qualification of the associated sample results is not necessary, but any non-conformities should be noted in the data validation summary.

Professional judgment may be required in instances where the sample and field duplicate results are less than the LOQ or project reporting limits. RPD results can be elevated when low (for example, < 5X the LOQ) or estimated concentrations in the samples and duplicates are reported.

It should be noted that RPDs or absolute differences for field duplicates are generally not calculated or reported by the laboratory, and should be calculated by the validator.

There are instances where an RPD is not calculable (for example, when one result is a non-detect and the other is > LOQ). In those cases, the RPDs are not calculated but the non-conformity should be noted in the data validation report. The reported concentrations should be carefully examined to determine what conditions would permit one result to be reported at or above the LOQ/Reporting Limit (RL), and the other to be reported below the LOQ/RL or as a non-detect.

The equation for RPD calculations is given in Appendix B.

4.0 Stage 2A Validation

Note: Stage 2A includes all of Stage 1

Stage 2A requires the review and qualification of the following summary documents:

- Ion Ratio Summary
- Extracted Internal Standard Recovery Summary
- Laboratory Control Sample/Laboratory Control Sample Duplicate Recovery and Relative Percent Difference Summary
- Matrix Spike/Matrix Spike Duplicate Recovery and Relative Percent Difference Summary
- Post Spike Sample Recovery Summary
- Method Blank Summary form
- Dilution/Reanalysis Summary

Stage 2A is the validation of preparation batch specific QC data in addition to any sample specific parameters included in Stage 1.

Generally, a “preparation batch” of samples consists of 20 field samples (maximum) along with blank, duplicate, and control/matrix type QC samples. They are meant to be analyzed together on a single instrument. However, laboratories may choose to split up a batch over multiple instruments to save time. In this case, if the use of multiple instruments is uncovered in a Stage 2A validation, the validator should request from their point of contact a Stage 2B validation to review sequence logs. The use of multiple instrumentation should be noted in the data validation report.

4.1 Ion Ratio

Ion ratios can be used to help determine if the matrix of the sample has resulted in a bias in the data. A laboratory can calculate ion ratios in a number of ways, which are outlined in Appendix B. To determine if a bias has potentially occurred, the ion ratio is evaluated against the ion ratio of standards, which do not contain matrix interferences. In-house acceptance criteria for evaluation of transition ion ratios should be used and should not exceed 50-150%.

Evaluation of Ion Ratios

Verify the ion ratio(s) for each detect were reported, met in-house acceptance criteria, and in-house acceptance criteria did not exceed 50-150%. For detects reported with ion ratios exceeding in-house control limits and/or the 50-150% acceptance criteria, qualify the sample results as estimated **J** and note all affected results in the data validation report. Ion ratio failures could be caused by matrix interference and/or be the result of the presence of isomers in the sample at different ratios than the ratio of isomers present in the calibration standards. A full evaluation (Stage 4 validation) of the raw data and quantitation report is necessary to fully evaluate the potential cause of the failure.

4.2 Extracted Internal Standard (EIS) Recovery

Extracted Internal Standard (EIS) recoveries are used to correct for bias associated with matrix interferences and sample preparation efficiencies, injection volume variances, chromatographic behavior, and mass spectrometry ionization efficiency. All samples, standards, blanks, and QC samples are fortified with EIS analytes. EIS analytes are added to the solid sample prior to extraction and to an aqueous sample in the original sample container prior to extraction. For aqueous samples prepared by serial dilution (e.g., Aqueous film forming foam (AFFF)), EIS analytes are added to the final dilution of samples prior to analysis.

Verify that EIS recoveries and acceptance limits were reported for all field samples, batch QC samples, standards, and instrument blanks.

Sample and batch QC EIS percent recoveries should be within control limits established in the QAPP or the QSM. Verify that no samples or batch QC have EIS percent recoveries outside the criteria.

If any EIS percent recovery is out of specification, then a reextraction (if applicable) and reanalysis should be performed and reported. The laboratory should have reported both runs if the first was unsuccessful.

The laboratory does not have to reanalyze a sample if a matrix spike/matrix spike duplicate or sample/sample duplicate was performed on the sample with out-of-control EIS percent recoveries showing the same matrix effects, as long as the batch QC display acceptable EIS percent recoveries.

Each EIS percent recovery should be within control limits established in the QAPP or within 50-150% (if DoD QSM criteria is used) of the area of the mid-point standard in the ICAL for associated standards. On days when an ICAL is not performed, the daily initial continuing calibration verification (CCV) can be used.

The EIS retention times (RTs) for all field and QC samples should be within 0.40 minutes (if DoD QSM criteria is used) of the retention time of the midpoint standard in the ICAL, or on days when an ICAL is not performed, the initial CCV is used.

Evaluation of Extracted Internal Standards

If EIS percent recoveries are out of specification with no evidence of re-extraction (if applicable) and reanalysis, justification should be noted in the laboratory case narrative (e.g., limited sample volume prevented reanalysis). If justification is not noted, the point of contact identified in the project QAPP should be reached for further guidance.

If the EIS percent recovery control criteria displayed in the deliverable are not the same ranges stipulated in the QAPP or the DoD QSM, reference the required control ranges for evaluation instead of the summarized ranges in the deliverable. The project team should be informed to implement changes to the current deliverables or those to be created in the future. Please follow the notification protocols outlined in the QAPP (such as the UFP-QAPP Worksheet #6).

Detects for analytes quantitated using an EIS percent recovery > 150% should be qualified estimated with a negative bias **J-**. Non-detects should not be qualified.

Detects for analytes quantitated using an EIS percent recovery < 50% but ≥ 20% should be qualified estimated with a positive bias **J+** for detects. Non-detects should be qualified estimated **UJ**.

If extremely low area counts are reported (< 20%), detects and non-detects should be qualified **X**.

If an EIS retention time varies by more than 0.40 minutes (if DoD QSM criteria is used), use professional judgment to qualify the sample results and note all affected results in the data validation report.

EIS results may not be reported as “diluted out” since they are used as the internal standard for calculation of the native analyte. A full evaluation (Stage 4 validation) of the sample, chromatogram, mass spectral ions and quantitation report may be necessary to determine that diluted analytes are quantified correctly.

Some extracts may require dilution, to bring analytes within the calibration range. This can result in EIS dilution to the point that EIS recoveries may not be sufficiently measurable and would require EIS fortification to the diluted extract. Detects for analytes quantified from this type of diluted extract should be qualified as estimated **J**. Non-detects in the diluted extract should be reported from less-diluted or undiluted extract results.

In the special case of a blank analysis with EIS percent recoveries out of specification, the reviewer should give special consideration to the validity of associated sample data. The basic concern is whether the blank problems represent an isolated problem with the blank alone, or whether there is a fundamental problem with the analytical process. For example, if the samples in the batch show acceptable EIS percent recoveries, the reviewer may determine the blank problem to be an isolated occurrence for which no qualification of the data is required.

4.3 Laboratory Control Sample/Laboratory Control Sample Duplicate (LCS/LCSD)

An LCS is an analyte free sample matrix spiked with known amounts of the analytes of interest and taken through all sample preparation, cleanup and analytical steps. LCSs establish the method precision and bias for a specific batch of samples. Analysis of LCSDs may be required by the QAPP, or may be used as an indication of batch precision in instances where matrix spike duplicate analysis is not possible (e.g., a limited volume of sample).

LCS (sometimes called a “Blank Spike”) and, if analyzed, LCSD recoveries should be within the QC limits specified in the QAPP or as listed in the DoD QSM. If an LCSD was analyzed, the RPDs should be within the QC limits specified in the QAPP.

Evaluation of LCS/LCSD

Verify that results (from appropriate summary form), percent recoveries, RPDs (if applicable) and acceptance limits were reported for all target analytes.

If the spike percent recovery control criteria displayed in the deliverable are not the same range (i.e., outside or wider than) as those stipulated in the QAPP or the DoD QSM, reference the required control ranges for evaluation instead of the summarized ranges in the deliverable. The project team should be informed to implement changes to the current deliverables or those to be created in the future.

In-house control limits are acceptable for any analytes not specified in the QAPP or DoD QSM. No qualification is necessary for any reported in-house control limit that is within (i.e., same or less than) those specified in the QAPP or DoD QSM. If the laboratory’s in-house control limits are wider than those in the QSM but the results remain within the DoD QSM limits, no qualification is necessary. If the laboratory’s in-house control limits are wider than those in the QSM and the results are outside of the DoD QSM limits, qualify the appropriate data as **X**.

If the LCS percent recoveries were greater than the upper control limit, qualify detects for the analyte in associated samples as estimated with a positive bias **J+**. Non-detects should not be qualified.

If the LCS percent recoveries were less than the lower control limit, qualify detects for the analyte in associated samples as estimated with a negative bias **J-** and non-detects as **X**, exclusion of data is recommended.

If the LCS/LCSD was not spiked with all target analytes, notify the project team by following the notification protocols outlined in the QAPP (such as UFP-QAPP Worksheet #6) and qualify detects for those analytes not spiked as **X** and non-detects for those analytes not spiked as **X**, exclusion of data is recommended.

If the LCS/LCSD RPDs were greater than the acceptance limits, qualify detects for the analyte in the associated sample(s) as estimated **J**. Non-detects should not be qualified.

Professional judgment should be utilized in qualifying data for circumstances other than those listed above.

4.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD data are used to determine the effect of the matrix on a method’s recovery efficiency and precision for a specific sample matrix.

Generally, qualifying action is taken only on the parent sample based on MS/MSD non-conformities. In instances where it can be determined that the results of the MS/MSD affect only the sample spiked, then qualification should be limited to that sample alone. Using informed professional judgment, the data reviewer may use the MS/MSD results in conjunction with other QC criteria (i.e., EIS and LCS) and determine the need for additional qualification beyond that applied to the parent sample when the laboratory is having a systemic problem in the analysis of one or more analytes, which affects all associated samples.

Field QC samples (e.g., field blank, equipment blank, source blank) should not be used for the MS/MSD. If a field blank was used for the MS/MSD, this fact should be included in the data validation summary. Sample matrix effects may not be observed with field blanks; therefore, the recoveries and precision do not reflect the extraction or analytical impact of the site matrix.

The laboratory should spike and analyze an MS/MSD from the specific project site as required by the QAPP for each matrix type and analytical batch. The MS and MSD should be spiked per QSM requirements with all target analytes. If the parent sample for the MS/MSD was from another site or project (for example, not enough sample collected, or multiple site samples analyzed within a single batch), the reason should be documented in the data validation report, and sample results should not be qualified due to any non-conformities noted in non-site-specific matrices.

Evaluation of MS/MSD

MS/MSD data should be reported on a MS/MSD summary form (or equivalent). Verify that the MS/MSD were spiked with all target analytes, and that percent recoveries were reported for all target analytes.

Compare the percent recovery and (RPD for each analyte with LCS control limits established by the QAPP. If the spike percent recovery control criteria displayed in the deliverable are not the same range (i.e., outside or wider than) as those stipulated in the QAPP or the DoD QSM, reference the required control ranges for evaluation instead of the summarized ranges in the deliverable. The project team should be informed to implement changes to the current deliverables or those to be created in the future. Please follow the notification protocols outlined in the QAPP (such as UFP-QAPP Worksheet #6).

If the MS/MSD was not spiked with all target analytes, notify the project team by following the notification protocols and qualify detects in the parent sample for those analytes in each batch not spiked as **X**, and non-detects in the parent sample for those analytes not spiked as **X**, exclusion of data is recommended.

If the MS or MSD percent recoveries were greater than the upper control limit, qualify detects for the analyte in the associated parent sample as estimated **J+**. Non-detects should not be qualified.

If the MS or MSD percent recoveries were less than the lower acceptance limit but ≥ 10%, qualify detects for the analyte in the associated parent sample as estimated **J-** and non-detects as estimated **UJ**. If the percent recoveries were < 10%, qualify detects for the analyte in the associated parent sample as estimated **J-** and non-detects as **X**, exclusion of data is recommended.

If the MS/MSD RPDs were greater than the acceptance limits, qualify detects for the analyte in the associated sample(s) as **J**. Non-detects should not be qualified.

Failure of MS/MSD due to the presence of target analyte(s) in the parent sample at > 4X the spike concentration or if the matrix spikes are diluted to less than the LOQ, matrix spike non-conformities should not result in any qualifications. Note the incident in the data validation report.

4.5 Post Spike Sample

Post spike sample data are used to verify the instrument was capable of accurately quantifying PFAS in the sample's matrix at the reported LOQ. This QC sample is only applicable to aqueous and AFFF samples that were prepared using serial dilution instead of solid phase extraction (SPE).

A post spike sample should be associated with every PFAS target analyte that is reported as a non-detect or < LOQ in the associated sample.

Evaluation of Post Spike Sample

Post spike sample data should be reported on a post spike sample summary form. Verify that the post spike samples were spiked with all target analytes reported as non-detect or < LOQ in the associated sample. The lowest possible dilution while meeting QC criteria (EIS percent recovery and post spike percent recovery) should be reported for these analytes. This dilution should be spiked at a concentration at the LOQ (after dilution is taken into account).

The post spike sample percent recoveries should be within 70 - 130%. If the spike percent recovery control criteria displayed in the deliverable are not the same range (i.e., outside or wider than) as those stipulated in the QAPP or the DoD QSM, reference the required control ranges instead of the summarized ranges in the deliverable. The client should be informed to implement changes to the current deliverables or those to be created in the future. Follow the notification protocols outlined in the QAPP (such as UFP-QAPP Worksheet #6).

If the post spike sample percent recoveries were less than the lower acceptance limit but ≥ 20%, qualify non-detects as estimated **UJ**.

If the post spike sample percent recoveries were < 20%, qualify non-detects as **X**, exclusion of data is recommended.

If the post spike sample percent recoveries were >130%, qualify detects for the analyte in the associated parent sample as estimated **J+**. Non-detects should not be qualified.

4.6 Method Blanks

A method blank is used to identify systemic contamination originating in the laboratory that may have a detrimental effect on project sample results. The validator should identify samples associated with each method blank using a method blank summary form (or equivalent). Verify that the method blank has been reported per batch.

Compare the results of each method blank with the associated sample results. The reviewer should note that the blank analyses may not involve the same weights, volumes, percent moistures, or dilution factors as the associated samples.

These factors should be taken into consideration when applying the 5X criteria (discussed in Section 3.3.1), such that a comparison of the total amount of contamination is actually made. Care should be taken to factor in the percent moisture or dilution factor when doing comparisons between detects in the sample and the method blank.

Evaluation of Method Blanks

If no method blank was analyzed, qualify detects in samples with no associated method blank as **X**. Non-detects do not require qualification.

If gross contamination exists (defined as greater than a Project Action Limit) in the method blanks, all analytes affected should be qualified as **X** due to interference in all affected samples and this should be noted in the data validation comments.

If target analytes are found at low levels in the method blank(s), it may be indicative of a problem at the laboratory and should be noted in the data validation report.

If an analyte is detected in the method blank, but not in the associated samples, no action is taken.

If an analyte is detected in the method blank and in the associated samples, the action taken depends on both the method blank and sample concentrations. Table II (Blank Qualifications) and Section 3.3.1 discussions on evaluations of results from the DL/LOD to LOQ is also applicable to the method blank.

Additionally, there may be instances where little or no contamination was present in the associated method blanks, but qualification of the sample was deemed necessary. Contamination introduced through dilution water is one example. Although it is not always possible to determine, instances of this occurring can be detected when contaminants are found in the diluted sample result, but are absent in the undiluted sample result. It may be impossible to verify this source of contamination. However, if the reviewer determines that the contamination is from a source other than the sample, the data should be qualified. In this case, the 5X rule does not apply. The sample value should be reported as a non-detect and the reason should be documented in the data validation report. Qualification of the data should be performed as given in Table II.

Professional judgment should be applied to any field blank result that was associated with a contaminated method blank. Generally, if the field blank result was qualified as a non-detect due to the method blank, it does not need to be applied to the associated sample results. However, the fact that the field blank was qualified should be noted in the data validation report.

Multiple blank contaminations (such as a batch with field blanks and a method blank) does not establish a ‘hierarchy’ of one blank over another. Each blank must be evaluated individually. Blanks should not be qualified due to the results of other blanks.

4.7 Sample Dilution and Reanalysis

Laboratories may dilute samples due to high analyte concentrations or reanalyze samples due to quality control non-conformities, and document both sets of results. Generally, the laboratory will report the “best” value for a given analyte in the official laboratory report (or equivalent form). The validator should evaluate both the reported and the initial analysis result. In the case of AFFF samples, the laboratory should report the lowest dilution that met all quality control criteria (e.g., post spike recovery and EIS recovery) for each target analyte. The validator should consider the application of appropriate qualifiers to the reported results within the scope of the project due to elevated LODs/LOQs or other quality control anomalies. Qualifiers apply only to the reported results in the official laboratory report.

Evaluation of Sample Dilution and Reanalysis

When sample results are reported at more than one dilution due to analyte concentrations exceeding the calibration curve, the lowest LODs are generally used for the non-detects unless a QC criterion has been exceeded.

Results reported from dilutions lead to elevated LODs for non-detects. The data validation report should indicate the reason for all reported dilutions (including cases where the laboratory did not perform an undiluted analysis) resulting in elevated sensitivity limits for non-detected results.

When reanalysis has occurred due to quality control non-conformities, the validator should ensure that the non-conformity was corrected during the reanalysis. If that is not the case, then the appropriate qualifier should be placed on the reported results.

In some cases, using professional judgment, the validator may determine that an alternate result was more appropriate than the one reported. In those cases, explain the rationale for accepting the alternate result in the data validation report.

In some cases, reanalysis may lead to exceedances of holding time. Use professional judgment to evaluate the results and apply the appropriate qualifiers (if required).

5.0 Stage 2B Validation

Note: Stage 2B includes all of Stage 1, and Stage 2A

Stage 2B requires the review and qualification of the following summary documents for each instrument.

- Sequence and Preparation Logs (or equivalent to include Instrument Blanks)
- Instrument Performance Check Summary (mass calibration verification)
- Initial Calibration Summary (any equivalent to include the Initial Calibration Analyte Responses, Isomeric Profiles, Average Response Factors, and Regression)
- Instrument Blank Summary
- Initial/Continuing Calibration Verification and Instrument Sensitivity Check Summaries (any equivalent to include Initial and Continuing Calibration Verifications and Instrument Sensitivity Checks)

Stage 2B adds for review, the validation of instrument specific QC data.

5.1 Sequence and Preparation Logs

Sequence logs are reviewed by the data validator to ensure all QC samples (both batch and instrument specific) had been analyzed within a specific batch, in the correct order. Preparation logs are reviewed by the data validator to ensure that samples had the proper extraction performed, within specified holding times. The logs themselves do not require validation. However, non-conformities uncovered in the review of the logs may point the validator to specific samples that require further review. Non-conformities uncovered in preparation or sequence logs should be noted in the data validation report.

Sequence logs are helpful in identifying when multiple instrumentation is used to analyze a batch of samples. For example, it is not uncommon to analyze a single batch of 20 samples at the same time on two or more instruments. At a minimum, mass calibration and mass calibration verification documentation should be included for each instrument used. Batch QC should be reviewed on each instrument, as appropriate. Non-conformities involving the use of multiple instruments should be noted in the data validation report.

5.2 Instrument Performance Checks

LC/MS/MS instrument performance checks (referred to as mass calibration verifications) are performed to ensure mass resolution, identification, and to some degree, sensitivity are all within criteria. Conformance is determined using reference standards; therefore, acceptance criteria should be met in all circumstances. Check that all samples and associated QC analyses are associated with an acceptable mass calibration verification.

Make certain that a mass calibration verification has been performed prior to the initial calibration used. The mass calibration verification should verify a mass range which includes the ion masses of all target analytes. Mass accuracy should be verified to be within ± 0.5 amu of the true value by the acquisition of a full scan continuum mass spectrum of a PFAS stock standard or by following the instrument manufacturer’s instructions for performing a mass calibration verification and using the instrument manufacturer’s recommended standards as long as they verify the mass range of the PFAS ions of interest.

Evaluation of Instrument Performance Checks

Careful consideration should be given to any reported results that accompany a mass calibration verification that does not meet criteria. Based on QSM requirements, the samples should not have been analyzed. All associated data should be qualified as **X**, exclusion of data is recommended.

5.3 Initial Calibration

The objective of initial calibration is to ensure that the instrument is capable of producing acceptable qualitative and quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance prior to sample analysis and of producing an acceptable calibration curve.

The instrument should be calibrated for all target analytes and isotopically labeled analogs of target analytes (EIS analytes) with a minimum of five calibration standards depending on the type of curve. More standards are required for higher order regression curves. Isotope dilution quantitation should be used when an EIS analyte of the target analyte is commercially available. In instances when not available for a target analyte, the EIS analyte with the closest retention time or chemical similarity to the target analyte should be used for quantitation. Under no circumstances should external calibration quantitation be used.

The instrument calibration summary should identify which analytes were calibrated using standards that contained branched and linear isomers of the analyte. Branched and linear isomers should be used for calibration standards when they are commercially available as a certified standard. Table III lists standards that are currently commercially available and used. The target analyte response for analytes containing branched and linear isomer should be result of the summation of peaks from all isomers. If a certified standard is not available, a technical standard may be used to identify retention time and ion transition ratios, but may not be used for calibration. In these instances, a certified linear standard should be used to build the calibration curve, and the samples must be quantified for all isomers that meet the technical grade standard identification for retention time and ion transitions.

Table III: Currently Available Certified PFAS Standards Containing Branched and Linear Isomers
Perfluorohexanesulfonic acid (PFHxS)
Perfluorooctanesulfonic acid (PFOS)
2-(N-methylperfluorooctanesulfonamido) acetic acid (NMeFOSAA)
2-(N-ethylperfluorooctanesulfonamido) acetic acid (NEtFOSAA)

Evaluation of Initial Calibration

If target analytes were not calibrated, qualify associated non-detects and detects as **X**, exclusion of data is recommended.

If less than the required minimum number of calibration standards were used, qualify all associated data as **X**.

If the laboratory has analyzed more than the required number of calibration standards and picked out the “best” set (e.g., analyzed seven calibration standards and picked the five “best” to pass calibration criteria), make note of this in the data validation report and qualify the data as **X**.

Any other manipulation of calibration points (such as ‘dropping’ calibration levels at the ends of the calibration curve) should have a technical justification documented in the laboratory report. Use professional judgment to evaluate the data. If no technical justification is provided, then make note of this in the data validation report and qualify the data as **X**.

The lowest calibration standard should be at or below the LOQ. If the LOQ is below the lowest calibration standard, then the LOQ has been reported in a manner that is inconsistent with QSM requirements. If the concentration of the lowest calibration standard was greater than the LOQ and the concentration of the associated (Instrument Sensitivity Check) ISC is at the LOQ and meets its acceptance criteria, no qualification is needed. If the concentration of the lowest calibration standard was greater than the LOQ and the associated ISC concentration is greater than the LOQ or it fails to meet acceptance criteria, qualify all associated data as **X** that are at a concentration below the concentration of the lowest calibration standard that meets acceptance criteria and make note of this in the data validation report.

Each calibration standard should recover within 70 - 130% of its true value. If this criteria is not met for an analyte, make note of this in the data validation report and qualify all affected data as **X**, exclusion of data is recommended.

Verify isotope dilution quantitation was used for all target analytes where isotopically labeled analogs are commercially available and EISs were used for target analytes when they are not. If isotopically labeled analogs were not utilized when commercially available, make note of this in the data validation report and qualify the associated data as **X**, exclusion of data is recommended.

Inform the point of contact (QAPP Worksheet #6) for further instruction in those instances of unwarranted manipulation of calibration curves. As an example, calibration curves generated with excessive calibration points that are misapplied to achieve passing criteria (without any technical justification) requires prompt notification of the project team. If the issue cannot be resolved with the laboratory, make note of this in the data validation report and qualify all affected data as **X**, exclusion of data is recommended.

In order to produce acceptable sample results, the response of the instrument must be within the working range established by the initial calibration. Any sample detections above the working range of the calibration curve should be accompanied by a dilution that is within the working range. If dilutions were not performed, qualify all detections above the initial calibration working range as estimated **J,** and make note of the lack of dilution(s) in the data validation report.

If dilution(s) were performed that were within the working range of the initial calibration, then qualification of the data is not necessary. Make note in the data validation report that dilution(s) were performed. If reported concentration exceeded the calibration range, qualify detects as estimated **J**.

If branched isomers were not included in the summed result reported, qualify associated detects as **J-.**

If the LOD is not 2 to 4 times the DL for target analytes, use professional judgment to qualify the sample results and note all affected results in the data validation report. If the LOQ is not the lowest calibration standard, then any detects that fall between the LOQ and the lowest calibration standard should be qualified as estimated **J**.

5.3.1 Response Factors (RFs) and Relative Standard Deviation (%RSD)

Evaluate the average response factors (RFs) for all target analytes. RFs are an indicator of the sensitivity of the analyte to detection and quantitation by Mass Spectrometry (the higher the RF the more sensitive the analyte).

All target analytes should have an associated %RSD ≤ 20% for an average calibration fit.

Evaluation of RFs and %RSD

Evaluate the %RSD for all target analytes. If any target analyte has a %RSD > 20% and ≤ 30%, flag detects for the affected analytes as **J** and non-detects as **UJ** in the associated samples.

If the %RSD for any target analyte is excessively high (defined as > 30%), qualify associated sample results as **X**, exclusion of data is recommended.

Each calibration standard should recover within 70 - 130% of its true value. If this criteria is not met for an analyte, make note of this in the data validation report and qualify all affected data as **X**, exclusion of data is recommended.

5.3.2 Linear Least Squares Regression

The laboratory may employ a linear or weighted linear least squares regression. A minimum of five standards is required for a linear regression. Evaluate the coefficient of determination (r^2). The DoD QSM specifies that the r^2 value should be ≥ 0.99.

Evaluation of Linear Least Squares Regression

If the required number of calibration standards was not used, qualify detects as **X**, exclusion of data is recommended. Apply professional judgment to qualify non-detects based on the concentrations of the standards used.

If the r^2 value is < 0.99, qualify detects for the affected analytes **J** and non-detects **UJ** in the associated samples.

If the r^2 value is excessively low (defined as < 0.90), qualify all associated non-detects as **X**, exclusion of data is recommended, and detects as estimated **J**.

Each calibration standard should recover within 70 - 130% of its true value. If this criteria is not met for an analyte, make note of this in the data validation report and qualify all affected data as **X**, exclusion of data is recommended.

5.3.3 Non-Linear Regression

The laboratory may also generate a higher order curve for the calibration. The calibration curve should not be more than second order. It is a statistical requirement that the instrument response is the dependent variable (Y-axis). Verify that the instrument response is on the Y-axis.

A minimum of six standards is required for a second order (quadratic) curve.

Evaluate the correlation coefficients (r) for all applicable target analytes. The coefficient of determination (r^2) should be ≥ 0.99.

Evaluation of Non-Linear Regression

If the required number of calibration standards was not used, qualify detects as **X**, exclusion of data is recommended. Apply professional judgment to qualify non-detects based on the concentrations of the standards used.

If the r^2 value is < 0.99, qualify detects for the affected analytes **J** and non-detects **UJ** in the associated samples.

If the r^2 value is excessively low (defined as < 0.90), qualify all associated non-detects as **X**, exclusion of data is recommended, and detects as estimated **J**.

Calibration curves that are higher than second order (such as a third order polynomial fit) are not allowed in accordance with QSM requirements. Qualify **X** all associated data based on third order (or higher) calibration curves.

Each calibration standard should recover within 70 - 130% of its true value. If this criteria is not met for an analyte, make note of this in the data validation report and qualify all affected data as **X**, exclusion of data is recommended.

5.4 Initial (Secondary Source), Continuing Calibration Verification, and Instrument Sensitivity Check

The initial calibration curve should be verified with a standard that has been purchased or prepared from an independent source each time an initial calibration is performed. This standard is called the secondary source or Initial Calibration Verification (ICV). The LOQ should be verified with a standard that is prepared at the concentration of the LOQ each time an initial calibration is performed. This standard is called the ISC. Both the ICV and ISC should contain all of the target analytes. Note that multiple ICVs and ISCs may be analyzed to encompass all of the target analytes.

After the initial calibration has been verified with a second source and the ISC has verified the associated LOQ, samples may be analyzed continuously until an on-going calibration verification fails. To verify this, a CCV containing all target compounds should be analyzed at the beginning of every analytical sequence prior to sample analysis, after every ten field samples, and at the end of the analytical sequence. To ensure the instrument can achieve the LOQ throughout the analytical sequence, an ISC containing all target compounds should be analyzed at the beginning of every analytical sequence prior to sample analysis, every 12 hours thereafter. These continuing calibration checks verify satisfactory performance of the instrument on a day-to-day basis.

Verify the ICV was analyzed following the initial calibration and contained all target analytes. Verify the CCVs have been run prior to sample analysis, every ten field samples, and at the end of the analytical sequence. When a new initial calibration is performed, the ICV can serve as the first CCV if samples are being run afterwards. The CCVs after the first ICV are not required to be a second source.

Verify the ISC was analyzed following the initial calibration and contained all target analytes. Verify the ISCs have been run prior to sample analysis and every 12 hours thereafter.

The ICV, ISC, and CCV percent difference (%D) or percent drift for each target analyte and EIS analytes should be within ± 30%.

When a new initial calibration is performed, the ICV can serve as the first ISC if the ICV was analyzed at the LOQ. If the initial daily CCV is analyzed at the LOQ, it can also serve as the first ISC of the analytical sequence. The CCVs analyzed after the first ICV and the ISCs are not required to be a second source.

Evaluating the ICV, CCV, and ISC

Verify that the %Ds are within the acceptance criteria. If any target analytes do not meet the acceptance criteria, qualify detects for that analyte as estimated **J+** when the %D is higher than acceptance criteria and **J-** when below acceptance criteria. Non-detects are qualified as **UJ** in all associated samples for %D outside of acceptance criteria.

For gross exceedances of %D (defined as > 50% for ICV/ISC/CCV) qualify all associated data as **X**.

If the ICV (second source) and/or ISC have not been performed after an initial calibration or if samples have been analyzed prior to a valid ICV and/or ISC, qualify all associated data as **X**, exclusion of the data is recommended. No samples should have been analyzed without a valid ICV and ISC.

If the continuing calibration verification CCV and/or ISC have not been analyzed (either continuing or end-of-run), qualify all associated data as **X**. No samples should have been analyzed without a valid CCV and ISC.

If CCVs have been analyzed at a frequency less than every ten field samples, qualify the associated sample detects as **J** and the non-detects as **UJ**. If ISCs have been analyzed beyond the 12-hour time limit criteria, qualify the associated sample detects as **J** and the non-detects as **UJ**. For gross exceedances of the 12-hour time limit (defined as > 16 hours), qualify all associated data as **X**.

5.5 Instrument Blanks

Instrument blanks (IBs) are used to ensure that the LC/MS/MS system does not contribute unacceptable concentrations of a target analyte into a sample result. The IB should be analyzed immediately following the highest standard analyzed and daily prior to sample analysis. In order to quantify contamination, the IBs should contain EIS analytes. Each analyte in the IB should meet the acceptance criteria defined in the QAPP. The DoD QSM requires this acceptance criteria to be set at a minimum for each target analyte not to exceed ½ LOQ. QAPP defined criteria may be more stringent, especially in cases where there is a project-specific action level associated with the sum of a group of PFAS.

Evaluation of Instrument Blanks

Careful consideration should be given to any reported results that accompany an instrument blank that does not meet criteria. Based on QSM requirements the samples should not have been analyzed. All associated data should be qualified as **X**, exclusion of data is recommended.

6.0 Stage 3 Validation

Note: Stage 3 validation includes all of Stage 1, Stage 2A and Stage 2B

The following documents are used for a Stage 3 validation:

- Raw data (including any laboratory forms, instrument outputs, spreadsheets, or handwritten calculations necessary for recalculation and re-quantification)
- Standards traceability forms and worksheets
- Detection limit studies (optional)

Stage 3 validation includes the recalculation and re-quantification of selected samples, and method and instrument QC. The types of results that should be recalculated and re-quantified include target analytes, analytes with detects above the LOQ, and field QC samples (blanks and duplicates). For method QC results, spiked recoveries and method blanks should be considered. For instrument QC, calibrations (including response factors and regressions), calibration verifications, and EIS recoveries should be recalculated and re-quantified. Some calculations may include the need to review standards preparation and serial dilutions.

6.1 Samples and Field QC

When choosing samples, field QC and analytes for re-quantification and recalculation, consideration should be given to the laboratory's batching scheme to ensure a representative subsample of recalculations is performed. Additionally, if priority contaminants or contaminants of concern are identified in the QAPP, those analytes should be selected for re-quantification and recalculation. Other circumstances that should be prioritized for re-quantification and recalculation are diluted samples, manual integrations, re-runs of samples, and field QC blank failures.

Re-quantification and recalculation should be performed on the designated percentage of the samples per Sample Delivery Group (or however defined in the QAPP, such as percentage of total project samples) per analytical suite. As a minimum, it is recommended that 10% of the data should be re-quantified and recalculated unless specific instructions are given in the QAPP.

Sample recalculations should include the raw instrument result, re-quantified from the instrument response against the calibration function, and the final reported sample result, including any dilution, preparation factor, or percent moisture (if applicable). The equations in Appendix B can be used to calculate a sample result from the corresponding reported calibration or regression function, as appropriate.

Verify that one or more of the laboratory's reporting limits (such as limit of quantitation) are calculated correctly for the non-detects and reported accordingly. If a detection limit study was identified by the QAPP, recalculate one or more analyte detection limits.

Re-quantitate all detected target analytes in the 10% sample data chosen. For some samples, all results may be non-detects, therefore recalculation would not be necessary. Verify that sample-specific results have been adjusted correctly to reflect percent solids, original sample mass/volume, and any applicable dilutions.

Re-quantitate all detects found in the field QC blanks (such as trip blanks, field blanks, or equipment blanks). Field QC sample duplicate recalculations should include re-quantification of the same detected analyte sample/duplicate pair and verification of the %D, or RPD, as reported.

When recalculations require rounding of data, that rounding should be completed only once at the end of all calculations to minimize rounding errors. Calculations should be rounded to the significant figures of the underlying criteria. For example, an LCS criteria of 80 - 117% would still be considered acceptable if the recalculation was 117.4%.

Evaluation of Sample and field QC recalculations

If the laboratory's quantitation, or reporting limits (however defined) are calculated incorrectly, then continue to recalculate limits until it is determined that the problem is systemic (such as incorrect equations used) or isolated (such as a transcription or rounding errors).

For systemic (defined as widespread and major in nature) issues that cannot be corrected through a revised laboratory report, qualify all results as **X**, exclusion of data recommended.

For isolated cases, use professional judgment. It may be necessary to engage the point of contact as identified in the project QAPP to communicate with the laboratory, so they can provide revised (corrected) results. In all cases, if calculation errors affect project target analytes, the point of contact should be notified, and all affected results noted in the data validation report, including listing the calculation errors.

6.2 Method QC

Re-quantification of batch QC sample results should use raw instrument response in tandem with the reported calibration factor, response factor, or slope; the preparation information; and percent moisture for solid samples to recreate the reported result.

6.2.1 EIS Analytes Spike

Verify the concentrations of EIS analytes from the raw data. Verify that the EIS analyte result and percent recovery were calculated and reported correctly by re-calculating all EIS analytes in the 10% of chosen sample data and method QC that were originally selected.

6.2.2 LCS/LCSD

To check that the spike percent recovery was calculated and reported correctly, using the equation in Appendix B, re-quantitate and then recalculate all contaminants of concern as outlined in the UFP-QAPP Worksheet #12 or #15. Use a random 10% of the analytes in the LCS/LCSD if contaminants of concern (target analytes) have not been specifically identified. Recalculate RPDs (if applicable) from LCS/LCSD pairs that would result in the qualification of a sample.

6.2.3 MS/MSD

Re-quantitate 10% of the target analytes as listed in the UFP-QAPP Worksheet #12 or #15 for both the MS and the MSD. Use a random 10% of the analytes in the MS and MSD if contaminates of concern have not been identified. The RPDs of the recalculated MS/MSD pairs should be calculated from the MS/MSD concentrations, not from the recoveries.

6.2.4 Post Spike

Re-quantitate 10% of the target analytes spiked into the post spike sample. Use a random 10% of the analytes in the Post Spike if contaminates of concern have not been identified.

6.2.5 Method Blanks

Method blank analytical results are assessed to determine the existence and magnitude of contamination problems associated with sample extraction (if applicable) and analysis. If problems with any method blank exist, all associated data should be carefully evaluated to determine whether there is any bias associated with the data, or if the problem is an isolated occurrence not affecting other data. Results may not be corrected by subtracting any blank values.

Re-quantitate one or more detects found in the method blank (if applicable) from the reported average RF (or higher order regression, if used) per each batch of samples.

Evaluation of all EIS Analyte Spike, LCS, MS, and Method Blank Recalculations

If transcription errors (or other minor issues such as rounding errors) are found in method QC results, use professional judgment to qualify the data. It may be necessary to engage the point of contact as identified in the UFP-QAPP to contact the laboratory so they can provide revised (corrected) results. In all cases, if method QC calculation errors affect project target analytes, the point of contact should be notified, and all affected results noted in the data validation report, including listing the calculation errors.

For systemic (defined as widespread and major in nature) problems with LCS/LCSD or Post Spike calculations, qualify all affected analytes in associated samples as **X**, exclusion of data recommended.

For systemic problems with method blanks, or MS/MSD calculations qualify all affected analyte detects in associated samples as estimated **J** and non-detects as estimated **UJ**.

6.3 Instrument QC

6.3.1 Initial (Response Factors and Regressions) and Continuing Calibration Verifications

Initial calibration recalculations should use the raw instrument response for the target analytes and associated EIS analytes, to recreate the calibration curve from the individual calibration standards. If multiple types of calibration curves are employed in an analytical site, at least one analyte per curve type should be recalculated.

Commercial PFAS standards available as salts are acceptable, providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. If sample results were not corrected to the neutral acid but reported from the salt, qualify detects as **J+.**

Re-quantitate and recalculate the individual and average RFs, %RSDs, regression function (if used), and r^2 values reported for at least 10% of the target analytes per each EIS, preferably analytes of concern which were identified in the QAPP, per initial calibration curve type.

Re-quantitate and recalculate the ICV, CCV, ISC, RF results, and %D for at least 10% of the target analytes, proportionally selecting analytes based on each calibration curve type.

The laboratory may employ a linear or weighted linear least squares regression. The low standard should be recalculated using the calibration curve and evaluated. RFs should not be evaluated for analytes with linear or higher order regression curves. If the ICAL included refitting of the data back to the model (relative standard error), then recalculate 10% of the target analytes for the relative standard error in each ICAL.

Analytes should be within 70 - 130% of their true value for each calibration standard.

Evaluation of Instrument Performance Checks, ICAL, Calibration Factors, Regressions, ICV/CCV/ISC, and EIS Recalculations

If the files provided do not match the quantitation report, the RFs (equivalent to calibration factors, CFs) reported are likely to be from another initial calibration and the laboratory report should be revised. The point of contact (UFP-QAPP Worksheet #6) should be reached to get a revised (corrected) report from the laboratory. For calculation errors for RFs or any other regression equations that cannot be corrected in a revised report, qualify all the data as **X**.

The reprocessed standards of a regression curve should be within 30% of the true value. If the recalculated concentration is not within 30% of the true value, qualify detects (at the LOQ and above) for the affected analytes **J** and non-detects **UJ** in the associated samples.

Qualify all associated data as **X** if the corresponding ICV/CCV/ISC/%D has been calculated incorrectly by the laboratory and cannot be corrected in a revised laboratory report.

Qualify all data as **X** if the corresponding EIS had been calculated incorrectly (or if the EIS had been assigned to the wrong analyte) by the laboratory and cannot be corrected in a revised laboratory report.

In all cases where instrument QC are calculated incorrectly, the UFP-QAPP point of contact should be notified and noted in the data validation report.

6.4 Standards Traceability

Evaluate the calibration standards used for the analytes of concern. From the Certificate of Analysis (however named), verify that the “true values” of each analyte of concern were correctly applied to create the calibration curve, that all analytes of concern were in the calibration mix, and contained both branched and linear isomers, if commercially available. Some standards are made by manufacturers using the salt of a PFAS. In these cases, the concentration of those PFAS should be corrected to the neutral acid concentration. Results should be reported as the neutral acid with appropriate CAS number.

All initial instrument calibrations should be verified with a standard obtained from a second manufacturer prior to analyzing any samples. From the standard Certificate of Analysis, verify that a second source was used for the ICV. The use of a standard from a second lot obtained from the same manufacturer (independently prepared from different source materials) is acceptable for use as a second source standard.

Check that the stock standards were diluted properly into working standards by recalculating the dilutions of one or more calibration standards. Recalculate one or more method QC sample dilutions (such as LCS or MS/MSD) from the stock to the working standard.

Note: It is not the role of the data validator to evaluate the Certificate of Analysis for compliance with the *ISO-17034 Standard*, but to verify that stock and working standards were correctly applied in the creation of calibration curves.

Evaluation of Standards

Professional judgment should be used when evaluating errors in standards preparation. For minor issues, such as the calculation of a PFAS using the concentration of that PFAS as a salt (i.e. not correcting calculation to the neutral acid concentration), the project management team (UFP-QAPP Worksheet #6) should be contacted to get a revised (corrected) report from the laboratory. Minor issues (that do not affect the results of any target analytes) should be noted in the data validation report.

For systemic (widespread) issues that cannot be corrected by the laboratory, or issues that affect the results of target analytes, the data should be qualified as **X**, exclusion of data recommended.

For ICV standards that were not verified to be from a second source, qualify all affected data as **X**. No samples should be analyzed without a valid second source standard (per QSM requirements).

For expired standards, per QSM requirements, a laboratory cannot use a standard beyond its expiration date. All associated data should be qualified as **X** if expired standards were used. The expiration date of any working standard is based on the expiration date of the primary or stock standard.

6.5 Detection/Quantitation Limit Studies (Optional)

In some cases, a project QAPP may specify the review and validation of a detection/quantitation limit study. This could include studies such as Method Detection Limits (MDLs), quarterly LOD verifications, or LOQ verifications. The project QAPP should specify the criteria for evaluating the study. As a minimum, at least 10% of the raw data in the study should be recalculated.

Evaluation of Detection Limit Studies

The criteria for evaluating a detection/quantitation limit study should be listed in the project QAPP. The following guidance should be enacted if the QAPP does not specify the evaluation criteria.

If transcription errors (or other minor issues such as rounding errors) are found in detection/quantitation limit studies, use professional judgment to qualify the data. It may be necessary to engage the point of contact as identified in the project QAPP to communicate with the laboratory, so they can provide revised (corrected) results. In all cases, if calculation errors affect project detection or quantitation limits, the point of contact should be notified, and all affected results noted in the data validation report, including listing the calculation errors.

When calculation errors are uncovered that cannot be corrected by the laboratory and that affect detection/quantitation results, consideration should be given to qualify the study as **X**.

7.0 Stage 4 Validation

Note: Stage 4 validation includes all of Stage 1, Stage 2A, Stage 2B and Stage 3

Raw Data (including any instrument outputs, mass spectra, or chromatograms)

Stage 4 is a qualitative review of non-detected and detected results from instrument outputs. Chromatograms are checked for peak integration (10% of automated integration and 100% of manual integrations), baseline, and interferences; mass spectra are checked for minimum quantitative ion and qualitative ion signal-to-noise ratio, transition ion ratios, retention times or relative retention times are within method requirements for analyte identification. Raw data quantitation reports and ion transition chromatograms are required to perform review of the instrument outputs.

7.1 Target Compound Identification

The objective of the criteria for LC/MS/MS qualitative analysis is to minimize the number of erroneous identifications of target compounds. An erroneous identification can either be false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present).

The identification criteria can be applied more easily in detecting false positives than false negatives. More information is available for false positives because of the requirement for submittal of data supporting positive identifications. Negatives, or non-detects, on the other hand represent an absence of data and are therefore more difficult to assess.

The peak area of the branched isomers, if present, should be summed with the peak area integration of the linear isomer. Branched isomers elute prior to the linear isomer of a target analyte.

Target analyte detections should display a signal-to-noise of ≥ 10:1 for the quantitative ion and ≥ 3:1 for the confirmation ion, have proper peak integration, and display all ions at the correct retention times with passing ion ratios (50 - 150%).

The retention time of each target analyte and EIS should be within ± 0.4 minutes of the predicted retention and updated with the latest daily CCV. Check a minimum of 10% of the reported target analyte detects for retention time. RT performance in samples with only non-detects can be evaluated by reviewing the EIS times.

Evaluation of Target Compound Identification

The application of qualitative criteria for LC/MS/MS analysis of target analytes requires professional judgment. It is up to the reviewer's discretion to obtain additional information from their point of contact identified in the project QAPP, if qualitative identification problems are uncovered. The point of contact should arrange with the laboratory to obtain a revised (corrected) laboratory report. All qualitative identification problems should be discussed in the data validation report. If it is determined that incorrect identifications were made, or if a confirmed positive detect was made, but the confirmation ion was not detected (when available), then all affected data should be qualified as **X**, exclusion of data recommended.

Professional judgment should be used to qualify the data if it is determined that cross-contamination has occurred. If it is determined that cross-contamination has occurred, all affected data should be qualified as **X**. Any changes made to the reported analytes or concerns regarding target analyte identifications should be clearly indicated in the data validation report.

If evaluation of the ion ratios, retention times, or signal-to-noise for a detected target analyte is considered invalid, confer with the point of contact to identify in the project QAPP to consider changing the reported detect to a non-detect for the affected analyte.

While retention time windows are usually less critical to mass spectrometry systems, retention times have an acute effect on LC/MS/MS using Multiple Reaction Monitoring (MRM) mode. For example, retention time window drift on an MRM system can have a direct impact on the reported results. Professional judgment should be used to qualify the data.

7.2 Manual Integrations

For Stage 4, the reviewer should examine and verify the validity of all manual integrations.

Performing improper manual integrations, including peak shaving, peak enhancing, or baseline manipulation to meet QC criteria or to avoid corrective actions is unwarranted manipulation and misrepresents the data. All manual integrations should be reviewed by the data validator. When manual integrations are performed, raw data records should include a complete audit trail for those manipulations (i.e., the chromatograms obtained before and after the manual integration should be retained to permit reconstruction of the results). This requirement applies to all analytical runs including calibration standards and QC samples. The person performing the manual integration should sign and date each manually integrated chromatogram and record the rationale for performing manual integration (electronic signature is acceptable). Any manual integration should be fully discussed in the case narrative, including the cause and justification.

Evaluation of Manual Integrations

Some level of manual integration is considered necessary for the normal operation of chromatographic systems. Instances of properly integrated peaks do not require qualification, but should be noted in the data validation report. However, excessive manual integrations may show a lack of routine maintenance by the laboratory, a rush to complete samples, or the results of analyzing excessively ‘dirty’ samples. Excessive manual integrations may also be the result of faulty software peak/baseline integration.

The data validator should use professional judgment in the review of manual integrations. All instances of manual integrations should be noted in the data validation report. Instances of incomplete information for manual integrations (such as failure to provide justification) should be reported to the point of contact identified in the project QAPP to obtain a revised (corrected) laboratory report. Instances of excessive manual integrations that cannot be corrected by the laboratory (such as ‘dirty’ samples that cannot undergo further cleanup procedures) should be qualified as **X**.

If, in the professional judgment of the validator, there are instances of unwarranted manipulation of data (such as multiple manual integrations used to 'pass' QC criteria), then those cases should be reported to the project team as soon as practical (UFP-QAPP Worksheet #6).

Appendix A: Method QC Tables

Note: The following Table is based on the DoD QSM Standard. The Table does not include all the QC elements from the methods or as listed in this guidance document.

QC Check	DoD QSM Frequency and Acceptance Criteria
Aqueous Sample Preparation	Each sample and associated batch QC samples. Solid Phase Extraction (SPE) must be used unless samples are known to contain high PFAS concentrations (e.g., Aqueous Film Forming Foam (AFFF) formulations). Inline SPE is acceptable. Entire sample plus bottle rinsate must be extracted using SPE. Known high PFAS concentration samples require serial dilution be performed in duplicate. Documented project approval is needed for samples prepared by serial dilution as opposed to SPE.
Solid Sample Preparation	Each sample and associated batch QC samples. Entire sample received by the laboratory must be homogenized prior to subsampling.
Biota Sample Preparation	Each sample and associated batch QC samples. Sample prepared as defined by the project (e.g., whole fish versus filleted fish).
AFFF and AFFF Mixture Samples Preparation	Each sample and associated batch QC samples. Each field sample must be prepared in duplicate (equivalent to matrix duplicate). Serial dilutions must be performed to achieve the lowest LOQ possible for each analyte.
Sample Cleanup Procedure	Each sample and associated batch QC samples. Not applicable to AFFF and AFFF Mixture Samples. ENVI-Carb^{TM} or equivalent must be used on each sample and batch QC sample.

QC Check	DoD QSM Frequency and Acceptance Criteria
Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis. Mass calibration is verified after each mass calibration, prior to initial calibration (ICAL). Calibrate the mass scale of the MS with calibration compounds and procedures described by the manufacturer. Mass calibration range must bracket the ion masses of interest. The most recent mass calibration must be used for every acquisition in an analytical run. Mass calibration must be verified to be ±0.5 amu of the true value, by acquiring a full scan continuum mass spectrum of a PFAS stock standard or by following the instrument manufacturer's recommended standards as long as these standards verify the mass range of the PFAS ions of interest.
Mass Spectral Acquisition Rate	Each analyte, Extracted Internal Standard (EIS) Analyte. A minimum of 10 spectra scans are acquired across each chromatographic peak.
Calibration, Calibration Verification, and Spiking Standards	All analytes. Standards containing both branched and linear isomers must be used when commercially available. PFAS method analytes may consist of both branched and linear isomers, but quantitative standards that contain the linear and branched isomers do not exist for all method analytes. For PFAS that do not have a quantitative branched and linear standard, identify the branched isomers by analyzing a qualitative standard that includes both linear and branched isomers and determine retention times, transitions and transition ion ratios. Quantitate samples by integrating the total response (i.e., accounting for peaks that are identified as linear and branched isomers) and relying on the initial calibration that uses the linear isomer quantitative standard.

QC Check	DoD QSM Frequency and Acceptance Criteria
Sample PFAS Identification	All analytes detected in a sample. The chemical derivation of the ion transitions must be documented. A minimum of two ion transitions (Precursor → quant ion and precursor → confirmation ion) and the ion transitions ratio per analyte are required for confirmation. Exception is made for analytes where two transitions do not exist (PFBA and PFPeA). Documentation of the primary and confirmation transitions and the ion ratio is required. In-house acceptance criteria for evaluation of ion ratios must be used and must not exceed 50 - 150%. Signal-to-Noise Ratio (S/N) must be ≥ 10 for all ions used for quantification and must be ≥ 3 for all ions used for confirmation. Quant ion and confirmation ion must be present and must maximize simultaneously (± 2 seconds).
Ion Transitions (Precursor -> Product)	Every field sample, standard, blank, and QC sample. In order to avoid biasing results high due to known interferences for some transitions, the following transitions must be used for the quantification of the following analytes: PFOA: 413 → 369 PFOS: 499 → 80 PFHxS: 399 → 80 PFBS: 299 → 80 4:2 FTS: 327 → 307 6:2 FTS: 427 → 407 8:2 FTS: 527 → 507 NEtFOSAA: 584 → 419 NMeFOSAA: 570 → 419 If these transitions are not used, the reason must be technically justified and documented (e.g., alternate transition was used due to observed interferences).

QC Check	**DoD QSM Frequency and Acceptance Criteria**
Initial Calibration (ICAL)	At instrument set-up and after ICV or CCV failure, prior to sample analysis. The isotopically labeled analog of an analyte (Extracted Internal Standard Analyte) must be used for quantitation if commercially available (Isotope Dilution Quantitation). Commercial PFAS standards available as salts, are acceptable, providing the measured mass is corrected to the neutral acid concentration. Results shall be reported as the neutral acid with appropriate CAS number. If a labeled analog is not commercially available, the Extracted Internal Standard Analyte with the closest retention time or chemical similarity to the analyte must be used for quantitation. (Internal Standard Quantitation) Analytes must be within 70 - 130% of their true value for each calibration standard. ICAL must meet one of the two options below: Option 1: The RSD of the RFs for all analytes must be ≤ 20%. Option 2: Linear or non- linear calibrations must have $r^2 \geq 0.99$ for each analyte.
Retention Time window position establishment	Once per ICAL and at the beginning of the analytical sequence. Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the midpoint standard of the ICAL curve or the initial CCV may be used.
Retention Time (RT) window width	Every field sample, standard, blank, and QC sample. RT of each analyte and EIS analyte must fall within 0.4 minutes of the predicted retention times from the daily calibration verification or on days when ICAL is performed, from the midpoint standard of the ICAL. Analytes must elute within 0.1 minutes of the associated EIS. This criterion applies only to analyte and labeled analog pairs.
Instrument Sensitivity Check (ISC)	Prior to analysis and at least once every 12 hours. Analyte concentrations must be at LOQ; concentrations must be within ±30% of their true values.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis. Analyte concentrations must be within ± 30% of their true value.

QC Check	DoD QSM Frequency and Acceptance Criteria
Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analytical sequence. Concentration of analytes must range from the LOQ to the mid-level calibration concentration. Analyte concentrations must be within ± 30% of their true value.
Instrument Blanks	Immediately following the highest standard analyzed and daily prior to sample analysis. Concentration of each analyte must be ≤ ½ the LOQ. Instrument Blank must contain EIS to enable quantitation of contamination.
Extracted Internal standards (EIS)	Every field sample, standard, blank, and QC sample. Added to solid sample prior to extraction. Added to aqueous samples, into the original container, prior to extraction. For aqueous samples prepared by serial dilution instead of SPE, added to final dilution of samples prior to analysis. Extracted Internal Standard Analyte recoveries must be within 50% to 150% of ICAL midpoint standard area or area measured in the initial CCV on days when an ICAL is not performed.
Method Blank (MB)	One per preparatory batch. No analytes detected > ½ LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.
Laboratory Control Sample (LCS); **Matrix Spike (MS); Matrix Spike Duplicate (MSD)** **Relative percent difference**	One per preparatory batch. LCS: Blank spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. MS/MSD: Sample spiked with all analytes at a concentration ≥ LOQ and ≤ the mid-level calibration concentration. A laboratory should use the DoD QSM Appendix C Limits for batch control if project limits are not specified. If the analyte(s) are not listed, use in-house LCS limits if project limits are not specified. MSD or MD: RPD of all analytes ≤ 30% (between MS and MSD or sample and MD).

QC Check	DoD QSM Frequency and Acceptance Criteria
Post Spike Sample	Only applies to aqueous samples prepared by serial dilution instead of SPE that have reported value of < LOQ for analyte(s). Spike all analytes reported as < LOQ into the dilution that the result for that analyte is reported from. The spike must be at the LOQ concentration to be reported for this sample as < LOQ. When analyte concentrations are calculated as < LOQ, the post spike for that analyte must recover within 70 - 130% of its true value.

Appendix B: Formulas used in Stages 3 and 4 Data Validation

Calibration:

Response Factor (RF):

$$RF = \frac{A_s \times C_{IS}}{A_{IS} \times C_s}$$

Where:

A_S = Area, Standard
C_{IS} = Concentration, Extracted Internal Standard
A_{IS} = Area, Extracted Internal Standard
C_S = Concentration, Standard

Average RF:

$$mean\ RF = \overline{RF} = \frac{\sum_{i=1}^{n} RF_i}{n}$$

$$SD = \sqrt{\frac{\sum_{i=1}^{n}(RF_i - \overline{RF})^2}{n-1}}$$

$$RSD = \frac{SD}{\overline{RF}} \times 100$$

Where:

RF_i = RF for each calibration standard
$\overline{RF}$ = mean RF for each compound from the initial calibration
N = number of calibration standards

SD = standard deviation
RSD = Relative standard deviation

Relative Retention time:

$$RRT = \frac{Retention\ time\ of\ the\ analyte}{Retention\ time\ of\ the\ extracted\ internal\ standard}$$

Percent Difference:

$$\%D = \frac{C_s - C_k}{C_k} \times 100$$

Where:

C_s = Concentration, reported
C_k = Concentration, known

Sample Concentration:

Raw Values:

$$C_s = \frac{A_s * C_{IS}}{A_{IS} * \overline{RF}}$$

Where:

C_S= Concentration, sample
A_S=Area, Sample
C_{IS}= Concentration, Extracted Internal Standard
A_{IS}= Area, Extracted Internal Standard
$\overline{RF}$= Average RF

Linear Regression: y = mx + b

$$C_s = \frac{\left(\frac{A_s}{A_{IS}} - b\right) * C_{IS}}{m}$$

Where:

C_s =Concentration, Sample
A_s =Area, Sample
A_{IS} = Area, Extracted Internal standard
C_{IS} = Concentration, Extracted Internal Standard
b = Intercept
m = Slope

Quadratic Regression: y = ax^2 + bx + c

$$C_s = \frac{-b \pm \sqrt{b^2 - 4a\left(c - \frac{A_s}{A_{IS}}\right)}}{2a} \, x \, C_{IS}$$

Where:

C_s = Concentration, Sample
A_s = Area, Sample
A_{IS} = Area, Extracted Internal standard
C_{IS} = Concentration, Extracted Internal Standard
a = Quadratic Coefficient
b = Linear Coefficient
c = Constant Term

LCS Percent Recovery:

$$Percent\ Recovery = \frac{C_s}{C_K}\ x\ 100$$

Where:

C_s = Concentration, Reported
C_K = Concentration, Known

Post Spike, MS, or MSD Percent Recovery:

$$Percent\ Recovery = \frac{C_M - C_s}{C_K}\ x\ 100$$

Where:

C_M = Concentration, Post Spike, MS, or MSD
C_s = Concentration, Sample
C_K = Concentration, Known

MS/MSD or Duplicate Relative Percent Difference (RPD):

$$RPD = \frac{|C_s - C_d|}{(C_s + C_d)/2}\ x\ 100$$

Where:

C_s = Concentration, Sample
C_d = Concentration, Duplicate

Transition Ion Ratio:

$$IR = \frac{Qq}{Qc} \quad \text{or} \quad IR = \frac{Qc}{Qq}$$

Where:

IR = Ion Ratio

Qq= quantitative ion abundance

Qc= confirmation ion abundance

Transition Ion Percent Recovery:

$$Percent\ Recovery = \frac{R_s}{R_K}\ x\ 100$$

Where:

Rs= Ion Ratio, Reported
R_K= Ion Ratio, Known

Reported Values:

Aqueous

Concentration μg/L = $R*V_f*D_f/V_i$

Where:
R= Raw value from above in micrograms per liter (ug/L)
V_f= Final Volume of extract in liters (L)
V_i= Initial Volume extracted in liters (L)
$D_{f=}$ Dilution Factor

Solids

Concentration *μg/Kg* (Dry weight basis) = $(R \text{ x } V_f \times 1{,}000 \times D_f) / (W_s \times D)$

Where:
R = Raw value from above in micrograms per liter (ug/L)
V_f = Final volume of extract in liters (L)
W_s= Weight of soil/sediment extracted, in grams (g)
D_f = Dilution factor.
$D = \frac{100 - \%\ \text{moisture}}{100}$

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Attachment 4
Field Forms

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DAILY FIELD REPORT
PROJECT: **PROJECT No:**
DATE:
WEATHER:
SUBCONTRACTOR (S) ON SITE:
EQUIPMENT ON SITE:
TASK PERFORMED BY MMEC GROUP AND SUBCONTRACTORS
PROJECT OVERSIGHT AND QUALITY CONTROL MEASURES
HEALTH AND SAFETY PROJECT ACTIVITIES:
PROBLEMS ENCOUNTERED/CORRECTIVE MEASURES
PROJECT NOTES (if any, describe):
TOMORROW’S PLANNED ACTIVITIES:
PREPARED BY:
REVIEWED BY:

Page 1 of 1

Multi-MACJV

Daily PFAS Protocol Checklist

Date: ____________________ **Installation Name:** ___________________________________

Weather (*temp./precipitation*): ____________ **Investigation Area:** __________________________

Field Clothing and PPE:

- ☐ Field crew in compliance with Tables 1 and 2, SOP Wood-01
- ☐ Field crew has not used fabric softener on clothing and clothing is not new (washed a minimum of 6 times prior to use after purchase)
- ☐ Field crew has not used cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering or general hygiene (i.e., handwashing soaps or sanitizers) on exposed body parts this morning
- ☐ Field crew has not applied unacceptable sunscreen or insect repellant
- ☐ No clothing or boots containing Gore-Tex™ are present
- ☐ No latex gloves. Only powder-free nitrile gloves are used.

Field Equipment:

- ☐ No Teflon® containing or polytetrafluoroethylene (PTFE) and related fluorinated materials on-site
- ☐ All sample materials made from stainless steel, HDPE, acetate, silicon, or polypropylene.
- ☐ No waterproof field books on-site other than Rite in the Rain products to be used in the staging area only
- ☐ No plastic clipboards, binders, or spiral hard cover notebooks on-site
- ☐ Only fine or ultra-fine tipped Sharpie® markers or pens are used
- ☐ No adhesives (Post-It Notes) on-site
- ☐ Coolers filled with regular ice only. No chemical (blue) ice packs in possession

Sample Containers:

- ☐ All sample containers made of HDPE or polypropylene. Samples are not stored in containers made of LDPE
- ☐ Caps are lined or unlined and made of HDPE or polypropylene and the liner may not be make of Teflon or contain PFAS
- ☐ No glass sample containers are used for collection of PFAS samples

Wet Weather (as applicable):

- ☐ For personnel in direct contact with samples and/or sampling equipment, wet weather gear made of vinyl, polyurethane, PVC, wax or rubber- coated materials only

Equipment Decontamination:

- ☐ Laboratory certified and supplied “PFAS-free” deionized water on-site for decontamination of sample equipment
- ☐ Alconox and Liquinox to be used as decontamination materials

Food Considerations:

- ☐ No food or drink on-site with exception of bottled water and/or hydration drinks (i.e., Gatorade and Powerade) that is available for consumption only in the staging area

---

If any applicable boxes cannot be checked, the Field Manager shall describe the noncompliance issues below and work with field personnel to address noncompliance issues prior to commencement of that day’s work. Corrective action shall include removal of noncompliance items from the investigation area or removal of worker offsite until in compliance. Repeated failure to comply with PFAS sample protocols will result in the permanent removal of worker(s) from the investigation area.

Describe the noncompliance issues (include personnel not in compliance) and action/outcome of noncompliance:

____

____

____

Field Manager Name: ______________________________

Field Manager Signature: _____________________________ Time: ____________________

Multi-MACJV

Multi-MAC JV
1851 W 24th Street Suite 101
Yuma, AZ 85364-6104
(928) 344-8374

SHIP TO:

CHAIN OF CUSTODY

DATE: ____________

COC #: ____________

PAGE: ______ **OF** ______

Project Name:	Project Contact:	Bill To:	AMEC	Disposal Instructions:	LAB
Project Number:	Phone Number:			Shipment Method:	COURIER/FedEx
Project Manager:	Project Phase:			Waybill Number:	N/A

Sample Information							Methods for Analysis																									RUSH						
No.	**Sample ID**	Date Sampled	Time Sampled	Matrix																												24 Hour	48 Hour	72 Hour	5 Days	QC (MS/MSD)	TOTAL BOTTLES	HOLD All Analyses
1																																						
2																																						
3																																						
4																																						
5																																						
6																																						
7																																						
8																																						
9																																						
10																																						
11																																						
12																																						

Sampler's Signature:	**Date:**	**Time:**
Relinquished By/Affiliation:	**Date:**	**Time:**
Received By:	**Date:**	**Time:**
Relinquished By/Affiliation:	**Date:**	**Time:**
Received By:	**Date:**	**Time:**
Relinquished By/Affiliation:	**Date:**	**Time:**
Received By (LAB):	**Date:**	**Time:**

For Lab Use

Does COC match samples:	Y or N
Broken Container:	Y or N
COC seal intact:	Y or N
Other problems:	Y or N
AMEC contacted:	Y or N
Date contacted:	____________
Cooler Temperature at receipt:	______ C

Comments: **H=Hold Analysis Request X=Analyze**

NUMBER OF COOLERS SENT:

BORING NUMBER:	PROJECT NAME:	CONTRACT NUMBER:
	CLIENT:	PROJECT LOCATION:
START DATE/TIME:	COMPLETION DATE/TIME:	BLDG/SITE:
DRILLING CNTRCTR:	DRILLER:	LOCATION SKETCH
DRILLING METHOD:	BORING DIAMETER (in):	
EQUIPMENT:		
DEPTH TO WATER (feet bgs):	TOTAL DEPTH (feet bgs):	
LOGGED BY:		

DEPTH (ft bgs)	LITHOLOGIC DESCRIPTION	USCS SYMBOL	DRIVE INTERVAL	REVOVERED INTERVAL	TIME	PID (ppm)	REMARKS
0							
5							
10							
15							
20							
25							

Multi-MACJV	Multi-MAC JV 1851 W 24th Street Suite 101 Yuma, AZ 85364-6104 (928) 344-8374	BORING LOG DESIGNATION	Page ____of ____

Trench Log

Multi-MACJV

Location of Trench

	Project Name:
	Project Number:
	Project Manager:
	Logged by:
	Test Pit #
	Site #
	Started - Date:
	Time:
	Backfilled - Date:
	Time:
	Edited by:

Orientation:	Field Weather Conditions:

Trench Diagram

Depth:																						PID/OVA
ft.	in.																					

Trench Description

Description:

Sample Numbers:

Additional Information:

Multi-MACJV

MultiMAC JV

Well Development Form

Job #:
Date:
Well ID:

Facility:	**Site:**
Logged By:	**Checked By:**
Deveoped By:	**Development Method:**

Well Casing Total Depth (ft bgs):	**Well Casing Diameter (inches):**	**Well Screen Interval (ft bgs):**

Time	Depth to Water (feet btoc)	Gallons Removed	Turbidity (NTU)	pH	Temperature (°C)	Specific Conductivity (mS/cm)	DO (mg/L)	ORP (mV)	Recovery Rate (in/min)	Recovery Rate (gpm)	Notes

Total Gallons Removed ____________

Well development will be considered complete once a minimum of three well volumes have been removed and turbidity NTU readings have stabilized within 10 percent between readings over one well volume, or a maximum of 12 saturated well volumes have been removed (these volumes are in addition to removing the equivalent volume of any added potable water during well installation); see SOP Wood-05 (PFAS).

Multi-MACJV

Water/Product-Level Measurements

Project: ______________________________ **Date:** ______________________________

Project No. ______________________________ **Personnel:** ______________________________

Well ID	Date/Time	Depth to Product (feet btoc)	Depth to Water (feet btoc)	Total Depth (feet btoc)	Comments/Observations/PID Readings
					PID = ppm
					PID = ppm
					PID = ppm
					PID = ppm
					PID = ppm
					PID = ppm
					PID = ppm
					PID = ppm
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					PID = ppm
					PID = ppm

Multi-MACJV	**MULTI-MAC JV GROUNDWATER SAMPLING FIELD FORM**	**Job #:** **Date:** **Page of**

Field Personnel: **Monitoring Well ID:**

Start Time: **Weather Conditions:** **Approx. Air Temp (F):**

INITIAL WELL DATA & WELL PURGING INFORMATION

Water Temperature (degree C)	Water pH (S.U.)	Specific Conductivity (mS/cm)	Turbidity (NTUs)	Dissolved Oxygen (mg/L)	ORP (mV)	Water Level (feet btoc)	Time (0:00 - 23:59)	Volume Purged (milliliters)
Stabilization:	3 consecutive readings within:							
±1°C	±0.1 S.U.	±0.1 mS	<5NTU	±0.2 mg/L	±10 mV	-	-	-

Results of Field Ferrous Iron Kit (mg/L): **Total Purged:**

Measurements: 0.5 inch tubing: 0.020 gallons/linear foot 2" well casing: 0.17 gal/linear foot 4" well casing: 0.65 gal/linear foot

Sampling Method (circle one): dedicated bladder pump non-dedicated bladder pump peristaltic pump

Purge Pumping Rate (approx. mL/min):

Approx. Pump/Intake Depth:

Well Yield: High / Moderate / Low Decontamination Method: Alconox/dist. water wash, double rinse-distilled water

Decontaminated Equipment	Owner	ID#	Verification/Rinsate Sample ID

WELL CONDITION

Casing Size and Type:

Casing Condition:	OK / NA / Needs Repairs/Repaired	Lock Condition:	OK / NA / Needs Repairs/Repaired
Cap Condition:	OK / NA / Needs Repairs/Repaired	Monument Condition:	OK / NA / Needs Repairs/Repaired

NOTES:

SAMPLING INFORMATION / DATA

QA/QC Sample (circle one): Duplicate MS/MSD NONE

Analytical Parameters	**Minimum Sample Vol.**	**Preservative**	**Bottle Size**	**Number of bottles**	**Sample ID**	**Time Sampled**

Method of Transportation of samples: Courier FedEx

All samples were immediately placed into a cooler and packed with ice: YES / NO

Field Observations/Notes of Sampling Event:

Signature of Field Personnel:

FIELD CHANGE REQUEST FORM

Contract No.: N62470-19-D-4010	**CTO No.:** N6247320F4451	**Field Change Request Form No.:**
Location: IR Site 6 Former Naval Station Treasure Island, San Francisco, California		**Date:**

Document Titles:	**NIRIS Document #:**

RE: Drawing No.:________________________Title ______________________________

Specification Section____________________Title ______________________________

Other ____________________________

Description (items involved, submit sketch, if applicable)**:**

Reason for Change:

FIELD CHANGE REQUEST FORM

Contract No.: N62470-19-D-4010	**CTO No.:** N6247320F4451	**Field Change Request Form No.:**

Recommended Disposition (submit sketch, if applicable)**:**

Additional Details:

Will this change result in a contract cost or time change? ☐ Yes ☐ No

Estimate of contract cost or time charge (if any)

Preparer (signature)	Date	Preparer's Title	Technical Lead (Signature)	Date

Disposition

☐ Approved

☐ Not approved (give reason): ____________________

Engineer (signature) (if engineering related) ☐ Comments (attached) ☐ No Comments	Date	Project Manager (signature) ☐ Comments (attached) ☐ No Comments	Date
Navy ROICC (signature) ☐ Comments (attached) ☐ No Comments	Date	QC Manager (signature) ☐ Comments (attached) ☐ No Comments	Date
Navy RPM (signature) ☐ Comments (attached) ☐ No Comments	Date	NAVFAC SW QAO (signature) ☐ Comments (attached) ☐ No Comments	Date

Page 2 of 3

FIELD CHANGE REQUEST FORM

ATTACHMENTS:

DISTRIBUTION:

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Appendix B:
Contractor Quality Control Plan

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Naval Facilities Engineering Systems Command

Naval Facilities Engineering Systems Command
Southwest
Base Realignment and Closure
Program Management Office West
San Diego, CA

Final

Appendix B

Contractor Quality Control Plan

Remedial Investigation for Per- and Polyfluoroalkyl Substances at IR Site 6

Former Naval Station Treasure Island,
San Francisco, California

March 2022

Naval Facilities Engineering Systems Command Southwest
Base Realignment and Closure
Program Management Office West
San Diego, CA

Final

Appendix B

Contractor Quality Control Plan

Remedial Investigation for Per- and Polyfluoroalkyl Substances at IR Site 6

Former Naval Station Treasure Island, San Francisco, California

March 2022

DCN: MMAC-4010-5451-0006

Prepared for:
United States Department of the Navy
Naval Facilities Engineering Command Southwest
750 Pacific Highway
San Diego, CA 92132

Prepared by:
Multi-MAC JV
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Contract Number: N62470-19-D-4010; Task Order No. N6247320F5451

Table of Contents

Page

Acronyms and Abbreviations .... B-iii
B.1 Introduction B-1
B.2 Duties, Responsibilities, and Authorities of Quality Control Personnel B-3
  B.2.1 Program Quality Control Manager B-3
  B.2.2 Site Safety and Health Officer Alternate and Project Quality Control Manager B-3
  B.2.3 Site Safety and Health Officer B-4
B.3 Quality Control Documentation Procedures B-5
  B.3.1 Daily Contractor Quality Control Report B-5
    B.3.1.1 Documentation of Site Activities B-5
    B.3.1.2 Contractor Control Submittals B-6
  B.3.2 List of Definable Features of Work B-6
B.4 Procedures for Performing Three Phases of Quality Control B-7
  B.4.1 Quality Control Inspections B-7
    B.4.1.1 Preparatory Quality Control Inspections B-7
    B.4.1.2 Initial Quality Control Inspections B-8
    B.4.1.3 Follow-Up Quality Control Inspections B-8
    B.4.1.4 Inspection Documentation B-9
  B.4.2 Procedures to Complete Rework Items B-9
    B.4.2.1 Documentation of Nonconforming Items B-9
    B.4.2.2 Implementation of Corrective Action B-10
    B.4.2.3 Verification and Documentation of Corrective Action B-10

List of Attachments

Page

Attachment 1: Designation Letter, Resumes, and Training Certifications Attachment-1-1

Attachment 2: Contractor Quality Control Report Attachment-2-1

Attachment 3: Preparatory Phase Checklist....................Attachment-3-1

Attachment 4: Initial Phase Checklist Attachment-4-1

Attachment 5: Contractor Production Report....................Attachment-5-1

Attachment 6: Rework Item List Attachment-6-1

List of Figures

Page

Figure B-1: Location Map....................Figure-B-3

Acronyms and Abbreviations

AED	Automated External Defibrillator
AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
BRAC	Base Realignment and Closure
CIH	Certified Industrial Hygienist
CPR	Cardiopulmonary Resuscitation
CQC	Contractor Quality Control
DFOW	definable feature of work
DON	United States Department of the Navy
ECP	Environmental Condition Report
GNOME	General NOAA Operational Modeling Environment
HAZWOPER	Hazardous Waste Operations and Emergency Response
IR	Installation Restoration
LUST	leaking underground storage tank
MPPEH	material potentially presenting an explosive hazard
Multi-MAC JV	Multi-MAC Joint Venture
NAVFAC	Naval Facilities Engineering Command
NAVFAC SW	Naval Facilities Engineering Systems Command Southwest
NOAA	National Oceanic and Atmospheric Administration
NSTI	Naval Station Treasure Island
OSHA	Occupational Safety and Health Administration
PFAS	per- and polyfluoroalkyl substances
PMO	Program Management Office
QC	quality control

Acronyms and Abbreviations (continued)

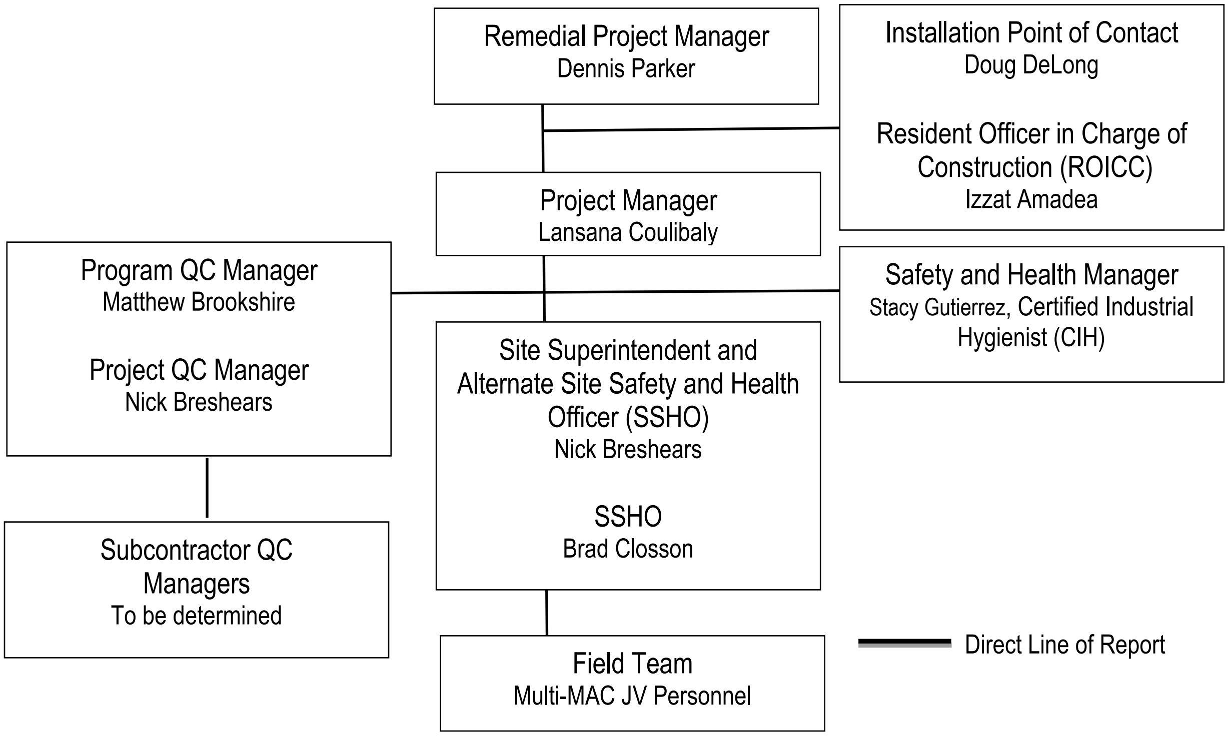
RI	Remedial Investigation
ROICC	Resident Officer in Charge of Construction
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
USACE	United States Army Corps of Engineering
UXO	unexploded ordnance

B.1 Introduction

Multi-MAC Joint Venture (Multi-MAC JV), a joint venture of Wood Environment & Infrastructure Solutions, Inc. and Nicklaus Engineering, Inc., is supporting the Base Realignment and Closure (BRAC) Program Management Office (PMO) West by conducting a Remedial Investigation (RI) at Installation Restoration (IR) Site 6 (Former Fire Training School) at former Naval Station Treasure Island (NSTI), San Francisco, California (Figure B-1). The RI at IR Site 6 will consist of evaluations of (1) the nature and extent of per- and polyfluoroalkyl substances (PFAS) in soil and groundwater, (2) sediment and porewater of the marine environment offshore of IR Site 6, and (3) potential risk to human health or the environment. The work is being performed under Contract Number N6247019D4010, Delivery Order Number N6247320F5451.

This Contractor Quality Control (CQC) Plan, which is Appendix B of the Work Plan for the RI, has been developed to address construction-related quality control (QC) activities specific to this project.

The CQC organizational structure and key members of the CQC organization for this project are presented in the chart below. The field QC representation and implementation team will be identified before the start of field work.



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B.2 Duties, Responsibilities, and Authorities of Quality Control Personnel

The various duties, responsibilities, and authorities of the key Multi-MAC JV QC personnel are summarized in the organization chart in Section B.1.

Note that subcontractor CQC Managers will also be identified and integrated into the overall QC activities. The responsibility and authority of the subcontractor CQC Managers will be the same as those of the Multi-MAC JV Project QC Manager. Attachment 1 provides the designation letter, resumes, and training certifications.

B.2.1 Program Quality Control Manager

Matthew Brookshire (Certified Manager of Quality/Organizational Excellence) is the Program QC Manager for this contract. Mr. Brookshire has over 20 years of experience in various environmental engineering projects for federal agencies, local governments, and private clients. Mr. Brookshire has extensive experience in QC management of projects for field investigations, removal actions, laboratory services, environmental compliance, and plan and report preparation (including work plans, sampling and analysis plans, field sampling plans, quality assurance project plans, site assessment reports, monitoring reports, and remedial investigation reports) for the United States Department of the Navy (DON).

B.2.2 Site Safety and Health Officer Alternate and Project Quality Control Manager

Nick Breshears is the Alternate Site Safety and Health Officer (SSHO) and Project Quality Control Manager for this effort. Mr. Breshears is an experienced engineer with Bachelor’s and Master’s Degrees in Civil Engineering. His technical experience includes Phase I and Phase II environmental site assessments, soil and groundwater sampling, waste characterization and management, site characterizations, remedial system design, implementation, and operations and maintenance. He is experienced in remedial systems for leaking underground storage tanks (LUSTs), and has managed soil vapor extraction, air sparge, free product recovery, and pump and treat systems. Mr. Breshears has conducted floating product evaluations, conducted groundwater sampling, and performed pilot soil vapor extraction tests at LUST sites in Arizona. He has completed pre-approval cost sheets, work plans, electronic contract management systems, implementation schedules, and pre-approval plans for multiple underground storage tank (UST) sites in Yuma, Arizona. He is also certified and experienced in performing asbestos inspections, planning and supervising abatement, and providing oversight for microbial sampling and abatement. Mr. Breshears has prepared plans and reports for numerous Naval Facilities Engineering Systems Command Southwest (NAVFAC SW) projects, including Accident Prevention Plans (APPs), Activity Hazard Analyses (AHAs) (including AHAs for COVID-19), and Work Plans. He has worked on various Environmental Condition Reports (ECPs) for the DON and is currently involved in Marine Corps Base Camp Pendleton storm/sewer drain assessments and sampling. He has run both continuous and instantaneous spill models for spills that occur within tidally affected water bodies using General National Oceanic and Atmospheric Administration (NOAA) Operational Modeling Environment (GNOME). He has experience working with large databases for both analytical data and air permits. Mr. Breshears has completed the Occupational Safety and Health Administration (OSHA) 30-hour training in construction safety and health, the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) general site worker training, and the HAZWOPER Supervisor/Site Safety Officer training, United States Army Corps of Engineering (USACE) 40 Hour EM 385-1-1 Safety and Health Training, First Aid and cardiopulmonary resuscitation (CPR) Training, and USACE Construction Quality Management for Contractors

B.2.3 Site Safety and Health Officer

Brad Closson is the SSHO. Mr. Closson is an experienced geologist with a Bachelor’s Degree in Geology. He has specialized expertise in conducting environmental and geotechnical site investigations. Site investigations have included drilling and logging of soil and rock borings and installation of groundwater monitoring wells and soil vapor wells to evaluate subsurface soil conditions for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites, construction projects, site assessments of former and current UST sites, and installation of treatment wells at Water Quality Assurance Revolving Fund sites. Mr. Closson has also performed groundwater quality sampling at UST and LUST sites and hazardous waste sampling, soil characterization sampling, PFAS soil/drinking water sampling, and soil vapor sampling. He has prepared Phase I and Phase II reports, APPs/Site Safety and Health Plans (SSHPs), site characterization reports, and remedial action plans. Prior to working in the environmental field, Mr. Closson worked for 4 years in a laboratory setting performing geochemical analysis of crude oils, rock core cuttings, and mud core samples. Mr. Closson has completed the OSHA 30-hour training in construction safety and health, the 40-hour HAZWOPER general site worker training, USACE 40 Hour EM 385-1-1 Safety and Health Training, and First Aid and CPR Training.

B.3 Quality Control Documentation Procedures

The section describes the daily CQC Report, documentation of site activities, and CQC submittals.

B.3.1 Daily Contractor Quality Control Report

The daily CQC Report will serve as the basic document for recording the daily CQC activities and will document the overall effectiveness of the QC program. The CQC Report Form (Attachment 2) will provide detailed information regarding job site location, work performance, weather conditions, types and results of inspections performed, locations and descriptions of deficiencies, deficiencies corrected, and other comments. The CQC Report Form will be completed and signed by the Project QC Manager. The CQC Report Form provides the following QC information:

- Date and relevant contractual information of the project work.
- QC activities performed as part of the three-phase CQC control process for each definable feature of work (DFOW). Section B.3.2 discusses the DFOWs for this project in more detail. Section B.4 describes the three-phase CQC process.
- QC Checklist Forms (Attachments 3 and 4) completed as part of the three-phase CQC control process for each DFOW.
- Rework items and the status of corrective actions implemented.
- Other related QC activities, such as meeting and/or inspections completed.
- Certification and test data reports in support of the QC activities.

B.3.1.1 Documentation of Site Activities

The following documents will be used for reporting onsite activities:

- **Site Safety Documentation:** Site safety documentation procedures are presented in the project APP and SSHP.
- **Daily Notes:** Internal daily notes will be kept for the site activities. These notes will be recorded on standard Multi-MAC JV daily notes forms or in a bound notebook. The notes will be recorded daily by the Project QC Manager or designee and will be used to prepare the daily CQC Report.

- **Contractor Production Report:** The SSHO will submit a daily Contractor Production Report (Attachment 5) to the DON summarizing the work performed by Multi-MAC JV and its subcontractors, including a description of trades working on the project, number of personnel working, use of major equipment, and delivery of major items.
- **Meeting Minutes:** CQC meeting discussions will be documented in meeting minutes. Copies of these minutes will be attached to the CQC Report in accordance with their three-phase activity classification.

B.3.1.2 Contractor Control Submittals

The daily CQC Report (Section B.3.1) and Contractor Production Report (Section B.3.1.1) are the primary CQC submittals required for this project.

B.3.2 List of Definable Features of Work

A DFOW is a work element that has discrete performance goals, can be separated from other tasks, and has distinct QC requirements. Based on the field work scope, the following DFOWs are identified:

- Pre-mobilization coordination meeting
- Mobilization
- Fieldwork (soil sampling, groundwater sampling, sediment and porewater sampling, and tidal study)
- Waste management and disposal
- Demobilization

DFOWs will be managed in accordance with the specific performance requirements in the Work Plan through the implementation of a three-phase inspection approach, as discussed in Section B.4.

B.4 Procedures for Performing Three Phases of Quality Control

The Multi-MAC JV CQC Program will be based on the three phases of control stated in the Unified Facility Guide Specification for both onsite and offsite QC. In general, the three phases of control are performed in stages as each DFOW is implemented, as follows:

- **Preparatory Phase:** Involves QC activities performed prior to field implementation of the DFOW.
- **Initial Phase:** Includes the QC activities performed during the first day of DFOW field implementation.
- **Follow-Up Phase:** Involves QC activities performed daily for continuing DFOW until completed satisfactorily.

These three phases of control and inspection formats provide an effective methodology through the entire project to see that product quality is met at each stage of the DFOW. Corrective actions, if required, can therefore be identified and implemented quickly.

QC Checklists (Attachments 3 and 4) for each phase are required for critical inspections and are completed to document results. Checklists will be prepared for QC activities associated with each DFOW. These checklists are maintained by the Project QC Manager and will become part of the inspection reports specified in Section B.4.1. QC inspection and test results are documented by the Project QC Manager in daily CQC Reports.

B.4.1 Quality Control Inspections

The QC inspection for each of the three phases of control are discussed in this section.

B.4.1.1 Preparatory Quality Control Inspections

Preparatory QC inspections are performed prior to beginning each DFOW. These inspections include review of submittal requirements and other contract requirements with supervisory personnel; verification of contract drawings and specifications so that provisions are made to provide required field control testing plans; examination of the work area to ascertain that the preliminary work has been completed; verification of field dimensions, lines, and grades; physical examination of materials and equipment; and review of the safety plan and appropriate activity hazard analysis.

Other inspections include receiving, calibration, and equipment inspections.

Receiving Inspection

Receiving inspections include a visual examination and accounting of materials obtained from suppliers upon arrival at the site. These inspections are performed to verify that the materials received meet design specifications, are free of defects, and have not been damaged in transit.

Calibration

Calibration of laboratory and field testing equipment is performed onsite and offsite using standards traceable to the National Bureau of Standards or other national standards, as appropriate. Calibration of equipment defines the accuracy of measurements taken and ensures that the instrumentation is generated defensible data.

Equipment Inspection

Equipment inspections are performed to verify that the equipment is in proper working order, is adequately charged and appropriately calibrated, and all necessary accessories are present. The inspection results will be documented using the Preparatory Phase Checklist (Attachment 3) and reported in the daily CQC Report (Attachment 2).

B.4.1.2 Initial Quality Control Inspections

Initial QC inspections are performed when the DFOW begins in the field. The initial QC inspections include an examination of the initial quality of workmanship and a review of control testing to confirm compliance with contract and Work Plan requirements. The initial inspections verify that safety standards are met and identify any conflicts between field implementation and the Work Plan requiring resolution and/or notification. It is critical that conflicts are resolved quickly so that work can continue without future issues. An initial QC inspection will be performed for each new crew working on the DFOW. The initial QC inspection is complete when compliance with acceptable quality standards are documented in daily CQC Reports. The initial QC inspection results will be documented using the Initial Phase Checklist (see Attachment 4) and reported in the daily CQC Report (Attachment 2).

B.4.1.3 Follow-Up Quality Control Inspections

Follow-up QC inspections are performed daily or at appropriate intervals during execution of the DFOW to verify continuing compliance with contract requirements and safety standards. Follow-up QC inspections are performed to verify compliance with contract requirements, maintain the workmanship, and see that the rework items (Section B.4.2) and QC testing are performed according to plan. Follow-up QC inspection reports are maintained by the Project QC Manager. The follow-up QC inspection results will be provided in the daily CQC Report (Attachment 2).

B.4.1.4 Inspection Documentation

All inspections will be a matter of record and will be documented on the inspection forms and maintained in accordance with CQC Plan requirements for documentation procedures. As discussed in Section B.3.1, the CQC Report, including QC Checklists, will serve as the basic document for recording the daily CQC activities and will document the overall effectiveness of the QC Program. The daily CQC Report (Attachment 2), Contractor Production Report (Attachment 5), and QC Checklist forms (Attachments 3 and 4) will be filled out and signed by the Project QC Manager.

B.4.2 Procedures to Complete Rework Items

During CQC activities, specific tasks not meeting Work Plan requirements will be identified as “rework items” that must be corrected before those tasks can be resumed. The Project QC Manager will maintain a list of rework items. The list will include information regarding the nonconformance or item that needs to be reworked, the date that the deficiency was discovered, and the date that the deficiency was corrected. If the correction was made on the same day that it was discovered, there is no requirement to report a rework item.

Nonconforming items and activities are those items or activities that do not meet project requirements. When such a condition is identified, Multi-MAC JV will implement a corrective action program to achieve the following:

- Document the nonconforming item or activity and determine the cause of nonconformance and its effect on project performance and the integrity of completed work.
- Correct or replace the nonconforming item in the most efficient and effective manner.
- Verify and document that the corrective action taken was successful.

B.4.2.1 Documentation of Nonconforming Items

The Project QC Manager will document nonconformance items on the daily CQC Report to clearly state what is not in compliance, the date on which the noncompliance was originally discovered, and the date on which the work was corrected.

B.4.2.2 Implementation of Corrective Action

Multi-MAC JV will stop work on items or features pending satisfactory correction of deficiencies noted by Multi-MAC JV project personnel or subcontractors. The Project QC Manager will have the authority to stop work until corrective actions are implemented. In some cases where the corrective action is obvious, it can be implemented immediately upon identification of the nonconformance. Other circumstances could require additional input from technical or operations staff, additional equipment and materials, or changes in existing structures or completed work. The Project QC Manager will not allow work to be added to or built upon nonconforming work unless the NAVFAC SW RPM concurs that the correction can be made without stopping ongoing work. If the corrective action requires a revision or variance to the contract specification or drawing, such revision or variance must be approved by the Contracting Officer before it is implemented in the field.

B.4.2.3 Verification and Documentation of Corrective Action

Successful completion of corrective actions for nonconformance will be verified by the Project QC Manager during a follow-up inspection. The daily CQC Report will reflect the corrective actions completed. Recurring nonconformance of a similar nature will be investigated to determine the root cause of the problem to eliminate or minimize future occurrences of the nonconformance. The status of rework items and corrective action will be documented using the Rework Items List form in Attachment 6.

Figures

Figure B-1: Location Map

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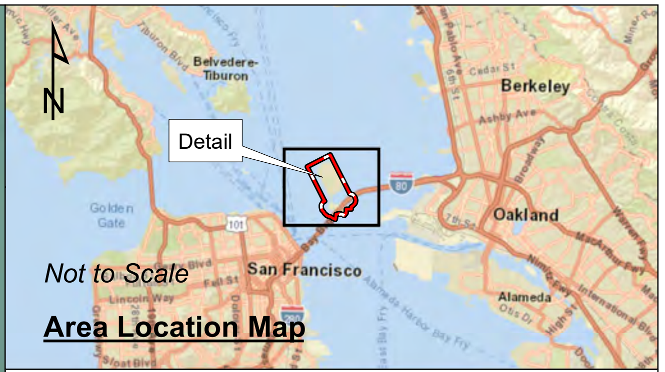

Not to Scale

Area Location Map

Legend

🟦 IRP Site 6 Location

🟥 Former Naval Station Treasure Island Boundary

Notes:
IRP = Installation Restoration Program
PFAS = Per- and Polyfluoroalkyl Substances

Basemap Source: ESRI Online Streaming Service 2020

N
0 0.125 0.25 0.375 0.5
In Miles
1 Inch = 0.25 Miles

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

IRP Site 6 Location Map

PROJECT NO.: 5026-20-4451
DATE: November 2020
DRAWN BY: KOB
CHECKED BY: LC

FIGURE
B-1

Date: 8/4/2020 File: Fig02_TI_SiteLocation.mxd

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Attachment 1:
Designation Letter, Resumes, and Training Certifications

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Multi-MACJV

Remedial Investigation for Per- and Polyfluoroalkyl Substances at IR Site 6
Former Naval Station Treasure Island, San Francisco, California

Contract Number: N62470-19-D-4010
Contract Task Order: 4451

Project Quality Control Manager
Letter of Designation

November 18, 2020

Mr. Nick Breshears,

This letter will serve to assign you as the Multi-MAC Joint Venture (MMAC JV) Project Quality Control (QC) Manager for the above-captioned contract task order. In this capacity, you will report directly to me and will administer the established requirements of the contract and Construction QC Plan. You will manage the three phases of control. You are authorized to stop work that is not in accordance with the contract and will exercise this authority consistent with the MMAC JV policies and procedures. You are authorized to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work.

If you have any questions or require additional information, please contact me at 858.633.2793.

Sincerely,

MMEC Group

Matt Brook

Matt Brookshire
Program Quality Control Manager

Attachment 2:
Contractor Quality Control Report

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CONTRACTOR QUALITY CONTROL REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

REPORT NO

PHASE	CONTRACT NO	CONTRACT TITLE

PREPARATORY

WAS PREPARATORY PHASE WORK PREFORMED TODAY? YES ☐ NO ☐

IF YES, FILL OUT AND ATTACH SUPPLEMENTAL PREPARATORY PHASE CHECKLIST.

Schedule Activity No.	Definable Feature of Work	Index #

INITIAL

WAS INITIAL PHASE WORK PREFORMED TODAY? YES ☐ NO ☐

IF YES, FILL OUT AND ATTACH SUPPLEMENTAL INITIAL PHASE CHECKLIST.

Schedule Activity No.	Definable Feature of Work	Index #

FOLLOW-UP

WORK COMPLIES WITH CONTRACT AS APPROVED DURING INITIAL PHASE? YES ☐ NO ☐

WORK COMPLIES WITH SAFETY REQUIREMENTS? YES ☐ NO ☐

Schedule Activity No.	Description of Work, Testing Performed & By Whom, Definable Feature of Work, Specification Section, Location and List of Personnel Present

REWORK ITEMS IDENTIFIED TODAY (NOT CORRECTED BY CLOSE OF BUSINESS)		REWORK ITEMS CORRECTED TODAY (FROM REWORK ITEMS LIST)	
Schedule Activity No.	Description	Schedule Activity No.	Description

REMARKS (Also Explain Any Follow-Up Phase Checklist Item From Above That Was Answered "NO"), Manuf. Rep On-Site, etc.

Schedule Activity No.	Description

AUTHORIZED QC MANAGER AT SITE DATE

GOVERNMENT QUALITY ASSURANCE REPORT

DATE

QUALITY ASSURANCE REPRESENTATIVE'S REMARKS AND/OR EXCEPTIONS TO THE REPORT

Schedule Activity No.	Description

GOVERNMENT QUALITY ASSURANCE MANAGER DATE

4296/2 (9/98)

SHEET 1 OF 2

CONTRACTOR QUALITY CONTROL REPORT

(CONTINUATION SHEET)
(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

REPORT NO.

PHASE	CONTRACT NO	CONTRACT TITLE

WORK COMPLIES WITH CONTRACT AS APPROVED DURING INITIAL PHASE? YES ☐ NO ☐

WORK COMPLIES WITH SAFETY REQUIREMENTS? YES ☐ NO ☐

	Schedule Activity No.	Description of Work, Testing Performed & By Whom, Definable Feature of Work, Specification Section, Location and List of Personnel Present
FOLLOW-UP		

REMARKS (Also Explain Any Checklist Item From Above That Was Answered "NO"), Manuf. Rep. On-Site, etc.

Schedule Activity No.	Description

Attachment 3:
Preparatory Phase Checklist

This page is intentionally blank.

PREPARATORY PHASE CHECKLIST

(CONTINUED ON SECOND PAGE)

		SPEC SECTION	DATE
CONTRACT NO	DEFINABLE FEATURE OF WORK	SCHEDULE ACT NO.	INDEX #

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED HOURS IN ADVANCE: YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

SUBMITTALS

REVIEW SUBMITTALS AND/OR SUBMITTAL REGISTER. HAVE ALL SUBMITTALS BEEN APPROVED? YES ☐ NO ☐

IF NO, WHAT ITEMS HAVE NOT BEEN SUBMITTED?

ARE ALL MATERIALS ON HAND? YES ☐ NO ☐

IF NO, WHAT ITEMS ARE MISSING?

CHECK APPROVED SUBMITTALS AGAINST DELIVERED MATERIAL. (THIS SHOULD BE DONE AS MATERIAL ARRIVES.)

COMMENTS:

MATERIAL STORAGE

ARE MATERIALS STORED PROPERLY? YES ☐ NO ☐

IF NO, WHAT ACTION IS TAKEN?

SPECIFICATIONS

REVIEW EACH PARAGRAPH OF SPECIFICATIONS.

DISCUSS PROCEDURE FOR ACCOMPLISHING THE WORK.

CLARIFY ANY DIFFERENCES.

PRELIMINARY WORK & PERMITS

ENSURE PRELIMINARY WORK IS CORRECT AND PERMITS ARE ON FILE.

IF NOT, WHAT ACTION IS TAKEN?

4296/2B1 9/98

SHEET 1 OF 2

PREPARATORY PHASE CHECKLIST

(CONTINUED FROM FIRST PAGE)

		SPEC SECTION	DATE
CONTRACT NO	DEFINABLE FEATURE OF WORK	SCHEDULE ACT NO.	INDEX #

TESTING

IDENTIFY TEST TO BE PERFORMED, FREQUENCY, AND BY WHOM.

WHEN REQUIRED?

WHERE REQUIRED?

REVIEW TESTING PLAN.

HAS TEST FACILITIES BEEN APPROVED?

SAFETY

ACTIVITY HAZARD ANALYSIS APPROVED? YES ☐ NO ☐

REVIEW APPLICABLE PORTION OF EM 385-1-1.

MEETING COMMENTS

NAVY/ROICC COMMENTS DURING MEETING.

OTHER ITEMS OR REMARKS

OTHER ITEMS OR REMARKS:

QC MANAGER DATE

4296/2B1 9/98 SHEET 2 OF 2

Attachment 4:
Initial Phase Checklist

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INITIAL PHASE CHECKLIST

		SPEC SECTION	DATE
CONTRACT NO	DEFINABLE FEATURE OF WORK	SCHEDULE ACT NO.	INDEX #

PERSONNEL PRESENT

GOVERNMENT REP NOTIFIED _____ HOURS IN ADVANCE: YES ☐ NO ☐

NAME	POSITION	COMPANY/GOVERNMENT

PROCEDURE COMPLIANCE

IDENTIFIY FULL COMPLIANCE WITH PROCEDURES IDENTIFIED AT PREPARATORY. COORDINATE PLANS, SPECIFICATIONS, AND SUBMITTALS.

COMMENTS: ____________________

PRELIMINARY WORK

ENSURE PRELIMINARY WORK IS COMPLETE AND CORRECT. IF NOT, WHAT ACTION IS TAKEN?

WORKMANSHIP

ESTABLISH LEVEL OF WORKMANSHIP.

WHERE IS WORK LOCATED? ____________________

IS SAMPLE PANEL REQUIRED? YES ☐ NO ☐

WILL THE INIITAL WORK BE CONSIDERED AS A SAMPLE? YES ☐ NO ☐

(IF YES, MAINTAIN IN PRESENT CONDITION AS LONG AS POSSIBLE AND DESCRIBE LOCATION OF SAMPLE) ____________________

RESOLUTION

RESOLVE ANY DIFFERENCES.

COMMENTS: ____________________

CHECK SAFETY

REVIEW JOB CONDITIONS USING EM 385-1-1 AND JOB HAZARD ANALYSIS

COMMENTS: ____________________

OTHER

OTHER ITEMS OR REMARKS

____
QC MANAGER DATE

4296/2C (9/98)

SHEET 1 OF 1

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Attachment 5:
Contractor Production Report

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CONTRACTOR PRODUCTION REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

DATE

CONTRACT NO

TITLE AND LOCATION

REPORT NO

CONTRACTOR

SUPERINTENDENT

AM WEATHER

PM WEATHER

MAX TEMP (F)

MIN TEMP (F)

WORK PERFORMED TODAY

Schedule Activity No.	WORK LOCATION AND DESCRIPTION	EMPLOYER	NUMBER	TRADE	HRS

JOB SAFETY

WAS A JOB SAFETY MEETING HELD THIS DATE? (If YES attach copy of the meeting minutes)	☐ YES	☐ NO	
WERE THERE ANY LOST TIME ACCIDENTS THIS DATE? (If YES attach copy of completed OSHA report)	☐ YES	☐ NO	
WAS CRANE/MANLIFT/TRENCHING/SCAFFOLD/HV ELEC/HIGH WORK/ HAZMAT WORK DONE? (If YES attach statement or checklist showing inspection performed.)	☐ YES	☐ NO	
WAS HAZARDOUS MATERIAL/WASTE RELEASED INTO THE ENVIRONMENT? (If YES attach description of incident and proposed action.)	☐ YES	☐ NO	

TOTAL WORK HOURS ON JOB SITE, THIS DATE, INCL CON'T SHEETS	
CUMULATIVE TOTAL OF WORK HOURS FROM PREVIOUS REPORT	
TOTAL WORK HOURS FROM START OF CONSTRUCTION	

Schedule Activity No.	LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED ☐ SAFETY REQUIREMENTS HAVE BEEN MET.

EQUIPMENT/MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB (INDICATE SCHEDULE ACTIVITY NUMBER)

Schedule Activity No.	Submittal #	Description of Equipment/Material Received

CONSTRUCTION AND PLANT EQUIPMENT ON JOB SITE TODAY. INDICATE HOURS USED AND SCHEDULE ACTIVITY NUMBER.

Schedule Activity No.	Owner	Description of Construction Equipment Used Today (incl Make and Model)	Hours Used

Schedule Activity No.	REMARKS

CONTRACTOR/SUPERINTENDENT DATE

4296/1 (9/98)

SHEET 1 OF 2

CONTRACTOR PRODUCTION REPORT
(CONTINUATION SHEET)

CONTRACT NO	TITLE AND LOCATION	DATE
		REPORT NO

WORK PERFORMED TODAY

Schedule Activity No.	WORK LOCATION AND DESCRIPTION	EMPLOYER	NUMBER	TRADE	HRS

Schedule Activity No.	LIST SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED

EQUIPMENT/MATERIAL RECEIVED TODAY TO BE INCORPORATED IN JOB (INDICATE SCHEDULE ACTIVITY NUMBER)

Schedule Activity No.	Submittal #	Description of Equipment/Material Received

CONSTRUCTION AND PLANT EQUIPMENT ON JOB SITE TODAY. INDICATE HOURS USED AND SCHEDULE ACTIVITY NUMBER.

Schedule Activity No.	Owner	Description of Construction Equipment Used Today (incl Make and Model)	Hours Used

Schedule Activity No.	REMARKS

INCLUDE ALL PERSONNEL WORK HOURS IN THE WORK PERFORMED SECTION ON THIS SHEET
INTO THE FRONT CONTRACTOR PRODUCTION REPORT

4296/1 (9/98)

SHEET 2 OF 2

Attachment 6:
Rework Item List

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REWORK ITEMS LIST

Contract No. and Title:

Contractor:

NUMBER	DATE IDENTIFIED	DESCRIPTION	CONTRACT REQUIREMENT (Spec. Section and Par. No., Drawing No. and Detail No., etc.)	ACTION TAKEN BY QC MANAGER	RESOLUTION	DATE COMPLETED

4296/3 (9/98)

SHEET 1 of 1

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Appendix C:
Waste Management Plan

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Naval Facilities Engineering Systems Command
Southwest
Base Realignment and Closure
Program Management Office West
San Diego, CA

Final

Appendix C

Waste Management Plan

Remedial Investigation for Per- and Polyfluoroalkyl
Substances at Installation Restoration Site 6

Former Naval Station Treasure Island,
San Francisco, California

March 2022

Naval Facilities Engineering Systems Command Southwest
Base Realignment and Closure
Program Management Office West
San Diego, CA

Final

Appendix C

Waste Management Plan

Remedial Investigation for Per- and Polyfluoroalkyl Substances at Installation Restoration Site 6

Former Naval Station Treasure Island, San Francisco, California

March 2022

DCN: MMAC-4010-5451-0006

Prepared for:
United States Department of the Navy
Naval Facilities Engineering Systems Command Southwest
750 Pacific Highway
San Diego, CA 92132

Prepared by:
Multi-MAC JV
1851 W 24th Street Suite 101
Yuma, AZ 85364-6104
(928) 344-8374
Contract Number: N62470-19-D-4010; Task Order No. N6247320F5451

Table of Contents

Page
Acronyms and Abbreviations.......... C-iii
C.1 Introduction.......... C-1
C.2 Remedial Investigation Activities.......... C-3
C.2.1 Release Contingency Planning.......... C-3
C.3 Waste Handling.......... C-5
C.3.1 Waste Handling.......... C-5
C.3.1.1 Excavated Asphalt/Concrete.......... C-5
C.3.1.2 Soil.......... C-5
C.3.2 Liquid Wastes.......... C-5
C.3.2.1 Regulated Substances Management.......... C-6
C.3.3 Potential Hazards.......... C-7
C.4 Applicable Regulatory Requirements.......... C-9
C.4.1 Federal Regulations.......... C-9
C.4.2 State of California Regulations.......... C-10
C.5 Waste Characterization.......... C-11
C.6 Storage by Waste Type.......... C-13
C.7 Waste Transportation, Treatment, and Disposal.......... C-15
C.8 References.......... C-17

List of Figures

Page
Figure C-1: Location Map.......... Figure-C-3
Figure C-2: Location Map.......... Figure-C-5

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Acronyms and Abbreviations

µg/L	microgram(s) per liter
APP	Accident Prevention Plan
BMP	best management practice
BRAC	Base Realignment and Closure
CAM	California Administrative Manual
CCR	California Code of Regulations
CFR	Code of Federal Regulations
DDW	Division of Drinking Water
DoD	United States Department of Defense
DON	United States Department of the Navy
DOT	United States Department of Transportation
ERA	Ecological Risk Assessment
GAC	granular activated carbon
HHRA	Human Health Risk Assessment
IDW	investigation-derived waste
IR	Installation Restoration
LC/MS-MS	liquid chromatography/tandem mass spectroscopy
LHA	lifetime health advisory
mg/kg	milligram(s) per kilogram
Multi-MAC JV	Multi-MAC Joint Venture
NAVFAC SW	Naval Facilities Engineering Systems Command Southwest
NSTI	Naval Station Treasure Island
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate

Acronyms and Abbreviations (continued)

PMO	Program Management Office
PPE	personal protective equipment
QSM	Quality Systems Manual
RI	Remedial Investigation
RSL	regional screening level
SAP	Sampling and Analysis Plan
STLC	soluble threshold limit concentration
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons
TTLC	total threshold limit concentration
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
WET	wet extraction test

C.1 Introduction

Multi-MAC Joint Venture (Multi-MAC JV), a joint venture of Wood Environment & Infrastructure Solutions, Inc. and Nicklaus Engineering, Inc., is supporting the Base Realignment and Closure (BRAC) Program Management Office (PMO) West by conducting a Phase I Remedial Investigation (RI) at Installation Restoration (IR) Site 6 (Former Fire Training School) at former Naval Station Treasure Island (NSTI), in San Francisco, California (Figures C-1 and C-2). The RI at IR Site 6 will consist of evaluations of (1) the nature and extent of per- and polyfluoroalkyl substances (PFAS) in soil and groundwater at IR Site 6, and (2) potential risk to human health and the environment. The work is being performed under Contract Number N6247019D4010, Delivery Order Number N6247320F5451.

This Waste Management Plan, which is Appendix C of the Work Plan for the Phase I RI, has been developed to address construction-related waste management activities specific to this project.

The objectives of the project are to perform a Phase I RI at the Former Fire Training School at former NSTI by collecting sufficient soil and groundwater analytical data to define the nature and extent of potential impact by PFAS, and perform a baseline Human Health Risk Assessment (HHRA) and evaluate groundwater analytical data against appropriate ecological screening criteria to support the conclusions of the supporting RI Report. PFAS analytical data from IR Site 6 collected during previous investigations will be incorporated with the results from this Phase I RI to define the nature and extent of PFAS contamination in soil and groundwater and will also be used in the baseline HHRA and Ecological Risk Assessment (ERA) to support site decisions.

The RI activities include installation and development groundwater monitoring wells, collection of groundwater samples, collection of soil samples, a fate and transport evaluation of the tidal mixing zone, and proper disposal of investigation-derived waste (IDW). The RI activities that will be completed are described in the Work Plan and Sampling and Analysis Plan (SAP; Appendix A of the Work Plan). A Phase I RI Report will be prepared to document the results of the RI and the baseline HHRA and ERA.

Wastes expected to be generated during RI activities include soil cuttings from well drilling, excavated soil, decontamination water, development water, and purge water. All soil cuttings and excavation wastes will containerized in lined soil bins with lockable lids. Purge water, development water, and decontamination water will be contained in United States Department of Transportation (DOT)-approved 55-gallon steel drums. In addition, should the area of drilling and/or excavation be paved with asphalt or concrete, these types of IDW materials will be generated. Solid wastes may include used personal protective equipment (PPE) such as latex gloves and general trash.

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C.2 Remedial Investigation Activities

The RI activities include installation and development of 15 groundwater monitoring wells; collection of groundwater samples from the 15 new groundwater monitoring wells and 9 existing groundwater monitoring wells; collection of 90 soil samples from 45 locations; a fate and transport evaluation of the tidal mixing zone; and proper disposal of IDW. The RI activities that will be completed are described in the Work Plan and SAP.

C.2.1 Release Contingency Planning

Multi-MAC JV has prepared standardized response plans to address potential release scenarios that could occur during the performance of these RI activities.

If a release of fuel is suspected or encountered, all mechanized equipment used for RI activities will be secured and inspected immediately to determine whether the equipment is the source of the release. Significant spills or threatened fuel releases will be reported immediately to the California Office of Emergency Services State Warning Center and the Unified Program Agency or 911.

A surface release from other sources such as buried utilities, unknown buried tanks, or other types of containers or piping will be reported immediately to the United States Department of the Navy (DON). The type and source of the release will be identified, and proper safety and PPE will be used to protect response personnel. Absorbent socks and dikes will be deployed immediately by response personnel to contain the extent of the release and prevent contamination of water resources while the source of the release is secured. Absorbent materials, pads, pillows, or socks will be used to clean up the balance of the released materials. The RI site equipment and response personnel will be decontaminated as necessary, and all collected product, decontamination materials, and used protective equipment will be characterized and containerized for proper disposal in accordance with waste management protocols. Post-response reports regarding notification documentation, any required medical monitoring and follow-up, waste disposition, and potential corrective actions will be provided to the Naval Facilities Engineering Systems Command Southwest (NAVFAC SW).

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C.3 Waste Handling

Wastes that will be generated include asphalt and or concrete, soil from drilling, groundwater from well development and purging, decontamination water, and solid wastes. Incidental liquid waste may be created during saw-cutting operations; this waste will be collected and managed by the saw-cutting subcontractor. Sections C.3.1 through C.3.3 describe handling of these waste types by field work task.

C.3.1 Waste Handling

Waste handling, including temporary storage and disposal, is discussed in the following subsections.

C.3.1.1 Excavated Asphalt/Concrete

Asphalt and/or concrete may be generated during the concrete coring portion of the project. Asphalt and/or concrete generated during this project will be segregated from other soil, temporarily stockpiled in the designated laydown area, and transported offsite for disposal and/or recycling.

Best management practices (BMPs), such as gravel bags or straw wattles, will be used to prevent debris from the stockpile from being washed away during a storm event. This asphalt and/or concrete material will be transported offsite following NAVFAC SW approval.

C.3.1.2 Soil

Excavated soil and soil cuttings from drilling will also be generated during the project. The soil generated during this project will be placed into soil bins lined with plastic and with lockable lids that can be secured for temporary storage in the designated IDW storage area. The soil will be sampled for laboratory analysis, and the results will be used to prepare a waste profile for acceptance approval by the designated disposal facility. All soil bins will be stored temporarily onsite pending receipt of the laboratory analysis results and disposal facility acceptance. The soil will then be transported to the disposal facility under a waste manifest to track the soil waste from the site to the disposal facility.

C.3.2 Liquid Wastes

Development water, purge water, and decontamination water from groundwater monitoring well drilling and sampling activities will be placed into DOT-approved 55-gallon drums and moved to the secured designated IDW storage area. The water wastes will be sampled for laboratory analysis, and the results will be used to prepare a waste profile for acceptance approval by the designated disposal facility. All liquid IDW drums will be stored temporarily onsite pending receipt of the laboratory analytical results and disposal facility acceptance. The liquid IDW drums will then be transported to the disposal facility under a waste manifest to track the waste from the site to the disposal facility.

C.3.2.1 Regulated Substances Management

Regulated waste that is sourced and generated by Multi-MAC JV's own actions is the responsibility of Multi-MAC JV or its subcontractors. Examples include, but are not limited to, wastes resulting from servicing vehicles (e.g., earth-moving equipment, generators, contaminated rags, filters, other contaminated consumables, etc.). Multi-MAC JV will coordinate with and provide the DON with documentation that these waste materials are properly disposed of or recycled.

Multi-MAC JV or its subcontractors will, label, segregate, accumulate, containerize, dispose of, and overall manage their waste as "the generator of the hazardous waste" in accordance with all federal, state, and local environmental laws or regulations, including, but not limited to, the following:

- Regulated waste/materials are not to be placed or disposed of in dumpsters or other waste (trash) containers.
- Regulated waste must be placed into DOT shipping containers.
- Wastes must be compatible with the containers used to store the waste.
- Any ignitable and/or reactive waste must be stored at least 50 feet from the closest inhabitable building.
- Containers are to be kept closed during storage except when adding or removing contents.
- Containers must have a clearly and properly filled-out label with the accumulation start date.
- Waste must be properly disposed of within 60 days from the initial accumulation start date.
- Inspection of the container storage area will be performed weekly, checking for open or leaking containers, missing labels, and or deterioration of containers or containment system.

Any hazardous waste or material spills or releases, regardless of quantity, must be reported immediately to the Fire Department at 911. Significant spills or threatened fuel releases will be reported immediately to the California Office of Emergency Services State Warning Center and the Unified Program Agency or 911. The cost of the cleanup and disposal of the spilled or released material is the sole responsibility of Multi-MAC JV or its subcontractors.

C.3.3 Potential Hazards

This section discusses human health hazards to workers resulting from potential exposures in workplace during the performance of this project. Information about nonchemical-related human health and environmental hazards is provided in the project Accident Prevention Plan (APP) (Multi-MAC JV, 2020).

The objective of this project is to define the nature and extent of PFAS compounds in the subsurface soil and groundwater at IR Site 6. Other potential hazards include crystalline silica and chromium dust from well completion activities, drilling hazards, and excavation and heavy equipment hazards. These hazards and the methods used to mitigate their impact are discussed in the APP (Multi-MAC JV, 2020).

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C.4 Applicable Regulatory Requirements

This section presents an overview of the primary regulatory requirements governing the management of wastes generated during this project. Federal, State of California, and local regulations are discussed in Sections C.4.1 and C.4.2.

C.4.1 Federal Regulations

Federal waste classifications are defined in 40 Code of Federal Regulations (CFR) 261. After a waste material has met the definition of a waste (40 CFR 261.2 and 40 CFR 261.4a) and is determined not to be an excluded waste (40 CFR 261.4b), it will become a hazardous waste if it is a “listed waste” (40 CFR 261.31 to 261.33). If the waste is not a “listed waste,” it still may be considered hazardous waste because of its hazardous characteristics (40 CFR 261.21 to 261.24), which include ignitability, corrosivity, reactivity, and toxicity.

For a waste to be considered hazardous under federal guidelines and regulations, the contaminant or constituent concentrations in a toxicity characteristic leaching procedure (TCLP) extract must exceed the TCLP limits for that specific contaminant or constituent. If the known total analytical contaminant concentrations are compared with the TCLP limits and the total contaminant concentrations are less than 20 times the published TCLP limits for the specific constituent, then TCLP extraction and r-analysis are not required because TCLP methodologies use a 20:1 dilution factor.

At this time, only three PFAS have U.S. EPA-derived toxicity values available to help understand potential health effects from exposure: perfluorobutanesulfonic acid (PFBS), perfluorooctanoic acid (PFOA), and perfluorooctane sulfonate (PFOS). In 2016, the United States Environmental Protection Agency (U.S. EPA) issued a drinking water lifetime health advisory (LHA) of 0.07 microgram per liter (µg/L) for PFOA and PFOS. When both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS (PFOA+PFOS) should also be compared with the 0.07-µg/L LHA level because of the similarity in the noncancer health effects of PFOS and PFOA (U.S. EPA 2016a, 2016b, 2016c). Although not legally enforceable, the LHA has been a driving force for investigation and remediation efforts.

Currently, PFBS is the only PFAS listed in the November 2021 U.S. EPA regional screening levels (RSLs). The generic RSL tables provide noncancer reference dose, screening levels for residential soil (19 milligrams per kilogram [mg/kg]), industrial soil (250 mg/kg), and tapwater (6 µg/L), and soil screening levels for protection of groundwater (0.0019 mg/kg) for PFBS only (U.S. EPA, 2021).

Once the waste has been characterized, it can be handled, transported, and documented until final disposition in accordance with 49 CFR 172.

C.4.2 State of California Regulations

To assess whether the waste is a hazardous waste under California regulations, specifically California Code of Regulations (CCR) Title 22 Division 4.5, waste samples must be analyzed for their total contaminant concentration and compared with the California total threshold limit concentration (TTLC) standards. If any contaminant concentration in the waste materials exceeds the specific California TTLC standard, then the waste is considered a hazardous material by California standards. If the contaminant concentrations do not exceed the TTLC standards but are more than 10 times the California soluble threshold limit concentration (STLC) standards, then the waste is required to undergo the California waste extraction test (WET). The rationale for this factor-of-10 is similar to the factor-of-20 rationale used for comparison with federal TCLP limits. If the WET test results exceed the STLC standards, then the waste is also considered a California hazardous waste, even if concentrations did not exceeded the federal TCLP and California TTLC standards.

On July 13, 2018, the California State Water Resources Control Board released guidelines for testing and reporting of PFOA and PFOS, based on Division of Drinking Water (DDW) recommendations. Notification levels are nonregulatory, health-based advisory levels established by the DDW for chemicals in drinking water that lack enforceable regulatory standards called maximum contaminant levels. The interim notification levels were 0.014 µg/L for PFOA and 0.013 µg/L for PFOS. In addition to setting interim notification levels for PFOA and PFOS, the California State Water Resources Control Board also included an interim response level of 0.07 µg/L for PFOA and PFOS combined, consistent with the drinking water LHA issued by U.S. EPA in 2016.

C.5 Waste Characterization

No reportable quantities of hazardous wastes are expected to be generated during the performance of this project; however, if physical conditions encountered during the performance of this project indicate the possible presence of regulated compounds, then the regulations discussed in Section C.4 will apply.

IDW aqueous and soil samples will be analyzed for some or all of the following parameters to characterize the waste for disposal:

- Volatile organic compounds (VOCs) by U.S. EPA Method 8260B
- Total petroleum hydrocarbon (TPH) as diesel and motor oil by U.S. EPA Method 8015D
- California Administrative Manual (CAM) 17 metals (soil only) by U.S. EPA Methods 6010B/7471A
- PFAS by liquid chromatography/tandem mass spectroscopy (LC/MS-MS) Compliant with United States Department of Defense (DoD) Quality Systems Manual (QSM) Version 5.3 Table B-15

For liquid IDW with a combined concentration of PFOA and PFOS greater than the U.S. EPA LHA of 0.07 µg/L, the liquid IDW should be treated onsite using granular activated carbon (GAC) or other acceptable technology so the combined PFOA and PFOS concentration is less 0.07 µg/L before disposal.

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C.6 Storage by Waste Type

Waste generated during excavation activities will be stockpiled in accordance with the BMPs identified above or collected in the appropriate DOT container, labeled with the content name and starting accumulation date, and stored at an interim, secure, waste storage area. Liquid waste will be disposed of appropriately by the subcontractor within 60 days of collection.

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C.7 Waste Transportation, Treatment, and Disposal

This section describes tentative plans for the transportation, treatment, and/or disposal of the various waste types as defined by applicable regulations.

Based on the laboratory analytical results for the soil and groundwater samples, a waste profile will be created that classifies the waste and is signed by the generating facility (or designated representative), acknowledging the classification. All soil, groundwater, and decontamination water will be transferred to the disposal facility under the waste profile generated for IR Site 6. A waste manifest will be generated from the waste profile and will be signed again by the generating facility (or designated representative) at the time the waste is readied for transport. The subcontracted waste transportation company will also sign the waste manifest accepting the load and will remove the waste from the generating facility’s property. When the waste arrives at the final disposal facility, the waste manifest will be signed by the final disposal facility, authorizing the acceptance of the waste. A copy of the waste manifest will be provided to the generating facility as proof of acceptance. The corrective action contractor will also retain a copy of the waste manifest as part of the official project files and will include a copy in the project report to the client.

Wastes determined to be nonhazardous will be transported offsite for recycling or disposal. Nonhazardous waste shipments will be tracked via standard paper manifests that are signed and dated by the waste generator, transporter, and disposal facility to track the movement of the wastes from the site to the final disposal facility. Copies of the standard manifests will be maintained by the generator, transporter, disposal facility, and corrective action contractor. The corrective action contractor will include the records of the shipments in project reporting, if required. Solid waste generated during sampling activities, such as PPE and miscellaneous trash, will be disposed of as nonregulated solid waste.

Documentation and tracking procedures will be implemented to ensure proper management and disposal of waste generated during field work. Waste documentation procedures involve labeling of the waste containers and maintenance of an inventory sheet for all waste containers. Tracking controls include the maintenance of a waste inventory from generation through disposal.

On June 30, 2018, U.S. EPA established a national system for tracking hazardous waste shipments electronically (called “e-Manifest”), thereby allowing U.S. EPA to accept electronic manifests in addition to the existing paper manifests. e-Manifest will be used to track hazardous wastes electronically from cradle to grave. Users can view, create, and sign electronic manifest forms electronically. e-Manifest will also allow generator and disposal site managers to manage and approve the forms electronically. U.S. EPA encourages the use of electronic submittals, although the statute allows optional use of paper manifests. Whenever possible, the corrective action contractor should attempt to use the e-Manifest system as it becomes more widely adopted by generators, transporters, and disposal facilities.

The management, storage, and disposal of waste will be controlled by implementing a waste-tracking log. The waste-tracking log will be updated on a daily basis and will be reconciled at the end of each week. The waste-tracking log will be maintained in the field.

The inventory form provides the following information:

- Site identification
- Dates of generation
- Method of storage
- Copies of manifests and transportation documentation
- Dates of waste treatment of disposal
- Method of disposal

The IDW storage area and all containers will be inspected periodically until all waste is removed for disposal. Any deficiencies found during the inspection that require corrective action (e.g., missing or damaged labels, leakage, or missing containers) will be recorded and reported to the Multi-MAC JV Quality Control Manager. Containers approaching the 60-day storage limit will also be documented.

The DON will be notified prior to initiation of each shipment of waste to be disposed of offsite and provided with a waste determination form for the designated materials to be shipped that will include the waste type, volume, transporting company, and name and location of receiving facility. No wastes will be shipped or disposed of without prior authorization from the DON representative. A Waste Disposal Report will be included in the RI Report that summarizes the classification, amounts, and disposal locations for all wastes transported offsite during the Phase I RI.

C.8 References

Multi-MAC Joint Venture, 2020. *Accident Prevention Plan Remedial Investigation for Per- And Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6*.

United States Environmental Protection Agency (U.S. EPA). 2016a. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)*. 822-R-16-004. May.

———. 2016b. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA).* 822-R-16-005. May.

———. 2016c. *Fact Sheet, PFOA and PFOS Drinking Water Health Advisories*. EPA 800-F-16-003. November.

———. 2021. *Regional Screening Levels*. November. Available at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

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Figures

Figure C-1: Location Map
Figure C-2: Location Map

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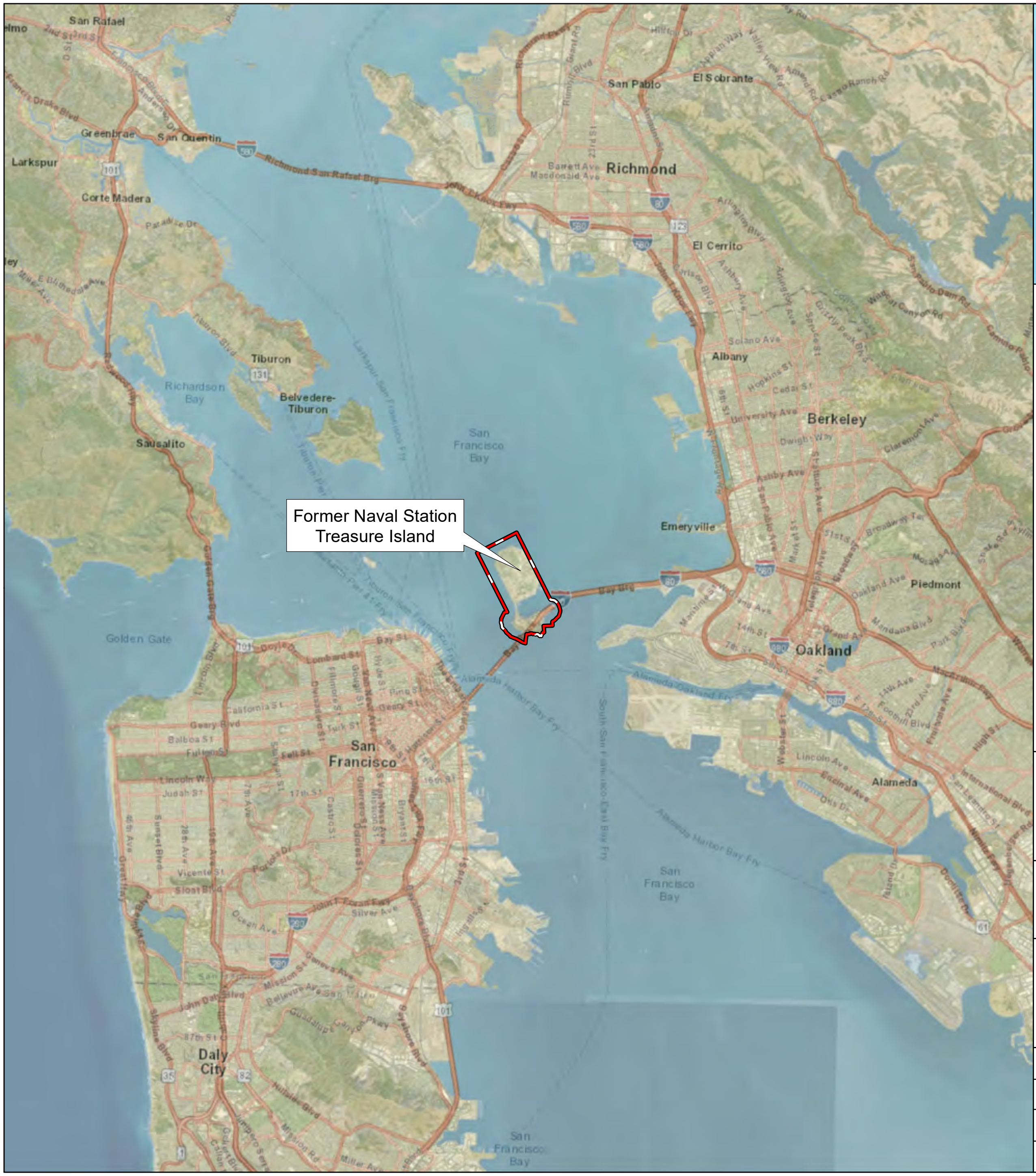

Not to Scale

Area Location Map

LEGEND

▭	Former Naval Station Treasure Island Boundary Boundary

Notes:
PFAS = Per- and Polyfluoroalkyl Substances

Basemap Source/Aerial Photo: ESRI ArcGIS online service 2020

N

0 1.5 3 6
In Miles

1 Inch = 3 Mile

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

Location Map

PROJECT NO.:	5026-20-4451
DATE:	November 2020
DRAWN BY:	KOB
CHECKED BY:	LC

NAVFAC

FIGURE

C-1

Date: 11/17/2020 Path: D:\FilesFromWork\5026-20\4451_TreasureIsland_PFAS_IRP6\GIS\Figs_TI_RI_WP_IRP6_Nov2020\Fig01_TI_IstallationLocation.mxd

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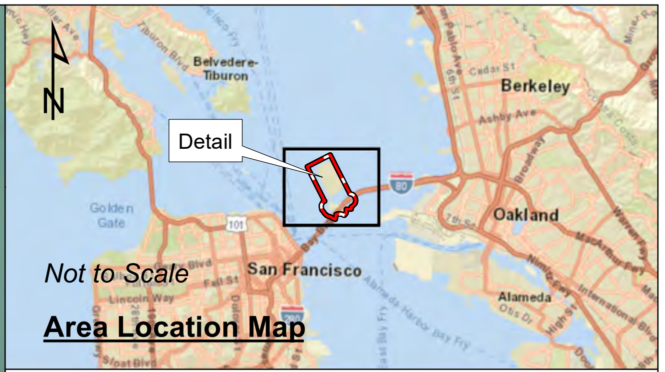

Not to Scale

Area Location Map

Legend

🟦 IRP Site 6 Location

🟥 Former Naval Station
Treasure Island Boundary

Notes:
IRP = Installation Restoration Program
PFAS = Per- and Polyfluoroalkyl Substances

Basemap Source: ESRI Online Streaming Service 2020

N

0 0.125 0.25 0.375 0.5
In Miles
1 Inch = 0.25 Miles

Remedial Investigation for
Per- and Polyfluoroalkyl Substances at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

IRP Site 6 Location Map

PROJECT NO.: 5026-20-4451	NAVFAC	**FIGURE**
DATE: November 2020		C-2
DRAWN BY: KOB		
CHECKED BY: LC		

Date: 8/4/2020 File: Fig02_TI_SiteLocation.mxd

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Appendix D:
Responses to Comments from Regulatory Agencies

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Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
Comments Received May 11, 2021, from Celina Hernandez, Engineering Geologist, Regional Water Board					
Comments on Draft Work Plan and Sampling and Analysis Plan					
1.	Section 3.1 (Nature and Extent of PFAS)	The Regional Water Board does not agree with the screening criteria presented in Section 3.1. Department of Defense screening criteria presented in this section does not include sediment and salt-waterecological target values which are proposed in Appendix A, Worksheet #11, Table 11-1. This section should compare existing data against screening criteria for all receptors and at least against the screening criteria in Table 11-1.	Section 3.1 describes the nature and extent of PFAS at IR Site 6 to date. Since only soil and groundwater samples have been collected thus far, those are the applicable screening criteria presented in Section 3.1.	The expectation is that the PFAS groundwater data evaluation be consistent across all Treasure Island technical reports by comparing to applicable Department of Defense (DoD) screening criteria in in Appendix A, Worksheet #11, Table 11-1, and applicable Water Board environmental screening levels (ESLs). See Navy's draft Five Year Review Addendum RTCs on Water Board Comment 4b and 5; and the draft annual monitoring report RTC on Water Board Comment 7 which indicates data will be compared to ESLs. Update Section 3.1 appropriately.	The DON (J. Lear) indicated during the Comment Resolution Meeting on October 25, 2021 that DON PFAS investigation will be performed in accordance with DoD Policy which requires comparison to the DoD screening levels, which does include the Water Board ESLs at this time. Furthermore, the RI will perform a baseline risk assessment using a comprehensive and site-specific information to evaluate the different receptors.
2.	Section 2.9 (Biological Resources) and Section 3.5.2 (Ecological Receptors and Exposure Pathways)	Regional Water Board staff do not agree with the statement that "No rare or endangered floral or faunal species are known to inhabit or visit the island on a regular basis (DON, 2003)." Recent fish tracking studies haveobserved the presence of migratory special status species (e.g., Chinook salmon, steelhead trout) in San Francisco Bay (Singer et al., 2013). Consideration of such species is pertinent for evaluating the protection of beneficial uses. Update Section 2.9, 3.5.2, and Table 3-1 as appropriate.	This statement was made in reference to terrestrial flora and fauna. The last sentence in that paragraph and in the first paragraph of Section 3.5.2 and last paragraph of Section 2.9 have been revised as follows: "*No rare or endangered* ***terrestrial*** *floral or faunal species are known to inhabit or visit the island on a regular basis (DON, 2003).*" The same revision has been made in Table 3-1. The DON agrees that migratory species have been documented in San Francisco Bay. However, it is unknown if these special status species are present nearshore of IR Site 6. Furthermore, marine ecological receptors will be evaluated in the food chain model as described in Sections 6.2.2 and 6.3.6.	Revised Section 2.9 text is acceptable, but the evaluation of ecological receptors and risk assessment in Section 6.0 remains open/on hold; pending Phase I data. The Navy agreed to compare data to the DoD screening criteria in Appendix A, Worksheet #11, Table 11-1 and Water Board ESLs (see Comment1 above).	Comment noted on Section 2.9 and Section 6.0. See response to Comment #1 above.
3.	Section 3.3 (Sources of Contamination and Potential Release Mechanisms)	Address the following: a. Potential Release Areas – More justification is needed for the potential release in this section. Provide more description of the conveyance line that transported aqueous film forming foam (AFFF) wastewater from IR Site 6 to the wastewater treatment plant (WWTP) (e.g. sanitary line, location enters from IR Site 6 to WWTP). Provide the reason that storage areas of material known to contain PFAS, AFFF concentrate, foam solution, and spent AFFF or water mixtures at IR Site 6 are not considered	a. The as-built drawings of the conveyance system showing the connection of the AFFF wastewater conveyance to the WWTP are not available to reference. However, the accurate GIS figure representing these systems is shown on Figure 3, including the location of the concrete-lined collector trench, the surge pit, and the OWS. From this figure, the wastewater from firefighting training flows by gravity from the paved L-shaped training area to the surge and sump pit from which it is pumped to the OWS.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		potential release areas. b. <u>Excluding Previous Excavations</u> – Regional Water Board staff do not agree with the statement in the last paragraph: "It is not anticipated that PFAS will be detected in the clean fill, and therefore the previous excavations will be taken into consideration during the site investigation and may be excluded from the exposure area considered in the risk assessment for PFAS." Provide justification for this assumption. Update text, Table 4-1, and Appendix A as appropriate.	An AFFF storage area or AFFF Station has been identified (location shown as Attachment F) and is approximately 40 feet north of the western edge of the helicopter training area shown of Figure 3. As a result, the location of proposed soil boring 06-SB81 has been moved to characterize the AFFF storage location shown on Figure 3. Figure 11 was updated to show the location of 06-SB81 (AFFF Station). The following sentence has been added to last paragraph of Section 2.1: "*An aqueous film-forming foam (AFFF) Station was located in the northern boundary of the central training areas adjacent to the V-ditch collector trench (Harding Lawson Associates, 1987) (Figure 3).*" The sampling rationale for the soil boring location in Table 4-1 of the Work Plan and Table 17-1 in Worksheet #17 of the SAP has been revised as follows: "*Evaluate the nature and extent of PFAS in soil at the former AFFF Station in the northern boundary of the central training areas adjacent to the V-ditch collector trench*". b. Added reference: Harding Lawson Associates (HLA). 1987. Initial Hazardous Material Investigation Firefighting Training Center. Treasure Island, California, August.Soil samples will be collected at depths of 0–2 feet bgs and approximately 4–6 feet bgs above the capillary fringe at each boring location. All soil sample data collected will be used the baseline human health risk assessment calculations. Source: Harding Lawson Associates. 1987. *Initial Hazardous Material Investigation Firefighting Training Center*. Treasure Island, California, August.		
4.	Section 4.0 (Remedial Investigation Sampling Approach) and	Regional Water Board staff do not agree that the two proposed nearshore pore water and sediment reference locations are located "in an area not impacted by potential PFAS release from IR Site 6 or othersources at former NSTI."	The text in the 4th bullet of Section 4.0 has been revised for clarity as follows: "*Collection of sediment samples from nine locations nearshore of IR Site 6, and two nearshore reference locations in an area not*	Reference locations – on hold (Associated with DTSC PM #24)	Comment noted. Characterization of nearshore sediment and pore water at IR Site 6 will be discussed in further detail for Phase II portion of the RI.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
	4.5 (Sediment and Pore Water Sampling Approach)	See Comment 12 for more explanation. Update Sections 4.0, 4.5, Table 4-1, and Appendix A as appropriate.	*impacted by potential PFAS release from IR Site 6 or from other PFAS areas of interest identified in the Final PFAS Preliminary Assessment (PA) at NSTI (Multi-MAC JV, 2021).*" The proposed reference locations (SE-10 and SE-11) were selected to evaluate potential ***ambient*** PFAS in surface sediment and pore water that did not originate from IR Site 6. Selection of these reference locations was based on the following: 1. The reference locations are in a sediment accretion zone, similar to the proposed nearshore sampling at IR Site 6 (see Attachment B). Ambient suspended sediment deposition nearshore of IR Site 6 would be similar to that in the reference locations. 2. The reference locations are not located downgradient of potential PFAS areas of interest identified in the Final NSTI PFAS PA (see Attachment A). 3. The reference locations are cross-gradient of IR Site 6 based on the reported groundwater gradient toward the northeast. 4. The reference locations are located approximately 760 feet cross-gradient of IR Site 6 based on reported groundwater gradient toward the northeast. 5. This RI will evaluate potential PFAS discharge to SF Bay from IR Site 6. It will be important to determine if concentrations of PFAS in porewater and sediments offshore from IR Site 6 are within the same range as ambient concentrations of PFAS in SF Bay presented in peer-reviewed literature (SFEI, 2020).		
5.	Section 4.0 (Remedial Investigation Sampling Approach)	Regional Water Board staff do not agree with the proposed PFAS analyte list of 18 PFAS compounds. However, the longer list provided in Table 1 of Attachment 2 in Appendix A is more appropriate given the DON's use of legacy AFFF at IR Site 6 and the potential threat it poses to aquatic species. Legacy AFFF, manufactured from late 1960s until 2002, contained several perfluoroalkane	The list of 18 PFAS analytes is part of the DON guidance (DON, 2020). The DON's current policy is to follow the list of PFAS recommended for analysis in this guidance because of the evolving state of the science in the development of PFAS analytical methods (i.e., the existence of multiple analytical methods that report slightly different target analytes). The DON further indicates that this list will be updated as new test methods are	EPA's October 2021, Strategic Roadmap for PFAS Action in 2021-2024 indicates a larger PFAS analyte list is in our future, if the analyte list is not adjusted now, it may be required in the future. See Note 1 at end of table.	The DON will continue to evaluate new analytical methods including the referenced U.S. EPA Method 1633 developed between U.S. EPA and DoD, as they are available.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		sulfonates and fluorotelomers that were not included in the 18 proposed PFAS. In addition, fluorotelomers are known to degrade to perfluorooctanoate (PFOA) and other perfluoroalkyl carboxylates (PFCAs) (ITRC, 2020). Aquatic life toxicity criteria and screening levels exist for many fluorotelomers and PFCAs (Divine, 2020). Therefore,the analyte list should be updated to include the following additional PFAS, consistent with Table 1 of Attachment 2 in Appendix A: • 4:2 Fluorotelomer sulfonate (4:2 FTS) • 6:2 Fluorotelomer sulfonate (6:2 FTS) • 8:2 Fluorotelomer sulfonate (8:2 FTS) Perfluoropentane sulfonate (PFPeS) • Perfluoroheptane sulfonate (PFHpS) • Perfluorononane sulfonate (PFNS) • Perfluorodecane sulfonate (PFDS) • Perfluorooctanesulfonamide (PFOSAm) • Perfluorobutanoate (PFBA) • Perfluoropentanoate (PFPeA)	approved and U.S. EPA and DoD issue guidance and directives regarding their appropriate use. Reference: DON. 2020. Interim Per- and Polyfluoroalkyl Substances Site Guidance for NAVFAC Remedial Project Managers, November 2020 Update. November 24.		
6.	Section 4.2.1 (Direct-Push Soil Sampling), fifth paragraph	Address thefollowing: a. The last paragraph on geochemical analysis may be more appropriate in another section of the Workplan (e.g. health and ecological risk assessment sections). b. The basis of the geochemical analysis is not clear. Provide a description regarding how the soil samples collected for geochemical analysis will be used to conduct the fate and transport evaluation.	a. The last paragraph merely indicates that samples for geochemical analyses will be collected using direct-push sampling techniques. It is appropriate for Section 4.2.1. b. Fate and transport of PFAS can be affected by carbon content in the soil (particularly longer-chain PFAS), pH, redox potential, and ionic charge. For instance, downward leaching of PFAS in unsaturated soils can occur during precipitation and irrigation that would promote dissolution of soil bound mass and transport the PFAS chemical to groundwater. The leaching potential is a function of both media properties (such as pH, redox potential, and increased partitioning with organic rich soils) and PFAS structural properties (such as ionic charge and PFAS molecule chain length) (ITRC, 2020), as follows "*PFAS can sorb to organic carbon, positively charged mineral surfaces, and oil by hydrophobic and electrostatic interactions. Low pH (increased hydrogen ion activity) and high*	b. The basis of geochemical analysis is still not explained. Explain how the data will be used. Confirm whether or not this will be included in phase I scope.	b. The geochemical analysis is included in the analysis of soil samples during the Phase RI. The geochemical analysis are not associated with site decision criteria like the PFAS analysis. The locations of geochemical samples are selected to provide coverage across the IR Site 6 and the samples selected for geochemical analysis are listed in Table 4-1.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			calcium ion activity tend to promote sorption. For the PFOS compound, anions in solution may compete with PFOS for electrostatic adsorption to positive surfaces (i.e., electrical double layer effect); however, anions in solution may also reduce repulsion of PFOS molecules, forcing them to pack together on weak positive to negative surfaces (NGWA Press, 2017). PFOS tends to exist as dissolved species in low salinity water, i.e., freshwater, but sorbed to sediment in high salinity water, e.g., in seawater (Weiss et al. 2015).” The above text has been added in the soil sampling fate and transport discussion in the 2nd paragraph of Section 3.4.		
7.	Section 4.4.1 (Summary of Previous Tidal Studies), second paragraph	The last paragraph needs clarification of biodegradation of PFAS versus petroleum hydrocarbons. Include a caveat that this discussion has limited relevance for PFAS since soluble petroleum hydrocarbons are susceptible to biodegradation whereas PFAS have more limited susceptibility to biodegradation.	The following sentence has been added to the end of the last paragraph of Section 4.4.1: “*Note that petroleum hydrocarbons have different transport and biodegradation characteristics than PFAS.”*		
8.	Section 4.4.2 (IR Site 6 Tidal Influence and Mixing Zone Evaluation), second paragraph	Regional Water Board staff do not agree with the proposed timing of tidal study. In general, for tidally influenced waterbodies, groundwater discharge is expected to be greatest during low tide rather than high tide. Therefore, it is recommended that the study be conducted during a seasonally low tide or, alternatively, during two periods, one period during highest tide and one period during lowest tide. Provide a justification for the timing of the study relative to tides.	The tidal study will be conducted over approximately 26 tidal cycles over a 2-week period. The second paragraph states that the tidal study will be performed during a period of “maximum tidal amplitude,” i.e., the period when the tidal cycle has the greatest difference between low and high tides, thus representing a seasonal low and high tide levels within the study period. In San Francisco Bay, such extreme tidal fluctuations are predicted to occur at least once each month according to NOAA Tide Predictions (tidesandcurrents.noaa.gov/noaatidepredictions.html ?id=9414782) as shown with highlighted text on Attachment G for the rest of 2021. The tidal study will occur within the period of maximum fluctuations when the lowest tide level is below the mean lower low water (MLLW) as shown on Attachment G.	Navy indicates the Tidal Study (Section 4.4 of the RI WP) will be conducted during Phase I over approximately 26 tidal cycles in a two-week period of extreme tidal fluctuation per the RTCs. This is acceptable.	
9.	Section 4.5 (Sediment and Pore Water Sampling	Address the following: a. <u>Pore Water Sampling Locations</u> –Regional Water Board staff do not agree with the sample spacing. The spacing between	a. The intent of the pore water and sediment sampling is to evaluate potential exposure of ecological receptors to PFAS potentially present in the bioactive zone. The shallow	Additional Regional Water Board Comment received by email on October 14, 2021 – Ross Steenson (Senior Geologist) and Nicole Fry (toxicologist):	Characterization of nearshore sediment and pore water at IR Site 6 will be discussed in further detail for Phase II portion of the RI.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
	Approach), Pore Water Sampling Approach and Method	samples on Figure13 varies between about 100 and 240 feet. While the spacing appears suitable for characterizing pore water where the contaminant source is in sediment, the spacing does not appear to be well designed for locating and characterizing contaminated groundwater discharges from the upland to surface water. In addition, no explanation is provided for the location of the first row of pore water samples, which is about 100 feet from the shoreline monitoring wells. Provide a technical rationale for the proposed location and spacing of pore water samples. USEPA (2008) indicates that a proper ecological risk evaluation of such discharges necessitates an accurate determination of the contaminated groundwater discharge location. Update the text, Table 4-1, and Appendix A as appropriate. b. Pore Water Sample Depths i. Regional Water Board staff do not agree with the proposal of one sample depth to evaluate pore water in Section 4.5.2. Pore water samples should be collected from two depths at each location to understand the gradient of PFAS concentrations in potentially migrating toward the San Francisco Bay. Ideally, one sample would be located immediately beneath the bioactive zone and one in the bioactive zone. This information is useful both for evaluating whether contaminated groundwater is discharging and for characterizing the initial exposure concentrations and attenuation through the bioactive zone. Update Section 4.5.2 and any other sections, Table 4-1, and Appendix A asappropriate. ii. Provide justification for assuming the bioactive zone is limited to the top 0.5 foot beneath the sediment	groundwater occurs in fill and fine to medium sand at IR Site 6 and primarily loose sand (original shoal sand); thus, the potential for a limited groundwater discharge area should be expected. Furthermore, the proposed sampling is intended to capture not only potential groundwater discharge impact on sediment and pore water, but also potential discharge from runoff and stormwater. Using the empirical Ghyben-Herzberg relation of freshwater-seawater interface, a groundwater discharge zone nearshore of IR Site 6 is estimated to be approximately 5 feet horizontally from the shoreline (Attachment E [Ghyben-Herzberg estimate]); thus, the shallow groundwater seepage likely occurs within the revetment/rip rap which extends to approximately 50 feet from the shoreline (Attachment C). It should be noted that the nearshore environment at IR Site 6 is low energy environment with net accretion of sediment (Attachment B); therefore, the sediment next to the toe of the revetment is representative of discharging groundwater at this location. The initial transect spacing is selected to be 50 feet from the shoreline based on the seawall construction at IR Site 6 (see Attachment C). The original seawall and the stone riprap extend at least 50 feet from the new shoreline. Thus, a minimum distance of 50 feet is required to provide boat access, limit refusal from encountering riprap materials, and maximize the availability of sediment not covered by riprap. The spacing for the subsequent transects will be revised to be approximately 30 feet to capture potential surface runoff and stormwater outfall discharge within the low energy environment nearshore of IR Site 6. Thus, the proposed sediment sampling locations will be revised to be 50 feet, 80 feet, 110 feet and 140 feet from the shoreline. b.	Based on this initial review, we have identified a critical issue to be addressed associated with RTC Comment 9 (Water Board) on Section 4.5 (Sediment and Pore Water Sampling Approach), Pore Water Sampling Approach and Method. We feel it is important to share the issue with you in advance of 10/18: Due to the physical access limitations that are not anyone's fault, the proposed porewater and sediment samples cannot be a primary line of evidence in characterizing the potential groundwater discharge or evaluating risk to receptors in the likely groundwater discharge zone. Summary of Issue: a. Based on the additional information provided by the Navy, there is a 50-foot-wide zone of rip rap along the shoreline near Site 6. The anticipated groundwater discharge zone likely occurs beneath the rip rap about 5 feet from landward edge of the rip. The proposed first transect of porewater samples is at the toe of the rip rap, about 45 feet distant bayward, considering the access challenges posed by the rip rap. The proposed locations are too far from the discharge zone and therefore not adequate for characterizing whether a groundwater discharge is occurring, characterizing the discharge or assessing risk. The porewater and sediment samples, as currently proposed, can be used to "screen in" (e.g., conclude that a groundwater discharge is occurring, conclude there appears to be significant risk) but not "screen out" (e.g., conclude a groundwater discharge is not occurring, conclude there is no significant risk). Based on the current scope of work, the groundwater well data will be the primary line of evidence for evaluating whether a groundwater discharge is occurring and the level of risk.	

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		surface. USEPA (2015) provides a compilation of available information on bioactive zone thicknesses. Alternatively, consider a field determination of the zone thickness. Update Section 4.5.2 and any other sections, Table 4-1, and Appendix A as appropriate. c. Pore Water Sampling Method The text in Section 4.5.2 and 4.5.3 presents conflicting information regarding the pore water sampling method. The first sentence in Section 4.5.2 indicates a “Van Veen grab sampler will be used to collect pore water in surface sediment” whereas the first sentence of Section 4.5.3 indicates “A vibracore sampler will be used to collect subsurface sediment and pore water samples from 11 offshore locations.” Please update the text as appropriate and/or provide the purpose for the different proposed methods. d. Pore Water Sampling Method Regional Water Board staff do not agree with the Van Veen sampler method proposed in Section 4.5.2. Provide an alternative method or justification for the proposed method. Update Section 4.5.2, Table 4-1, and Appendix A as appropriate. For the evaluation of contaminated groundwater discharges to surface water, the preferred pore water (interstitial water) sampling approach is in-situ sampling rather than ex-situ sampling because it is more likely to maintain the integrity of the sample (e.g., redox state). However, if in-situ sampling is not possible, then the least destructive sediment sampling method should be employed in the following descending order of preference: core, Eckman, Ponar, Van Veen (USEPA, 2001). While the Van Veen sampler is widely used to collect grab samples of surficial sediment, it is a poor method for collecting pore water samples because it destroys the sample integrity and is likely to capture surface water (i.e., it would not be representative). Pore water	i. The proposed pore water samples are intended to evaluate exposure to ecological receptors in the bioactive zone where benthic exposure will be evaluated and is expected to be at 0.5 ft below sediment surface per USEPA guidance (see RTC b.ii below). Additionally, per the response to Comment #9a above, the estimated groundwater discharge is likely to occur at the groundwater/surface water interface within the revetment/rip rap and mixing with shallow sediment and porewater during tidal fluctuations, rather than through upwelling of groundwater through the sediment away from the shoreline. ii. According to U.S. EPA (2015), “*In estuarine intertidal and subtidal, as well as marine coastal and offshore habitats, the biologically relevant sediment depths (biotic zone) for decisions related to ecological risk assessments extends to 5-15 cm. The 80th percentile of benthic depth distribution is less than 5 cm in most marine environments.*” Reference: U.S. EPA. 2015. Determination of The Biologically Relevant Sampling Depth For Terrestrial and Aquatic Ecological Risk Assessments. Ecological Risk Assessment Support Center. EPA/600/R-15/176. ERASC-105C. October). This interval may be revised on the basis of field observations. c. The title of Section 4.5.3 has been revised to “Vibracore Operation and Sediment Sampling”. The Van Veen grab sampler will be used for collection of pore water samples and the vibracore will be used to collect surface and subsurface sediment samples collocated with the pore water sample locations. The vibracore will not be used for pore water sample collection. To reflect this, the text in the first paragraph in Section 4.5.3 has been revised to clarify the intended use of the vibracore sampler as follows:		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		sample collection should endeavor to minimize changes to the in-situ condition of the water. Sample integrity issues include: (1) maintaining physicochemical conditions in the natural state by minimizing adsorption/leaching of chemicals to/from the device, and (2) the ability to maintain the sample in the redox state existing at the site. Given that sediment cores will be collected anyway, then additional cores could be advanced and pore water extracted from the cores by centrifugation in the laboratory, a standard procedure. e. <u>Additional Pore Water Analyses</u> – Regional Water Board do not agree with the proposed pore water analyses in Section 4.5.4. Consider analyzing both groundwater and pore water samples for major cations and anions to develop Piper or Trilinear diagrams (USGS, 1985) as a geochemical line of evidence for evaluating groundwater discharge to surface water. f. <u>Sediment Surface Elevations</u> – The Work Plan should include measuring the elevation of the sediment surface to support development of cross sections that would inform the conceptual site model and aid the evaluation of contaminated groundwater discharge to surface water. Please add a section in Section 4.5 describing the procedures.	"*A vibracore sampler will be used to collect surface and subsurface sediment samples from the 11 offshore locations.*" d. The DON elected to use the Van Veen grab sampler for pore water sample collection in the bioactive zone for the following reasons: i. The provided U.S. EPA (2001) reference in the comment also recommends use of the Van Veen sampler because of the nearshore site conditions anticipated at the proposed locations (silty to silty sand), other site concerns (including sampling near riprap), and likely turbulent tidal waters. Diver-deployed peepers were not considered a viable alternative for pore water sample collection, and the Trident probe is subject to lateral loading, particularly in areas of high water movement. Pore water sample collection may be limited in the very fine sediments anticipated in the surface sediment at this site. It is anticipated that the Van Veen sampler will cause less disruption to the surface sediments in the bioactive zone (see Attachment H for field photographs of grab surface sediment showing sample with intact sediment surface with existing vegetation on 2nd picture of Attachment H). ii. The PFAS detected in groundwater and soil at IR Site 6 do not volatilize or reduce/attenuate with changes in redox change, nor is it clear that sampling using the Van Veen sampler will result in significant change in redox conditions. iii. The specific sampling procedures are described in the Southern California Coastal Water Research Project (SCCWRP, 2014, also see Attachment H) and include the acceptability criteria for each retrieved sediment sample. After the Van Veen sampler is brought to the surface any standing water inside the sampler will be decanted using stainless steel turkey baster-type device to remove the water or other PFAS-free clean hand		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			tools. The decanted water will remove any surface water on top of the sediment in the sampler. The bulk sediment in the sampler also provides the added advantage to select exact sediment profile within the bioactive zone. The remaining sediment will then be shipped to the laboratory where it will be centrifuged to extract pore water. This sampling technique will likely provide a representative estimate of pore water concentrations for this specific site. This sampling methodology is described in Section 4.5.2. iv. Pore water has been collected successfully using the Van Veen grab sampler in an offshore sediment investigation at NSTI (TtEMI, 2001). This investigation was performed for PAHs, which are more sensitive to physiochemical changes than PFAS. e. The primary objective of the proposed pore water sampling is to evaluate the potential exposure of ecological receptors to PFAS nearshore of IR Site 6 within the bioactive zone. Cations and anions analyses will not support the assessment of risk to ecological receptors. See response to Comment #9a above about the potential location of groundwater discharge. f. A description of sampling location and measurement of sediment depth will be added to Section 4.5.1. A bathymetric survey is not required and is not planned for this phase of RI at IR Site 6. The following text is added to the first paragraph of Section 4.5.1: "*To navigate to each sampling location, a sub-meter Differential Global Positioning System (DGPS) will be used. The depth to the sediment surface will be sounded using the onboard transponder. Both the location, measurement time and depth will be recorded to approximately estimate the sediment surface elevation.*" Reference: Southern California Coastal Water Research Project (SCCWRP). 2014. Sediment		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			Quality Assessment Technical Support Manual. Technical Report 777. January.		
10.	Section 5.2 (Human Health Risk Assessment – Preliminary Scoping Activities),first paragraph	Regional Water Board staff disagree that the fish consumption pathway is not considered. Regardless of the current fishing practices and restrictions at IR Site 6, the potential beneficial use of the San Francisco Bay for commercial and sport fishing must be protected. Therefore, a quantitative baseline human health risk assessment (HHRA) for this pathway should be conducted. The perfluorooctane sulfonate (PFOS) and PFOA Environmental Screening Levels (ESLs; Water Board, 2020) provide risk-based levels for assessment of the fish consumption pathway and input values used in these ESLs should be considered when conducting the baseline HHRA. Technical justification should be provided if exposure parameters are different from those used in the fish consumption ESLs. Additional explanation is provided below: a. The Regional Water Board will not permit discharges that impact or threaten to impact existing or potential beneficial uses protected by the San Francisco Bay Regional Water Board's Basin Plan (Regional Water Board, 2017). Both federal and state statutes require permits from regulatory agencies for the discharge of anything to the waters of the state or the United States. The word "permit" means "permission," or as it applies to the regulation of environmental cleanup sites, an authoritative or special certificate of permission. Regulatory communications such as approvals, concurrences, no further action letters, and orders, constitute the permits for cleanup sites. b. Commercial and sport fishing is an existing and potential beneficial use of the San Francisco Bay that is protected by the Basin Plan. The Basin Plan also protects the beneficial use of groundwater that replenishes a surface water body. Therefore, the Basin Plan requires that groundwater discharges to surface water	The DON concurs that the fish consumption pathway is potentially relevant. It is assumed that consumption of fish and shellfish that may be exposed to offshore sediments in the vicinity of IR Site 6 may occur under current and future conditions. However, it is not currently known whether PFAS are discharging from the site to the shoreline. The RI will use an iterative process, and this phase of the investigation focuses on identifying the source and understanding whether PFAS are present in offshore media. The RI will identify whether PFAS are potentially present nearshore of IR Site 6 and at what concentrations. The RI will also document the species relevant for consumption by reviewing available site-specific fishing reports. If PFAS are present in pore water (used as a conservative surrogate for surface water), and relevant species are consumed near the site, then this information will provide the basis for evaluating the fish and shellfish consumption pathway in a future phase of work, if warranted. a. Comment noted. b. Comment noted. The RI report will make recommendations for the next step in the CERCLA process in coordination with the regulatory agencies.	The iterative approach should include quantitative evaluation of the fish and shellfish consumption pathway if contamination is found to be discharging to surface water regardless of current fish consumption near the site. (Associated with DTSC General Comment 1, 2, 3; DTSC Human and Ecological Risk Office (HERO) Comment 4).	Comment noted. Assessment of offshore recreation users at IR Site 6 will be discussed in further detail for Phase II portion of the RI.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		do not impact the existing or potential beneficial uses of that surface water body.			
11.	Section 5.3 (Human Health Risk Assessment – Exposure Points), second paragraph	Regional Water Board staff do not agree with the proposed HHRA procedures. To clarify, if hot spots are identified, exposure point concentrations should be calculated for each hot spot. In addition, for contaminated groundwater discharge zones, averaging should be limited to the appropriate pore water data within the discharge zones.	Hot spots are not anticipated because of the small site size. If hotspots are identified, the DON will coordinate with regulatory agencies on an appropriate approach to evaluate them.		
12.	Section 5.5.2 (Human Health Risk Assessment – Identification of Potential Exposure Scenarios), fourth paragraph, and Section 6.3.4 (Background Comparison)	Address the following: a. Regional Water Board staff do not agree with the use of "ambient", "background" and "anthropogenic" interchangeably. Please revise the text throughout the Work Plan as appropriate. For clarity, "background" should only be used to refer to naturally occurring chemicals and "ambient" should beused for man-made chemicals. PFAS are man-made chemicals, so there is no concentration of PFAS that can be considered "background." b. Regional Water Board staff do not agree with the proposed sediment and pore water reference locations (SE-10 and SE-11) to evaluate "background" conditions because they could be influenced by ambient surface water levelsof PFAS in the San Francisco Bay. Provide the justification for these proposed locations. Update Section 4.0, 5.5.2, Section 6.3.4, Table 4-1, and Appendix A as appropriate. c. To clarify, when evaluating contaminated groundwater discharges to surface water, groundwater concentrations upgradient of the release area are the appropriate background levels for comparison with pore water samples. The Regional Water Board will not permit groundwater discharges with contaminant concentrations that are significantly impacting or threaten to significantly impact existing or potential Beneficial Uses protected by the Basin Plan regardless of surface water ambient levels.	a. The RI Work Plan has been revised for consistency and uses the term "ambient concentrations" when describing releases of PFAS unrelated to DON activities at IR Site 6. b. The proposed reference locations (SE-10 and SE-11) were selected to evaluate potential ***ambient*** PFAS in surface sediment and pore water that did not originate from IR Site 6. Selection of these reference locations was based on the following: 1. The reference locations are in a sediment accretion zone, similar to the proposed nearshore sampling at IR Site 6 (see Attachment B). Ambient suspended sediment deposition nearshore of IR Site 6 would be similar to that in the reference locations. 2. The reference locations are not located downgradient of any potential PFAS areas of interest identified in the final NSTI PFAS PA (see Attachment A). 3. The reference locations are cross-gradient of IR Site 6 based on reported groundwater gradient toward the northeast. 4. The reference locations are located approximately 760 feet cross-gradient of IR Site 6 based on reported groundwater gradient toward the northeast. 5. This RI will evaluate potential PFAS discharge to SF Bay from IR Site 6. It will be important to determine if concentrations of PFAS in porewater and sediments offshore from IR Site 6 are within the same range as ambient concentrations of PFAS	b. Reference sampling locations - on hold	b. Comment noted. Characterization of nearshore sediment and pore water at IR Site 6 will be discussed in further detail for Phase II portion of the RI.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			in SF Bay presented in peer-reviewed literature (SFEI, 2020). c. Comment noted, as indicated in the response to Regional Water Board Comment #12a.	c. RTC does not address our comment. Please address our comment: The Regional Water Board will not permit groundwater discharges with contaminant concentrations that are significantly impacting or threaten to significantly impact existing or potential Beneficial Uses protected by the Basin Plan regardless of surface water ambient levels.	c. The groundwater discharge with PFAS concentrations that significantly impact or threaten the existing or potential beneficial uses of the bay is being assessed during this phased RI. The ambient PFAS in surface water is discussed with respect to future characterization that should distinguish between ambient PFAS from PFAS discharge from IR Site 6.
13.	Section 5.4 and 5.6 (Human Health Risk Assessment and Toxicity Assessment)	The Regional Water Board concurs that, "the COPC (contaminant of potential concern) approach will be used for the risk evaluation using both U.S. EPA toxicity criteria and State of California toxicity criteria, which may be implemented if the toxicity values for PFOS and PFOA developed by California in support of the drinking water notification levels are formally adopted into the California Toxicity Criteria Rule." Please clarify the meaning of the phrase "project period of performance" in both sections.	The term "project performance period" is a contractual term that is not germane to the Work Plan, it has been revised as follows: "The COPC approach will be used for the risk evaluation using both U.S. EPA toxicity criteria and State of California toxicity criteria, which may be implemented if the toxicity values for PFOS and PFOA developed by California in support of the drinking water notification levels are formally adopted into the California Toxicity Criteria Rule *if adopted prior to preparation of the draft HHRA.*"		
14.	Section 6.2.2.1 (Ecological Risk Assessment – Benchmark Comparisons), last paragraph	The Regional Water Board staff disagree that "measured sediment concentrations cannot be quantitatively assessed for protection of benthic invertebrates in the marine environment." While the Regional Water Board acknowledges that "reliable ecological screening benchmarks for bulk sediment have not yet been developed at the national regulatory level" for the protection of benthic invertebrates, the Sediment Quality Provisions of the Water Quality Control Plan for Enclosed Bays and Estuaries of California (State Water Board 2018) requires that the following narrative sediment quality objective for aquatic life benthic community protection be met: *Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries implemented using the integration of multiple lines of evidence approach.*	Effects on the benthic community will be quantitatively assessed by comparing sediment pore water concentrations with surface water screening benchmarks since pore water concentrations are considered a better representation of the bioavailable fraction than bulk sediment concentrations. Samples of pore water will be collected within the bio-active zone where benthic communities are located. If national ecological screening benchmarks for sediment are available during the preparation of the draft ERA, those screening benchmarks may be used by the DON to evaluate exposure of marine benthic invertebrates in the bay.	Sediment and porewater sampling/benthic community evaluation – on hold	Characterization of nearshore sediment and pore water at IR Site 6 will be discussed in further detail for Phase II portion of the RI.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		Therefore, the Work Plan must include an approach to meet this objective.			
15.	Section 6.2.3 (Ecological Risk Assessment – Screening-Level Exposure Estimate and Risk Calculation), fourth paragraph	Regional Water Board staff do not agree with the DON's policy "that resulting HQ values should not be compared or added together between COPECs (contaminant of potential ecological concern) or receptors; instead, they should be considered individually" per the 1999 "Navy Interim Policy for Conducting Ecological Risk Assessment" (1999 document). The cited 1999 document provides no discussion regarding toxicity reference values and adding/comparing hazard quotient values. Either remove this paragraph or provide adequate justification for retaining it.	PFAS HQs will not be added because of the lack of current consensus in the scientific community as to whether or not ecological effects of PFAS are additive and whether they even affect the same target organ or organ system. The reference will be corrected to the Tri-Service Handbook for Ecological Risk Assessment (Simini et al, 2000), and the Navy Guidance for Conducting Ecological Risk Assessments (DON, 2004). The Tri-Service guidance states that "Often, HQs are inappropriately added together to get a Hazard Index (HI) for multiple contaminants. ERAGS states that it may be appropriate to sum HQs into an HI, but only for contaminants that produce adverse effects by the same toxic mechanism." The 2004 DON guidance reiterates this point as "Because of the large degree of uncertainty regarding the cumulative effects of multiple contaminants, NAVFAC does not recommend the use of HIs unless adequate rationale is provided to support the summation of the individual HQ values." The referenced text, fourth paragraph of Section 6.2.3 is revised as follows: "*Because of the differences in the degree of conservatism in TRVs selected for various COPECs and receptors, it is DON policy that resulting HQ values should not be compared or added together between COPECs or receptors; instead, they should be considered individually (DON, 2004)*." Added reference: Simini, M., R.T. Checkai, and M.E. Maly. 2000. Tri-Service Remedial Project Manager's Handbook for Ecological Risk Assessment. SFIM-AEC-ER-CR-200015. Aberdeen Proving Ground, MD.		
16.	Section 6.3.1 (Ecological Risk Assessment – EPC Refinement)	The Regional Water Board staff do not agree with the procedure to use an arithmetic mean, median, or other measure of central tendency when there is insufficient data to calculate the 95 percent upper confidence limit. When there is insufficient data to calculate a 95 percent upper confidence limit of the arithmetic mean,	EPCs based on maximum concentrations will be used to estimate risks in the screening-level risk assessment. Estimates of central tendency will be used in the Tier II Step 3A risk refinement step to bound risk estimates. The preference is to use 95% UCL. However, the maximum concentration may be used as the EPC depending on data		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		the maximum value should be used. Update sections where appropriate.	distribution or detection frequency, in accordance with U.S. EPA CERCLA ecological risk assessment guidance.		
17.	Tables in the Work Plan	Address the following: a. Tables cover sheet, Table 3-1 – Correct the misspelling of "model." b. Table 2-3 – All detected PFAS should be tabulated. If not in this Work Plan, then in the next report. c. Table 5-2 – Confirm whether the entries "USEPA 2019" in the reference column should be "USEPA 2020" per the notes at the end of the table.	a. The spelling of "Conceptual Site Model" has been corrected. b. All reported PFAS compounds from previous soil (3 PFAS listed in Table 2-3) and groundwater (14 PFAS) sampling events will be reported in the RI report. Additionally, the RI report will provide the analytical results for all 18 PFAS analyzed during the proposed RI and during previous investigations in summary tables and analytical data appendices. c. The correct reference for U.S. EPA, 2019 in Table 5-3 is "*U.S. EPA, 2019. Update for Chapter 3 of the Exposure Factors Handbook, Ingestion of Water and Other Select Liquids. Office of Research and Development. EPA/600/R-18/259F. February*." This reference has been added, and the U.S. EPA 2020 reference has been removed.		
18.	Appendix A (Sampling and Analysis Plan)	a. Worksheet# 11, Table 11-1 – Regional Water Board staff do not agree with the no further action determination proposed and the proposed screening criteria. The table does not provide screening criteria for all receptors and exposure pathways for each media. For example, soil and groundwater screening criteria only consider direct human health contact and not surface water quality via soil leaching and groundwater discharge to surface water; no criteria for benthic organisms; and no criteria for human health fish consumption. Until all the screening criteria mentioned above are established or a baseline/site-specific human health and ecological risk assessment are conducted, no further action determinations cannot be made for any media. b. Attachment 2 (Laboratory Standard Operating Procedures), Table 1 – For clarity, explain the reason Table 11-1 of Worksheet #11 does not match thePFAS analyte list in Table 1 in Attachment 2 of Appendix A.	a. The DON is collecting pore water samples as a surrogate for surface water for comparison to the available surface water screening values in this RI. It is not necessary to have or use soil and groundwater screening criteria that are protective of soil leaching and groundwater discharge to surface water, for benthic organisms, and for human health fish consumption to make decisions. This is because these other media and pathways are being evaluated independently and in parallel with the upland investigation. A more robust and technically sound approach based on multiple lines of evidence is employed by direct collection of groundwater, sediment and porewater data at the exposure locations and using this data to evaluate risks. If risks are at acceptable levels in the other media, this would support no further action in soil and groundwater in relation to those pathways. b. Table 1 in Attachment 2 of Appendix A lists all the PFAS that the selected laboratory is capable of analyzing, and SAP Worksheet #11 Table 11-1 lists the 18 PFAS recommended	a. Porewater and sediment sampling – on hold; Phase I will use onshore data closest to Bay to conduct screening level risk assessment for ecological receptors. We anticipate more discussions during Phase I and during the development of Phase II activities. b. See Notes for Comment 5 above If the laboratory will have analytical results for all analytes in Table 1 of Attachment 2 in Appendix A, those results should be provided.	a. Characterization of nearshore sediment and pore water at IR Site 6 will be discussed in further detail for Phase II portion of the RI. b. See response to Water Board Comment #5 above.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		c. Attachment 3 (Standard Operating Procedures), Section 3 (References) – Correct the date of the California State Water Quality Control Board – Division of Water Quality sampling guidelines. The most recent version is September 2020 rather than March 2019. Extend this to similar references throughout the document.	for analysis per the DON (2020) guidance. See the response to Regional Water Board Comment #5. The DON further indicates that this list will be updated as new test methods are approved and U.S. EPA and DoD issue guidance and directives regarding their appropriate use. c. The standard operating procedures (See in Attachment 3 of the SAP) have been revised to use the most current SWRCB PFAS sampling guidelines.		
19.	Minor Corrections	Address the following: a. Section 2.1.3 (Future Planned Land Use), second paragraph, second sentence 3 – Replace “ate” with “at.” b. Section 2.7 (Hydrogeology), second paragraph – The last sentence is truncated. c. Section 3.1 (Groundwater), third bullet, second sentence – “All 48” should be“All 49.” d. Section 4.3.1 (Groundwater Monitoring Well Installation and Sampling), first paragraph – Check the wording of the second sentence; it’s confusing. e. Toxicity Reference Values – In Section 6.2.2 of the document (page 6-7) it appears that there should be a Section 6.2.2.4 entitled Toxicity Reference Values. f. Figure 2 – Under “Notes” above ground storage tank (AST) and underground storage tank (UST) acronyms are defined, however, there are no ASTs and USTs mapped on the figure. Please add ASTs and USTs. g. Figure 3 and 10 – Recommend adding stormwater catch basins and flow arrows to show the wastewater runoff flow path described in Section 3.3 on Figure 3 and 10. Recommend adding former USTs on Figure 10, and the oil/water separator system components shown on Figure 3. h. Figures 8 and 9 – Recommend consistent ordering of chemicals of	a. The suggested change has been made. b. The sentence has been revised as follows: “*Groundwater recharge primarily occurs from infiltration of precipitation with some contribution from landscape irrigation.*” c. The text is correct. Only 48 of the 49 samples detected PFOS, therefore the statement is correct. PFOS was not detected at temporary well HP10. d. The sentence has been revised as follows: “*The final well design can be adjusted relative to the measured static depth to groundwater, so that the final well design will allow for the collection of a representative groundwater sample from the depth of potential water-bearing sand and gravel layers observed in the boring.*” e. Concur. Section 6.2.2.4 Toxicity Reference Values has been added. f. Figure 2 has been revised to remove unused acronyms AST, PFAS, and UST. g. The catch basin locations have been added to the stormwater line feature to flat Figure 3; they cannot be shown accurately on the three-dimensional rendering of the CSM on Figure 10. Similarly, arrows showing AFFF wastewater flow have been added to Figure 3 to show flow direction along the collector trench to the surge pit. The connection between the surge pit and OWS is described in the text of the 2014 ROD (DON, 2014); no drawing showing this connection is available.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		concern on figures. Figure 8 presents PFOS then PFOA whereas Figure 9 presents PFOA then PFOS. i. Figure 9, Legend – Recommend renaming the solid grey line defined as “Utilities” to stormwater utility. Another option is to include “STM” in the line and define as stormwater utility.	h. The order of the presented compounds has been adjusted. i. Although the stormwater line is for the utilities of interest on Figure 9, other utilities such as water lines and steam lines are also shown. No change has been made to this figure.		
Comments Received May 19, 2021, from Peyton Ward, Project Manager, Site Mitigation and Restoration Program – Berkley, DTSC				**Additional Comments Received on October 25 and 28, 2021, during Comment Resolution Meetings, and on October 26 and 29, 2021, by email**	
General Comments					
1.		DTSC understands that the Navy does not plan to reference the San Francisco Bay Regional Water Quality Control Board’s (Water Board’s) Environmental Screening Levels (ESLs) in the Work Plan or subsequent Remedial Investigation (RI) report. However, in areas where the ESLs provide a point of comparison where no “nationally recognized” number is available, DTSC suggests that the Navy consider those ESLs for screening purposes. Consideration of the ESLs will allow the Navy to consider additional pathways, not covered by the screening levels proposed in the Work Plan. For example, in the absence of a soil screening level based on leaching potential, a remedy could leave concentrations in soil in place that threaten groundwater quality.	The DON has prepared and submitted its position in a letter to Mr. Alec Naugle, Chief, Toxics Cleanup Division of the Regional Water Board, on the Interim Final ESLs for PFOS and PFOA memo (Regional Water Board, 2020) on March 8, 2021. The DON is investigating PFAS releases and potential risk under CERCLA, which provides a consistent, risk-based approach for cleanup, robust state agency review, and public participation using the authority provided under the DERP, 10 U.S.C Sections 2701–2711.	DTSC defers to WB re: use of ESLs.	See the response to the previous Regional Water Board comment on the use of ESLs.
2.		The United States Environmental Protection Agency (USEPA) Regional Screening Level (RSL) calculator toxicity value for perfluorobutanesulfonic acid (PFBS) has been revised as of the date of these comments. The revised RSL worksheet will be released this month. Please revise the screening levels in this Work Plan for PFBS in response to this change.	The toxicity value for PFBS has been updated with the most recent U.S. EPA toxicity value and the associated RSLs for respective media. Changes have been made to Sections 2.11, 3.1, 5.6, Table 2-3, Figures 8 and 9.		
3.		Please provide an in-depth description of novel coronavirus disease 2019 (COVID-19) prevention procedures. Procedures must be sufficient to ensure that DTSC staff are not put at risk when performing fieldwork oversight.	The APP for this project contains a detailed description of the COVID-19 prevention procedures. A reference to these procedures will be included in the text of the RI report. These	As previously requested, please provide a copy of the Accident Prevention Plan so DTSC’s Industrial Hygiene staff can review the COVID prevention procedures.	See attached the COVID-19 portion of a comprehensive site APP and Site and Health Safety Plan. This section is for DTSC informational purposes only.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		Please draft these procedures in consultation with the new California Division of Occupational Safety and Health (CalOSHA) standard (enclosed) (T8 California Code of Regulations [CCR] Section 3205).	procedures conform to the new CalOSHA standard (T8 CCR Section 3205).		
4.		The date of first use of PFAS-containing aqueous film-forming foam (AFFF) is not specified in the Work Plan. Please provide a more specific date as this will assist in the development of the conceptual site model (CSM). For example, Section 3.3. describes that military specifications required PFAS-containing AFFF by 1969, yet the text indicates that use of PFAS-containing AFFF on Site began in the 1970s.	The Military Specification for AFFF (MIL-F-24385) was issued in 1969. The 3M Company AFFF product was approved by the DON and made available for use in 1970; however, the exact date of its first use at IR Site 6 is not known.		
5.		The Work Plan repeatedly refers to "potential release(s)" of PFAS on the Site. DTSC objects to this terminology as the release of PFAS-containing AFFF is well-documented and preliminary sampling has identified PFAS impacts in soil and groundwater. Please revise the work plan throughout to either reference "documented release(s)" or remove this qualifying language.	The word "potential" has been deleted from "potential releases" when discussing soil or groundwater. The use of "potential" is retained for offshore sediment and pore water where it is not known if the onshore PFAS release has impacted this media.	The following sections still include language referring to "potential" releases: the Section 3.3. header and body text ("PDAS may have been released to the environment at former NSTI IR Site 6 because of AFFF"), Table 4-1, Appendix A: Worksheet 10 (Section 10.1.1 and 10.5), Appendix A: Worksheet 17, and Attachment A3 (Section 5.2).	The release of PFAS at IR Site 6 is positively stated in Section 3.1 as follows: "*The environmental impacts on IR Site 6 from activities at the Former Fire Training School were identified in soil and groundwater in previous investigations, as discussed in Section 2.11.*" Thus, there is no ambiguity regarding whether PFAS have been released on at least four locations onsite. The objective of the RI is to delineate the extent of the release, and this involves characterizing other potential release locations. The Section 3.3 header refers to "potential release mechanisms"; this is appropriate because even though there may be a known release based on sampling, the mechanisms for that release (sources, timing/frequency, type of release, etc.) may not be. The use of "potential release" from past activities in the second paragraph of Section 3.3 is appropriate because previous sampling focused primarily on the former burn pits where release of PFAS have been confirmed at four of five soil sampling locations. The extent of the release has not been delineated. The RI will facilitate delineation of additional potential release locations at 40 new sampling locations in and around IR Site 6, including AFFF storage areas (e.g., 06-SB81) and former buildings (e.g., 06-

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
					SB85), etc. The extent of the release area(s) will be documented in the RI report. Similarly, "potential release" is used in Worksheet #10 of the SAP to describe the delineation effort. Table 4-1 presents the rationale for sampling a given location to confirm whether a release has actually occurred at that location with the objective to delineate the nature and extent of PFAS onsite. Section 5.2 in Attachment 3 of the SAP simply presents field procedures to guide field sampling at PFAS sites; these procedures are not specific to IR Site 6. The use of "potential PFAS" is appropriate.
6.		Appendix C refers to imported fill material. If fill is being imported, please ensure that the guidelines laid out in the DTSC Information Advisory Clean Imported Fill Material (DTSC, 2011) are followed. If import fill is anticipated, please also revise Appendix A, Sampling and Analysis Plan (SAP) to include a worksheet on import fill.	Use of imported fill is not anticipated during the RI. Reference to imported clean fill has been removed from the Waste Management Plan.		
Specific Comments					
1.	Executive Summary, 1st sentence, 4th paragraph	Please revise the first sentence of the fourth paragraph to clarify that 11 total sediment and pore water samples will be taken, including the two from reference locations.	This sentence has been modified as follows: "*Additionally, 11 cores will be advanced nearshore of IR Site 6 to collect sediment samples. The samples will be collected from nine primary sampling locations and two reference locations.*"		
2.	Section 1.1 1st paragraph	Section 1.1 – Please revise the first paragraph to make it clear that, in addition to groundwater, pore water concentrations will be used to determine if there are unacceptable impacts to receptors, including ecological receptors.	The first sentence of this paragraph has been revised as follows: "The objectives of the project are to determine whether per- and polyfluoroalkyl substances (PFAS) released to the environment from activities at IR Site 6 are migrating to San Francisco Bay and whether the presence of PFAS in soil, groundwater, pore water and/or sediments presents an unacceptable risk to site users *and ecological receptors*."		
3.	Section 2.1.3	This section jumps around between describing the entire former NSTI and Site 6. Please streamline the text to increase clarity. Please also include a brief description of the prior remedial action at Site 6 and what a "removal"	This section is solely about IR Site 6. A brief description of the 2016 remedial action is already provided in this section as documented in the RACR. The measures to be taken as a result of removal or change to any component of the	I reiterate my request that the potential treatment wetland associated with the wastewater treatment plan be included in the discussion of future land use, as it is included in the Design for Development document.	The following text has been added to the end of the first paragraph of Section 2.1.3: "*There are no perennial surface water bodies at IR Site 6. Future plans for lands adjacent to IR Site 6 may include development of*

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		of any component of it would entail. Please also include the potential for a treatment wetland associated with the wastewater treatment plant in the description of future land use.	remedy are described in the final LUC RD, as referenced in this section. To streamline the text, specific information on future use of areas outside the footprint of IR Site 6, including the referenced wastewater treatment plant, will not be presented in the IR Site 6 specific RI report.		*stormwater wetlands (CE2-Kleinfelder JV, 2018).*" Source: CE2-Kleinfelder Joint Venture (CE2-Kleinfelder JV). 2016. Final Remedial Design Remedial Action Work Plan, Installation Restoration Site 6, Former Naval Station Treasure Island, San Francisco, California. April.
4.	Section 2.5	Section 2.5 includes a description of the soils on YBI. This is not relevant to Site 6 and should be removed.	The discussion of YBI geology has been removed from the text where appropriate.		
5.	Section 2.11	Please revise the penultimate bullet to clarify that the prior remedial action at Site 6 did not target or consider PFAS.	The following sentence has been added to the fourth bullet: "*This remedial action did not target PFAS-impacted soil at IR Site 6.*"		
6.	Section 3.3	Section 3.3 – Please revised the text to take into consideration the potential for PFAS in groundwater to have contaminated clean fill used to backfill prior excavations.	The depth of the excavations ranged from 1 to 2 feet bgs in most areas to as much as 5 feet in a very limited area of the site. Based on previous groundwater level measurements at IR Site 6, the shallowest depth to groundwater between 2013 and 2020 in the area of the remedial action (e.g.,06-MW25) was a depth of 4.3 feet adjacent to a small area previously remediated to a depth of 5 feet bgs. There is no evidence to indicate that groundwater has risen significantly to impact the overlying fill materials with PFAS.		
7.	Section 3.4	Section 3.4 states that the mass of PFAS released to the subsurface at Site 6 has not been estimated. Please include a historical assessment of past use to estimate the mass of release. If not, please provide a technical justification for excluding this line of research.	There are no available records that document the amount, specific formulations, and concentrations (e.g., 3% or 6% formulation) of AFFF used at IR Site 6 during its operational history. In addition, even though a substantial portion of the soil at the site has been removed in several removal actions, PFAS were not part of the analyte list, so a reliable distribution of PFAS cannot be assessed. Without this information, it is not possible to calculate a reliable mass estimate for the site.		
8.	Section 3.4	Section 3.4 – Please clarify the construction of the collector trench (e.g., concrete- lined, bare earth, etc.), as well as any available information about its condition throughout the period of its use (e.g., intact, fractured, etc.).	According to available information, the collector trench was a shallow, concrete-lined V-ditch used to convey wastewater from firefighting training area within the paved L-shaped area to a surge pit and OWS for oil recovery (HLA, 1987). However, there are no as-built drawings or available records documenting the condition of the trench during the		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			relevant time period. Please note that the collector trench location will be characterized during this RI. A total of 12 soil sample locations will be advanced immediately adjacent to or near the collector trench or other important collection points such as the OWS, surge pit and sump pit (Figure 11).		
9.	Section 3.5.2	Section 3.5.2 states that there are no endangered floral or faunal species known to inhabit the Island. Several special status species are known to occur in the waters around Treasure Island including: green sturgeon, central California steelhead, winter-run Chinook salmon, California sea lion, harbor seal, Double-crested Cormorant, and California Brown Pelican. Please expand the text accordingly.	This statement refers to **terrestrial** flora and fauna. The first sentence in that paragraph has been changed to indicate terrestrial flora and fauna. The DON agrees that that special status migratory fish have been observed in San Francisco Bay (see Regional Water Board Comment #2). Note that the double-crested cormorant and Pacific harbor seal have been identified as receptors to be evaluated using food chain models in Section 6.2.1.2.	The text is silent on special status birds. DTSC requests that language consistent with prior approved documents be used. For example, the Corrective Alternatives Evaluation for Site YF3 states: "The California least tern (Sterna antillarum browni) and California brown pelican (Pelecanus occidentalis) feed throughout the region and have been observed near former Naval Station Treasure Island (Tetra Tech, 2003)."	Section 3.5.2 has been revised as follows: "*Several water-dependent special-status species, including the California least tern (Sterna antillarum browni) and California brown pelican (Pelecanus occidentalis), feed throughout the region and have been observed near former NSTI (TtEMI, 2003).*" Source: TtEMI. 2003. Final Corrective Action Plan, Inactive Fuel Lines, Naval Station Treasure Island, San Francisco, California. December.
10.	Section 4.1.2	Please note that Underground Service Alert (USA) tickets should be submitted as early as possible. USA tickets at Site 6 will have to be cleared through the Terradex Alert system, to ensure that all necessary precautions are being observed. This could delay the start of fieldwork.	Comment noted. The underground utility location, including notification of USA, will begin as soon as possible following notice to proceed.		
11.	Section 4.2.1 and Section 5.3	Based on other sections of the Work Plan, as well as discussions during the November 19, 2020, Base Realignment and Closure (BRAC) Cleanup Team (BCT) meeting, it is DTSC's understanding that soil samples will be taken from the soil/groundwater interface, to capture PFAS's tendency to partition to the interface between environmental media. Please revise this section to make it clear that a soil sample will be collected from the groundwater interface.	The text of Section 4.2.1 has been revised as follows: "*Subsurface soil samples will also be collected from a depth of approximately 6 feet bgs using a direct-push drive sampler that will obtain soil samples up to 48 inches long to collect a soil sample at the soil/groundwater interface. The deeper soil sample will be collected from the portion of the 48 inches sample core, based on field observation, that is representative of the capillary fringe.*" Since section 5.3 is intended to describe the aggregation of previous and proposed analytical data to perform an HHRA, and not to describe the soil sampling, the proposed clarification in Section 4.2.1 is considered sufficient.	Please provide more details on how these sample counts were arrived at.	A number of proposed geochemical samples were selected to provide coverage across the investigation area. Please note that site decisions are not tied to the results of geochemical sampling, and data quality objectives (e.g., regulatory or screening criteria) have not been developed for them. At 14 soil sampling locations, soil samples will be collected for geochemical analysis. A total of 11 samples to be analyzed for saturated hydraulic conductivity and effective porosity are in the saturated zone; all 14 samples will be analyzed for the other 10 geochemical analyses listed in Section 4.2.3. The results of the geochemical analysis are intended to inform the fate and transport of PFAS in subsurface soil. Text in Section 4.2.3 has been revised as follows:

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
					"The locations of geochemical samples are selected to provide coverage across the IR Site 6. The samples selected for geochemical analysis are listed in Table 4-1."
12.	Section 4.2.3	Please revise the text to explain how the 11 of 14 samples will be selected for geochemical properties.	Table 4-1 lists the 11 samples selected for additional geochemical analyses. The text has been revised as follows to direct the reader to this explanation: "*In addition, at 14 soil sample locations, soil samples will be collected for geochemical analysis as described in Section 4.2.1. Eleven (11) of the 14 soil samples will be selected based on soil type, moisture content and other physical characteristics to ensure all potential soil types found at IR Site 6 are analyzed for geochemical parameters.*"		
13.	Section 4.3.1.1	Please revise Section 4.3.1.1 to state that bollards will be installed to protect the wells from damage due to vehicle traffic.	The text is revised as follows: "*Following well installation, a traffic-rated, flush-mounted well cover and four bollards will be installed at each new groundwater monitoring well for protection from vehicle traffic.*"		
14.	Section 4.3.2	Please note that containerized waste pending analysis should be labeled "pending" not "nonhazardous pending."	The next to last sentence in Section 4.3.1.2 has been revised as follows: "*The drums will be labeled as pending receipt of the laboratory analytical report.*"		
15.	Section 4.3.1.4	Please clarify in the text why two 250-milliliter (ml) samples will be collected at each groundwater sampling location.	A volume of 250 mL is the standard amount required by the laboratory for PFAS analysis, and the second bottle is used as a backup by the laboratory. Please see SAP Worksheet #19 for the project requirements for sample containers.		
16.	Section 4.4.	Please clarify whether "recently installed monitoring wells" refers to the wells installed as part of the Work Plan.	"Recently installed monitoring wells" refer to ones that will be installed as part of this RI not previously installed wells. The text in the first sentence of Section 4.4 has been revised as follows: "*Hydraulic communication between site groundwater and San Francisco Bay will be re-evaluated using the existing monitoring wells and monitoring wells to be installed as part of this RI to assess the magnitude of potential groundwater transport of PFAS-impacted groundwater into the bay (Figure 12).*"		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
17.	Section 4.4.1	Section 4.4.1 discusses results from other sites indicating groundwater contamination is not migrating toward the Bay. Results of prior sampling on and near Site 6 have found the highest concentrations in wells closest to the shoreline. Therefore, this discussion does not appear to be relevant. Please remove or provide a justification for including it.	The results discussed in this section indicating contaminants were not migrating to the Bay from UST 240, which is within the boundaries of IR Site 6. Therefore, fate and transport investigations performed for UST 240 are relevant to IR Site 6.		
18.	Section 4.6	Section 4.6 – The final paragraph of this section appears to be out of order. Please re-order this section to describe the waste before going into the characterization and disposal process.	The last paragraph of Section 4.6 has been moved to the beginning of the second paragraph.		
19.	Sections 5.2, Section 5.5.1 and 5.5.2	Sections 5.2, Section 5.5.1 and 5.5.2 are ambiguous about the prevalence of fishing at Treasure Island. DTSC staff have observed people fishing on Treasure Island on nearly every occasion they have visited the Island. In addition, the DTSC Project Manager (PM) has seen people fishing from or immediately adjacent to Site 6. Please revise the text to remove this ambiguity.	The DON concurs that the fish consumption pathway is potentially relevant. It is assumed that consumption of fish and shellfish that may be exposed to offshore sediments in the vicinity of IR Site 6 may occur under current and future conditions. However, it is not currently known whether PFAS are discharging from the site to the shoreline. The RI will use an iterative process, and this phase of the investigation focuses on identifying the source and understanding whether PFAS are present in offshore media. The RI will identify whether PFAS are potentially present nearshore of IR Site 6 and at what concentrations. The RI will also document the species relevant for consumption by reviewing available site-specific fishing reports. If PFAS are present in pore water (used as a conservative surrogate for surface water), and relevant species are consumed near the site, then this information will provide the basis for evaluating the fish and shellfish consumption pathway in a future phase of work, if warranted.	DTSC still objects to the use in Sections 5.5.1 and 5.5.2 of language qualifying the presence of fishing activities on the Island. These instances include: Section 5.5.1 – "Fishing and shellfish harvesting may occur offshore"; and Section 5.5.2 – "Fishing activities will be documented if present." Please remove this language from the final draft.	The second sentence of Section 5.4.1 will be revised as follows: "*Onshore fishing activities have been observed throughout NSTI and in the general vicinity of IR Site 6 by various stakeholders.*" This will serve as documentation that fishing occurs. The third paragraph of Section 5.4.2 will be deleted as requested: "~~Fishing activities will be documented if present and any restrictions (existence of receptor), combined with a discussion of any detected concentrations in pore water and sediment (existence of migration pathway).~~"
20.	Figure 2	DTSC requests that the depth of prior excavation be presented in a color ramp to aid in interpretation.	Use of the color ramp was not deemed effective in attempts to clarify the map. No change has been made to the legend.		
21.	Figures 8 & 9	Please include the screening levels for each respective media on these figures.	The requested screening levels will be provided on these figures.		
22.	Figure 11	Soil boring location 06-SB69 has a much smaller label than the rest of the proposed samples. Please make all sample location labels uniform.	The label font has been changed to match the font used for the other labels.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
23.	Figure 12	The proposed groundwater wells do not appear to be designed to fully delineate the extent of the PFAS plume, which should be an objective of the RI. For example, results of the 2020 PFAS sampling revealed concentrations of PFAS exceeding screening levels outside the boundaries of Site 6 in all terrestrial directions (e.g., HP01 through HP09 and HP11-HP13), including into the wastewater treatment plant (WWTP) property and Site 32. Please propose additional locations that can be sampled at least as a first attempt to fully delineate the extent of the plume.	The proposed monitoring well locations for this RI should be sufficient to define the extent of the plume emanating from sources at IR Site 6. Additional investigation is planned for other sites in the vicinity of IR Site 6 during the planned PFAS Site Inspection to evaluate other potential sources at NSTI. Should additional wells be required in additional to those planned in this Work Plan, those recommendations will be included in the conclusions and recommendations section of the RI report.	Need to harmonize between this document and PFAS PA re: how impacts on WWPT plant will be investigated.	The DON accepts that further delineation will be performed onshore. Five new monitoring wells will be installed to delineate the previously reported PFAS concentrations within the WWTP and northeast of IR Site 6 during this initial phase of the RI. The work plan and SAP have been revised accordingly (e.g,, the five additional locations are shown on Figure 12 of the work plan).
24.	Figure 13	Figure 13 shows the reference locations for sediment and pore water sampling as offshore from Site 12. As was mentioned in the November 8, 2020, BCT meeting discussing this Work Plan, DTSC does not consider this an appropriate reference location. Though the Navy has asserted that PFAS-containing AFFF would not have been used in open burning at the Site 12 Solid Waste Disposal Areas (SWDAs) due to timing, the site remains a disposal area. Considering the evolving understanding of what products and practices release PFAS into the environment, it is not appropriate to use the area immediately adjacent to the SWDAs as a reference area. Further, based on the results of the September 2020 hydropunch sampling, the PFAS plume in groundwater has not been bounded in the direction of Site 12. It is possible that releases of PFAS at Site 6 have migrated into groundwater at Site 12 and may be discharging in the direction of the proposed reference locations. DTSC requests that the Navy identify a reference area that has no history of burning, dumping, or other industrial impacts in the immediate vicinity, for example, along the southwestern shoreline of Treasure Island.	See the response to Regional Water Board Comment #12 regarding the rationale for reference sampling locations. The nearest reference location is 760 feet away and cross-gradient from the 2020 Hydropunch locations. The reference locations were selected cross-gradient of IR Site 6 and other potential PFAS release locations per the Final Basewide PFAS PA Report for NSTI. Although the reference areas are located offshore of a former disposal area, disposal ended in in the mid-1960s prior to development and use of AFFF. The suggested southwestern corner of NSTI is primarily erosional and is not representative of the sediment characteristics nearshore of IR Site 6 (see response to Regional Water Board Comment #12 and Attachment B). Additionally, the DON has identified a new PFAS AOI, AOI 4 (Building 180 Truck Washrack transferred to TIDA) near the southwestern shoreline of NSTI (see Attachment A). This may make this area unsuitable as a reference area.	Reference locations – on hold	Characterization of nearshore sediment and pore water at IR Site 6 will be discussed in more detail for Phase II portion of the RI.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
25.	Figure 16	Please ensure that this figure is kept up to date. For example, the Work Plan was submitted for agency review later than described in the Project Schedule, which will affect downstream dates. Updates can be held until the Final Work Plan is ready for submission.	The schedule will be modified as schedule changes occur. The most up-to-date schedule will be presented in the Final RI Work Plan.		
26.	Table 2-3	Please include the screening levels on each page of this table, not just the final page.	The table has been revised to move the screening levels to the header row.		
27.	Table 3-1	The Information Category column includes an entry “Physical Profile and Use and Exposure File” Please clarify in the table what an exposure file is.	The use of “File” was a typographic error, the column entry has been changed to “*Physical Profile Land Use and Exposure Profile.*”		
28.	Table 3-1	Relationship of Contaminant Sources to Potential Receptors states that “there are no known current contaminant sources.” Please clarify this statement. Is this intended to express that there are no current PFAS release operations at Site 6? Prior sampling has made it clear that there are PFAS impacts to both soil and groundwater onsite.	The text has been revised as follows: “*There are no current operations at IR Site 6 that would lead to additional releases of PFAS. Human receptors may come into contact with PFAS in surface and subsurface soil or groundwater while onsite.*”		
29.	Table 3-1:	Table 3-1: Relationship of Contaminant Sources to Habitat and Potential Receptors – Please add “terrestrial” to the start of the statement “ecological receptors will not be exposed to PFAS…”.	The text has been revised as follows: “*Terrestrial ecological receptors will not be exposed to PFAS, if present, in soil because they are not present onsite.*”	The text is silent on special status birds. DTSC requests that language consistent with prior approved documents be used. For example, the Corrective Alternatives Evaluation for Site YF3 states: “The California least tern (Sterna antillarum browni) and California brown pelican (Pelecanus occidentalis) feed throughout the region and have been observed near former Naval Station Treasure Island (Tetra Tech, 2003)."	The text in Section 3.5.2 has been revised as requested. See also the response to Comment #9.
30.	Table 4-1	a. Please confirm the depths and extent of prior excavation and fill for the sampled included in this table. DTSC has identified some potential discrepancies between the depths described in Table 4-1 and shown in Figure 2. For example, 06-SB70 appears to fall in an area that was excavated to 2.5 feet below ground surface (ft bgs), not 1-2 ft bgs, and 06-SB76 does not appear to fall within the prior excavation. b. Please clarify that both the shallow and deeper soil samples will be analyzed for	a. The depth of fill has been confirmed in Table 4-1, and the figures have been checked to ensure that no discrepancies exist. Please note that to address Regional Water Board Comment #3 on the lack of PFAS characterization of the fill used in the excavated areas, the soil sampling approach will be revised to collect samples in the “fill material.” Thus, soil sampling will be performed consistently at depths of 0–2 feet bgs and approximately 4–6 feet bgs above the capillary fringe at each boring location. Table 4-1 of the work plan and SAP Worksheet #17		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		PFAS and that geochemical analysis will be done at certain locations in addition. c. 06-SB78 – Please include the sump pit identified in this sampling location rational on the appropriate figures. d. 06-SB89 – Please revise the figures to include the tanks identified in this sampling location rationale.	Table 17-1 and Worksheet #18 Table 18-2 have been revised accordingly. b. All samples collected during this RI (soil sediment, pore water, and groundwater), will be analyzed for PFAS, as described in Sections 4.2.3, 4.3.2, and 4.5.4. Footnote #8 in Table 4-1 has been revised as follows: "*Analytical groups for each sampling location are listed Sections 4.2.3, 4.3.2, and 4.5.4 of the Work Plan and in SAP Worksheet #18 Table 18-1.*" These reference sections also list the media samples that will be submitted for geochemical analyses. c. The sump pit is not associated with boring 06-SB78. The entry for 06-SB78 has been revised to remove the first bullet in Table 4-1. d. Figures 3, 8, and 11 show the former AST as a circular feature southeast of the collector trench.		
31.	Tables 5-1 through 5-4	Please present these tables as 11"x17" as they are difficult to read at their current size.	Tables 5-1 through 5-4 have been presented in ledger format for ease of reading.	Please present Table 5-4 across two pages so as not to shrink the print size.	Exposure to nearshore sediment and pore water at IR Site 6 will be discussed in more detail for Phase II of the RI; therefore, Table 5-4 has been deleted in this work plan.
32.	Table 5-2	In the printed copy there are several letters missing from the table title. Please revise.	Formatting of the table title has been revised as follows: "*Table 5-2: Exposure Assumption Values Used For Daily Intake Calculations (RAGS D: Table 4): Reasonable Maximum Exposure – Groundwater*".		
33.	Appendix A SAP	Please ensure that all changes made in the body of the Work Plan in response to these comments are also made, where needed, in Appendix A.	The revisions to the Work Plan have been made in the SAP (Appendix A).		
34.	Appendix A: SAP, Worksheet #6	Please revise this worksheet to reflect that DTSC will be notified of any field change requests and work stoppages.	DTSC notifications of field change requests are described in SAP Worksheet #6 under "Regulatory Agency Interface" as follows: "*The RPM will inform the regulatory agencies of the need for any field change requests and send them copies of the completed field change request for informational purposes.*" "	Please also address DTSC's request to be informed of work stoppages.	The text has been revised as follows: "*The RPM will inform the regulatory agencies of the need for any field change requests **and work stoppages** and will send them copies of the completed field change requests **and work stoppage documentation** for informational purposes.*"

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
35.	Appendix A: SAP, Worksheet #9	Please add a date for the scoping session.	The scoping meeting date of "*8 October 2020"* has been added to the first line after "Meeting Summary."		
36.	Appendix A: SAP, Worksheet #11	Step 5 states that "if concentrations of PFAS in groundwater samples exceed the screening criteria specified in Table 11-1, then the groundwater results will be used to evaluate the potential transport of PFAS to San Francisco Bay." Please describe how exceedances of groundwater screening levels for human health relate to transport to the Bay. It is not appropriate to compare or use exceedances of the human health screening levels to determine the fate and transport of PFAS.	Step 5, item 2 has been revised as follows: "***If** concentrations of PFAS in groundwater samples exceed the screening criteria specified in Table 11-1, **then** additional evaluation (e.g., tidal study, geochemical evaluation, etc.) will be used to evaluate the potential transport of PFAS to San Francisco Bay. **Otherwise**, additional characterization of PFAS in groundwater is not warranted at IR Site 6.*" Please note that multiple lines (e.g., sediment) of evidence approach is being used in this RI to assess offshore pathways, thus ensuring that complete exposure pathways are being evaluated as described in Step 5, Item 4.	Defer to WB re: use of ESLs.	See the response to the previous Regional Water Board comment on the use of ESLs.
37.	Appendix A: SAP, Worksheet #11	Appendix A: Worksheet #11: Step 5 – Please note that the risk range of 10^{-4} to 10^{-6} is not intended to imply that any risk within this range is acceptable. The actual level of acceptable risk is a site-specific risk management decision, with 1 x 10^{-6} as the point of departure for making such decisions. The NCP requires clear justification to be provided for risk management decisions which result in residual risk levels greater than 1 x 10^{-6}.	While the DON risk assessment follows the U.S. EPA guidance described in the 1991 Memo (U.S. EPA. 1991. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. OSWER DIRECTIVE 9355.0-30. 22 April) on the role of the BHHRA in risk management decision, the DON and the regulatory agencies have collaboratively made risk management decision taking into account state guidance at the end of the baseline risk assessment. To that end, the following statement was expressly included to Worksheet #11, Step 5 of the SAP: "***Further action may also be recommended for cancer risks in excess of 1x10^{-6}, based on site-specific information***."	Point of departure for risk assessment is 1 x 10^-6; specific language discussed on call; see HERO-HH #9. DTSC requested that the text on risk management range in Worksheet #11 (STEP 5, 3.a.) be revised as follows: "*If the baseline HHRA concludes that PFAS in soil and/or groundwater, and sediment and/or pore water (which is evaluated as a surrogate for surface water) where appropriate, pose potentially acceptable risk (cancer risk within the CERCLA risk management range of 10^{-6} to 10^{-4}, and noncancer hazard index per target organ below 1), **then the DON and regulatory agencies will review the results to determine whether no further action is appropriate**.*"	The text in Worksheet #11 Step 5 has been revised as requested by DTSC HERO.
38.	Appendix A: SAP, Worksheet #11	Step 7 – Please describe under what circumstances all three sediment samples will not be collected.	We anticipate that all three samples will be collected at each location; however, little or no recovery in the collected core is possible, especially under challenging conditions in the Bay. Field personnel will make professional judgments as to the best procedures to be used to ensure all three sediment samples are collected at each location. The specific circumstances where all three sediment samples will not be collected cannot be specifically listed but lack of recovery is a common problem for core sampling.	Sediment sampling procedures – on hold	Comment noted. Characterization of nearshore sediment and pore water at IR Site 6 will be discussed during the Phase II RI planning stages; the previous comment on the circumstances when three sediment samples will not be collected has been addressed.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			The first bullet under the Sediment and Pore Water subheading has been revised as follows: "*Nine cores will be advanced nearshore of IR Site 6 to collect sediment, and 2 cores will be advanced in a reference area not impacted by potential PFAS release from IR Site 6. Three sediment samples will be collected at each sediment sampling location at a depth of 0–0.5 foot bgs to evaluate exposure to PFAS in the bioactive zone, and at depths of 1–2 feet and 2–3 feet below the sediment surface for further evaluation of the nature of extent of PFAS in nearshore sediment. The sediment cores will be collected using a vibracore sampler driven into the sediment to the desired sampling depth.*"		
39.	Appendix A: SAP Worksheet #15	Please ensure all footnotes appear on the page to which they refer. Currently footnotes spill onto the next page and shift the headings. Also, lettered footnotes are used in the table but are not defined in the notes section.	The format of these tables has been revised to keep the footnotes on the same page they are called out. This has resulted in blank pages for a few tables. The letter footnotes for the sediment and pore water screening criteria have been revised to numeric footnotes, e.g., "b" to "2" and "c" to "3."		
40.	Appendix A: SAP, Worksheet #17	Please clarify whether sediments samples from the reference area will be geochemically characterized. If not, please provide a technical justification.	The sediment samples at the reference location are not planned to be geochemically characterized in the RI because geochemical characterization is only needed to evaluate PFAS migration potential. Therefore, geochemical characterization is proposed for the offshore sediment adjacent IR Site 6 to evaluate the release areas of PFAS from onshore and their potential vertical and lateral migration in sediment.		
41.	Appendix A: SAP, Worksheet #20	The footnote states that one equipment blank will be collected per day of sampling and that 15 days of soil are anticipated. However, the table only lists 10 equipment blanks for soil. Please resolve this discrepancy.	The footnote 5 in SAP Worksheet# 20 has been revised as follows: "*Equipment Blank: An equipment blank (rinsate blank) is used to assess the effectiveness of decontamination procedures for reusable sampling equipment. Collected at a frequency of one per day per method of sample collection. Assumes 10 days of soil sample collection, and 3 days of groundwater sample collection*."		
42.	Appendix A: SAP, Worksheet #27	Please clarify what location-specific identifiers quality control (QC) samples will have as part of the sample name, as relevant.	The field, equipment, and temperature blanks are tied to a sampling date rather than to specific sampling locations. The duplication QC is tied and		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			appended to specific sampling locations; the text has been revised as follows: “***Duplicate Samples:*** *Duplicate sample identifiers will consist of a “DUP,” a sequential number, and the DATE (YYYYMMDD). For example: GWXXDUP01-20210601*.”		
43.	Appendix B: CQCP, Section B.3.1	DTSC requests that the Navy Remedial Project Manager (RPM) send a daily fieldwork update to DTSC. This can either be a direct forward from the contractor or a summary.	Weekly summary of reports describing field activities will be sent to DTSC and RWCQB.		
44.	Appendix B: CQCP, Section B4.2.2	Please revise the document to clarify that, in instances of when DTSC staff visiting the Site feel unsafe, recognize an unsafe condition, or witness unsafe acts by others, DTSC and Water Board staff have stop work authority. The stop work implied by this comment refers to the immediate and temporary halt of fieldwork activities and not a contractual or permanent work stoppage.	The safety requirements for this RI are described in the site-specific safety and health plan submitted to the Navy-Marine Corps Public Health Center for review and approval. The CQCP is not the project safety document and is intended for the DON RPM and Resident Officer in Charge of Construction to track the construction-related QC milestones and requirements. No change has been made to this appendix. However, the following procedure has been added to Worksheet #6 to document that official site visitors can request stop work: “*If DON staff or an official site visitor notes an unsafe condition, they can request that work be stopped temporarily to address the immediate condition. If the unsafe condition requires attention beyond a temporary work stoppage, an official Stop Work Order can be initiated through notification to the DON BRAC RPM, LRPM, and/or BEC who will in turn notify the DON ROICC and Multi-MAC JV PM*.”		
45.	Appendix C: WMP, Section C2.1 and C3.2.1	Please revise these sections to state that significant or threatened spills must be immediately reported to the California Office of Emergency Services State Warning Center and the Unified Program Agency or 911.	The investigation-derived waste from the soil cutting and groundwater purging, and decontamination fluid are not expected to be classified as “significant or threatened spills” requiring notification to the California Office of Emergency Services State Warning Center and the Unified Program Agency or 911. No change has been made to this appendix.	The response fails to address DTSC’s comment about potential releases of fuel discussed in these sections. A release of fuel may require notification to the California Office of Emergency Services State Warning Center and the Unified Program Agency or 911.	Although fuel will not be stored onsite during the RI field investigation, the text in the second paragraph of Section C.2.1 and the last paragraph of Section C.3.2.1 has been revised as follows: “*Significant spills for threatened fuel releases will be reported immediately to the California Office of Emergency Services State Warning Center and the Unified Program Agency or 911*.”

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
46.	Appendix C: WMP, Section C3.1.2	Please revise this section to make it clear that imported fill material will be covered with 10-millimeter polyethylene sheeting at all times when not being actively used.	The text has been corrected to remove the second paragraph of Section C.3.1.2 because the initial proposed trenching will not be performed, and imported fill materials is no longer needed.		
Comments Received May 19, 2021, from Jesse Negherbon, Senior Hazardous Substances Engineer, Engineering and Special Projects Office – Berkley, DTSC				**Additional comment received during Comment Resolution Meeting on October 25,-2021**	
Comments and Recommendations					
1.	Section 3.3	**Sources of Contamination and Potential Release Mechanisms.** The first paragraph on Page 3-4 notes that wastewater potentially containing PFAS was generated and treated at the Site and discharged to the adjacent wastewater treatment plant. We assume the treatment refers to the former oil-water separator system. Please provide further clarification how wastewater was treated at the Site and then conveyed to the wastewater treatment plant. We recommend that the Work Plan includes the investigation of soil along the alignment of the conveyance system (e.g-piping, trench) to the point of discharge in the wastewater treatment plant area.	The accurate GIS figure representing these systems is shown on Figure 3, including the location of the concrete-lined collector trench, the surge pit, and the OWS. From this figure, the waste firewater flows by gravity from the paved L-shaped training area to the surge and sump pit from which it is pumped to the OWS. The OWS was used to treat the wastewater by removing floating petroleum products before the wastewater was sent to the WWTP. AFFF and water mixtures are included as potential release areas as indicated in third and fourth paragraphs of Section 3.3 and in the proposed SAP shown on Figures 11 and 12. A total of 12 soil sample locations will be advanced immediately adjacent to or near the collector trench or other important collection points such as the OWS, surge pit and sump pit (Figure 11 and Table 4-1).		
2.	Section 4.0	**Remedial Investigation Sampling Approach.** It should be ensured that the technical approach and quality assurance / quality control measures for this investigation are consistent with the California State Water Resources Control Board (SWRCB) Division of Water Quality *PFAS Sampling Guidelines for Non-Drinking Water* (2020) requirements (Note, there is a link to a guidance document that won't go into space)	The sampling approach is consistent with the requirements presented in the referenced SWRCB document.		
3.	Section 4.2	**Soil Sampling Procedures and Analytical Parameters.** The Work Plan states that soil samples will be collected from the 0 – 2-foot interval, below the existing ground surface (bgs), and from the 6 – 8-foot interval bgs. We note that the Site 6 Record-of-Decision (ROD) document states that historic groundwater	The soil samples collected to a depth of approximately 6 feet bgs are intended to evaluate the capillary fringe, just above the static groundwater interface. The depth to groundwater reported during recent groundwater sampling events indicates that the groundwater table ranges from approximately 6–8 feet bgs at IR Site	Additional details are required on how the capillary fringe will be determined in the field.	The capillary fringe will be determined in the field by the field geologist using soil moisture (i.e., saturation) and taking into account the groundwater water depth in nearby monitoring wells. The depth to groundwater is listed for nine existing monitoring wells at IR Site 6 in the 2020 Basewide Groundwater Monitoring

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		levels range between 3 and 8 feet bgs at the Site, and soil samples collected between 6 and 8 feet bgs at Site 6 may originate from below the groundwater table in some locations. The current sampling plan does not appear to inform on contamination in unsaturated soils between 2 and 6 feet bgs, or from soils at the capillary fringe above the groundwater table. This could serve as a data gap for the vertical distribution of PFAS in the soil column and present challenges for anticipating potential impacts to contaminated soil from future sea level rise. We also recognize that while previous remedial actions at the Site included the excavation and removal of soil in some locations, they did not cover the entirety of the potentially impacted area and the depth of excavation varied. We recommend that additional soil samples are included in the investigation to further characterize the unsaturated zone soil, and soils from the capillary fringe above groundwater.	6. The actual sampling depth for the deeper soil sample will be based on field observations of the soil during drilling. Thus, two sampling depths will be used to characterize the unsaturated zone and are deemed sufficient to characterize PFAS in soil at IR Site 6.		Report; groundwater elevations at IR Site 6 were measured from 3.70 to 4.55 feet amsl in June 2020, or from depths of 4.62 to 6.59 feet bgs. Soil cuttings will be logged by the field geologist in accordance with the ASTM International (ASTM) D2488-17 Visual-Manual Method based on the USCS. Logging will be overseen by a California-licensed PG. The following has been added to the third paragraph of Section 4.2.1: *“The deeper soil sample will be collected from the portion of the 48-inch-long sample core that is representative of the capillary fringe (i.e., just above the soil/groundwater interface), based on field observations of the soil moisture content of the sample core in accordance with the ASTM D2488-17 Visual-Manual Method (based on the Unified Soil Classification System). In addition, the depth to groundwater measured in nearby monitoring wells (if available) may be used to help assess the depth of the capillary fringe. “*
4.	Section 4.2	**Soil Sampling Procedures and Analytical Parameters.** Various sections of the Work Plan (e.g. - Figure 16, Appendix A SAP, Appendix C Waste Management Plan) include discussion or descriptions of trenching to be completed during the investigation, from which soil samples will be collected for analysis. The Appendix C Waste Management Plan indicates trenches will be dug to a depth of 8 feet and a length of 100 ft, from which samples will be collected. However, based on the discussion provide in the main narrative of the work plan, soil samples will only be collected from boring. Please clarify if the investigation work will include any trenching on Site 6 and remove any discussion of work that is not anticipated to be completed during the investigation.	No trenching will be performed. Trenching was initially discussed as a characterization method and is thus discussed in SAP Worksheet #9 (project scoping meeting). Any other text describing trenching has been removed from the SAP (Appendix A) and WMP (Appendix C).		
5.	Section 4.4	**Tidal Influence Study.** The Work Plan should clearly identify if any of the utilities within Site 6, or adjacent to the Site 6 perimeter, are known to be located within the saturated zone. If so, the work plan should detail how tidal	The NSTI utility GIS database has the inverted elevation data for only the stormwater line, which connects the site and San Francisco Bay through the outfall. Based on the measured groundwater elevation in the existing nine monitoring wells and		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		influence will be assessed within utility trenches located in the saturated zone.	adjacent stormwater lines, the saturated zone is below the stormwater lines (see Attachment D). We do not have elevation information for the other utilities.		
6.	Section 4.5.4	The analytical suite specified in the Work Plan contains the 18 PFAS analytes included in USEPA Method 537.1. However, we note the California SWRCB has requested that landfills, airport facilities, chrome platers, wastewater treatment plants, bulk fuel storage terminals, and refineries in California analyze water samples for additional PFAS analytes to support a statewide assessment of PFAS contamination in water systems and groundwater. The most recent SWRCB PFAS investigative order for bulk fuel terminals and refineries include 13 additional analytes, beyond those included in USEPA Method 537.1. We also note that commercial laboratories are capable of analyzing up to 24 additional PFAS analytes using methods compliant with Table B-15 of DoD QSM Version 5.3. Therefore, we recommend that consideration is given to including additional PFAS analytes in the Work Plan for laboratory analysis, to be consistent with the SWRCB's PFAS investigation effort (Note: there are two web links that are not included since they mess up the table formatting).	The list of 18 PFAS analytes is part of the DON guidance (DON, 2020). The DON will follow the list of PFAS recommended for analysis in this guidance because of the evolving state of the science in the development of PFAS analytical methods (i.e., the existence of multiple analytical methods that report slightly different target analytes). The DON further indicates that this list will be updated as new analytical methods are approved and U.S. EPA and DoD issue guidance and directives regarding their appropriate use.	DTSC defers to WB re: analytical suite.	See the response to the previous Regional Water Board comment on the use of ESLs. Additionally, during the comment resolution meeting, the BRAC team reiterated that it must follow DoD policies established to guide PFAS investigations, and these policies currently specify the analysis of 18 PFAS analytes.
7.	Section 5.0	**Human Health Risk Assessment.** We note that USEPA recently updated the toxicity assessment for perfluorobutanesulfonic acid (PFBS) in April 2021. Please update or revise any project screening levels for PFBS that may have been impacted by the most current USEPA toxicity assessment for PFBS.	The toxicity value for PFBS has been updated with the most recent U.S. EPA toxicity value and May 2021 RSL. Changes are made to Sections 2.11, 3.1, 5.6, Table 2-3, Figures 8 and 9.		
Comments Received May 14, 2021, from Carol Wortham, Quality Management Officer, Environmental Chemistry Laboratory, Berkley, DTSC					
Comments					
1.	SAP Worksheet #12	**Measurement Performance Criteria Table** 1. Explain why equipment blanks, field blanks, and temperature blanks are included but method blanks and	1. Method blanks and instrument blanks are included in SAP Worksheet #24 and are not considered measurement performance criteria (MPC) to be included in Worksheet #12.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		instrument blanks required by the method are not included. 2. Explain why matrix spikes (MS) and matrix spike duplicates (MSD) are included but laboratory control samples (LCS) required by the method are not included. 3. Explain why internal standards are included but the extracted internal standard analytes specified in the method are not included. 4. On the page following this table, there is a title "Table 11-1: DoD Other Applicable PFAS Screening and Criteria for Media of Concern (continued)" along with some footnotes. Explain why the table is missing and why it is included in this worksheet.	2. LCSs are included in SAP Worksheet #24 and are not considered MPC to be included in Worksheet #12. 3. Internal standards in SAP Worksheet #12 have been changed to "*extracted internal standards*" for clarification and consistency with QSM Version 5.3. 4. The format of SAP Worksheet #12 has been corrected to present the header line for Table 12-1 rather than the header row for Table 11-1.		
2.	SAP Worksheet #14	**Section 16 Third-Party Data Validation** 1. Stage 2A: LCS/LCS duplicate (LCSD) [recovery and relative percent difference (RPD) summary. Worksheet #28 does not include acceptance criteria for the RPD value for LCS/LCSD and needs to be updated with this information for validation. 2. Identify if the data validation report will include evaluation of the potential bias (i.e. positive or negative) associated with the sample results.	1. The acceptance criteria for the RPD value for LCS/LCSD are not identified in QSM Version 5.3 Table B-15. The LCS/LCSD RPD acceptance criteria will follow the MS/MSD RPD criteria stated in QSM Version 5.3. 2. The data validation report will not include evaluation of potential bias. The evaluation of potential bias, along with the other PARCCS criteria, will be evaluated in the usability discussion included in the RI report.	1. It is acceptable to use the MS/MSD RPD criteria for LCS/LCSD RPD but it is confusing to the laboratory and validator to list it as MS and MSD in the LCS and LCSD section. Language needs to be updated for clarification. 2. It is not clear in Worksheet #37 how bias will be evaluated and identified in the usability assessment.	1. The following text has been added to the last paragraph of Stage 2A in SAP Worksheet #14: "*Both LCS/LCSD and MS/MSD RPD acceptance criteria will be evaluated against the MS/MSD RPD stated in the QSM 5.3 (≤ 30 percent).*" 2. Accuracy and bias are synonymous terms. The term bias has been added to the Accuracy section in SAP Worksheet #37 to clarify that this section is evaluating bias.
3.	SAP Worksheet #24	**Analytical Instrument Calibration Table** 1. Not all the items identified in this table are associated with calibration of the instrument. To be consistent with the Department of Defense (DoD) Quality System Manual (QSM) Version 5.3 Appendix B Table B-15, the header for column two needs to be changed from "Calibration Procedure" to "Quality Control Check" and the header for column three needs to be changed from "Frequency of Calibration" to "Minimum Frequency". 2. Aqueous Sample Preparation SOP (Standard Operating Procedure)	1. The header for the second column has been changed from "*Calibration Procedure*" to "*Quality Control Check,*" and the header for the third column has been changed from "*Frequency of Calibration*" to "*Minimum Frequency.*" 2. The Aqueous Sample Preparation SOP reference has been changed from "*MS019.4*" to "*OP069.4.*" 3. The Solid Sample Preparation SOP reference has been changed from "*MS019.4"* to "*OP070.4*". 4. No AFFF samples will be collected, and the AFFF and AFFF Mixture Samples Preparation	6. Please add back the word "standard" in the language and update will be acceptable.	6. The word standard "standard" has been added to the following text in the acceptance criteria for mass calibration: "*Calibrate the mass scale of the mass spectrometer with **standard** calibration compounds and procedures described by the manufacturer.*"

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		Reference: Change the reference from MS019.4 to OP069.4. 3. Solid Sample Preparation SOP Reference: Change the reference from MS019.4 to OP070.0. 4. AFFF and AFFF Mixture Samples Preparation: In section 1.2.4 of SOP MS019.4 it states that the laboratory does not perform definitive analysis of Aqueous Film Forming Foam (AFFF) samples, and these samples must be subcontracted for definitive analysis. If AFFF samples will be collected, the subcontract laboratory to be used must be identified in this document including their SOP and associated information in all tables of this document. If AFFF samples will not be collected, this row will be removed from the table. 5. 11)Sample Cleanup Procedure SOP Reference: Change the reference from MS019.4 to OP069.4 and OP070.4. 6. Mass Calibration Acceptance Criteria: “or by following the instrument manufacturer’s recommended standards as long as these standards verify the mass range of the PFAS ions of interest” is not included in the DoD QSM Ver 5.3 Table B-15 language nor the laboratory SOP. Explain where this information was obtained and why it should be included in the table. 7. ICAL Acceptance Criteria: DoD QSM Ver 5.3 Table B-15 allows for the use of standards available as salts for calibration. Explain why this was excluded from this table. 8. RT Window Position Establishment Acceptance Criteria: The information in the first two sentences is repeated in the third. Remove the repeat information. 9. 15)EIS Analytes SOP Reference: Add OP069.4 and OP070.4.	row has been deleted from SAP Worksheet #24. 5. The Sample Cleanup Procedure SOP reference has been changed from “*MS019.4*” to “*OP069.4 and OP070.4.*” 6. Mass Calibration Acceptance Criteria have been revised in accordance with QSM Version 5.3 Table B-15. 7. ICAL Acceptance Criteria have been revised in accordance with QSM Version 5.3 Table B-15. 8. RT Window Position Establishment Acceptance Criteria have been revised in accordance with QSM Version 5.3 Table B-15. 9. “*OP069.4 and OP070.4*” have been added to the EIS Analytes SOP reference.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
4.	SAP Worksheet #28	**Laboratory QC Samples Table** 1. Analytical Method/SOP Reference: Add OP069.4 and OP070.4 as these Quality Control (QC) Samples are part of the sample preparation process. 2. Method Blank-Corrective Action: Explain why all the corrective actions listed in DoD QSM Ver. 5.3 Table B-15 were not included in this table. 3. LCS-Method/SOP QC Acceptance Limits: Use language stated in MS/MSD section. DoD QSM Ver. 5.3 Table B-15 specifies that control limits listed in that document are to be used, not laboratory control limits. 4. LCS-Method/SOP QC Acceptance Limits: In SAP Worksheet #14 Section 16 Third-Party Data Validation, Stage 2A lists evaluation of RPD for LCS/LCSD analysis. This table does not specify acceptance criteria for RPD. Update for consistency of document. 5. LCS-Corrective Action: Explain why all the corrective actions listed in DoD QSM Ver. 5.3 Table B-15 were not included in this table. 6. LCS-Measurement Performance Criteria: Use language from MS/MSD Method/SOP QC Acceptance Limits as it corresponds to the language in Table B-15 of the DoD QSM Ver. 5.3 document. 7. MS/MSD-Frequency/Number: Use language from LCS entry to address batches that are fewer than 20 samples. 8. MS/MSD-Method/SOP QC Acceptance Limits: The acceptance criteria for the RPD is not included in the table and needs to be added. 9. MS/MSD-Flagging Criteria: The language is repeated in the entry. Remove one of the repetitive sentences.	1. “*OP069.4 and OP070.4*” have been added to the “analytical method/SOP reference” section SAP Worksheet #28. 2. Method Blank Corrective Action has been revised in accordance with QSM Version 5.3 Table B-15. 3. LCS Method/SOP QC Acceptance Limits have been revised in accordance with QSM Version 5.3 Table B-15, when available. The following compounds do not have limits in the QSM: HFPO-DA, 11-Cl-PF3OUdS, 9Cl-PF3ONS and ADONA and will use laboratory specified limits as stated in the QC limit table. 4. The LCS/LCSD RPD Acceptance Criteria have been updated in accordance with the MS/MSD RPD criteria in the QSM 5.3. 5. LCS Corrective Action has been revised in accordance with QSM Version 5.3 Table B-15. 6. LCS Measurement Performance Criteria have been revised to use language from the MS/MSD Method/SOP QC acceptance limits. 7. The MS/MSD Frequency/Number has been revised as follows: “*One MS/MSD per 20 or fewer field samples of the same matrix collected from the same installation*” 8. MS/MSD Method/SOP QC Acceptance Limits have been revised in accordance with QSM Version 5.3 Table B-15. 9. MS/MSD Flagging Criteria have been revised in accordance with QSM Version 5.3 Table B-15. 10. MS/MSD Corrective Action has been revised in accordance with QSM Version 5.3 Table B-15. 11. MS/MSD Person(s) Responsible for Corrective Action has been changed to “*Analyst/Laboratory Quality Assurance Officer.*” 12. Method/SOP limits will not be used for evaluating MS/MSD %D or RPD. The text in SAP Worksheet #28 for MS and MSD	1. Acceptable 2. Acceptable 3. Update is needed to remove references to MS/MSD and use language in QSM Version 5.3 Table B-15. 4. Add reference that if LCSD is analyzed, RPD must pass criteria of 30% as specified in the MS/MSD section to clarify. (see item 6 below. 5. Acceptable 6. For clarification, specify that if an LCSD is analyzed, the RPD will meet criteria specified in the QSM MS/MSD section then list the criteria. (see item 4 above) 7. Acceptable 8. Acceptable 9. Acceptable 10. Acceptable 11. Acceptable 12. The language in the Measurement Performance Criteria still specifies that the most current laboratory-specified limits, < 30% RPD. This is not consistent with the QSM. 13. Acceptable 14. Acceptable	1. Comment noted. 2. Comment noted. 3. The term MSD has been removed from the second sentence in the LCS Method/SOP QC Acceptance Limits column. In addition, the third sentence in this column has been modified as follows: “*A laboratory must use the DoD/DOE QSM Appendix C* ***MS/MSD*** *Limits for* ***LCS/LCSD*** *batch control…”. The last sentence has also been changed to state that “RPD ≤ 30 percent (between* ***LCS and LCSD.)***” 4. The following footnote (2) has been added to the QC Limit Table at the end of SAP Worksheet #28: “*LCL and UCL bounds represent LCS/LCSD limits from the QSM 5.3 and will be used for both LCS/LCSD and MS/MSD evaluation*.” 5. Comment noted. 6. The measurement performance criteria for LCS in SAP Worksheet #28 have been modified as follows: “***If an LCSD is analyzed****, the RPD must be ≤ 30% (between* ***LCS*** *and* ***LCSD****).*” 7. Comment noted. 8. Comment noted. 9. Comment noted. 10. Comment noted. 11. Comment noted. 12. The measurement performance criteria for the MS/MSD have been modified as follows: “*RPD ≤ 30% (between MS and MSD or sample and MD)*” 13. Comment noted. 14. Comment noted.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		10. MS/MSD-Corrective Action: Explain why the language does not match that of DoD QSM Ver. 5.3 Table B-15. Explain how the document will ensure that there is enough sample provided to re-extract and reanalyze the MS/MSD if required. 11. MS/MSD-Person(s) Responsible for Corrective Action: Explain why the Quality Assurance Officer was left out. 12. MS/MSD-Measurement Performance Criteria: Use language from Method/SOP QC Acceptance Limits once updated or the criteria specified in DoD QSM Ver. 5.3 Table B-15. 13. Post-Spike Sample: This requirement is associated with the analysis of AFFF and AFFF mixture samples. Per comment 10 above, the laboratory listed in the document will not be performing analysis on these types of samples. Either remove this from the table or update the document with all the information for the laboratory that will be performing analysis on these types of samples. 14. QC Limit Table: Comparison of this table to the limits specified in DoD QSM Ver. 5.3, two errors were found. The LCL (Lower Control Limit) for Perfluorobutane sulfonic acid in aqueous samples should be 72 and the LCL for Perfluooctane sulfonic acid in solid samples should be 68. Update the table.	acceptance criteria have been updated in accordance with QSM Version 5.3. 13. No AFFF samples will be collected, and the Post-Spike Sample row has been removed from SAP Worksheet #28. 14. The QC Limit Table at the end of SAP Worksheet #28 has been updated in accordance with QSM Appendix C (Tables C-44 and C-45).		
5.	SAP Worksheet #36	**Analytical Data Validation (Steps IIA and IIB) Summary Table** Explain why the table appears to be addressing Stage 4 data review rather than IIA and IIB data review.	Although Stage 4 validation contains all components of Stage 2A and 2B validation, all PFAS investigations are required to conduct a 100% Stage 4 validation.	The title of this worksheet seems to contradict what was identified in the response and in Worksheet #14.	The title of SAP Worksheet #36 has been changed to "*Analytical Data Validation (**Stage 4**) Summary Table.*"
6.	SAP Worksheet #37	**Usability Assessment** In the first paragraph, it states that "The analytical laboratory will be responsible for reviewing all analytical data generated under this contract to ensure that they meet the requirements of the UFP-QAPP" (Uniform	The UFP-QAPP has been cited as "(*U.S. EPA*, *2005*)." The title of the UFP-QAPP has been identified in the reference section as follows: "*U.S. EPA. 2005. Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP). EPA*		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		Federal Policy Quality Assurance Project Plan). Identify the title of the UFP-QAPP and specify how the laboratory will be informed of the information included in the UFP-QAPP.	*QA/G-4. Office of Environmental Information EPA/240/B- 06/001. March.*" As stated in SAP Worksheet #7, the project manager from the laboratory will be responsible for communicating with Multi-MAC JV and will be provided a copy of the UFP-QAPP.		
Comments Received May 19, 2021, from Marikka Hughes, Engineering Geologist, Geological Services Unit, Geological Services Branch, Site Mitigation and Restoration Program, DTSC					
Comments and Recommendations					
1.	Section 4.2.1 and Appendix A: SAP Worksheet #11	*Direct-Push Soil Sampling; Appendix A: Sampling and Analysis Plan (SAP), SAP Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements* The Work Plan provides conflicting soil sample depths that should be evaluated and corrected for consistency. For example, Section 4.2.1 states soil samples will be collected from 0 to 2 feet below ground surface (bgs) and 6 to 8 feet bgs, but the worksheets in Appendix A state soil samples will be collected from 0 to 2 and 4 to 6 feet bgs. Further, Worksheets 11, 14, 17, and 18 indicate that soil sample depths will vary based on location and previous site activities.	The soil samples will be collected from the depths specified in *Table 4-1 Rationale for Remedial Investigation Sampling Locations at IR Site 6*. The SAP in Appendix A has been revised to present the approximate sampling depths of 0–2 feet and 4–6 feet bgs, with the deeper depth based on field observations to capture the capillary fringe/groundwater interface.		
2.	Section 4.2.1	*Direct-Push Soil Sampling* This section should discuss why the soil borings will be advanced to 6 to 8 feet bgs and why soil samples will be collected from this interval. Additionally, it is unclear why 2-foot-long sample intervals are proposed. It is recommended that the sample intervals be at most 1 foot in length.	The depth of the boring is estimated to be approximately between 6-8 feet bgs to obtain samples from the capillary fringe/groundwater interface (see the response to Marikka Hughes Comment #1). Because the exact depth to groundwater will be based on field observation and may vary from borehole to borehole, the sampling interval is 2 feet long to allow for selection of the portion of the sample that represents the capillary fringe/groundwater interface. Additional portions of the sample may also be selected for geochemical analysis.		
3.	Section 4.2.2	*Soil Sampling Decontamination Procedures* a. This section mentions a backhoe bucket, but the rest of the Work Plan does not. It is recommended that this section be revised to delete the reference to a backhoe if this	a. The backhoe bucket would have been used for trenching which is no longer part of this RI. References to the backhoe bucket have been removed from the text.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		equipment will not be used in the implementation of this work. b. The Work Plan should specify that PFAS-free laboratory grade deionized water will be used as the final rinse in the decontamination procedures.	b. Item 3 in the description of the decontamination procedures has been modified as follow: "*PFAS-free laboratory-grade distilled or deionized water rinse*."		
4.	Section 4.2.3	*Laboratory Analysis* a. The Work Plan should specify which laboratory analytical method will be used to analyze the samples. Additionally, it should indicate how many PFAS compounds will be included in the analyte list. b. A paragraph is included in Section 4.2.3 on groundwater sample analysis. As this information is included in a later subsection focused on groundwater, it is recommended that this paragraph be deleted	a. The laboratory analytical method for PFAS has been referenced in the text as follows: "*PFAS will be analyzed for using modified U.S. EPA Method 537.1. This method is LC/MS-MS compliant with DoD QSM Version 5.3 (DoD, 2019), or latest update upon analysis*." b. The referenced section has been deleted.		
5.	Section 4.3.1	*Groundwater Monitoring Well Installation and Sampling* a. The text should indicate what drilling technology will be used to install the monitoring wells and what diameter the boreholes will be. b. This section is unclear on the proposed design of the monitoring wells. The text states that the well screen will be 5 feet long, but then adds that the screened interval will be from 5 to 15 feet bgs. This discrepancy occurs repeatedly in the Work Plan and should be reviewed and corrected as necessary. Considering the shallow depth to water, it is recommended that a 5-foot well screen be used for these new wells.	a. The first sentence of Section 4.3.1 has been replaced with the following: "*Groundwater monitoring wells will be installed using hollow stem auger drilling techniques. The monitoring wells will be installed inside of approximately 8-inch-diameter borings. The monitoring well will be advanced to a depth approximately 15.5 feet bgs and screened across the water table.*" b. Screen length will be 10 feet from approximately 5 to 15 feet bgs. This may be adjusted in the field to ensure that the top of the screen is above the top of the groundwater table. Text has been revised in this Section 4.3.1 and in all other applicable areas of the Work Plan to state the well screen will be 10 feet long.		
6.	Section 4.3.1.6	*Groundwater Sampling Decontamination Procedures* The text states that equipment and field blank samples will not be necessary if a peristaltic pump is used for groundwater sample collection. While the tubing that will be used for this sampling will not contain PFAS compounds, the collection of equipment and	Although the tubing will be used for sampling will be factory-verified to be PFAS free, one equipment blank and one field blank will be collected by running deionized water through a 1-foot section of the tubing to confirm that the tubing is PFAS free. Because the tubing will be single use and disposable and will be the only portion of the sampling equipment to be in contact with the		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		field blanks is still recommended to evaluate if there are potential sources of PFAS compounds involved in the sampling. It is recommended that the last sentence of this section be revised to indicate that equipment and field blank samples will be collected.	groundwater, multiple equipment blanks will provide no benefit for the QA/QC evaluation of the sampling methodology. The last paragraph of Section 4.3.1.6 has been revised as follows: *"If a peristaltic pump is used, decontamination will not be required of the pump since only the tubing will touch the groundwater; however, the tubing must be replaced between each well. One equipment blank will be collected by running deionized water through the disposable PFAS-free tubing used for sampling of site groundwater."*		
7.	Section 4.3.1.7	*Well Purging Activities* This section should specify what type of sample tubing will be used during the purging and sampling of the wells.	The sample tubing will be PFAS-free tubing that will be connected to a peristatic pump, as indicated in the response to Marikka Hughes Comment #6.		
8.	Section 4.3.3	*Sample Packaging and Shipment* The text should indicate what laboratories will be conducting the laboratory analyses.	Agreed. The last sentence in the first paragraph of Section 4.3.3 has been revised as follows: "*The samples will be shipped to SGS Orlando as described in SAP Worksheet #30 (Appendix A).*"		
9.	Section 4.4.2	*IR Site 6 Tidal Influence and Mixing Zone Evaluation* a. As stated i n Comment 5b above, the Work Plan is inconsistent in identifying what the well screen interval will be in the proposed wells, but this section indicates that only wells screened from 5 to 15 feet bgs will be used in the tidal study. The text should be revised to accurately reflect the proposed well construction and the importance of screening the wells across 5 to 15 feet bgs. b. The text indicates that Table 4-1 identifies the wells to be included in the tidal study. For ease of use, it is recommended that a separate table be added to the Work Plan that includes only the wells proposed for this tidal study and their well construction information.	a. Text has been revised to state that well screen planned for approximately 5 to 15 feet bgs in all new monitoring wells may be adjusted in the field so that the top of the screen is above the water table. b. Rather than adding an additional table, it is considered more efficient to show the wells to be used in the tidal study on Figure 12. An Asterix has been added to the well ID for the wells proposed for the tidal study in Tables 4-1 and Worksheet #17 of the SAP for clarity.		
10.	Section 4.5 and Appendix A: SAP Worksheet	*Sediment and Pore Water Sampling Approach* and *Appendix A: Sampling and Analysis Plan,*	The proposed sampling is intended to capture not only potential groundwater discharge impact to sediment and pore water, but also potential		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
	#17	*SAP Worksheet #17 Sampling Design and Rationale* In the discussion on sediment and pore water sampling, it is unclear how the sample locations and distances from shore were selected. The Work Plan should be revised to provide a technical rationale for the selected locations.	previous discharge from runoff and stormwater. The lateral spacing is approximately 50 feet from the shoreline and 30 feet increment for subsequent transects. Selection of the initial 50 feet spacing was based on the seawall construction at IR Site 6 (see Attachment A). The original seawall and the stone riprap extend at least 50 feet from the new shoreline. Thus, a minimum distance of 50 feet is required to provide boat access, limit refusal from encountering riprap materials, and maximize the availability of sediment not covered by riprap.		
11.	Appendix A: SAP Worksheet #11	*Project Quality Objectives/Systematic Planning Process Statements* a. *Step 4: Define the Boundaries of the Study:* This worksheet contradicts other sections of the Work Plan by stating that the proposed wells will be installed to a depth of 11 feet bgs. Other sections imply or state that the wells will be installed to depths of 10 or 15 feet bgs. This discrepancy should be evaluated and corrected as appropriate. b. *Step 7: Develop the Plan for Obtaining Data:* The first sentence in the paragraph on groundwater states: "A total of 9 existing monitoring wells and 10 new groundwater monitoring wells will be installed." This should be revised to clarify that 10 monitoring wells are being installed and sampled and nine existing monitoring wells are also being sampled. c. *Step 7: Develop the Plan for Obtaining Data:* The paragraph on groundwater indicates that the new monitoring wells will be installed with 5 feet of well screen, which contradicts what the main text of the Work Plan says. This should be ted and corrected as needed. d. *Table 11-1:* As noted in Comment 1 above, it is recommended that the California Notification Levels and ESLs be used as screening criteria for this investigation.	a. The third sentence of Step 4, Item 2 has been revised as follows: "*Groundwater monitoring wells will be installed to a depth of approximately 15 feet bgs and will have a 10-foot screen across the water table*." b. The first two sentences under the **Groundwater** subheading have been revised as follows: "*A total of 10 new groundwater monitoring wells will be installed. The 10 new wells and 9 existing monitoring wells will be sampled for PFAS to delineate the extent of PFAS in groundwater (Figure A-11).*" c. There will be 10 feet of well screen. This contradiction has been corrected throughout the Work Plan. d. Only screening levels that have been vetted and approved by DoD will be used for decision making on this project.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
12.	Appendix A: SAP Worksheet #14	*Summary of Project Tasks* a. *Section 14.4 Soil Sampling:* The text indicates that soil borings will be advanced to 6 to 8 feet bgs, soil samples will be collected at 0 to 2 and 4 to 6 feet bgs, and that groundwater is expected at 4 to 6 feet bgs. As stated in Comment 2 above, there is a discrepancy in the Work Plan regarding the depth of the subsurface soil sample. Additionally, it is unclear why the borings would be advanced deeper than the deepest soil samples. Further, the Work Plan should clarify if the purpose of these deeper soil samples, potentially in the first groundwater zone, are intended to evaluate saturated conditions at the site. b. *Section 14.5.1 Groundwater Monitoring Well Design*: This section identifies that the new monitoring wells will have 5-foot-long well screens. As stated in previous comments, this is inconsistent with other sections of the Work Plan. This discrepancy should be evaluated and corrected as needed. c. *Section 14*.7 Tidal Study: This section indicates that all wells included in this study (including new monitoring wells) will be screened between 5 and 15 feet bgs, but the design of the proposed monitoring wells is inconsistent across the Work Plan. This section should be revised after the well screen discrepancy is resolved.	a. Comment noted. See the response to Marikka Hughes Comments #1 and #2. b. Comment noted. See response to Marikka Hughes Comment # 5. c. Comment noted. See the response to Marikka Hughes Comment # 5.		
13.	Appendix A: SAP Worksheet #15	*Reference Limits and Evaluation Table* It is recommended that this table be revised to use the California Notification Levels and ESLs to evaluate the laboratory quantification and detection limits.	Only screening levels vetted and approved by DoD will be used for this RI.		
14.	Appendix A: SAP Worksheet #18	*Sampling Locations and Methods/SOP Requirements Table* This table identifies the well screen interval for all wells included in this investigation as 5 to 15 feet bgs, which may be accurate for existing wells, but may not be accurate for the	Inconsistencies in monitoring well design in the Work Plan have been corrected.		

Remedial Investigation Work Plan for PFAS at IR Site 6
Former Naval Station Treasure Island, San Francisco, California

Appendix D: Responses to Comments from Regulatory Agencies

**Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at
Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California**

#	Section	Comment	Response	Additional Comment	Additional Response
		proposed wells based on discrepancies in the Work Plan. The table should be revised as needed to match the rest of the Work Plan.			
Comments Received April 29, 2021, from Kimberly Gettmenn, Staff Toxicologist, Human and Ecological Risk Office (HERO), DTSC				**Comments Received during Comment Resolution Meeting on October 28. 2021, and by email on October 29, 2021**	
General Comments					
1.	Section 3.3, Table 4-1, and Appendix A: SAP Worksheets #11, #17, and #18	Clean Fill HERO recommends collecting samples in the clean fill areas unless the fill was previously sampled for PFAS prior to being placed at IR Site 6. The Work Plan states that it is anticipated that the clean fill does not contain PFAS, however, unless the fill has been sampled for PFAS, and the source of the clean fill is PFAS-free, HERO recommends collecting soil samples from the clean fill. Please revise all aspects of the Work Plan to include sampling of the clean fill including but not limited to Section 3.3, Table 4-1, SAP Worksheets #11-Step 7, #17, Table 17-1, and #18.	Comment noted. To address this comment and a similar comment by the Regional Water Board, the DON will revise the sampling to collect soil sample in the "fill material." Thus, the soil sampling will be performed consistently at depths of 0–2 feet bgs and 4–6 feet bgs above the capillary fringe at each boring location.	HERO concurs with and appreciates the Response to collect soil samples in the "fill material". HERO reviewed the Draft Final Work Plan provided with the Responses to ensure that the text was revised to include the sampling of soil in the "fill material" at the depth of 0 to 2 feet below ground surface and we have the following comments: a. The text was revised in Section 3.3, Table 4-1, Worksheets #17-Table 17-1 and #18. HERO appreciates these revisions. b. NEW COMMENT - Section 5.4.1 – Soil. The text on page 5-4 in Section 5.4.1 was not revised to reflect the response that the soil samples will be collected in the "fill material". HERO recommends revising the text for consistency with the Response and rest of the Draft Final Work Plan. c. NEW COMMENT - Section 5.5.4 – Exposure Point Concentrations – First Bullet. The text on page 5-7, first bullet in Section 5.5.4 was not revised to reflect the response that the soil samples will be collected in the "fill material". HERO recommends revising the text for consistency with the Response and rest of the Draft Final Work Plan. d. NEW COMMENT - Section 5.8 – Uncertainty Analysis. The text on page 5-13, was not revised to reflect the response that the soil samples will be collected in the "fill material". HERO recommends revising the text for consistency with the Response and rest of the Draft Final Work Plan.	a. Comment noted. b. The last paragraph of Section 5.4.1 (now Section 5.3.1) that discusses clean fill being excluded from exposure consideration has been deleted. c. The last two sentences of the first bullet in Section 5.5.4 (now Section 5.4.4) have been deleted for consistency of this section with the rest of the work plan. d. The following text has been added at the end of Section 5.8 (now Section 5.7): "*It is also noted that extensive excavation and backfilling with clean fill have occurred onsite. Sampling will take place within the clean fill that represents the likely exposure depth intervals (0–6 feet bgs), and as a result, the planned sampling could characterize fill emplaced following the remedial action, and this decision would represent concentrations that are a mixture of fill and PFAS-containing original source material. The potential unavoidable bias of including these samples in the HHRA will be considered in the uncertainty analysis.*"
2.	Section 3.5.1, Section 5.5.2, Figure 14 and Table 5-1	Human Receptors HERO recommends also evaluating a residential receptor as part of the forthcoming HHRA along with the proposal to evaluate the	Because of previous remedial action for IR Site 6 in 2016 (CE2-Kleinfelder, 2018), ICs are already in place to prevent residential use. The existing ICs include prohibition of residential use of IR Site	DTSC requests evaluation of the residential pathway	The DON agrees to include a hypothetical future residential scenario. The text has been revised to incorporate this exposure scenario, Table 5-1 has been revised with appropriate

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		construction worker and recreational receptor. Evaluation of the residential receptor will provide risk managers with information as to whether land use controls are necessary at IR 6 for an unrestricted land use scenario due to the presence of PFAS. Please revise all aspects of the Work Plan to include evaluation of the residential receptor including but not limited to Section 3.5.1, Section 5.5.2, Figure 14, and Table 5-1.	6 (residential uses include constructing a residence, hospital for humans, or day care facility for children and growing produce for human consumption), implementation of approved contaminated soil and groundwater management plans for any future excavations at IR Site 6, and prohibition of alteration, disturbance, or removal of any component of the remedial action. These ICs are described in the LUC RD (CE2-Kleinfelder, 2018). Therefore, residential use is already prohibited at the site and will not be included in the HHRA.		soil exposure parameters for a resident, and the residential exposure scenario has been added to Figure 13.
3.	Section 5.0 and Section 5.7	Human Health Risk Assessment Risk Characterization HERO does not concur with not adding the risk assessment results from the PFAS HHRA to the residual risks from other chemicals at IR Site 6. Please explain why the cumulative risk will not be updated to include risk and noncancer hazard from PFAS detected at the site.	Previous remedial actions resulted in minimal residual risk onsite. Therefore, the addition of residual risks from other chemicals to the risk from PFAS is unlikely to change the risk management outcomes for the site. Evaluation of potential cumulative risks due to residual concentrations can be considered during the next The five-year review for NSTI in 2025.	HERO acknowledges that institutional controls (ICs) restrict use of IR Site 6 for residential use; however, HERO requests that residential receptors be evaluated to prevent the site falling through the crack. HERO also requested that discussion of current ICs be included in Section 5.	The DON agrees to include a hypothetical future residential scenario as a receptor in the RI work plan and report. The text has been revised to incorporate this exposure scenario, Table 5-1 has been revised with appropriate soil exposure parameters for a resident, and the residential exposure scenario has been added to Figure 13. Section 5.5.1 (now Section 5.4.1) and Section 5.8 (now Section 5.7) have been revised to include discussion of existing ICs. The DON agrees to evaluate cumulative risk, considering residual risk from other non-PFAS, in the baseline risk assessment. Revision is made to Sections 5.3, 5.5 and 5.6 of the work plan, and Worksheet #11, STEP 5 of the SAP.
4.	Section 5.2, Section 5.5.2, Figure 14	Shellfish and Recreational Fish Consumption HERO does not concur with the proposed path for evaluating shellfish and recreational fish consumption in the HHRA and we recommend a quantitative evaluation for these pathways. a. According to the Work Plan, the HHRA will only document the relevant species and restrictions and will not evaluate shellfish or fish consumption pathway. The reasoning is that there are no nationally accepted surface water screening levels for PFAS for protection of human health through fish consumption. The San Francisco Bay Regional Water Quality Control Board has established PFOS and PFOA Environmental Screening Levels (ESLs) for groundwater based on seafood	The DON concurs that the fish and shellfish consumption pathway is potentially relevant. The RI will be performed in an iterative process, and this phase of the investigation focuses on identifying the source and understanding whether PFAS are present in the different media. The RI report will also document the species relevant for consumption. If PFAS are detected in pore water and relevant species are consumed near the site, then this information will provide the basis for the evaluation of the fish and shellfish consumption pathway in a future phase of work. a. Only DON vetted and approved screening levels will be used for this RI. b. The RI will be performed using an iterative process, and an evaluation of the shellfish and	Wrapped up in WB comments; need to resolve in tandem.	Because characterization of nearshore sediment and pore water at IR Site 6 will be discussed for Phase II of the RI, evaluation of this pathway is no longer germane to Phase I of the RI; HERO did not have a follow-on comment to the response during the October 28, 2021, risk-specific comment resolution meeting.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
		ingestion. Given that there are screening values available, a screening level risk assessment should be evaluated for the fish consumption pathway. PFAS have been found in fish. b. Additionally, a site-specific baseline HHRA evaluating the shellfish and fish consumption pathway should conducted. Both USEPA and OEHHA have exposure parameters available for conducting a site-specific shellfish and fish consumption HHRA. c. Please include a table with the site-specific exposure parameters for shellfish and fish consumption in the Work Plan.	fish consumption pathway may be performed in a subsequent phase of work. c. Exposure parameters will be provided if an evaluation of the shellfish and fish consumption pathway is proposed in a future phase of work.		
5.	Section 5.4.1	PFAS Sampling Results In Section 5.4.1, the text states that the soil analytical data will be compiled in data summary tables. Please clarify if the data summary tables will list the concentrations for all PFAS chemicals or only the concentrations for PFOA, PFOS, and PFBS. HERO recommends listing the sampling results for all PFAS detected in soil, groundwater, pore water and sediment.	Data tables will include PFAS to be used in the HHRA and ERA (9 of the 18 PFAS on the current DoD PFAS list) with statistical summaries because these are the only chemicals with toxicity values available. The complete analytical data and third validation report for all 18 PFAS will be presented in appendices of the RI report.		
6.	Section 5.5.4	Groundwater and Pore Water Exposure Point Concentrations (EPCs) Please provide technical justification for calculating a 95 percent upper confidence limit (UCL) on the mean for groundwater and pore water samples. Please also provide clarification as to whether the 95 percent UCL for groundwater will be calculated per groundwater well or using all the groundwater data at IR Site 6. For groundwater, HERO generally recommends using the most recent round of data for risk assessment purposes, as this is representative of current site conditions.	Recreational exposure occurs in surface water, and will be evaluated using pore water as a conservative surrogate for surface water (does not account for dilution between pore water and surface water). Calculating a UCL allows for evaluation of a realistic exposure scenario for a recreational user, who is expected to move around the nearshore water at IR Site 6. Regarding construction worker exposure to groundwater, this exposure pathway is highly conservative, considering that the practice of dewatering excavations typically prevents direct contact with groundwater within this scenario. However, if exposure occurs via direct contact, the exposure concentrations would likely be composed of groundwater seepage from multiple points entering an excavation. Therefore, considering only a single point is likely overly conservative for this exposure pathway, and a 95% UCL is appropriate.	Groundwater and Pore Water Exposure Point Concentrations (EPCs) (Section 5.5.4). HERO acknowledges the Response explaining why using a 95 percent upper confidence limit (UCL) on the mean for groundwater and pore water samples as the EPC in the risk assessment is appropriate. While HERO acknowledges that using a single point is likely overly conservative, HERO recommends that the USEPA OSWER Directive 9283.1-42[1], Determining Groundwater Exposure Point Concentrations, Supplemental Guidance, be consulted when calculating the 95% UCL for the groundwater and pore water samples.	Concur. USEPA OSWER Directive 9283.1-42[1], Determining Groundwater Exposure Point Concentrations, Supplemental Guidance, will be consulted when calculating the 95 percent UCL for the groundwater and pore water samples. However it is currently unknown whether it will be possible to identify the core of the plume. Source: U.S. EPA. 2014. Determining Groundwater Exposure Point Concentrations, Supplemental Guidance. OSWER Directive 9283.1-42. Washington. March.

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
			The DON will use most recent round of data for the risk assessment during this RI.		
7.	Section 5.6	Toxicity Assessment HERO concurs with the approach stated in the text on page 5-10, "If California toxicity values are formally adopted and dual- tracking is conducted, a second set of risk estimates will be calculated using a similar toxicity criteria hierarchy, except that State of California toxicity criteria will be used preferentially over federal criteria, as recommended in 22 California Code of Regulations (CCR) Appendix I. Specifically, if DTSC HHRA Note #10 recommends alternative toxicity values (DTSC, 2019c), they will be preferentially selected." This comment is for information only.	Comment noted.	HERO acknowledges the Response. Please note, revised text was added to Section 5.4 and Section 5.6 regarding use of the OEHHA toxicity criteria for PFOS and PFOA, and that if these values are formally adopted into the California Toxicity Criteria Rule (TCR) prior to preparation of the draft HHRA, the values may be considered in the HHRA. HERO recommends that if the toxicity criteria values are adopted into the TCR, prior to the draft final version that they be used in the risk assessment.	The draft final version of the work plan is scoped to provide responses to comments received on the draft version to achieve concurrence; it is not scoped to revise the risk assessment.
8.	Section 5.8	Uncertainty Analysis Soil Sampling Depths. In the forthcoming HHRA, HERO recommends including a discussion about the uncertainty associated with collecting surface samples from 0-2 feet bgs, and not collecting surface samples from the recommended 0-0.5 feet bgs sampling depth interval. HERO acknowledges that the depth interval was chosen for consistency with existing data; however, there is a level of uncertainty that comes will collecting surface soil samples at a depth interval other than the recommended interval from State and USEPA guidance.	Concur. The requested discussion has been added to the uncertainty analysis in Section 5.8 as follows: *"The surface soil sampling depth interval of 0-2 ft was selected for consistency with existing data. Some uncertainty may be associated with the use of soil sample results from the 0 to 2 feet bgs depth interval to estimate health risks from exposure to surface soil. In general, the preferred depth interval for evaluating surface soil exposure is 0 to 0.5 feet bgs rather than 0 to 2 feet bgs. The uncertainty analysis of the HHRA qualitatively evaluates the likelihood that the use of 0 to 2 feet bgs to represent surface soil may result in an underestimate of health risks for surface soil. However, while the PFAS detected in site soil (PFOS and PFOA) may be adsorbed to high organic surface soil, they are also soluble unlike many inorganic metals, and will migrate vertically with infiltration/rain water. The potential underestimation of exposure to surface soil is likely compensated for by biasing sample locations toward likely release areas (i.e., former burn areas and AFFF wastewater conveyance system), which is unlikely to replicate actual exposure patterns, and the use of conservative exposure assumptions."*		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
9.	Appendix A: SAP Worksheet #11	Step 5 – Develop the Analytical Approach. HERO does not concur with decision criteria 3a that states, "**If** the baseline HHRA concludes that PFAS in soil and/or groundwater, and sediment and/or pore water (which is evaluated as a surrogate for surface water) where appropriate, pose acceptable risk to human health based on consideration of detected concentrations, **then** no further action to address potential impacts on human health will be required." HERO does not agree with the text "acceptable risk" in decision criteria, as there are no qualifiers as to what "acceptable risk" is in the decision criteria. HERO recommends revising the decision criteria to remove reference to risk and state whether the detected concentrations exceed or are less than their respective screening criteria.	This step in the decision criteria is intended to occur following the risk assessment; therefore, an evaluation of acceptable risk following the risk assessment is appropriate. Unacceptable risk is defined in bullet b. Therefore, this bullet has been revised to add a definition for acceptable risk: "*3a.* ***If*** *the baseline HHRA concludes that PFAS in soil and/or groundwater, and sediment and/or pore water (which is evaluated as a surrogate for surface water) where appropriate, pose potentially acceptable risk (cancer risk within the CERCLA risk management range of* 10^{-6} *to* 10^{-4}*, and noncancer hazard index per target organ below 1),* ***then*** *no further action to address potential impacts on human health will be required.*" The HQ is anticipated to drive risk management decisions for PFAS.	See DTSC follow up Comment #37.	SAP Worksheet #11 (Step 5, 3.a.) has been revised as follows per DTSC follow-up Comment #37: "*If the baseline HHRA concludes that PFAS in soil and/or groundwater pose potentially acceptable risk (cancer risk within the CERCLA risk management range of* 10^{-6} *to* 10^{-4} *and noncancer hazard index per target organ below 1),* ***then the DON and regulatory agencies will review the results to determine whether no further action is appropriate***."
Specific Comments					
1.	Table 5-1.	For the construction worker HERO recommends using an adherence factor (AF) of 0.8 mg/cm^2-event and a skin surface area (SA) of 6032 cm^2 per HHRA Note 1[1]. Please revise the table. HERO will also accept a risk assessment that present risk values using USEPA default construction worker exposure parameters and HERO default construction worker exposure parameters.	The requested change has been made.		
Comments Received April 13, 2021, from Brian Faulkner, Senior Toxicologist, Ecological Risk Assessment Section (ERAS), Human and Ecological Risk Office (HERO), DTSC					
General Comments					
1.	Section 6	Section 6 of the work plan outlines the proposed ecological risk process from the Screening Level Ecological Risk Assessment up through a Tier II Baseline ERA, Step 3a Risk Refinement. The described process is based on established guidance and is acceptable.	Comment noted.		
2.		The proposed PFAS screening values for evaluation of ecological risk for sediments and pore water, which are chronic values selected from Conder et al 2020 and Divine et al 2020, are appropriate for the ecological screening level risk assessment step.	Comment noted.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
3.		The selected human health environmental screening levels for PFAS in groundwater are lower than the ecological risk-based values for saltwater, which should ensure that any potential future risks that could arise due to contaminant transport from on-site source areas to ecological receptors in the offsite habitat will be identified.	Comment noted.		
Comments Received May 16, 2021, from Langan Engineering and Environmental Services, Inc. on Behalf of the Treasure Island Development Authority (TIDA)					
Specific Comments					
1.	Section 4.3.1.1,	**Surface Completion**: Please indicate what well protection measures will be implemented at the newly installed monitoring wells, especially those wells installed within unpaved areas of the site (e.g., bollard installation). Additionally, with larger trucks, drill rigs, and equipment scheduled to be on site for completion of this work, please also consider implementing well protection measures at existing monitoring wells (e.g., bollard installation).	Following well installation, a traffic-rated, flush-mounted well cover and bollards will be installed for each new groundwater monitoring well for protection from vehicle traffic.		
General Comments					
2.		Please include the boundary of the "central training yard" on the report figures (where applicable).	The boundary of the central training yard is shown on Figure 3 and Figures 8 through 13 as the area within the collector trench.		
3.		Please consider including boundaries of the paved/unpaved areas of the Site on the report figures (where applicable).	If these areas are known and can be shown, they have been added to the appropriate figures. It is assumed that only the areas of IR Site 6 outside of remedial excavation areas are paved.		
Minor Comments					
4.	Section 2.1.1,	**Historical Land Use, first paragraph**: Sentences 3 and 4 are essentially the same. Consider removing one of these sentences.	The third sentence has been deleted.		
5.	Section 2.1.3,	**Section 2.1.3, Future Planned Land Use**: The acronym "SSFPUC" used in the first sentence should be "SFPUC". In the second paragraph, the word "ate" in the second sentence should be "at".	The requested changes were made.		

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Comment	Response	Additional Comment	Additional Response
Comments Received May 11, 2021, from Dale Smith, Restoration Advisory Board (RAB) Member					
Specific Comments					
1.		As this is a very technical document, I don't have the expertise to comment on the correctness of the chosen strategy nor whether the chosen regulations and guidelines are the ones preferred by the regulators; I leave that to them. However, this is an issue of great concern for individuals and organizations in the bay area. It is most unfortunate the NAVFAC environmental program has refused to provide a presentation for the RAB community members and the public on this subject. It would have been worthwhile to learn how the regulators envision moving forward, as the bay/estuary already is badly polluted by these chemicals.	Comment noted. The DON appreciates your review of this Work Plan and has responded to comments received by the regulatory agencies above.		
2.		It is not true that migrating species are less likely to be impacted by PFAS. It is found in oceans around the world. Polar Bears in the Arctic have been found to have levels of 1,300 ppb.	The intent of this text was to indicate that rare or endangered terrestrial floral or faunal species are not known to occur at IR Site 6. The text in Section2.9 has been revised for clarification.		
3.		Marine organisms are recognized as a concern, but birds are not. Birds, including cormorants, osprey, bald eagles, diving ducks, are seriously impacted and should be evaluated when choosing a remedy.	Exposure of representative ecological receptors such as birds and marine mammals will be evaluated during the future remedy selection where appropriate.		
4.	Appendix A	In the SAP worksheet 9 Tahirih Linz properly should be addressed as Ms. Linz, not Mr. Izzat Amadea properly should be addressed as Mr. Amadea, not Mr. Izzat.	The name of Ms. Linz has been corrected in subheading **VIII. OPEN DISCUSSION** in SAP Worksheet #9. Similarly, the name of Mr. Amadea has been corrected in subheading **VI. LOGISTICS** in SAP Worksheet #9**.**		
5.	Appendix C	In the Waste Management Plan waste is generated from the digging of ten trenches adjacent to the bay. They are not shown on any figure. There is something called a collector trench, but it is not adjacent to the bay.	The trenching was removed from the scope of work. References to the trenching have been removed from the WMP. The collector trench is in the central portion of IR Site 6 (see Figure 2).		

Acronyms and Abbreviations:

AF = adherence factor; AFFF = aqueous film-forming foam; amsl = above mean sea level; AOI = area of interest; APP = Accident Prevention Plan; AST = aboveground storage tank; ASTM = ASTM International; BCT = Base Realignment and Closure Cleanup Team; bgs = below ground surface; BRAC = Base Realignment and Closure; COVID-19 = Corona Virus Disease 2019; CalOSHA = California Occupational Safety and Health Administration; CCR = California Code of Regulations; CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; cm = centimeter(s); cm^2 = square centimeter(s); COPC = contaminant of potential concern; COPEC = contaminant of potential ecological concern; COVID or COVID-19 = Corona Virus Disease of 2019; CQCP = contractor quality control plan; CSM = conceptual site model; DERP = Defense Environmental Restoration Program; DoD = United States Department of Defense;

Responses to Comments
Draft Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

DOE = United States Department of Energy; DON or Navy = United States Department of the Navy; DTSC = California Environmental Protection Agency Department of Toxic Substances Control; EPC = exposure point concentration; ERA = ecological risk assessment; ERAS = Ecological Risk Assessment Section; ESI = extracted internal standard; ESL = environmental screening level; ft = foot (feet); FTS = fluorotelomer sulfonate; GIS = geographical information system; gw or GW = groundwater; HERO = Human and Ecological Risk Office; HHRA = human health risk assessment; HQ = hazard quotient; IC = institutional control; ICAL = initial calibration; IR = Installation Restoration; ITRC = Interstate Technology & Regulatory Council; LCL = lower control limit; LCS = laboratory control sample; LCSD = laboratory control sample duplicate; LCMSMS or LC-MS/MS = liquid chromatography with tandem mass spectroscopy; LUC = land use control; mg/cm^2 = milligram(s) per square centimeter; mL or ml = milligram(s) per liter; MS = matrix spike; MSD = matrix spike duplicate; NAVFAC = Naval Facilities Engineering Systems Command; NCP = National Oil and Hazardous Substances Pollution Contingency Plan; NMPHC = Navy Marine Cops Public Health Center; NOAA = National Oceanic and Atmospheric Administration; NSTI = Naval Station Treasure Island; OEHHA = Office of Environmental Health Hazard Assessment; OSWER = Office of Solid Waste and Emergency Response; OWS = oil/water separator; PA = preliminary assessment; PAH = polycyclic aromatic hydrocarbon; PARCCS = precision, accuracy, representativeness, completeness, comparability, and sensitivity; P.E. = Professional Engineer; PFAS = per- and polyfluoroalkyl substances; PFBA = perfluorobutanoate; PFBS = perfluorobutanesulfonic acid; PFCA = perfluoroalkyl carboxylate; PFDS = perfluorodecane sulfonate; PFNS = perfluorononane sulfonate; PFOA = perfluorooctanoic acid; PFOS = perfluorooctanesulfonate; PFOSAm = perfluorooctanesulfonamide; PFPeA = perfluoropentanoate; PFPeS = perfluoropentane sulfonate; PG = Professional Geologist; PM = Project Manager; QA = quality assurance; QC = quality control; QSM = Quality Systems Manual; RACR = remedial action completion report; RAGS = Risk Assessment Guidance for Superfund; RD = remedial design; Regional Water Board or Water Board or WB = California Regional Water Quality Control Board; RI = remedial investigation; ROD = Record of Decision; RPD = relative percent difference; RPM = Remedial Project Manager; RSL = regional screening level; RT = response time; RTC = response to comment; SA = surface area; SAP = Sampling and Analysis Plan; SCCWRP = Southern California Coastal Water Research Project; SOP = standard operating procedure; SWDA = Solid Waste Disposal Area; SWRCB = California State Water Resources Control Board; TIDA = Treasure Island Development Authority; UCL = upper confidence limit; UGFGS = United Facilities Field Guide Specification; UFP-QAPP = Uniform Federal Policy Quality Assurance Project Plan; USA = Underground Service Alert; U.S.C = United States Code; USCS = United Soil Classification System; U.S. EPA or USEPA = United States Environmental Protection Agency; USGS = United States Geological Survey; UST = underground storage tank; WMP = waste management plan; WWTP = wastewater treatment plant; YBI = Yerba Buena Island

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
Comments Received January 24, 2022, from Celina Hernandez, Engineering Geologist, Regional Water Board			
Comments on Revised Draft Final Work Plan and Sampling and Analysis Plan			
1.	Section 2.11 (Previous Investigations)	Does not include 2020 hydropunch sampling. Please add.	Section 2.11, page 2-9, last bullet includes the 2020 Hydropunch sampling for PFAS during September 2020 and referenced Figure 9 (locations of previous PFAS sampling including the 13 Hydropunch locations). The Hydropunch sampling is also listed in Table 2-3 (PFAS analytical results in groundwater) from Page Table-11 to Table-12.
2.	Section 3.3 (Sources of Impact)	a. Does not mention the AFFF station in activities in the second paragraph. It should be considered a potential release/source area. Same comment for Figure 10 (Conceptual Site Model). b. Explain the features of the AFFF station (e.g., underground tank, dispenser, above ground tank, etc.)	a. The third bullet in Section 3.3 has been revised for clarification as follows: "*Improper filling and leakage from storage tanks and the AFFF Station (see Figure 3) or from firefighting trucks.*" Figure 10 has been revised to show the "AFFF Station" as requested. b. The AFFF station shown on Figure 3 is identified in the 1987 Harding Lawson Associates (HLA) report with no description on the figure or in the text. As such, it is not known whether it was an aboveground or an underground structure. However, the proposed sampling will characterize both surface and subsurface soil adjacent to this location (soil boring location 06-SB81).
3.	Sections 4.3.1.7. and 4.3.1.8	Possible discrepancy in purge rate for low flow sampling procedures between Section 4.3.1.7 and 4.3.1.8. Please clarify.	Section 4.3.1.7 describes the pumping rate of 500 mL/min during purging of the well until the geochemical parameters (e.g., pH) stabilize between consecutive measurements. Section 4.3.1.8 describes the not-to-exceed pumping rate of 100 mL/min to fill the sample containers. Because the sampling will occur after the purging is complete, the redundant text in the first four bullets of Section 4.3.1.8 has been removed for clarity.
4.	Sections 5.2 and 5.3	Section 5.2 and 5.3 indicates an evaluation of residual legacy chemicals co-located with PFOS, PFOA, and PFBS will be used for cumulative risk calcs and identified as COPCs. Are the legacy chemicals the Site 6 COPCs?	Yes. Previously identified chemicals at IR Site 6 were considered COPCs in earlier HHRA. The same approach will be followed for this project: non-PFAS chemicals at IR Site 6 that were previously investigated/evaluated but not excavated during the remedial action will be carried through the HHRA as COPCs for the ingestion and dermal contact pathway (soil) and ingestion pathway (groundwater).
5.	Section 5.4.2	This section is missing the sediment and surface water exposure routes and is not consistent with Figure 13 or the description in Section 3.5.1.	The third bullet in Section 5.4.2 has been revised to describe the sediment and surface water exposure as follows: "*Evaluation of the recreational visitor exposure to surface water and sediment and consideration of the fish/shellfish consumption pathway will be described in the next phase of the RI*."
6.	Section 6.2 (Groundwater Exposure Pathway Assessment)	Need clarification on the following text: a. "If PFAS are not detected in shoreline groundwater, exposure pathways will be found to be incomplete. If PFAS are detected in shoreline groundwater at concentrations less than ecological no-effect screening values, exposure pathways will be found to be complete, but with an unlikelihood of adverse effects." b. "Ecological no-effect screening values" are not defined in this Workplan. Please define or revise term for consistency throughout Workplan. Are these the same listed in Table 11-1 in SAP, Worksheet #11?	a. The first sentence in the last paragraph of Section 6.2 has been clarified as follows: "*If PFAS are not detected in shoreline groundwater, exposure pathways to aquatic receptors in the bay will be considered incomplete*." b. Yes, the sources for ecological no-effect screening values are listed in the preceding paragraph on page 6-3 of Section 6.2, and the values are the same as those listed in Worksheet #11 Table 11-1 of the SAP. The second sentence in the last paragraph of Section 6.2 has been revised for clarification as follows: "*If PFAS are detected in shoreline groundwater at concentrations less than ecological no-effect screening values (see Worksheet #11 and Table 11-1 of the SAP, Appendix A), exposure pathways will be considered complete, but with an unlikelihood of adverse effects*."
7.	Figure 11	Figure 11 (Proposed Soil Sampling Location Map) – The description under the Legend for the pink circle appears incorrect. The text states "Proposed Soil Boring and Geochemical Sample Well." Please revise, as needed.	The legend for the proposed soil sampling location in Figure 11 has been revised as follows: "*Proposed Soil Boring and Geochemical Sampling Location.*"

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
8.	Figure 12	Location MW39 is located downgradient of potential source area (Collector Trench and Surge Pit) Should it be downgradient of MW32, where the highest concentrations are detected and perpendicular to the Bay? Same comment for Table 4-1 (Rationale for Remedial Investigation Sampling Locations at IR Site 6), and Appendix A, Worksheet #17, Table 17-1.	Monitoring well location 06-MW39 will be moved to be downgradient of well 06-MW32 as requested. The rationale for locating well 06-MW39 will be to be downgradient of 06-MW32 where the highest concentrations of PFAS were detected onsite. Figure 12 of the work plan and Figure A-11 of the SAP will be revised accordingly.
9.	Figure 13 (Human Health Risk Assessment Conceptual Site Model)	This figure should show human health and ecological risk assessment conceptual site model which would be consistent with Section 3.5 (Potential Receptors and Exposure Pathways).	The requested change has been made, and the ecological pathways are now shown on Figure 13 with the human health exposure pathways.
10.	Table 2-1 (Summary of Previous Investigations)	This table does not include the hydropunch sampling completed in 2020. Add if this was overlooked.	A new entry has been added to Table 2-1 to document the Hydropunch sampling event.
12.	Table 3-1 (Conceptual Site Model)	Under Physical Profile, Beneficial Resources, the SF Bay should be considered a beneficial resource.	The entry under Beneficial Resources in Table 3-1 has been revised as follows: "*There are no known beneficial resources onshore TI; however, the adjacent San Francisco Bay is considered a beneficial resource*."
13.	SAP Worksheet #3 (Distribution List) and Worksheet #5	Missing Tahirih Linz, some navy email addresses look incorrect on Worksheet 3.	The DON project team for the SAP generally includes the RPM, the Lead RPM, and the Chemist. It is assumed that the RPM will distribute the required documentation to his/her internal team (including Tahirih Linz and other DON stakeholders). Email addresses have been reviewed and changes have been made, as needed.
14.	SAP Worksheet#11	Step 5, item 1 and 2, after "Otherwise, additional characterization is not warranted" add "at this time." Also add: "if new technical information on PFAS arises, additional actions may be required in the future."	We concur with the suggested language. Text in STEP 5, Items 1 and 2 has been revised as follows: "*1. If concentrations of PFAS in soil samples exceed the screening criteria specified in Table 11-1, then the soil results will be used to evaluate the residual PFAS present in soil. Otherwise, additional characterization is not warranted at this time. **If new technical information on PFAS arises, additional actions may be required in the future.*** *2. If concentrations of PFAS in groundwater samples exceed the screening criteria specified in Table 11-1, then additional evaluation (e.g., PFAS concentrations in wells nearest the shoreline, tidal study, etc.) will be used to assess the potential transport of PFAS to San Francisco Bay. Otherwise, additional characterization of PFAS in groundwater is not warranted at this time. **If new technical information on PFAS arises, additional actions may be required in the future**.*"

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
Comments Received February 1, 2022, from Peyton Ward, Project Manager, Site Mitigation and Restoration Program – Berkeley, DTSC			
General Comments			
1		The following comments have been accepted: General Comments 1 through 6, Specific Comments 1-18, 20-46	The DON thanks DTSC for its review.
Specific Comments			
1	Section 5.0 and Figure 13	Sections 5.0 and subsections should reflect all exposure Pathways presented in Figure 13, as well as the additional pathways requested below. Furthermore, the residential pathway should include the same exposure pathways as the recreator (e.g., the fish consumption and sediment/surface water contact) as a resident is likely also to take part in recreation opportunities including fishing and swimming/wading. Though these pathways will not be quantitatively assessed during Phase 1 of the RI, they should not be omitted from the description of relevant exposure pathways.	The recreational visitor exposure scenario shown on Figure 13 includes the fish consumption pathway and will be further evaluated during a future phase of the RI, as needed. Risks for the recreational visitor scenario may include a range of potential scenarios, including a scenario in which the recreator resides on the island, and these risks may be added to the hypothetical residential scenario. This is noted in revised Figure 13 (revised footnote a). The third bullet in Section 5.4.2 has been revised to describe the sediment and surface water exposure as follows: "*Evaluation of the recreational visitor exposure to surface water and sediment and consideration of the fish/shellfish consumption pathway will be described in the next phase of the RI*." Similarly, Figure 13 has been revised to show the referenced exposure pathways to be evaluated in the next phase of the RI as requested.
2	Section 5.5	Section 5.5 has removed language related to the California Toxicity Criteria Rule and indication that any toxicity values adopted by the State of California prior to the issuance of the final RI Report will be incorporated into that report. Please revise the text to restore these items.	Section 5.5 has been updated to indicate that the development and finalization of the RI Report will consider the adoption of additional toxicity criteria associated with PFAS issued at the federal and/or state level. Because the regulatory environment regarding PFAS is continually changing, the DON will remain flexible and open to discussion with the partnering agencies for incorporation of additional toxicity criteria in the RI Report at the time it is relevant. The following text has been added to the end of Section 5.5: "*It is acknowledged that the regulatory environment regarding PFAS is continually changing. Therefore, adoption of additional toxicity criteria associated with PFAS issued at the federal and/or state level will be considered during the development of the RI Report.*"
3	Section 4.0	The sample counts for soil and groundwater have changed between the prior draft (March 12, 2021 and October 11, 2021) and this draft (January 14, 2022). Please confirm that the total sample count is increasing. For example, Section 4.2 has been revised from stated that 40 shallow soil borings will be drilled with two samples collected per boring to stating that 30 shallow borings with two sample per boring will be advanced. It is DTSC's understanding that the numbers presented in Section 4.0 include collection of soil samples from the 15 groundwater borings to be advanced but it is not clear and consistent throughout the text. Please provide a response to this comment documenting the change between drafts and revise the text, as needed, to be clear and consistent.	The sample counts did change because of the addition of 5 new monitoring wells in the revised draft final work plan. Forty-five (45) soil borings will be advanced, and two soil samples (1 surface and 1 subsurface) will be collected at each location (Figure 11). Groundwater monitoring wells will be installed at fifteen of the soil boring locations (Figure 12). Groundwater samples will be collected from the 15 new and 9 existing groundwater monitoring wells.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
Comments Received February 1, 2022, from Kimberly Gettmenn, Staff Toxicologist, Human and Ecological Risk Office, DTSC			
General Comments			
1.	Section 3.3, Table 4-1, Sampling and Analysis Plan (SAP) Worksheets #11, #17 and #18	All of HERO's comments and concerns regarding collecting sampling in the "fill material" have been addressed adequately and the text in the Work Plan has been revised accordingly. HERO has no additional comments.	The DON thanks HERO for its review.
2.	Section 3.5.1, Section 5.4.2, Figure 13 and Table 5-1	HERO concurs with the Response and appreciates that the DON has agreed to evaluate the hypothetical future residential scenario. The text in section 5.4.2, Table 5-1, and Figure 13 have been revised accordingly. However, the text in Section 3.5.1 does not discuss the hypothetical future residential scenario. Please revise the text to reflect that this receptor will be evaluated. For exposure pathways to be evaluated under the hypothetical future resident, HERO also recommends that the fish/shellfish consumption and incidental ingestion of surface water pathways be included. HERO acknowledges that evaluation of these pathways will occur during the Phase II remedial investigation. Please revise the text and Figure 13 to include evaluation of fish/shellfish consumption and incidental ingestion of surface water for the hypothetical future resident.	The text in Section 3.5.1 has been revised to include a discussion of hypothetical future resident exposure scenario. The recreational visitor exposure scenario shown on Figure 13 includes the fish consumption pathway and will be further evaluated during the Phase II RI. Risks for the recreational visitor scenario may include a range of potential scenarios, including a scenario in which the recreator resides on the island, and these risks may be added to the hypothetical residential scenario. This is noted on revised Figure 13 (revised footnote a). Section 3.5.1 text has been updated as follows: "*The planned future use of the site is as an open space and recreational area. The development plan also indicates that an approximately 0.9-acre area in the southeastern portion of IR Site 6 will be used for public services and institutional purposes to support the replacement of the existing WWTP (TIDA, 2011). Potential future human receptors at former IR Site 6 include construction workers and recreational visitors. Potential exposure media identified for the construction worker include soil and groundwater. Potential exposure media for recreational visitors are soil, nearshore water, sediment, and fish/shellfish (impacts currently unknown). Exposure pathways may include direct contact (incidental ingestion and dermal contact) with these media and ingestion of fish or shellfish. Access to the site is currently restricted, and the site is not open for public use.* *Hypothetical future user includes residents, who may be exposed to soil, and may also be recreationally exposed to sediment, surface water, or the fish or shellfish consumption pathway. This exposure scenario is considered hypothetical because of existing land use controls and the planned future use.*"
3.	Section 5.0	HERO concurs with the Response that cumulative risk/hazard in the forthcoming baseline HHRA will include risk/hazard from the PFAS investigation and the residual risks/hazards from the chemicals left onsite. HERO also concurs with and appreciates that a hypothetical future residential scenario will be evaluated in the baseline HHRA. HERO has no additional comments.	The DON thanks HERO for its review.
4	General Comments 4a, 4b, and 4c of the Revised Draft Final Work Plan	Shellfish and Recreational Fish Consumption. The scope of the Work Plan has changed, and the evaluation of the recreational fish/shellfish consumption will be evaluated during Phase II of the remedial investigation. For completeness and transparency HERO recommends that this pathway and the receptors be discussed in Section 5.4.2 – Identification of Potential Exposure Scenarios. The text can state that this pathway and receptor will be evaluated during Phase II of the remedial investigation that will be completed later. This Work Plan should discuss all receptors and pathways that will be evaluated in the forthcoming HHRA regardless which phase the evaluation will occur, i.e., Phase I of the remedial investigation or Phase II of the remedial investigation. HERO recommends revising the text and figures in the Work Plan where	The third bullet in Section 5.4.2 has been revised to describe the sediment and surface water exposure as follows: "*Evaluation of the recreational visitor exposure to surface water and sediment and consideration of the fish/shellfish consumption pathway will be described in the next phase of the RI.*" Similarly, Figure 13 has been revised to show the referenced exposure pathways to be evaluated in the next phase of the RI as requested.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
		appropriate to discuss and show all receptors and pathways that will be evaluated in a HHRA.	
5	PFAS Sampling Results	concurs with the Response. No additional response is necessary.	The DON thanks HERO for its review.
6	Section 5.5.4	HERO concurs with the Response that the USEPA OSWER Directive 9283.1-421, *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* will be consulted when calculating the 95% UCL for the groundwater and pore water samples. HERO has no additional comments.	The DON thanks HERO for its review.
7	Section 5.6	In the Revised Draft Final Work Plan dated January 2022 all text discussing the OEHHA toxicity criteria for PFOS and PFOA, the California Toxicity Criteria Rule (TCR), and conducting a dual-tracking HHRA have been removed. HERO does not concur with the removal of this language and recommends putting the language back into the text of the Revised Draft Final Work Plan. Please note that the previous version reviewed by HERO, the Draft Final Work Plan dated October 2021, include the appropriate text. Additionally, HERO continues to recommend that if the PFOA and PFOS toxicity criteria values are adopted into the TCR, prior to the draft final version that they be used in the human health risk assessment.	Section 5.5 has been updated to indicate that the development and finalization of the RI Report will consider the adoption of additional toxicity criteria associated with PFAS issued on the federal and/or state level. Because the regulatory environment regarding PFAS is continually changing, the DON will remain flexible and open to discussion with the partnering agencies for incorporation of additional toxicity criteria in the RI Report at the time it is relevant. The following text was added to the end of Section 5.5: "*It is acknowledged that the regulatory environment regarding PFAS is continually changing. Therefore, adoption of additional toxicity criteria associated with PFAS issued on the federal and/or state level will be considered during the development of the RI Report.*"
8	Section 5.7	Soil Sampling Depths. HERO concurs with and appreciates the Response. HERO reviewed the additional text added in Section 5.7 that discusses the uncertainty in collecting surface soil samples from the depth of 0 to 2 feet bgs, and not from the recommended 0-0.5 feet bgs sampling depth interval. HERO has no additional comments.	The DON thanks HERO for its review.
9	SAP Worksheet #11 – Step 5	Develop the Analytical Approach. HERO acknowledges the Response and defers to the Project Managers Response to DTSC follow up Comment 37.	The DON thanks HERO for its review.
Specific Comments			
1.	Table 5-1	HERO concurs with and appreciates the Response. HERO reviewed the Draft Final Work Plan provided with the Responses and Table 5-1 was updated to incorporate HERO's comment. HERO has no additional comments.	The DON thanks HERO for its review.
2	Worksheet #10.5.3 – Prior PFAS Investigations, Third Bullet, page A-51	Please revise the PFBS groundwater screening level listed on page A-51 from 40 µg/L to 0.6 µg/L. This change does not change the conclusion of the bullet.	The PFBS screening value has been revised in Worksheet #10 Section 10.5.3 of the SAP.
3	Figure 13	Under the hypothetical future resident receptor, please include as potentially complete exposure pathways ingestion of fish/shellfish and incidental ingestion of surface water.	Figure 13 has been revised as requested.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
Comments Received February 7, 2022, from Langan Engineering and Environmental Services, Inc. on Behalf of the Treasure Island Development Authority			
General Comments			
1		The QA/QC program is unclear. SOPs in the attached SAP indicate specific blanks to be collected. We suggest tabularized summary to clarify QA/QC sampling protocol for each event. Please consider initial event equipment blanks, decon source water blanks, equipment rinsate blanks, equipment blanks collected at varying time of the day following decon (instead of just at the end of the day), equipment blanks should be performed at a rate of 1/day/piece of equipment. If multiple sampling setups are used with submersible pumps, an equipment blank should be performed for each setup. Same would go for hand augers or other soil sampling tools. ITRC Section 11.1 of the ITRC's Per-and Polyfluoroalkyl Substances (PFAS) Technical/Regulatory Guidance Document (July 2021 updated version being published shortly) has a base table to reference for a good baseline QA/QC program. Consider collection of an equipment blank for all equipment contacting samples prior to event initiation and following the initial decontamination step.	Worksheet #12 Table 12-1 documents the measurement performance criteria, which include all required QC samples and their frequency in compliance with recommendations made by U.S. EPA, ITRC, and the EMDQ. Worksheet #20 also documents the required QC samples and includes the following footnotes: • Equipment Blank: An equipment blank (rinsate blank) is used to assess the effectiveness of decontamination procedures for reusable sampling equipment. Collected at a frequency of one per day per method of sample collection.
2		The 12/7/2021 DoD memorandum "Update for Establishing a Consistent Methodology for the Analysis of Per- and Polyfluoroalkyl Substances in media Other than Drinking Water" indicated the need to implement Draft Method 1633, which reports upwards of 40 compounds. We suggest this method and reporting list be implemented in this investigation in place of Method 537.1. Confirm the reporting list for the Draft 1633 method. SGS AXYS Analytical Services Ltd., the laboratory that helped develop the method and the only lab to date with DoD ELAP accreditation, notes this method reports and tests for 40 compounds, including the primary PFOA, PFOS, and PFBS(https://www.sgsaxys.com/2021/09/14/epa-announces-availability-of-epa-1633-draft-pfas-method-developed-by-sgs-axys-sgs-axys-continues-to-expand-range-of-pfas-testing-methods/). Update in main work plan text and SAP.	The current method used for the analysis of PFAS is the LC/MS/MS compliant with QSM Version 5.3 Table B-15. Because there are limited options for laboratories DoD accredited for U.S. EPA Method 1633 and no contracted laboratory with State of California ELAP certification within the timeframe for the proposed RI, the new U.S. EPA Method 1633 will not be implemented at this time. Therefore, no changes to the work plan or SAP have been made for this project.
3		Has there been any consideration given to Total Oxidizable Precursor (TOP) Assay to assess precursor potential to transform/degrade over time into the regulated perfluorinateds? This is a potential especially considering the primary source is decades old usage of legacy AFFF, which have complex chemical formulations and should be a consideration in the risk assessment.	The TOP assay is considered a screening technique by DoD, as there currently is no published method for the TOP Assay technique. The technique has not undergone the validation process needed for the EPA or DoD to consider it a standardized method that has demonstrated the robustness needed to result in consistent data when utilized by multiple laboratories. The DoD does not consider this a technique that can be used for the collection of definitive data; therefore, it does not fall under the scope of DoD ELAP accreditation. Therefore, for these reasons the assay will not be implemented for this investigation.
4		Please include references throughout work plan text to appropriate SOP in the SAP for details.	References are included throughout the Work Plan where appropriate to reference the field SOPs, which are also documented in the SAP.
5		Applicable screening levels should incorporate and screen against screening levels established or being considered by State of California as well and should be included. See the Regional Water Quality Control Board Interim Final ESLs for PFOS and PFOA (May 2020).	The DON PFAS investigation will be performed in accordance with current DoD policy. The policy requires comparison with the DoD screening levels, which presently do not include the Regional Water Board ESLs. Additionally, the RI will include a baseline risk assessment using comprehensive and site-specific information to evaluate the different receptors.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
6		Groundwater sampling material restrictions focus should be on materials and equipment that have a realistic likelihood of contacting the sample or a plausible mechanism of transport to the sample. a. Recent studies have indicated likely contamination from materials like clothing and field books and even some sampling materials, is low and the focus should be upon controlling what contacts the sample. (Denly, et.al., 2019-Remediation and Rodowa, et al., 2020-Environmental Science and Technology). b. Standard good sampling practices would inform keeping items like food and food wrappings outside of sampling areas and measures such as frequent hand washing and glove changes address concerns of possible carry over from those types of items. c. Restrictions such as shoes with Gore-Tex membranes, field clothing washed 6-times, are unnecessary restrictions that in some cases cannot be documented or present little to no risk of contact with the sample	Comment acknowledged. The remedial investigation is required to follow standard operating procedures in accordance with the following documents: • California State Water Resources Control Board (SWRCB) Division of Water Quality. 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines for Non-Drinking Water. September. • Delta Consultants. 2010. Report of Investigation Activities at Select Firefighting Foam Training Areas and Foam Discharge Sites in Minnesota. February. MPCA, 2008. Closed Landfill Program Sampling Protocol for Monitoring Wells. October. • Transport Canada. 2013. Perfluorochemical (PFAS) Field Sampling Protocol. May. • United States Department of Defense (DoD). 2021. Memorandum for Assistant Secretary of the Army (Installation, Energy, and Environment); Assistant Secretary of the Navy (Energy, Installations and Environment); Assistant Secretary of the Air Force (Installations, Environment and Energy); Director, National Guard Bureau (Joint Staff, J8); Director, Defense Logistics Agency (Installation Support). Subject: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15. The requirements of these guidance documents are detailed in SOP Wood-01 and prohibit the use of certain field books, clothing, including Gore-Tex, and sampling materials during sample collection. Food, food wrappings and hand washing, and glove use are also documented in the SOP. As new information becomes available, the field SOPs will be revised as appropriate to reduce the potential for cross-contamination.
Specific Comments			
1	Section 1.1 Objectives, Page 1.1 First Paragraph:	The objectives should include defining the nature and extent of PFAS impacts to the soils and groundwater at the Site. Knowing the full nature and extent of the impacts would be necessary to support a risk assessment. The second paragraph indicates the purpose for collecting the proposed soil and groundwater samples. It should be noted as an objective of the proposed work explicitly in this paragraph as well.	The first paragraph of Section 1.1 has been modified as follows: *“The objectives of the RI are to determine whether per- and polyfluoroalkyl substances (PFAS) released to the environment from activities at IR Site 6 are migrating to the surface waters of San Francisco Bay**, assess the nature and extent of PFAS in soil and groundwater,** and determine whether PFAS in soil and groundwater present an unacceptable risk to site users and ecological receptors.”*
2	Section 2.1.3, Future Planned Land Use	Please include reference to Section 2.8 for details confirming the water cannot be used for drinking water per California State Water Resources Control Board Resolution 88-63 and Regional Water Quality Control Board Resolution No. 89-39.	The third sentence in the first paragraph of Section 2.1.3 has been revised as follows: *“Groundwater at IR Site 6 is not a potential source of drinking water **(see Section 2.8)**, and no other uses of groundwater are planned at IR Site 6.”*
3	Section 3.1, Nature and Extent of PFAS	Soil: the DOD screening levels are based on incidental ingestion (residential and worker). Is consideration being given to assess leachability of the PFAS in the soil? Groundwater: related to the usability of prior PFAS sampling, were the HydroPunch samples filtered or centrifuged to remove suspended solids/turbidity? Were prior groundwater samples collected with proper protocols in place to confirm the intended usability?	A site-specific quantitative evaluation of leachability is not scoped and will not be performed. Groundwater samples collected during the planned RI will not be filtered. The field crew will use a low flow sampling method to minimize turbidity in groundwater samples. Hydropunch samples were not field filtered or centrifuged. Hydropunch sampling was performed as a screening tool to access the nature and extent of PFAS in groundwater and inform where additional groundwater monitoring wells would be needed for this PFAS RI. Appropriate sampling procedures were described in the sampling plan (NOREAS, 2020) used to perform the Hydropunch sampling. *NOREAS, Inc. (NOREAS). 2020. Field Change Request to the Final Sampling and Analysis Plan, Basewide Groundwater and Soil Gas Monitoring at Installation Restoration Sites 6, 12, 21, and 24, Former Naval Station Treasure Island, San Francisco, CA. April 2017.*

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
4	Section 3.3, Sources of Impacts and Potential Release Mechanisms	Though training ceased, was AFFF product stored at IR Site 6 after 1992 and were there any reported incidences of releases or spills in the storage areas? Are lines that transmitted water to the WWTP being evaluated? To build on this, is consideration being given to address potential impacts related to the WWTP as it appear to have receive known PFAS impacted runoff? Could clean fill placed during previous remedial actions now be impacted through contact with PFAS impacted groundwater? Is sampling of the previously placed clean fill considered? Proposed sample locations and depths should be distributed to ensure representative samples of previously placed clean fill are included in the investigation.	The lines that transmitted firefighting wastewater are being characterized, see the rationale for sampling locations in Table 4-1. Examples include 06-SB68, SB70, 79, etc. Although not a goal of this RI, potential impacts related to the WWTP may be indicated by the results of soil and groundwater sampling. Proposed monitoring well 06-MW44 is within the WWTP and proposed monitoring well 06-MW47 is just outside the WWTP in a downgradient direction. Data from these points as well as others have the potential to assist in evaluating if there are impacts from the WWTP but will not be a required part of analyses performed for this PFAS RI. The depth of the excavations ranged from 1 to 2 feet bgs in most areas to as much as 5 feet in a very limited area of the site. Based on previous groundwater level measurements at IR Site 6, the shallowest depth to groundwater between 2013 and 2020 in the area of the remedial action (e.g.,06-MW25) was a depth of 4.3 feet adjacent to a small area previously remediated to a depth of 5 feet bgs. There is no evidence to indicate that groundwater has risen significantly to impact the overlying fill materials with PFAS. Yes, sampling in the placed clean fill is being considered. Soil samples will be collected at depths of 0–2 feet bgs and approximately 4–6 feet bgs above the capillary fringe at each boring location. All soil sample data collected will be used in the risk assessment calculations. Proposed sample locations and depths are distributed to ensure representative samples of previously placed clean fill are included in the investigation.
5	Section 4.0, Remedial Investigation Sampling Approach	Method 537.1 is a drinking water method. If using the method for media other than drinking water, Method 537.1 (modified) should be utilized. Many labs can report longer PFAS lists using 537.1 (modified). For example, Eurofins will report a "full list" of 24 compounds as a standard report. Please include references to SOPs within the attached SAP where appropriate for discussion; many questions on procedures are clarified in those documents.	The second sentence of the second paragraph in Section 4.0 has been modified as follows: *The 18 PFAS are included in U.S. EPA Method 537.1* ***and will be analyzed*** *using liquid chromatography and tandem mass spectrometry (LC/MS-MS) compliant with DoD Quality Systems Manual (QSM), version 5.3 Table B-15 (DoD, 2019).* It is understood that many laboratories can analyze for longer lists of compounds; however, currently, the DON requires reporting of the 18 PFAS compounds identified in the U.S. EPA Drinking Water Method 537.1. Reference to Method 537.1 is not to indicate that that method will be used for the analysis of PFAS, but rather to list it as a source for the list of PFAS compounds that will make up the analyte list. The SAP includes references to the laboratory SOP, which is on file at the laboratory and is also submitted as a related deliverable to the Work Plan/SAP.
6	Section 4.1.3, Mobilization and Site Setup	As the buildings have been demolished and sample locations are established, could the laydown and staging area be identified on the proposed plans prior to mobilization?	The site laydown and staging area will be determined by the DON Contractor Support Office during the pre-construction kickoff meeting prior to site mobilization.
7	Section 4.2.1, Soil Sampling	For samples within prior excavation areas, clarify if sample depths will be collected to represent both the clean fill placed during prior excavations and the fill material/shoal sands that underlie the clean fill. Both of these soil horizons should be assessed. Sample depths are focused on the unsaturated zone and capillary fringe. Has consideration been given to assessing soils within the saturated zone or the underlying Younger Bay Mud? Is there or will there be consideration of testing leachability (LEAF method if acceptable) to assess the support conclusions of the F&T assessment? Clarify the general approach to order of sample collection based on known soil concentrations (i.e. sampling from edge locations first followed by locations near potential sources in an attempt to sample from "clean to dirty"?) Reference to the SAP or other attachments for details as appropriate.	At each soil boring within a prior excavation area (and for all soil borings) soil samples will be collected from 0 – 2 feet bgs and approximately 4 – 6 feet bgs (depending on the capillary zone depth). The 0 – 2 feet bgs sample will represent clean fill and the approximately 4 – 6 feet bgs sample will represent the TI native material. Evaluation of soils in the saturated zone is not needed to achieve the goals of this RI. They may be sampled in subsequent investigations to assist in evaluating potential remedial actions. The evaluation may include testing the leachability of these soils. A site-specific quantitative evaluation of leachability is not scoped and will not be performed. A specific progression for sampling is not planned to allow field personnel the flexibility to efficiently complete the sampling while observing general sampling protocols to minimize cross-contamination.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
8	Section 4.2.2, Soil Sampling Decontamination Procedures	Do not store sampling tools in aluminum foil as aluminum foil (non-stick type) has been shown to contain PFAS. We recommend avoiding using aluminum foil in direct contact with sampling equipment that could contact your sample (Rodowa, et al., 2020-Environmental Science and Technology). If it cannot be avoided, a blank of the foil used should be collected.	Aluminum foil has been removed from Step 4 regarding general sampling equipment decontamination in Section 4.2.2.
9	Section 4.2.3, Laboratory Analysis	Will the lab provide the PFAS-Free final rinse water as noted in the SOP? If not, what is the source and will they certify it is PFAS free? If not, a blank should be collected from each batch of rinse water purchased to confirm it is indeed PFAS-Free as per the SOP.	Yes, the laboratory will provide certified PFAS-free DI water for use as the final rinse water.
10	Section 4.3, Well Installation and Groundwater Sampling	What is being done to provide vertical delineation of PFAS impacts in groundwater? Was consideration given to the use of passive samplers to limit potential cross contamination and generation of IDW? The use of passive samplers would be beneficial to limiting cross contamination potential and reducing IDW generation. Use of peristaltic pumps would negate this as they provide a similar benefit.	Based on previous investigations, groundwater at IR Site 6 is not considered to be stratified; therefore, vertical delineation within the same water-bearing zone is not performed. All groundwater monitoring wells installed as part of this investigation will be advanced to a depth of approximately 15.5 feet bgs and screened from approximately 5 to 15 feet bgs. Passive samplers will not be used for this investigation. A portable peristaltic pump will be used for groundwater sample collection. Decontamination procedures described during groundwater sampling are sufficient to limit cross-contamination based on many previous PFAS investigations at numerous DON installations; these procedures are described in Sections 4.3.1.5 and 4.3.1.6.
11	Section 4.3.1, Groundwater Monitoring Well Installation and Sampling	Please note whether lubricants used by drillers on augers and rods contacting the subsurface will be reviewed for potential PFAS content before mobilization. Include a description of decontamination procedures for drill rods and other equipment being used in the installation and development process.	Drilling equipment that are PFAS free have been requested from the drilling subcontractors and will be verified in the field during mobilization using the Multi-MAC JV PFAS Field Protocols. Decontamination procedures during drilling are described in Section 4.2.2.
12	Section 4.3.1.4, Groundwater Sampling	What type of pump will be used for the low-flow sampling? Specify if peri-pump or submersible as peri-pump limits potential cross contamination or include reference to appropriate SOP in the SAP for details.	A peristaltic pump will be used for this investigation as indicated in Section 4.3.1.7.
13	Section 4.3.1.6, Groundwater Sampling Decontamination Procedures	Reformat to a bulleted stepwise list like the soil decontamination section for clarity on process or include reference to appropriate SOP in the SAP for details. Please clarify why submersible pumps are included in this section, give that it appears peristaltic pumps will be used based on well depths. Please address the decontamination of drilling rigs.	The description of the decontamination procedure is clear, and additional revision is not required for this section. Existing wells will require sampling. Submersible pump sampling procedures are provided in case submersible pumps are present in the existing wells. Decontamination procedures during drilling are described in Section 4.2.2.
14	Section 4.6, Investigation-Derived Waste Management	Specify the analytical method to be used for disposal classification. Is there any concern about sending known PFAS impacted general refuse for disposal offsite as a non-regulated waste, rather than disposing of it as a non-hazardous waste?	The analytical methods used to characterize investigated-derived waste (IDW) are listed in Section 4.6, including VOCs, TPH, PFAS, and CAM 17 metals. The results will be provided to the disposal facility for acceptance of the IDW. The classification of the IDW is not known at this time.
15	Appendix A, Sampling and Analysis Plan, Executive Summary	Clarify reporting list as 1633 can report 40 compounds. Page A-8: while PFOA, PFOS, and PFBS are the only compounds with human health considerations, many of the other PFAS compounds can facilitate a stronger understanding of the impacts and are likely to be subject to future regulations. They should be considered in site management decisions and risk assessments accordingly.	The method used for the analysis of PFAS is the LC/MS/MS compliant with QSM Version 5.3 Table B-15. Because of the limited availability of laboratories, DoD ELAP certified to U. S. EPA Draft Method 1633 (QSM Version 5.4, Table B-24), as well as contracts with SAP proposed laboratories have already been awarded, U. S. EPA Draft Method 1633 will not be used in this phase of the investigation. Therefore, no changes to the work plan or SAP have been made. However, in future investigation work, the inclusion of analysis of non-drinking water media by Draft Method 1633 will be considered by the project team.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
16	Appendix A, Sampling and Analysis Plan, Worksheet 10, Section 10.5.4	Bullet number one should note the intent is to delineate horizontally and vertically. Confirm the baseline Human Health Risk Assessment will account for impacts of all PFAS tested and not be limited to only PFOA, PFOS, and PFBS.	Bullet (1) sufficiently describes the problem definition of both delineation (vertically and horizontally), so no additional changes to the text have been made. The HHRA will evaluate PFOA, PFOS, and PFBS at this time because those are the PFAS with currently accepted U. S. EPA available Tier I, II, or III available toxicity values for them (e.g., PFBS) or have been recognized as Tier III values by ASD (e.g., PFOA and PFOS). However, as additional toxicity criteria are developed for other PFAS and issued by U. S. EPA as Tier I, II, or III values the DON will consider them as applicable within the timeline for completing the RI.
17	Appendix A, Sampling and Analysis Plan, Worksheet 11	Step 2 - clarify the goal of vertical and horizontal delineation.	STEP 4 describes the delineation of PFAS (vertically and horizontally), so no additional changes have been made to the text.
18	Appendix A, Sampling and Analysis Plan, Worksheet 14	Section 14.13: Clarify PFAS analytical method for IDW.	All aqueous and solid PFAS (characterization and IDW) will be analyzed using LC/MS-MS compliant with QSM 5.3 Table B-15.
19	Appendix A, Sampling and Analysis Plan, Worksheet 18	Table 18-1 Update to QSM 5.4.	QSM 5.3 is sufficient for the proposed PFAS analysis by LC/MS-MS, so no additional changes to the text have been made.
20	Appendix A, Sampling and Analysis Plan, Worksheet 20	Will a blank be collected from the water level meters too? This table should include listing of a decon source water blank from the potable water source. As samples are being shipped cross-country, consideration should be given to include a trip blank (we recognize this is not common).	The equipment blank will be collected from the representative field equipment, potentially including the water level meter. Laboratory-provided PFAS-free water will be used for decontamination as indicated in footnote 5 of Worksheet #20, so no source blank will be collected as a result. The use of laboratory-provided PFAS free water is also documented in Section 14.9. Trip blanks are not planned for this investigation.
21	Appendix A, Sampling and Analysis Plan, Worksheet 21	We suggest working references to these into the main text. Would add clarity up front for details.	References to the SOPs are presented in the main text, particularly in Worksheet #14. They will be updated as needed prior to work plan finalization.
22	Appendix A, Sampling and Analysis Plan, Attachment 3, PFAS SOPs, Wood-01	Consider updating with more recent field sampling guidance references beyond the 2013 transport Canada Guidance in light of recent studies and more recent guidance publications elsewhere. There is a discrepancy between decon procedures noted for larger equipment in SOP Wood-01 and SOP Wood-10, which indicates a final PFAS-Free water rinse for larger equipment, which is not noted in SOP Wood-01. Will larger equipment have a PFAS-Free rinse per the decon procedures?	Comment noted. As new information become available, the field SOPs will be revised as appropriate to reflect new guidance documents. There are no inconsistencies with regard to larger equipment. The last bullet under Equipment Decontamination in SOP Wood-01 is intended to clarify that for larger equipment, a pressure washer will be used. The previous bullet clearly indicates that downhole equipment will be decontaminated using Alconox and Liquinox soap and PFAS-free water.
23	Appendix C, Waste Management Plan	Is the disposal facility known at this time?	The disposal facilities have been identified for this investigation, but the contracted facility has not yet been selected.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

#	Section	Additional Comment	Response
Comments Received February 4, 2022, from Dale Smith, Restoration Advisory Board Member			
General Comments			
1		I appreciate that a more conservative hazard quotient is being used because of possible co-occurrences of multiple PFAS and other chemicals. I find the confounding of conditions on Treasure Island as a whole and Site 6 misleading. Perhaps a discussion of Treasure Island fauna in one paragraph and then a focus on Site 6 would more clearly distinguish the differences between the two.	The DON appreciates your review. Because IR Site 6 is a very small portion (4.5 acres) of the 403 acres of the land area of Treasure Island, many of the features used to represent IR Site 6 have not been observed at IR Site 6. Thus, general Treasure Island features are used to describe IR Site 6 because Treasure Island contains IR Site 6.
Specific Comments			
1	Page 3-6	The PFAS plume is under Building 461 which is the only building in the vicinity of Site 6. Understanding the problem with the riprap offshore, sampling on shore down gradient from the building seems appropriate, but has not occurred and doesn't seem likely to. Why?	Building 461 is outside the area of historical PFAS release (use of AFFF during firefighting training). However, wells will be used to characterize groundwater in all four directions at the building, including upgradient well 06-MW26, downgradient wells 06-MW33, and 06-MW39, and cross-gradient wells 06-MW32, HP01, and HP02.
2	Page 3-7	Discussions of avian and aquatic species using the island seems contradictory depending on where in the document the comment is made. Both animals and benthic species are impacted by either consuming aquatic species or living in water. It sounds like the navy is trying to minimize the impact of PFAS on fauna. Bald eagles may not land on TI, but they certainly consume the fish; the San Francisco Estuary Institute has tested the resident pair of Mill Valley and found them containing high levels of PFAS, especially PFOS.	Comment acknowledged. Section 3.5.2 confirms that there is a potential exposure of benthic invertebrates and birds to PFAS in surface water.
3	Page 4-	The text does not state the diameter of the monitoring wells to be installed, just the diameter of the boreholes. Should not the monitoring well dimension be stated as well?	The text indicating the diameter of proposed monitoring wells is presented in Section 4.3.1. The wells will be 2 inches in diameter.
4	Page 4-7	Why will only 11 of 14 soil samples be analyzed for effective porosity and saturated hydraulic conductivity and not all soil samples?	The 11 geochemical samples will provide sufficient coverage across the site to evaluate effective porosity and saturated hydraulic conductivity in subsurface soil.
5	Page 6-2	The navy has repeatedly stated that because the island is man-made, there are no native species present. In fact, there are. When remediation was done south of the 1100 series housing area, possibly near the daycare center, narrow-leaved cattails (Typha angustifolia) grew adjacent to the hole full of water in it and coyote brush (Baccharis pilularis) frequently pops up only to be removed by the navy or the property caretaker. If left unattended the entire island would be reclaimed by primarily native plants.	The text in Section 6.2 is specific to terrestrial ecological receptors on the 4.5 acres of IR Site 6. The DON agrees with the reviewer that the habitat of IR Site 6 is not the same as that of the rest of Treasure Island.
6	Page 4-45	The description of the historical use is better and more complete in the SAP rather than in the RI Work Plan. I suggest repeating the SAP language for clarity and consistency.	A description that is similar to the site description and history in Worksheet #10 of the SAP is presented in Section 2.0 of the Work Plan.
7	Figure 5	In Appendix D, Attachment A Figure 5 shows where PFAS were assumed or known to have been used, but the Pandemonium is not included. Did not exercises involving burning ships take part on the Pandemonium? It seems like a huge investment to have an actual vessel in site if it were used only for finding radioactive objects. Also, Figure 5 occurs in the main document. This figure and other in this section should have differentiating numbers.	The areas of interest shown on Figure 5 of Appendix D, Attachment A, represent areas where PFAS may have been used and released based on a detailed evaluation of site history and DON activities. This information is presented in the Basewide Preliminary Assessment conducted by the DON at former Naval Station Treasure Island in 2021.

Responses to Comments
Final Work Plan for Remedial Investigation of Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Program Site 6
Former Naval Station Treasure Island, San Francisco, California

Acronyms and Abbreviations:

µg/L = microgram(s) per liter; AFFF = aqueous film-forming foam; bgs = below ground surface; CAM = California Administrative Manual; COPC = contaminant of potential concern; DI = deionized; DoD = United States Department of Defense; DON or Navy = United States Department of the Navy; DTSC = California Environmental Protection Agency Department of Toxic Substances Control; ELAP = Environmental Laboratory Accreditation Program; ESL = environmental screening level; HERO = Human and Ecological Risk Office; HHRA = human health risk assessment;
IDW = investigation-derived waste; IR = Installation Restoration; ITRC = Interstate Technology & Regulatory Council; LCMSMS or LC-MS/MS = liquid chromatography with tandem mass spectroscopy; MPCA = Minnesota Pollution Control Agency; mL/min = milliliter(s) per minute; NTU = nephelometric turbidity unit(s); PFAS = per- and polyfluoroalkyl substances; PFBS = perfluorobutanesulfonic acid; PFOA = perfluorooctanoic acid; PFOS = perfluorooctanesulfonate; QA = quality assurance; QC = quality control; QSM = Quality Systems Manual; RAB = Restoration Advisory Board; Regional Water Board or Water Board or WB = California Regional Water Quality Control Board; RI = remedial investigation; RPM = Remedial Project Manager; SAP = Sampling and Analysis Plan; SF = San Francisco; SOP = standard operating procedure; SWRCB = California State Water Resources Control Board; TCR = Toxicity Criteria Rule; TI = Treasure Island; TIDA = Treasure Island Development Authority; TOP = total oxidizable precursor; TPH = total petroleum hydrocarbons; U.S. EPA or USEPA = United States Environmental Protection Agency; VOC = volatile organic compound; WWTP = wastewater treatment plant

References

California State Water Resources Control Board (SWRCB) Division of Water Quality. 2020. Per- and Polyfluoroalkyl Substances (PFAS) Sampling Guidelines for Non-Drinking Water. September.

Delta Consultants. 2010. Report of Investigation Activities at Select Firefighting Foam Training Areas and Foam Discharge Sites in Minnesota. February.

Harding Lawson Associates (HLA). 1987. Initial Hazardous Material Investigation Firefighting Training Center. Treasure Island, California, August.

Interstate Technology & Regulatory Council (ITRC). 2021. Per-and Polyfluoroalkyl Substances (PFAS) Technical/Regulatory Guidance. July.

MPCA. 2008. Closed Landfill Program Sampling Protocol for Monitoring Wells. October.
Transport Canada. 2013. Perfluorochemical (PFAS) Field Sampling Protocol. May.

United States Department of Defense (DoD). 2019. DoD Quality Systems Manual (QSM), Version 5.3.

United States Department of Defense (DoD). 2021. Update for Establishing a Consistent Methodology for the Analysis of Per- and Polyfluoroalkyl Substances in media Other than Drinking Water. December 7.

United States Department of Defense (DoD). 2021. Memorandum for Assistant Secretary of the Army (Installation, Energy, and Environment); Assistant Secretary of the Navy (Energy, Installations and Environment); Assistant Secretary of the Air Force (Installations, Environment and Energy); Director, National Guard Bureau (Joint Staff, J8); Director, Defense Logistics Agency (Installation Support). Subject: Investigating Per- and Polyfluoroalkyl Substances within the Department of Defense Cleanup Program. September 15.

United States Environmental Protection Agency (U.S. EPA). 2014. OSWER Directive 9283.1-421, Determining Groundwater Exposure Point Concentrations, Supplemental Guidance.

Below are the January 24, 2022, Water Board Comments on the January 2022, *Revised Draft Final Work Plan Remedial Investigation for Per- and Polyfluoroalkyl Substances (PFAS) at Installation Restoration Site 6 Former Naval Station Treasure Island, San Francisco, California,* and the follow up comments on the response to comments received on February 28, 2022 from the Navy.

Acceptance of the revision or follow up comments are provided in bold text below. The following comments require follow up and are highlighted in yellow: 5, 6, 7, 9, 11. All comments are minor except for Comment 5 and 9 on Figure 13 (Conceptual Site Model).

We can coordinate a call to discuss.

Prepared by Celina Hernandez, Water Board
3/1/2022

1. Section 2.11 (Previous Investigations) – Does not include 2020 hydropunch sampling. Please add. **2/28/2022 revision ok. Addressed in Table 2-1.**
2. Section 3.3 (Sources of Impact) –
    a. Does not mention the AFFF station in activities in the second paragraph. It should be considered a potential release/source area. Same comment for Figure 10 (Conceptual Site Model). **2/28/2022 revision ok.**
    b. Explain the features of the AFFF station (e.g. underground tank, dispenser, above ground tank, etc.). **Not explained, but I'm ok with leaving out at this time.**
3. Possible discrepancy in purge rate for low flow sampling procedures between Section 4.3.1.7 and 4.3.18. Please clarify.
    a. 4.3.1.7 Well Purging Activities states "Wells will be purged at a maximum rate of 500 milliliters per minute (mL/min))." **No further comment.**
    b. 4.3.1.8 Groundwater Sample Collection states "The maximum purge rate when filling sample containers for the PFAS analytes will be 100 mL/min." **This section revised 2/28/2022 and ok**.
4. Section 5.2 and 5.3 indicates an evaluation of residual legacy chemicals co-located with PFOS, PFOA, and PFBS will be used for cumulative risk calcs and identified as COPCs.

    Are the legacy chemicals the Site 6 COPCs? **No further comment**
5. Section 5.4.2 – This section is missing the sediment and surface water exposure routes and is not consistent with Figure 13 or the description in Section 3.5.1.

Please explain the reason no ecological receptors are checked for surface water on Figure 13. Section 3.5.2 (Ecological Receptors and Exposure Pathways) seems to provide information but it is not presented in Figure 13.

Response: Figure 13 has been revised to include direct contact/dietary ingestion for the ecological receptors.

6. 6.2 (Groundwater Exposure Pathway Assessment) – Need clarification on the following text:

   "If PFAS are not detected in shoreline groundwater, exposure pathways will be found to be incomplete. If PFAS are detected in shoreline groundwater at concentrations less than ecological no-effect screening values, exposure pathways will be found to be complete, but with an unlikelihood of adverse effects."

   "Ecological no-effect screening values" are not defined in this Workplan. Please define or revise term for consistency throughout Workplan. Are these the same listed in Table 11-1 in SAP, Worksheet #11?

   This was not addressed. Please explain "Ecological no-effect screening values" in text or change to ecological target value per Table 11-1.

   Response: The term "Ecological no-effect screening values" will be revised to "Ecological target values" throughout the work plan to be consistent with Table 11-1.

7. Figure 10 (Figure 11 (Proposed Soil Sampling Location Map) – The description under the Legend for the pink circle appears incorrect. The text states "Proposed Soil Boring and Geochemical Sample Well."

   Please revise, as needed.

   Please explain what was changed on Figure 11. It is not clear. The location of 06-MW39 does not match Figure 12, please verify this is correct.

   Response: Figure 11 was revised along with Figure 12; however, the earlier version of Figure 11 was accidentally attached to the transmittal.

   Following the site visit on March 1, 2022; Figures 11 and 12 were further revised to move 3 shoreline monitoring wells (06-MW37, 06-MW38, and 06-MW39) slightly south out of the existing riprap. These revised Figures 11 and 12 of the work plan and their equivalent Figures A-10 and A-11 of the SAP are attached.

8. Figure 12 (Proposed Groundwater Sampling Location Map) – Location MW39 is located downgradient of potential source area (Collector Trench and Surge Pit).

Should it be downgradient of MW32, where the highest concentrations are detected and perpendicular to the Bay? Same comment for Table 4-1 (Rationale for Remedial Investigation Sampling Locations at IR Site 6), and Appendix A, Worksheet #17, Table 17-1.

2/28/2022 revision ok.

9. Figure 13 (Human Health Risk Assessment Conceptual Site Model) – This figure should show human health and ecological risk assessment conceptual site model which would be consistent with Section 3.5 (Potential Receptors and Exposure Pathways).

   See Comment 5 above.

   Response: please see the response to Comment 5 above.

10. Table 2-1 (Summary of Previous Investigations) – This table does not include the hydropunch sampling completed in 2020. Add if this was overlooked. **2/28/2022 revision ok.**

    Table 3-1 (Conceptual Site Model) – Under Physical Profile, Beneficial Resources, the SF Bay should be considered a beneficial resource. **Not addressed, please explain to close out.**

    Response: The statement "There are no known beneficial resources onshore TI; however, the adjacent San Francisco Bay is considered a beneficial resource" was added to Table 3-1 of the redline edits to the Revised Draft Final Work Plan submitted on February 28, 2022. The page of the word document is Table-14 or page 120 of 136.

11. SAP Worksheet #3 (Distribution List) and Worksheet #5 - Missing Tahirih Linz, some navy email addresses look incorrect on Worksheet 3. **Tahirih not added but other revisions made. No further comment.**

12. SAP Worksheet#11 – Step 5, item 1 and 2, after "Otherwise, additional characterization is not warranted" add "at this time." Also add: "if new technical information on PFAS arises, additional actions may be required in the future."

    2/28/2022 revision ok.

Department of Toxic Substances Control

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March 7, 2022

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FINAL WORK PLAN – REMEDIAL INVESTIGATION FOR PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) AT INSTALLATION RESTORATION (IR) SITE 6, FORMER NAVAL STATION, TREASURE ISLAND, SAN FRANCISCO, CALIFORNIA (SITE CODE: 201210)

Dear Ms. Linz:

The Department of Toxic Substances Control (DTSC) has reviewed the Final *Remedial Investigation for Per- And Polyfluoroalkyl Substances (PFAS) At Installation Restoration (IR) Site 6, Former Naval Station, Treasure Island, San Francisco,* dated March 2022 (Work Plan). DTSC also reviewed responses to comments provided by DTSC on the Draft Work Plan on May 19, 2021, on the withdrawn Draft Final Work Plan on November 22, 2021, and on the Revised Draft Final Work Plan on February 9, 2022.

DTSC has no further comments that need to be addressed at this time. However, DTSC has the following comments for the administrative record below.

1. DTSC appreciates that the Navy will evaluate all the receptors and exposure pathways outlined on Figure 13 including direct contact, fish consumption, and recreational pathways associated with swimming and wading.
2. DTSC appreciates that the Navy has committed to performing risk assessment using California toxicity criteria if they become available. DTSC understands that the Navy may elect to perform a dual-track risk assessment using both state and federal values.

If you have any questions, please feel free to contact me at 510-540-3798 or peyton.ward@dtsc.ca.gov.

Sincerely,

Peyton Ward, MEM
Project Manager
Site Mitigation and Restoration Program – Berkeley
Department of Toxic Substances Control

cc: (via email)

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