APPENDIX A
Sediment Logs

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel / Dames & Moore (D&M)

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point lead test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
UU	Unconsolidated undrained triaxial compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Date Excavated 6/14/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 1.28 Vertical Datum NAVD88		Easting (X) 1239960.00 Northing (Y) 639448.00	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
	0		ZIA-3-MS/PW		SM	Light gray silty fine to coarse sand with gravel and cobble	NS	<1	
	1				SP-SM	Light gray-brown fine to coarse sand with silt and gravel			
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1A-3

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 2
Sheet 1 of 1

Date Excavated 6/14/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 0.97 Vertical Datum NAVD88		Easting (X) 1240060.00 Northing (Y) 639512.00	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
0	0		ZIA-6-PW/MS		SP-SM	Light gray fine to coarse sand with silt, gravel and cobbles	NS	<1	
					SP-SM	Light gray-brown fine sand with silt and gravel			
-1	1								
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1A-6

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 3
Sheet 1 of 1

Date Excavated 6/15/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 1.24 Vertical Datum NAVD88		Easting (X) 1240168.45 Northing (Y) 639577.14		Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
1	0		ZIA-9-MS/PW		SP-SM	Light brown-light gray fine to coarse sand with silt, gravel and cobbles	NS	<1	
					SP-SM	Light gray fine to coarse sand with silt and gravel			
	1								
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1A-9

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 4
Sheet 1 of 1

Date Excavated 6/15/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 1.00 Vertical Datum NAVD88		Easting (X) 1240310.00 Northing (Y) 639662.59	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
0	1		ZIA-12-MS/PW		SP-SM	Light gray fine to coarse sand with silt, gravel and cobble	NS	<1	
					SP-SM	Light gray fine to coarse sand with silt and gravel			
-1	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1A-12

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 5
Sheet 1 of 1

Date Excavated 6/14/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 0.71 Vertical Datum NAVD88		Easting (X) 1239742.09 Northing (Y) 639358.44	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
	0		ZIB-1-MS/PW		SP	Brown-gray fine to coarse sand with gravel and cobble	NS	<1	
	1				SP-SM	Brown-gray fine to coarse sand with silt and gravel			
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1B-1

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 6
Sheet 1 of 1

Date Excavated 6/14/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 4.10 Vertical Datum NAVD88		Easting (X) 1239850.00 Northing (Y) 639360.00	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
4			ZIB-2-PW/MS		SM	Light gray-brown silty fine to coarse sand with gravel and cobble	NS	<1	
	1								
3					SP-SM	Light gray fine to coarse sand with silt and gravel			
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1B-2

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 7
Sheet 1 of 1

Date Excavated 6/14/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 2.57 Vertical Datum NAVD88		Easting (X) 1240390.00 Northing (Y) 639706.00	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
2	0		ZIB-3-PW/MS		SP-SM	Gray-light brown fine to coarse sand with silt, gravel and cobbles	NS	<1	
					SP-SM	Light gray fine to coarse sand with silt and gravel			
	1								
1									
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1B-3

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 8
Sheet 1 of 1

Date Excavated 6/15/2022	Total Depth (ft) 2	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 1.45 Vertical Datum NAVD88		Easting (X) 1240495.52 Northing (Y) 639799.50	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
	0		ZIB-4-PW/MS		SP-SM	Gray fine to coarse sand with silt, gravel and cobbles	NS	<1	
	1				SP-SM	Light gray-light brown fine to coarse sand with silt and gravel			
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger Z1B-4

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 9
Sheet 1 of 1

Date Excavated 6/29/2022	Total Depth (ft) 2.5	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment	Groundwater not observed Caving not observed
Surface Elevation (ft) 3.59 Vertical Datum NAVD88		Easting (X) 1240030.00 Northing (Y) 639475.00	Coordinate System WA State Plane North Horizontal Datum NAD83 (feet)	

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
3			OCM-1-CAP		SP	Light gray fine to coarse sand with gravel and cobble	NS	<1	
			OCM-1_MS			Geotextile fabric			
	1				SP-SM	Light gray fine to coarse sand with silt and gravel			
2							HS		
	2								

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger OCM-1

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 10
Sheet 1 of 1

Date Excavated	6/29/2022	Total Depth (ft)	2.5	Logged By NRS Checked By BJT	Excavator GeoEngineers, Inc. Equipment
Groundwater not observed Caving not observed					
Surface Elevation (ft)	7.15	Easting (X)	1240050.00	Coordinate System	WA State Plane North
Vertical Datum	NAVD88	Northing (Y)	639451.00	Horizontal Datum	NAD83 (feet)

Elevation (feet)	Depth (feet)	SAMPLE: Testing Sample	SAMPLE: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	Notes
7			OCM-2-CAP		SP-SM	Gray silty fine to coarse sand with silt, gravel and cobbles	NS	<1	
			OCM-2-MS		SM	Gray silty fine to coarse sand			
	1					Geotextile fabric			
6					SP	Brown fine to medium sand	HS		
					SM	Gray silty fine to coarse sand			
	2								
5									

Notes: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Hand Auger OCM-2

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 11
Sheet 1 of 1

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel / Dames & Moore (D&M)

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point lead test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
UU	Unconsolidated undrained triaxial compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Drilled Start 6/27/2022 End 6/27/2022	Total Depth (ft) 9.5	Logged By BRD Checked By BJT	Driller Holt Drilling, Inc.	Drilling Method Sonic	
Surface Elevation (ft) 8.52 Vertical Datum NAVD88		Hammer Data NA		Drilling Equipment Sonic track rig, Crane	
Easting (X) 1239975.42 Northing (Y) 639405.86		System Datum WA State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	

Notes: Cores completed at each location during low tide. Crane lowered rig from upland to the sample location.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		114					SP-SM	Light brown fine to coarse sand with silt, brick chunks, 25 percent shell hash	NS		
								SP-SM	Gray to black fine to corse sand with silt, brick fragments, medium density	HS		NAPL present from 1 to 8 feet
5								WD	Black sawdust with wood/log chunks (6-inch by 4-inch by ½-inch), creosote	HS		
	5				Z1A-1_5.5-7.5			WD	Dark black sawdust, wood chunks	HS		Heavy hydrocarbon odor
					Z1A-1_7.5-9.0 Z1A-1-PW (7.5-9.5)							Sediment for porewater extraction sample Z1A-1-PW collected from 7½ to 9½ feet bgs
0								WD	Dark brown-black sawdust with fine to coarse sand, low density			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Boring Z1A-1

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 2
Sheet 1 of 1

Date:9/9/22 Path:\\GEOENGINEERS.COM\WAN\PROJECTS\0\0356114\GINT\0356114408.GPJ DBLibrary/Library/GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEIB_ENVIRONMENTAL_STANDARD_NO_GW

Drilled	Start 6/27/2022	End 6/27/2022	Total Depth (ft) 6.5	Logged By BRD / Checked By BJT	Driller Holt Drilling, Inc.	Drilling Method Sonic
Surface Elevation (ft) / Vertical Datum	3.97 NAVD88		Hammer Data	NA	Drilling Equipment	Sonic track rig, Crane
Easting (X) / Northing (Y)	1239956.54 639419.64		System Datum	WA State Plane North NAD83 (feet)	Groundwater not observed at time of exploration	

Notes: Cores completed at each location during low tide. Crane lowered rig from upland to the sample location.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample / Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		66				SP	Sand with shell hash (>50 percent) and approximate 2-inch cobbles (approximately 10 percent)			
							WD	Brown-black sawdust and wood chunk (5-inch by 3-inch by 2½-inch)			
0					Z1A-2_3.5-5.5				MS		Heavy hydrocarbon odor
	5						SP	Gray-black fine to coarse sand, <5 percent wood	SS		

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Boring Z1A-2

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 3
Sheet 1 of 1

Drilled Start 6/28/2022 End 6/28/2022	Total Depth (ft) 8.5	Logged By BRD Checked By BJT	Driller Holt Drilling, Inc.	Drilling Method Sonic	
Surface Elevation (ft) 7.41 Vertical Datum NAVD88		Hammer Data NA		Drilling Equipment Sonic track rig, Crane	
Easting (X) 1240079.38 Northing (Y) 639468.25		System Datum WA State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	

Notes: Cores completed at each location during low tide. Crane lowered rig from upland to the sample location.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		102					SP-GP	Brown silty fine to medium sand with gravel, cobbles, brick fragments and 25 percent shell hash (dense, moist)	SS		
								WD	Wood chips/sawdust with black silt (medium dense, moist to wet) (80 percent wood content)	HS		NAPL present from 1 to 5.5 feet
								WD	Sawdust with brown silt (loose, moist to wet) (75 to 90 percent wood content)	HS		
-5						Z1A-4_4-PW (3-7)						Sediment for porewater extraction sample Z1A-4-PW collected from 3 to 7 feet bgs
	5					Z1A-4_3.5-5.5		ML	Gray silt with fine sand (dense, moist)	MS		
-6						Z1A-4_6.5-8.5		WD	Wood chips, sawdust and trace wood chunks with silt (loose, moist) (90 percent wood content)	NS SS		

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Boring Z1A-4

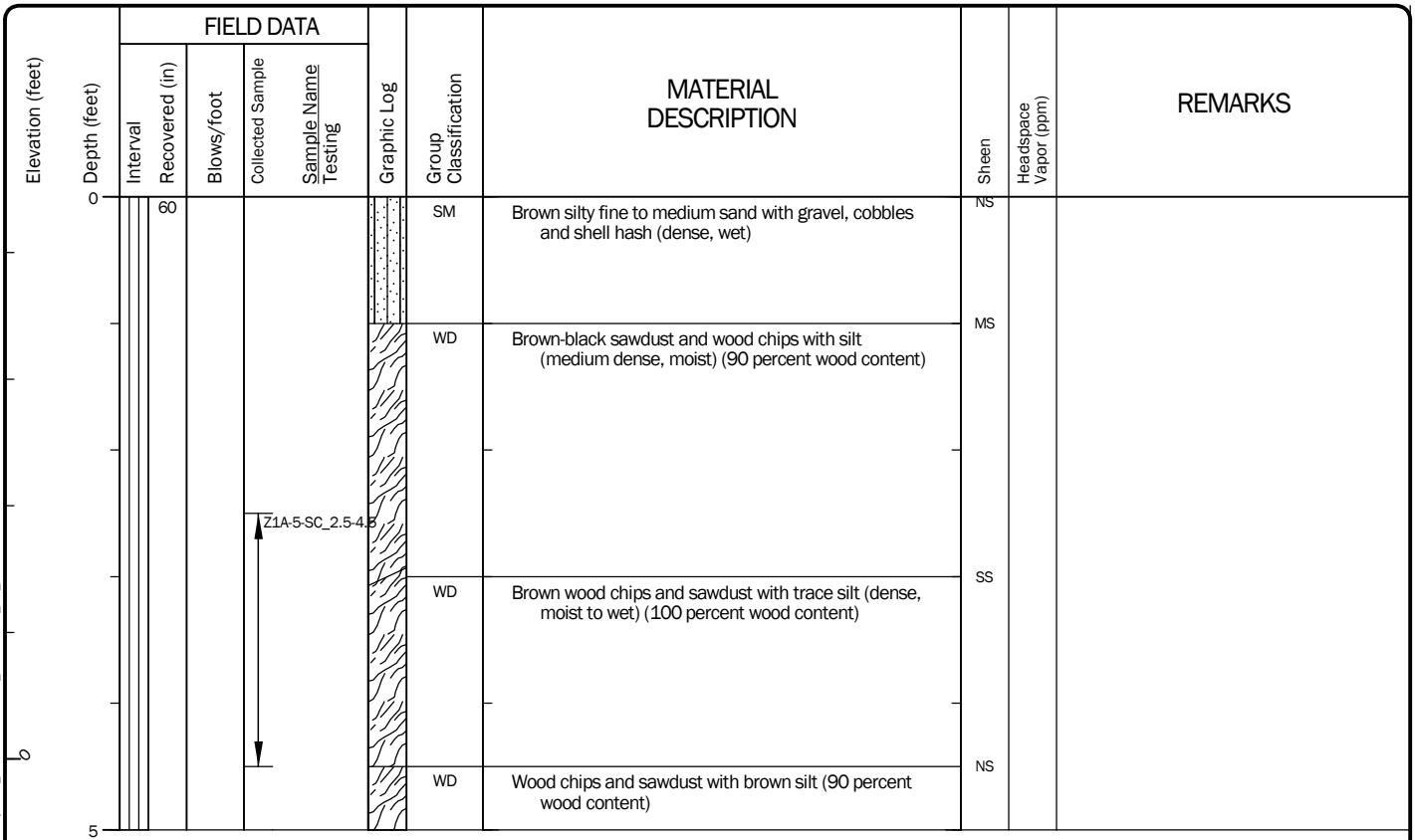
GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 4
Sheet 1 of 1

Drilled	Start 6/28/2022	End 6/28/2022	Total Depth (ft) 5	Logged By BRD / Checked By BJT	Driller Holt Drilling, Inc.	Drilling Method Sonic
Surface Elevation (ft) / Vertical Datum	4.44 NAVD88		Hammer Data	NA	Drilling Equipment	Sonic track rig, Crane
Easting (X) / Northing (Y)	1240070.65 639485.29		System Datum	WA State Plane North NAD83 (feet)	Groundwater not observed at time of exploration	

Notes: Cores completed at each location during low tide. Crane lowered rig from upland to the sample location.



Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Boring Z1A-5

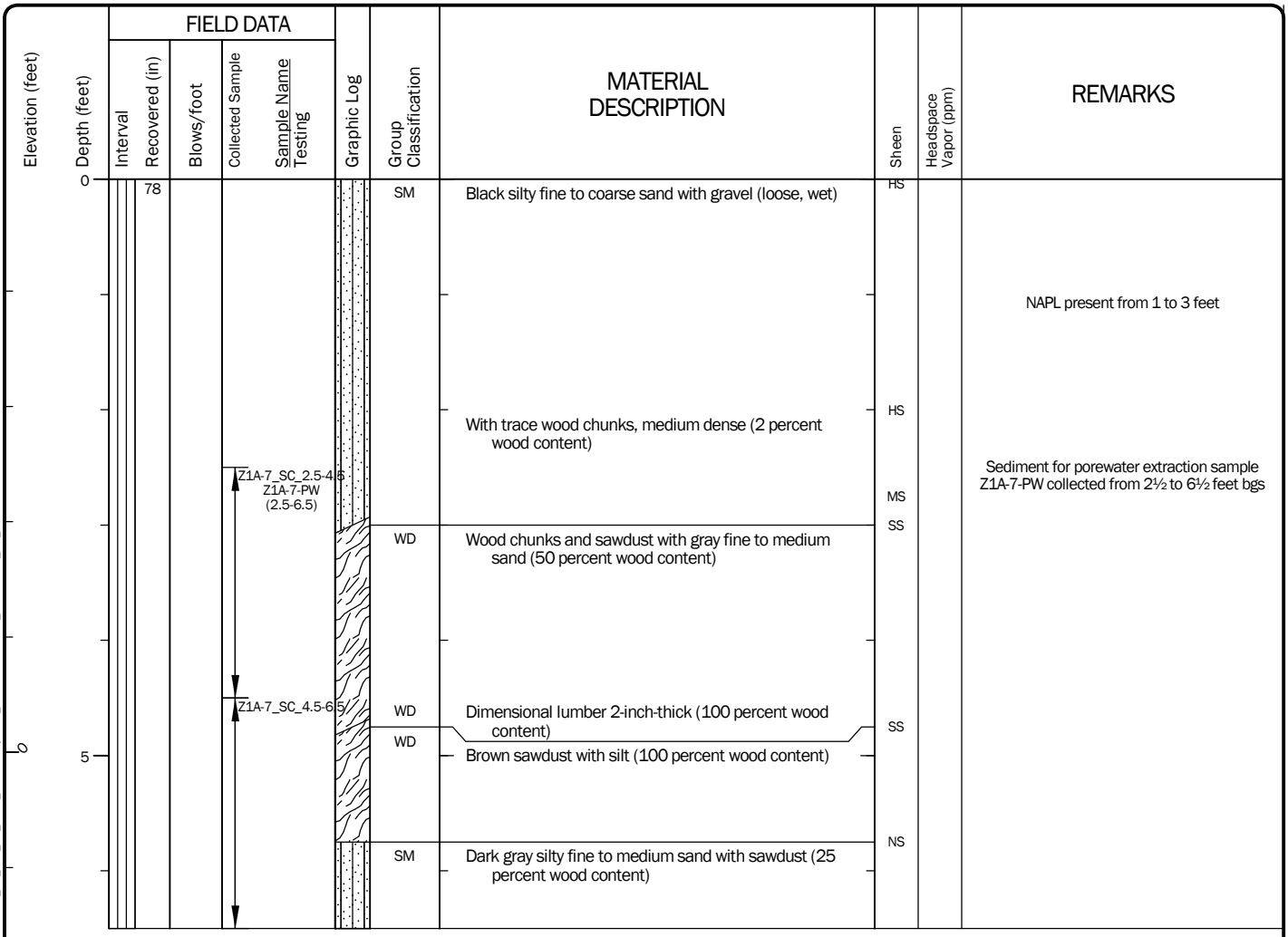
GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 5
Sheet 1 of 1

Drilled Start 6/28/2022 End 6/28/2022	Total Depth (ft) 6.5	Logged By BRD Checked By BJT	Driller Holt Drilling, Inc.	Drilling Method Sonic	
Surface Elevation (ft) 4.97 Vertical Datum NAVD88		Hammer Data NA		Drilling Equipment Sonic track rig, Crane	
Easting (X) 1240190.42 Northing (Y) 639557.19		System Datum WA State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	

Notes: Cores completed at each location during low tide. Crane lowered rig from upland to the sample location.



Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Boring Z1A-7

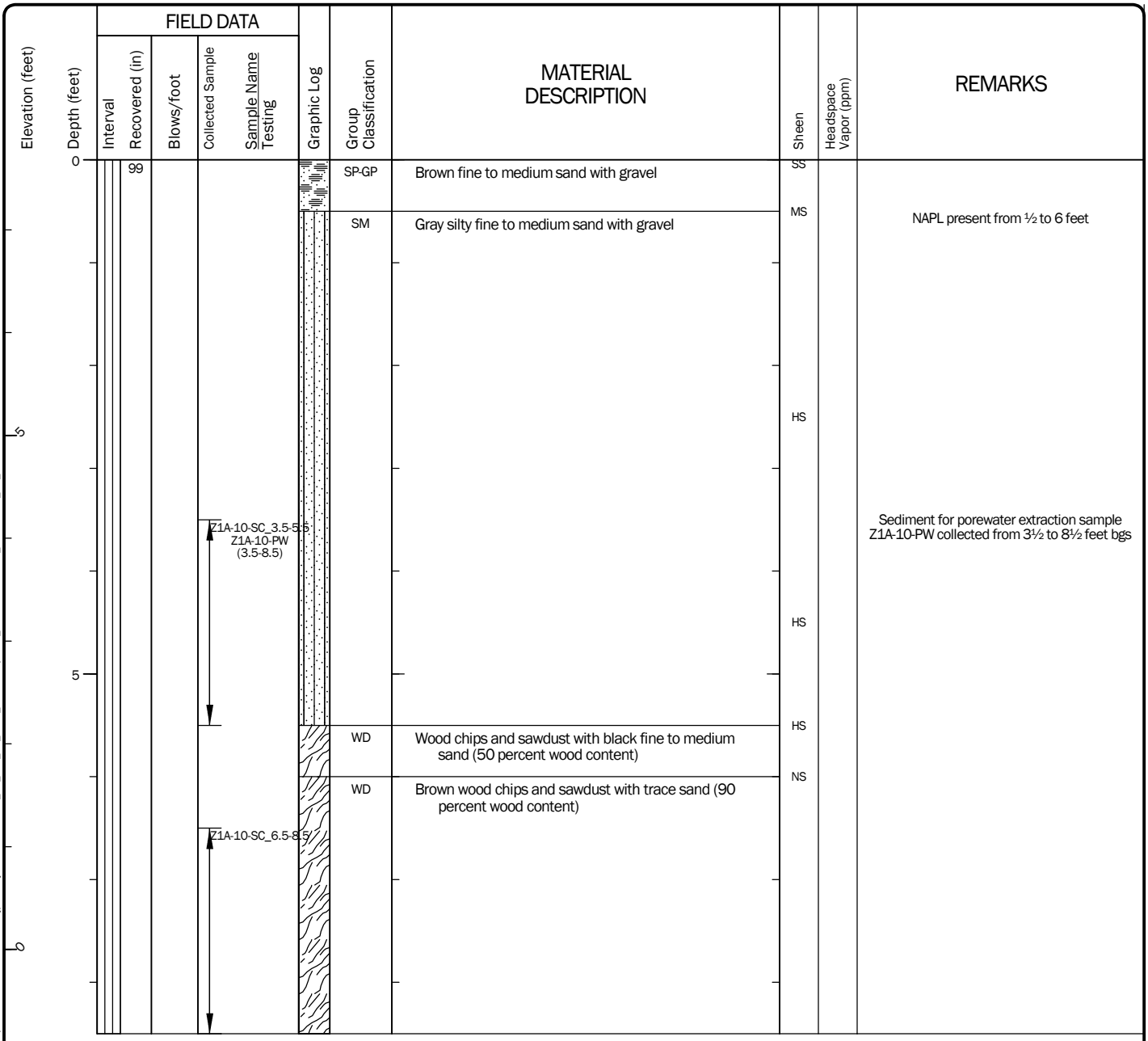
GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 6
Sheet 1 of 1

Drilled Start 6/29/2022 End 6/29/2022	Total Depth (ft) 8.5	Logged By BRD Checked By BJT	Driller Holt Drilling, Inc.	Drilling Method Sonic	
Surface Elevation (ft) 7.68 Vertical Datum NAVD88		Hammer Data NA		Drilling Equipment Sonic track rig, Crane	
Easting (X) 1240325.47 Northing (Y) 639620.76		System Datum WA State Plane North NAD83 (feet)		Groundwater not observed at time of exploration	

Notes: Cores completed at each location during low tide. Crane lowered rig from upland to the sample location.



Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Boring Z1A-10

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 7
Sheet 1 of 1

Drilled	Start 6/29/2022	End 6/29/2022	Total Depth (ft)	6.5	Logged By / Checked By	BRD / BJT	Driller	Holt Drilling, Inc.	Drilling Method	Sonic
Surface Elevation (ft) / Vertical Datum	5.94 / NAVD88				Hammer Data	NA	Drilling Equipment	Sonic track rig, Crane		
Easting (X) / Northing (Y)	1240316.75 / 639637.79				System Datum	WA State Plane North NAD83 (feet)	Groundwater not observed at time of exploration			

Notes: Cores completed at each location during low tide. Crane lowered rig from upland to the sample location.

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Sheen	Headspace Vapor (ppm)	REMARKS
	0		72					SM	Brown-gray silty fine to coarse sand with gravel and cobbles	SS		
5								SM	Dark gray to gray silty fine to medium sand with occasional gravel	HS		NAPL present from 1½ to 5 feet
						Z1A-11-SC_4.0-6.0		WD	Wood chunks and sawdust with black fine to medium sand (80 percent wood content)	HS		
0	5							WD	Brown sawdust and wood chips (100 percent wood content)	NS		

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on GPS coordinates collected in the field. Vertical approximated based on topographic survey by Wilson Engineering and Surveying 10/28/2015.

Log of Boring Z1A-11

GeoEngineers

Project: R.G. Haley
Project Location: Bellingham, Washington
Project Number: 0356-114-08

Figure 8
Sheet 1 of 1

APPENDIX C
Data Validation Report

GeoEngineers

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Data Validation Report

Project: City of Bellingham – R.G. Haley Remedial Design
June 2022 Sampling Event

GEI File No: 0356-114-08

Date: September 1, 2022

This report documents the results of a United States Environmental Protection Agency (USEPA)-defined Stage 2B data validation (USEPA Document 540-R-08-005; USEPA 2009) of analytical data from the analyses of sediment and porewater samples collected as part of the June 2022 sampling event, and the associated laboratory and field quality control (QC) samples. The samples were obtained from the R.G Haley Site located in Bellingham, Washington.

OBJECTIVE AND QUALITY CONTROL ELEMENTS

GeoEngineers, Inc. (GeoEngineers) completed the data validation consistent with the USEPA Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review (USEPA, 2020) (National Functional Guidelines) to determine if the laboratory analytical results meet the project objectives and are usable for their intended purpose. Data usability was assessed by determining if:

- The samples were analyzed using well-defined and acceptable methods that provide reporting limits below applicable regulatory criteria;
- The precision and accuracy of the data are well-defined and sufficient to provide defensible data; and
- The quality assurance/quality control (QA/QC) procedures utilized by the laboratory meet acceptable industry practices and standards.

The data validation included review of the following QC elements:

- Data Package Completeness
- Chain-of-Custody Documentation
- Holding Times and Sample Preservation
- Surrogate Recoveries
- Method Blanks
- Matrix Spikes/Matrix Spike Duplicates
- Laboratory Control Samples/Laboratory Control Sample Duplicates
- Laboratory/Field Duplicates
- Instrument Tuning
- Internal Standards
- Initial Calibrations (ICALs)
- Continuing Calibrations (CCALs)

- Miscellaneous

VALIDATED SAMPLE DELIVERY GROUPS

This data validation included review of the sample delivery groups (SDGs) listed below in Table 1.

TABLE 1: SUMMARY OF VALIDATED SAMPLE DELIVERY GROUPS

Laboratory SDG	Samples Validated
22F0267	Z1A-3-MS, Z1A-6-MS, Z1A-9-MS, Z1A-12-MS, Z1A-3-PW, Z1A-6-PW, Z1A-9-PW, Z1A-12-PW, Z1B-1-MS, Z1B-2-MS, DUP-1-MS, Z1B-3-MS, Z1B-4-MS, Z1B-1-PW, Z1B-2-PW, DUP-1-PW, Z1B-3-PW, Z1B-4-PW
22G0019	Z1A-1-SC_5.5-7.5, Z1A-1-SC_7.5-9.5, Z1A-2-SC_3.5-5.5, Z1A-4-SC_3.5-5.5, Z1A-4-SC_6.5-8.5, Z1A-5-SC_2.5-4.5, Z1A-7-SC_2.5-4.5, Z1A-7-SC_4.5-6.5, Z1A-10-SC_3.5-5.5, Z1A-10-SC_6.5-8.5, Z1A-11-SC_4.0-6.0, OCM-1-CAP, OCM-1-MS, OCM-2-CAP, OCM-2-MS
22G0121	Z1A-1-PW, Z1A-4-PW, Z1A-7-PW, Z1A-10-PW

CHEMICAL ANALYSIS PERFORMED

Analytical Resources, Inc. (ARI), located in Tukwila, Washington, performed laboratory analyses on the samples using one or more of the following methods:

- Petroleum Hydrocarbons (NWTPH-Dx) by Method NWTPH-Dx;
- Petroleum Hydrocarbons with Silica Gel (SG) Cleanup (NWTPH-Dx/SG) by Method NWTPH-Dx/SG;
- Polycyclic Aromatic Hydrocarbons (PAHs) by Method SW8270E;
- Pentachlorophenol (PCP) by Method SW8041A;
- Total Organic Carbon (TOC) by Method EPA9060A; and
- Total Solids by Method SM2540G-97

DATA VALIDATION SUMMARY

The results for each of the QC elements are summarized below.

Data Package Completeness

ARI provided the required deliverables for the data validation according to the National Functional Guidelines. The laboratory followed adequate corrective action processes and the identified anomalies were discussed in the relevant laboratory case narrative.

Chain-of-Custody Documentation

Chain-of-custody (COC) forms were provided with the laboratory analytical reports. The COCs were accurate and complete when submitted to the laboratory.

Holding Times and Sample Preservation

The sample holding time is defined as the time that elapses between sample collection and sample analysis. Maximum holding time criteria exist for each analysis to help ensure that the analyte concentrations found at the time of analysis reflect the concentration present at the time of sample collection. Established holding times were met for each analysis. The sample coolers arrived at the laboratory within the appropriate temperatures of between 2 and 6 degrees Celsius, with the exceptions noted below.

SDG 22F0267: One sample cooler temperature recorded at the laboratory was 1.3 degrees Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

SDG 22G0019: One sample cooler temperature recorded at the laboratory was -1.1 degrees Celsius. It was determined through professional judgment that since the samples were not frozen, this temperature should not affect the sample analytical results.

Surrogate Recoveries

A surrogate compound is a compound that is chemically similar to the organic analytes of interest, but unlikely to be found in an environmental sample. Surrogates are used for organic analyses and are added to the samples, standards, and blanks to serve as an accuracy and specificity check of each analysis. The surrogates are added to the samples at a known concentration and percent recoveries (%R) are calculated following analysis. The surrogate recoveries for field samples were within the laboratory control limits, with the following exceptions:

SDG 22F0267: (PAHs) The %R for surrogate 2-Fluorobiphenyl was greater than the control limits in Sample Z1A-12-MS; however, the sample was spiked with seven additional surrogates and in each case the %R values were within their respective control limits. No action was required for this outlier.

The %R for surrogate phenol-d5 was less than the control limits in Sample Z1B-4-PW; however, the sample was spiked with seven additional surrogates and in each case the %R values were within their respective control limits. No action was required for this outlier.

(PCP) The %R values for surrogate 2,4,6-Tribromophenol were greater than the control limits in Samples Z1B-2-PW and Z1B-4-PW. There were no positive results for pentachlorophenol in these samples; therefore, no qualifications were required.

SDG 22G0019: (PAHs) The %R for surrogate 2-Fluorobiphenyl was greater than the control limits in Samples OCM-1-MS, OCM-2-MS, Z1A-5-SC_2.5-4.5, and Z1A-10-SC_3.5-5.5; however, the samples were spiked with seven additional surrogates and in each case the %R values were within their respective control limits. No action was required for these outliers.

SDG 22G0121: (PAHs) The %R for surrogate 2,4,6-Tribromophenol was greater than the control limits in Samples Z1A-4-PW and Z1A-7-PW; however, the samples were spiked with seven additional surrogates and in each case the %R values were within their respective control limits. No action was required for these outliers.

Method Blanks

Method blanks are analyzed to ensure that laboratory procedures and reagents do not introduce measurable concentrations of the analytes of interest. A method blank was analyzed with each batch of

samples, at a frequency of 1 per 20 samples. For each sample batch, method blanks were analyzed at the required frequency. None of the analytes of interest were detected in the method blanks.

Matrix Spikes/Matrix Spike Duplicates

Since the actual analyte concentration in an environmental sample is not known, the accuracy of a particular analysis is usually inferred by performing a matrix spike (MS) analysis on one sample from the associated batch, known as the parent sample. One aliquot of the sample is analyzed in the normal manner and then a second aliquot of the sample is spiked with a known amount of analyte concentration and analyzed. From these analyses, a %R is calculated. Matrix spike duplicate (MSD) analyses are generally performed for organic analyses as a precision check and analyzed in the same sequence as a matrix spike. Using the results from the MS and MSD, the relative percent difference (RPD) is calculated. The %R control limits for MS and MSD analyses are specified in the laboratory documents, as are the RPD control limits for MS/MSD sample sets.

One MS/MSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for each analysis and the %R and RPD values were within the proper control limits, with the following exceptions:

SDG 22F0267: (NWTPH-Dx and NWTPH-Dx/SG) The laboratory performed an MS/MSD sample set on Sample Z1A-12-MS. The %R values for diesel-range hydrocarbons were greater than the control limits in the MS/MSD extracted on 6/21/2022. The positive results for this target analyte were qualified as estimated (J) in Sample Z1A-12-MS.

(PAHs) The laboratory performed an MS/MSD sample set on Sample Z1A-3-MS. The %R values for indeno(1,2,3-cd)pyrene were greater than the control limits in the MS/MSD extracted on 6/21/2022. The positive result for this target analyte was qualified as estimated (J) in Sample Z1A-3-MS.

Additionally, in the same MS/MSD sample set, the %R for pentachlorophenol was greater than the control limits in the MS; however, the %R for this target analyte was within the control limits in the corresponding MSD. No action was required for this outlier.

(TOC) The laboratory performed an MS/MSD sample set on Sample Z1A-3-MS. The %R for TOC was greater than the control limit in the MSD extracted on 6/20/2022; however, the %R for this target analyte was within the control limit in the corresponding MS. No action was required for this outlier.

SDG 22G0019: (NWTPH-Dx and NWTPH-Dx/SG) The laboratory performed an MS/MSD sample set on Sample Z1A-10-SC_3.5-5.5. The %R values for diesel-range hydrocarbons were greater than the control limit in the MS/MSD extracted on 7/6/2022. The positive results for this target analyte were qualified as estimated (J) in Sample Z1A-10-SC_3.5-5.5.

(PAHs) The laboratory performed an MS/MSD sample set on Sample Z1A-10-SC_3.5-5.5. The %R values for 1-Methylnaphthalene, 2-Methylnaphthalene, acenaphthene, naphthalene, pentachlorophenol, and phenanthrene were outside the control limits in the MS/MSD extracted on 7/7/2022. The positive results for 1-Methylnaphthalene, 2-Methylnaphthalene, acenaphthene, naphthalene, and phenanthrene were qualified as estimated (J) in Sample Z1A-10-SC_3.5-5.5. There were no positive results for pentachlorophenol in this sample; therefore, no qualification was required.

Additionally, in the same MS/MSD sample set, the RPD for naphthalene was greater than the control limit. The positive result for this target analyte was qualified as estimated (J) in Sample Z1A-10-SC_3.5-5.5.

Also, in the same MS/MSD sample set, the %R for fluoranthene was less than the control limits in the MS; however, the %R for this target analyte was within the control limits in the corresponding MSD. No action was required for this outlier.

Laboratory Control Samples/Laboratory Control Sample Duplicates

A laboratory control sample (LCS) is a blank sample that is spiked with a known amount of analyte and then analyzed. An LCS is similar to an MS, but without the possibility of matrix interference. Given that matrix interference is not an issue, control limits for accuracy and precision in the LCS and its duplicate (LCSD) are usually more rigorous than for MS/MSD analyses. Additionally, data qualification based on LCS/LCSD analyses would apply to each sample in the associated batch, instead of just the parent sample. The %R control limits for LCS and LCSD analyses are specified in the laboratory documents, as are the RPD control limits for LCS/LCSD sample sets.

One LCS/LCSD analysis should be performed for every analytical batch or every 20 field samples, whichever is more frequent. The frequency requirements were met for each analysis and the %R and RPD values were within the proper control limits.

Laboratory Duplicates

Internal laboratory duplicate analyses are performed to monitor the precision of the analyses. Two separate aliquots of a sample are analyzed as distinct samples in the laboratory and the RPD between the two results is calculated. Duplicate analyses should be performed once per analytical batch. If one or more of the samples used has a concentration less than five times the reporting limit for that sample, the absolute difference is used instead of the RPD. The RPD control limits are specified in the laboratory documents. Laboratory duplicates were analyzed at the proper frequency and the specified acceptance criteria were met, with the exception noted below.

SDG 22F0267: (TOC) A laboratory duplicate analysis was performed on Sample Z1A-3-MS. The RPD for TOC was greater than the control limit. The positive result for TOC was qualified as estimated (J) in Sample Z1A-3-MS.

Field Duplicates

Field duplicates are similar to laboratory duplicates in that they are used to assess precision. Two samples (parent and duplicate) are created in the field by subsampling the homogenized sample and submitting them to the lab as separate samples. Duplicate samples were collected and analyzed for the same parameters as the associated parent samples. Precision is determined by calculating the RPD between each pair of samples. If one or more of the sample analytes has a concentration less than five times the reporting limit for that sample, then the absolute difference is used instead of the RPD. The RPD control limit for water samples is 35 percent. The RPD control limit for sediment samples is 50 percent.

SDG 22F0267: One field duplicate sample pair, Z1B-2-MS and DUP-1-MS, were submitted with this SDG. The precision criteria for the target analytes were met for these sample pairs, with the exception of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, diesel-range hydrocarbons (SG), fluoranthene, lube oil-range hydrocarbons (SG), and phenanthrene. The positive results for these target analytes were qualified as estimated (J) in this sample pair.

One field duplicate sample pair, Z1B 2-PW and DUP-1-PW, were submitted with this SDG. The precision criteria for the target analytes were met for these sample pairs, with the exception of fluoranthene and phenanthrene. The positive results and reporting limits for these target analytes were qualified as estimated (J and UJ, accordingly) in this sample pair.

Instrument Tuning

Instrument tuning for analyses by gas chromatography/mass spectrometry (GC/MS) are completed to ensure that mass resolution, identification, and sensitivity of the analyses are acceptable. Instrument tuning should be performed at the beginning of each 12-hour period during which samples or standards are analyzed. The frequency and specified acceptance criteria were met for each applicable analysis.

Internal Standards (Low Resolution Mass Spectrometry)

Like the surrogate, an internal standard is a compound that is chemically similar to the analytes of interest, but unlikely to be found in an environmental sample. Internal standards are used only for the mass spectrometry instrumentation and are usually added to the sample aliquot after extraction has taken place. The internal standard should be analyzed at the beginning of a 12-hour sample run and the control limits for internal standard recoveries are 50 percent to 200 percent of the calibration standard. The internal standard recoveries were within the control limits, with the following exceptions:

SDG 22G0019: (PAHs) The %R for internal standard phenanthrene-d10 was outside the control limits in Samples Z1A-1-SC_5.5-7.5 and Z1A-5-SC_2.5-4.5. The positive results for benzo(a)anthracene, fluoranthene, and phenanthrene were qualified as estimated (J) in these samples.

The %R values for internal standards chrysene-d12, di-n-octylphthalate-d4, perylene-d12, and phenanthrene-d10 were outside the control limits in Sample Z1A-7-SC_2.5-4.5. The positive results for 1-Methylnaphthalene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were qualified as estimated (J) in this sample.

The %R for internal standard perylene-d12 was outside the control limits in Sample Z1A-7-SC_4.5-6.5. The positive results for 1-Methylnaphthalene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were qualified as estimated (J) in this sample.

The %R for internal standard chrysene-d12 was outside the control limits in Samples Z1A-4-SC_6.5-8.5, Z1A-5-SC_2.5-4.5, and Z1A-7-SC_4.5-6.5. The positive results for chrysene were qualified as estimated (J) in these samples.

The %R values for internal standards acenaphthene-d10, chrysene-d12, and phenanthrene-d10 were outside the control limits in Sample OCM-2-MS. The positive results for acenaphthene, benzo(a)anthracene, chrysene, fluoranthene, pentachlorophenol, and phenanthrene were qualified as estimated (J) in this sample.

The %R values for internal standards acenaphthene-d10, perylene-d12, and phenanthrene-d10 were outside the control limits in Sample Z1A-10-SC_3.5-5.5. The positive results for 1-Methylnaphthalene, acenaphthene, benzo(a)anthracene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, pentachlorophenol, and phenanthrene were qualified as estimated (J) in this sample.

The %R values for internal standards acenaphthene-d10 and phenanthrene-d10 were outside the control limits in Sample Z1A-4-SC_3.5-5.5. The positive results for acenaphthene, benzo(a)anthracene, fluoranthene, pentachlorophenol, and phenanthrene were qualified as estimated (J) in this sample.

Initial Calibrations (ICALs)

The initial calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. For inorganic analyses, the %R values were within the control limits of 90% and 110%. For organic analyses, the percent relative standard deviation (%RSD) and relative response factors (RRF) values were within the control limits stated in the USEPA Contract Laboratory

Program National Functional Guidelines for Organic Data Review (USEPA 2020), with the following exceptions:

SDG 22G0019: (PAHs) The %RSD for fluoranthene and pentachlorophenol were greater than the control limits in the initial calibration verification performed on 7/14/2022. The positive results for fluoranthene were qualified as estimated (J) in Samples OCM-1-MS, Z1A-1-SC_7.5-9.5, Z1A-5-SC_2.5-4.5, Z1A-7-SC_2.5-4.5, Z1A-7-SC_4.5-6.5, Z1A-10-SC_3.5-5.5, Z1A-10-SC_6.5-8.5, and Z1A-11-SC_4.0-6.0.

The %RSD for chrysene, fluoranthene, and pentachlorophenol were greater than the control limits in the initial calibration verification performed on 7/15/2022. The positive results for chrysene, fluoranthene, and pentachlorophenol were qualified as estimated (J) in Samples OCM-2-MS, Z1A-1-SC_5.5-7.5, and Z1A-4-SC_3.5-5.5. The positive results for chrysene and fluoranthene were qualified as estimated (J) in Samples Z1A-2-SC_3.5-5.5 and Z1A-4-SC_6.5-8.5.

SDG 22G0019: (PAHs) The %RSD for pentachlorophenol was greater than the control limits in the initial calibration verification performed on 7/13/2022. There were no positive results for this target analyte in the associated field samples; therefore, no qualifications were required.

Continuing Calibrations (CCALs)

The continuing calibrations were conducted according to the laboratory methods and consisted of the appropriate number of standards. For inorganic analyses, the %R values were within the control limits of 90% and 110%. For organic analyses, the percent difference (%D) and relative response factors (RRF) values were within the control limits in the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (USEPA 2020), with the following exceptions:

SDG 22F0267: (PAHs) The %D for pentachlorophenol was greater than the control limits in the continuing calibration verification performed on 6/30/2022. The positive results for this target analyte were qualified as estimated (J) in Samples Z1A-9-MS, Z1A-12-MS, and Z1B-2-MS.

SDG 22G0019: (PAHs) The %D for pentachlorophenol was greater than the control limits in the continuing calibration verification performed on 7/15/2022. The positive results for this target analyte were qualified as estimated (J) in Samples OCM-2-MS, Z1A-1-SC_5.5-7.5, and Z1A-4-SC_3.5-5.5.

Miscellaneous

SDG 22F0267: (NWTPH-Dx) Due to an oversight in the preparation laboratory, a single extract was not split for analysis of both with and without silica gel cleanups. Unique aliquots were extracted for each method, adding to the variance between the values reported for a given sample. No action is required for this oversight.

(PCP) The laboratory reported two sets of results for Samples Z1A-3-PW, Z1A-6-PW, Z1A-12-PW, and DUP_1-PW, an initial and a reanalysis. The reanalysis reported results for were labeled as do-not-report (DNR) and should not be used for any purpose.

The laboratory reported two sets of results for Z1A-9-PW, Z1B-1-PW, Z1B-2-PW, Z1B-3-PW, and Z1B-4-PW, an initial and a reanalysis. The initial reported results for were labeled as do-not-report (DNR) and should not be used for any purpose.

SDG 22G0019: (PAHs) For Sample OCM-2-MS, the laboratory flagged the pentachlorophenol result with an “M”, indicating that this result is an estimated value with low spectral match parameters. For this reason, the positive result for this target analyte was qualified as estimated (J) in this sample.

For Sample Z1A-1-SC_5.5-7.5, the laboratory flagged the 1-Methylnaphthalene, chrysene, fluoranthene, and pentachlorophenol results with an "M", indicating that these results are an estimated value with low spectral match parameters. For this reason, the positive results for these target analytes were qualified as estimated (J) in this sample.

For Sample Z1A-4-SC_3.5-5.5, the laboratory flagged the pentachlorophenol result with an "M", indicating that this result is an estimated value with low spectral match parameters. For this reason, the positive result for this target analyte was qualified as estimated (J) in this sample.

The laboratory reported two sets of results for Samples OCM-2-MS, Z1A-2-SC_3.5_5.5, Z1A-4-SC_3.5-5.5, Z1A-4-SC_6.5-8.5, Z1A-5-SC_2.5-4.5, Z1A-7-SC_2.5-4.5, and Z1A-11-SC_4.0-6.0, initial results and reanalysis results, due to target analyte instrument calibration range exceedance. The following lists which were labeled as DNR and should not be used for any purpose.

Sample OCM-2-MS: The reanalysis results for the PAH target analytes were labeled as DNR and should not be used for any purpose.

Sample Z1A-2-SC_3.5-5.5: The initial results for fluoranthene, naphthalene, and phenanthrene and the reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

Sample Z1A-4-SC_3.5-5.5: The initial results for 1-Methylnaphthalene, 2-Methylnaphthalene, acenaphthene, and phenanthrene and the reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

Sample Z1A-4-SC_6.5-8.5: The initial results for fluoranthene and phenanthrene and the reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

Sample Z1A-5-SC_2.5-4.5: The initial results for benzo(a)pyrene, naphthalene, and phenanthrene and the reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

Sample Z1A-7-SC_2.5-4.5: The initial results for benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, and phenanthrene and the reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

Sample Z1A-11-SC_4.0-6.0: The initial results for 1-Methylnaphthalene, fluoranthene, and phenanthrene and the reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

The laboratory reported three sets of results for Samples Z1A-7-SC_4.5-6.5 and Z1A-10-SC_3.5-5.5, initial results, first reanalysis results, and second reanalysis results, due to target analyte instrument calibration range exceedance. The following lists which were labeled as DNR and should not be used for any purpose.

Sample Z1A-7-SC_4.5-6.5: The initial results for benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, and phenanthrene, the first reanalysis results for fluoranthene and phenanthrene and the second reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

Sample Z1A-10-SC 3.5-5.5: The initial results for 1-Methylnaphthalene, 2-Methylnaphthalene, acenaphthene, naphthalene, and phenanthrene, the first reanalysis for 2-Methylnaphthalene and the second reanalysis results for the remaining PAH target analytes were labeled as DNR and should not be used for any purpose.

SDG 22G0121: (PAHs) The laboratory reported two sets of results for Z1A-4-PW, an initial and a reanalysis. The reanalysis reported results for were labeled as do-not-report (DNR) and should not be used for any purpose.

OVERALL ASSESSMENT

As was determined by this data validation, the laboratory followed the specified analytical methods. Accuracy was acceptable, as demonstrated by the surrogate, LCS/LCSD, and MS/MSD %R values, with the exceptions noted above. Precision was acceptable, as demonstrated by the LCS/LCSD, MS/MSD, and field duplicate RPD values, with the exceptions noted above.

The data are acceptable for the intended use, with the following qualifications listed below in Table 2.

TABLE 2: SUMMARY OF QUALIFIED SAMPLES

Sample ID	Analyte	Qualifier	Reason
OCM-1-MS	Fluoranthene	J	ICAL
OCM-2-MS	Acenaphthene	J	Internal Standard Recovery
	Benzo(a)anthracene	J	Internal Standard Recovery
	Chrysene	J	Internal Standard Recovery/ICAL
	Fluoranthene	J	Internal Standard Recovery/ICAL
	Pentachlorophenol	J	Internal Standard Recovery/ICAL/CCAL/See Miscellaneous
	Phenanthrene	J	Internal Standard Recovery
Z1A-1-SC_5.5-7.5	1-Methylnaphthalene	J	See Miscellaneous
	Benzo(a)anthracene	J	Internal Standard Recovery
	Chrysene	J	ICAL/See Miscellaneous
	Fluoranthene	J	Internal Standard Recovery/ICAL/See Miscellaneous
	Pentachlorophenol	J	ICAL/CCAL/See Miscellaneous
	Phenanthrene	J	Internal Standard Recovery
Z1A-1-SC_7.5-9.5	Fluoranthene	J	ICAL
Z1A-2-SC_3.5-5.5	Chrysene	J	ICAL
	Fluoranthene	J	ICAL
Z1A-3-MS	Indeno(1,2,3-cd)pyrene	J	MS/MSD Recovery
	TOC	J	Laboratory Duplicate Precision
Z1A-4-SC_3.5-5.5	Acenaphthene	J	Internal Standard Recovery
	Benzo(a)anthracene	J	Internal Standard Recovery
	Chrysene	J	ICAL
	Fluoranthene	J	Internal Standard Recovery/ICAL
	Pentachlorophenol	J	Internal Standard Recovery/ICAL/CCAL/See Miscellaneous
	Phenanthrene	J	Internal Standard Recovery
Z1A-4-SC_6.5-8.5	Chrysene	J	Internal Standard Recovery/ICAL
	Fluoranthene	J	ICAL
Z1A-5-SC_2.5-4.5	Benzo(a)anthracene	J	Internal Standard Recovery
	Chrysene	J	Internal Standard Recovery
	Fluoranthene	J	Internal Standard Recovery/ICAL
	Phenanthrene	J	Internal Standard Recovery

Sample ID	Analyte	Qualifier	Reason
Z1A-7-SC_2.5-4.5	1-Methylnaphthalene	J	Internal Standard Recovery
	Benzo(a)pyrene	J	Internal Standard Recovery
	Benzo(b)fluoranthene	J	Internal Standard Recovery
	Benzo(k)fluoranthene	J	Internal Standard Recovery
	Chrysene	J	Internal Standard Recovery
	Dibenzo(a,h)anthracene	J	Internal Standard Recovery
	Fluoranthene	J	ICAL
	Indeno(1,2,3-cd)pyrene	J	Internal Standard Recovery
Z1A-7-SC_4.5-6.5	1-Methylnaphthalene	J	Internal Standard Recovery
	Chrysene	J	Internal Standard Recovery
	Dibenzo(a,h)anthracene	J	Internal Standard Recovery
	Fluoranthene	J	ICAL
	Indeno(1,2,3-cd)pyrene	J	Internal Standard Recovery
Z1A-9-MS	Pentachlorophenol	J	CCAL
Z1A-10-SC_3.5-5.5	1-Methylnaphthalene	J	MS/MSD Recovery/Internal Standard Recovery
	2-Methylnaphthalene	J	MS/MSD Recovery
	Acenaphthene	J	MS/MSD Recovery/Internal Standard Recovery
	Benzo(a)anthracene	J	Internal Standard Recovery
	Dibenzo(a,h)anthracene	J	Internal Standard Recovery
	Diesel-range hydrocarbons	J	MS/MSD Recovery
	Diesel-range hydrocarbons (SG)	J	MS/MSD Recovery
	Fluoranthene	J	Internal Standard Recovery/ICAL
	Indeno(1,2,3-cd)pyrene	J	Internal Standard Recovery
	Naphthalene	J	MS/MSD Recovery/MS/MSD Precision
	Pentachlorophenol	UJ	Internal Standard Recovery
	Phenanthrene	J	MS/MSD Recovery/Internal Standard Recovery
Z1A-10-SC_6.5-8.5	Fluoranthene	J	ICAL
Z1A-11-SC_4.0-6.0	Fluoranthene	J	ICAL
Z1A-12-MS	Diesel-range hydrocarbons	J	MS/MSD Recovery
	Diesel-range hydrocarbons (SG)	J	MS/MSD Recovery
	Pentachlorophenol	J	CCAL
Z1B-2-MS	Benzo(a)anthracene	J	Field Duplicate Precision
	Benzo(a)pyrene	J	Field Duplicate Precision
	Benzo(b)fluoranthene	J	Field Duplicate Precision
	Benzo(k)fluoranthene	J	Field Duplicate Precision
	Chrysene	J	Field Duplicate Precision
	Diesel-range hydrocarbons (SG)	J	Field Duplicate Precision
	Fluoranthene	J	Field Duplicate Precision
	Lube oil-range hydrocarbons (SG)	J	Field Duplicate Precision
	Pentachlorophenol	J	CCAL
	Phenanthrene	J	Field Duplicate Precision

Sample ID	Analyte	Qualifier	Reason
DUP-1-MS	Benzo(a)anthracene	J	Field Duplicate Precision
	Benzo(a)pyrene	J	Field Duplicate Precision
	Benzo(b)fluoranthene	J	Field Duplicate Precision
	Benzo(k)fluoranthene	J	Field Duplicate Precision
	Chrysene	J	Field Duplicate Precision
	Diesel-range hydrocarbons (SG)	J	Field Duplicate Precision
	Fluoranthene	J	Field Duplicate Precision
	Lube oil-range hydrocarbons (SG)	J	Field Duplicate Precision
	Phenanthrene	J	Field Duplicate Precision
Z1B-2-PW	Fluoranthene	UJ	Field Duplicate Precision
	Phenanthrene	UJ	Field Duplicate Precision
DUP-1-PW	Fluoranthene	J	Field Duplicate Precision
	Phenanthrene	J	Field Duplicate Precision

REFERENCES

U.S. Environmental Protection Agency (USEPA). "Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use," EPA-540-R-08-005. January 2009.

U.S. Environmental Protection Agency (USEPA). "Contract Laboratory Program National Functional Guidelines for Organic Superfund Methods Data Review," EPA-540-R-20-005. November 2020.