Data Usability & Presentation

What Regulators Want: Quality Site Assessments & Investigations Using the Conceptual Site Model Approach

Elizabeth Denly, TRC, Vice President, PFAS Initiative Leader & Chemistry Director

Emily Wassmer, TRC, Group Manager & Senior Geologist

Data Usability

Why Do We Need to Evaluate the Lab's Data?

- Data may be used to make costly decisions
- Data may have potential to impact human health
- Need to confirm quality data available and appropriate to support decisions
- Need to determine potential low or high biases, potential uncertainties, potential false positive or false negative results

Even if the lab follows all method-required procedures, there can still be data quality/usability issues.

Effective Post-Sampling Laboratory Communications

- Read the Report / Review the Data
  - As soon as you get it!

- Why?
  - Information is extremely time-sensitive – Anything requiring the laboratory to re-analyze samples dependent on hold time
  - The longer you wait, the shorter the memories become, both in the lab and with the field personnel that collected the samples
  - The longer you wait, the longer it takes a laboratory to produce requested documentation

- ❑ Right list of analytes?
- ❑ All samples analyzed?
- ❑ Required reporting limits achieved?
- ❑ Does anything look unusual?

Evaluation Categories

- Laboratory Performance
- Field Performance
- Matrix Interferences

Laboratory Performance	Field Performance	Matrix Interferences
Method Blanks	Field Blanks	Surrogates
Lab Control Samples	Sample Preservation	Internal Standards*
Holding Times	Field Duplicates	Matrix Spikes
Calibrations*		Laboratory Duplicates
Tunes*		

**Not typically included in Level 2 deliverables*

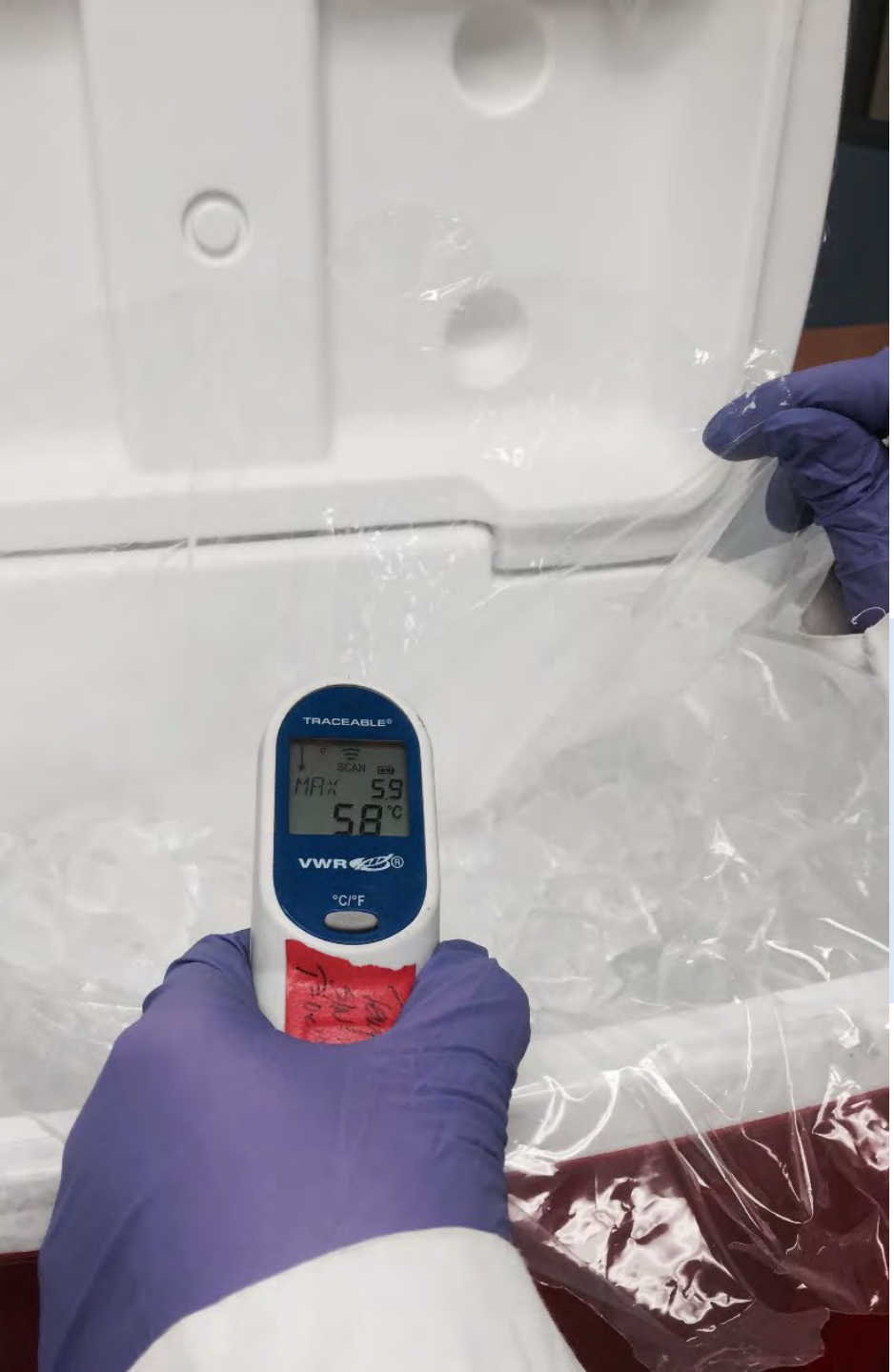
What is Affected by Each Parameter?

Sample-Specific	Batch-Specific
Holding Time	Method Blanks
Sample Preservation	Lab Control Samples
Field Duplicates	Calibrations*
Surrogates	Tunes*
Internal Standards*	Field Blanks
Matrix Spikes	
Laboratory Duplicates	

**Not typically included in Level 2 deliverables*

Organic Versus Inorganic Methods: *Examples*

Organic	Inorganic
Volatile Organic Compounds (VOCs)	Metals
Semivolatile Organic Compounds (SVOCs) Polycyclic Aromatic Hydrocarbons (PAHs)	Cyanide
Pesticides	Hexavalent Chromium
Polychlorinated Biphenyls (PCBs)	Anions
Dioxins/Furans	Hardness
Total Petroleum Hydrocarbons (TPH) Extractable Petroleum Hydrocarbons (EPH) Volatile Petroleum Hydrocarbons (VPH)	
Per- and Polyfluoroalkyl Substances (PFAS)	



Sample Preservation & Integrity

Was the Cooler Temperature ≤ 6° C?

Typically noted on COC or separate cooler receipt form.

What if samples are delivered to the laboratory on the same day of collection and temperatures are outside of the acceptance criteria but samples are on ice?

Temperature too low: likely okay as long as waters not frozen
Temperature too high: use professional judgment

- Metals
- PCBs or Dioxins
- VOCs (potential low bias)

Sample Preservation & Integrity

Was the Proper Chemical Preservative Used?

- Chemical Preservation of Aqueous Samples (examples)
  - **Metals** (nitric acid; pH <2)
  - **VOCs** (hydrochloric acid; pH <2)
  - **TOC** (sulfuric acid; pH <2)
  - **Cyanide** (sodium hydroxide; pH >12)

- Chemical Preservation of Soil/Sediment Samples
  - Most common: **VOCs**
    - ✓ **Low-level:** 5 grams with sodium bisulfate/DI water and magnetic stir bar
    - ✓ **Low-level**: 5 grams with DI water and magnetic stir bar
    - ✓ **High-level:** 5 grams with methanol

Most labs will note on cooler receipt form or in narrative IF there is an issue.

Option to chemical preservation is EnCore™ samplers.

Potential Issues with Lack of Preservation

Water VOCs not acid-preserved	Holding time reduced to 7 days
Water: other parameters not properly preserved	If >1 day to preservation, may have low bias
Soil VOCs not preserved	Detected results low bias Nondetect results rejected

Significant Data Quality Issue:
Lack of Preservation for Soil Samples for VOCs

Sample Preservation & Integrity

Air Samples

- Canister Vacuums
- Flow Controller Calibrations

Flow controller relative percent differences (RPDs) should be <20.

Want canister vacuum to be between 5-10” Hg; don’t want it to be 0.

Canister and Flow Controller Information

Samplenum	Client ID	Media ID	Media Type	Date Prepared	Bottle Order	Cleaning Batch ID	Can Leak Check	Initial Pressure (in. Hg)	Pressure [illegible] Receipt [illegible]. Hg)	Flow Controler Leak Chk	Flow Out mL/min	Flow In mL/min	% RPD
L1414095-01	5ALLB-1	0383	#20 AMB	06/23/14	104424		-			Pass	3.3	3.4	3
L1414095-01	5ALLB-1	999	6.0L Can	06/23/14	104424	L1413371-04	Pass	-29.2	-6.0	-	-	-	-
L1414095-02	5ALLB-2	0256	#16 SV	06/23/14	104424		-	-	-	Pass	3.1	3.2	3
L1414095-02	5ALLB-2	969	6.0L Can	06/23/14	104424	L1413442-02	Pass	-29.6	-8.0	-	-	-	-
L1414095-03	9ALLB-1	0201	#16 AMB	06/23/14	104424		-	-	-	Pass	3.2	3.4	6
L1414095-03	9ALLB-1	1526	6.0L Can	06/23/14	104424	L1413371-03	Pass	-29.5	-7.4	-	-	-	-
L1414095-04	9ALLB-2	0201	#16 AMB	06/23/14	104424		-	-	-	Pass	3.		
L1414095-04	9ALLB-2	639	6.0L Can	06/23/14	104424	L1411852-01	Pass	-29.1	-4.6	-	-		
L1414095-05	252-1	0240	#16 AMB	06/23/14	104424		-	-	-	Pass	3.0	0.4	153
L1414095-05	252-1	1799	6.0L Can	06/23/14	104424	L1413293-01	Pass	-29.3	-22.1	-	-	-	-

Sample Preservation & Integrity

Were Preparation & Analytical Holding Times Met?

- Need to check for ***every*** sample and ***every*** analysis
- Make sure lab provides both **PREPARATION** and **ANALYSIS** dates, when applicable.

Holding Times for Some Common Analyses

Holding Times and Preservation Requirements			
Parameter	**Reference Method**	**Acceptance Criteria**	
		Aqueous	**Solid**
VOCs	EPA 8260B	14 days (pH <2 with HCl) 7 days (un-preserved)	Low-level in 5 mL water: 48 hours to storage in freezer; 14 days to analysis Low-level in 5 mL NaHSO4: 14 days to analysis High-level in methanol: 14 days to analysis EnCore samplers: 48 hours to preservation for low-level and high-level analyses; above holding times for analysis apply
SVOCs	EPA 8270D	7 days to extraction; 40 days from extraction to analysis	14 days to extraction; 40 days from extraction to analysis
Metals (ICP-AES)	EPA 6010C	6 months to analysis (pH <2 with HNO_3)	6 months to analysis
Mercury	EPA 7470A, EPA 7471B	28 days to analysis (pH <2 with HNO_3)	28 days to analysis
Metals (GFAA)	EPA 7010	6 months to analysis (pH <2 with HNO_3)	6 months to analysis
Metals (ICP-MS)	EPA 6020A	6 months to analysis (pH <2 with HNO_3)	6 months to analysis
TPH	EPA 8015B	GRO: 14 days to analysis (pH <2 with HCl) DRO: 7 days to extraction; 40 days from extraction to analysis	GRO: 14 days to analysis (methanol) DRO: 14 days to extraction; 40 days from extraction to analysis
PCBs	EPA 8082A	1 year to extraction; 40 days from extraction to analysis	1 year to extraction; 40 days from extraction to analysis
Pesticides	EPA 8081B	7 days to extraction; 40 days from extraction to analysis	14 days to extraction; 40 days from extraction to analysis
Herbicides	EPA 8151A	7 days to extraction; 28 days to methylation; analysis immediately after methylation	14 days to extraction; 28 days to methylation; analysis immediately after methylation

Example Holding Time (HT) Check

PAHs in Soil

Collected 6/11/23

The Lab provides **dates prepared** and **dates analyzed**.
The **collection** dates are on the COC.

Therefore, YOU can calculate whether holding times were met.

Extracted 6/16/23

- 5 days lapse
- (HT = 14 days from collection)

Analyzed 6/23/23

- 7 days lapse
- (HT = 40 days from extraction)

If Holding time missed: *Data potentially biased low*

If Holding time missed by >2x holding time: *Data may not be usable for project objectives*

Evaluate Holding Times

VOCs: 14 days to analysis
SVOCs: 14 days to extraction; 40 days from extraction to analysis

Typical sample result summary form

- Number of VOCs reported
- Results, RLs, units
- Dilution results
- Collection date, prepared date, analysis date
- Percent solids (dry weight)
- Surrogate recoveries

VOCs in soil

Client Sample ID: -SS-01-TOP
Date Collected: 01/29/20 09:50
Date Received: 01/30/20 09:30

Lab Sample ID: XX XXX-1
atrix: Solid
Percen olids: 79.9

Method: 8260C - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,1-Trichloroethane	ND		5.75		ug/Kg	☼	01/30/20 13:45	01/31/20 12:23	1
1,2-Dichlorobenzene	ND		5.75		ug/Kg	☼	01/30/20 13:45	01/31/20 12:23	1
1,1,2,2-Tetrachloroethane	ND		5.75		ug/Kg	☼	01/30/20 13:45	01/31/20 12:23	1
1,1,2-Trichloroethane	ND		5.75		ug/Kg	☼	01/30/20 13:45	01/31/20 12:23	1

SVOCs in soil

Client Sample ID: -SS-01-TOP
Date Collected: 01/29/20 09:50
Date Received: 01/30/20 09:30

Method: 8270D - Semivolatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Biphenyl	ND		2120	312	ug/Kg	☼	01/31/20 14:48	02/03/20 21:31	10
bis (2-chloroisopropyl) ether	ND		2120	424	ug/Kg	☼	01/31/20 14:48	02/03/20 21:31	10
2,4,5-Trichlorophenol	ND		2120	574	ug/Kg	☼	01/31/20 14:48	02/03/20 21:31	10
2,4,6-Trichlorophenol	ND		2120	424	ug/Kg	☼	01/31/20 14:48	02/03/20 21:31	10
2,4-Dichlorophenol	ND		2120	225	ug/Kg	☼	01/31/20 14:48	02/03/20 21:31	10
2,4-Dimethylphenol	ND		2120	511	ug/Kg	☼	01/31/20 14:48	02/03/20 21:31	10

Why are Reporting Limits Important?

- What regulatory or screening criteria need to be achieved?
- Are the lab's reporting limits (RLs) below the regulatory or screening criteria?

Groundwater Samples (ug/L)			
Analyte	**Sample RL (method)**	**ME RAG/Residential**	**ME RAG/Construction Worker**
Benzo(a)pyrene	2.0 (8270) 0.1 (8270 SIM)	0.25	11,000
Arsenic	5.0 (6010: ICP/OES) 0.5 (6020: ICP/MS)	0.52	5,800

RAG = Remedial Action Guideline
SIM = Selective Ion Monitoring

If Reporting Limits (RLs) above screening criteria, may not be able to achieve objectives.

If RLs Above Screening Criteria, Why?

Analytical Limitation

- **MEDEP RAGs or MCLs** needed for PAHs? Request SIM
- Metals: may need ICP/MS (6020/200.8) instead of ICP/atomic emission spectroscopy (AES) (6010/200.7)

Dilutions Performed

- Is dilution reasonable?
- Does the lab note if it is due to non-target compounds?
- Is it due to an elevated extract volume?

Reminders

Laboratory Performance	Field Performance	Matrix Interferences
Method Blanks	Field Blanks	Surrogates
Lab Control Samples	Sample Preservation	Internal Standards*
Holding Times	Field Duplicates	Matrix Spikes
Calibrations*		Laboratory Duplicates
Tunes*		

* Not typically provided in Level 2 deliverables

Sample-Specific	Batch-Specific
Holding Times	Method Blanks
Sample Preservation	Lab Control Samples
Field Duplicates	Calibrations*
Surrogates	Tunes*
Internal Standards*	Field Blanks
Matrix Spikes	
Laboratory Duplicates	

* Not typically provided in Level 2 deliverables

Blanks: Method Blanks, Field Blanks, & Equipment Blanks

- Purposes:
  - **Method Blank:**
    To check for potential lab contamination in the sample preparation and analysis step
  - **Field/Equipment/Trip Blanks:**
    To check for potential contamination from ambient field conditions, equipment, or shipping/storage

- Does each prep batch have its own method blank?
- Were field/equipment blanks collected at the required frequency?

Method Blank Data in Your Data Package

Method: 8260C - Volatile Organic Compounds by GC/MS

Lab Sample ID: MB 480-515744/2-A
Matrix: Solid
Analysis Batch: 515698

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 515744

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
1,1,1-Trichloroethane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,2-Dichlorobenzene	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,1,2,2-Tetrachloroethane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,1,2-Trichloroethane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,1-Dichloroethane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,1-Dichloroethene	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,2,4-Trichlorobenzene	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,2-Dibromo-3-Chloropropane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,2-Dichloroethane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,2-Dichloropropane	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1
1,3-Dichlorobenzene	ND		5.00		ug/Kg		01/31/20 10:30	01/31/20 11:48	1

Method: 6010C - Metals (ICP)

Lab Sample ID: MB 480-515713/1-A
Matrix: Solid
Analysis Batch: 516280

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 515713

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	ND		14.7		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Arsenic	ND		1.96		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Barium	ND		0.490		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Beryllium	ND		0.196		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Cadmium	ND		0.196		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Chromium	ND		0.490		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Lead	ND		0.979		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Nickel	ND		4.90		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Selenium	ND		3.92		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Silver	ND		0.588		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Molybdenum	ND		0.979		mg/Kg		01/31/20 10:43	02/04/20 13:07	1
Thallium	ND		5.88		mg/Kg		01/31/20 10:43	02/04/20 13:07	1

Method blanks will be reported in data package.

- Each method
- Each day of analysis/extraction
- Results for all target analytes reported in samples

Blank Evaluation

Method Blanks, Field Blanks, & Equipment Blanks

- Is anything detected in the blank?
- Are there any potential **false positives**?
- **General Rule of Thumb:** If concentration in sample <2x the blank concentration, the result is potentially a false positive
- **Common contaminants:** methylene chloride, acetone, phthalates, 2-butanone

2x Blank = 4 ug/L	2x Blank = 4 ug/L
Sample conc = 120 ug/L	Sample conc = 3 ug/L
Real Hit	False Positive

Acetone in Blank = 2 ug/L

Question

The lab method blank contains 130 ug/kg benzene. One of the field samples associated with this blank contains 250 ug/kg benzene. How would you evaluate the benzene result in this field sample?

A. Report as is since it is highly unlikely benzene is a laboratory contaminant.

B. Flag the benzene result as a potential false positive since the concentration is <2x the blank concentration.

C. Report as is since the benzene result is > the blank concentration.

Reminders

Laboratory Performance	Field Performance	Matrix Interferences
Method Blanks	Field Blanks	Surrogates
Lab Control Samples	Sample Preservation	Internal Standards*
Holding Times	Field Duplicates	Matrix Spikes
Calibrations*		Laboratory Duplicates
Tunes*		

* Not typically provided in Level 2 deliverables

Sample-Specific	Batch-Specific
Holding Times	Method Blanks
Sample Preservation	Lab Control Samples
Field Duplicates	Calibrations*
Surrogates	Tunes*
Internal Standards*	Field Blanks
Matrix Spikes	
Laboratory Duplicates	

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Laboratory Control Samples (LCS)

- **Purposes:** To check the accuracy of the method in the absence of any matrix effects
- What are LCSs?
- Does each analytical or prep batch have its own LCS?

LCS Data in Your Data Package

Lab Sample ID: LCS 480-515790/2-A
Matrix: Solid
Analysis Batch: 515974

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 515790

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Biphenyl	1660	1527		ug/Kg		92	59 - 120
bis (2-chloroisopropyl) ether	1660	1519		ug/Kg		92	44 - 120
2,4,5-Trichlorophenol	1660	1456		ug/Kg		88	59 - 126
2,4,6-Trichlorophenol	1660	1402		ug/Kg		85	59 - 123
2,4-Dichlorophenol	1660	1431		ug/Kg		86	61 - 120
2,4-Dimethylphenol	1660	1390		ug/Kg		84	59 - 120
2,4-Dinitrophenol	3320	2503		ug/Kg		75	41 - 146
2,4-Dinitrotoluene	1660	1626		ug/Kg		98	63 - 120
2,6-Dinitrotoluene	1660	1598		ug/Kg		96	66 - 120
2-Chloronaphthalene	1660	1399		ug/Kg		84	57 - 120
2-Chlorophenol	1660	1480		ug/Kg		89	53 - 120
2-Methylnaphthalene	1660	1468		ug/Kg		88	59 - 120
2-Methylphenol	1660	1483		ug/Kg		89	54 - 120

Lab Sample ID: LCSSRM 480-515713/2-A
Matrix: Solid
Analysis Batch: 516280

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 515713

Analyte	Spike Added	LCSSRM Result	LCSSRM Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	282	98.17		mg/Kg		34.8	10.0 - 129.8
Arsenic	155	117.1		mg/Kg		75.5	64.5 - 120.0
Barium	439	343.6		mg/Kg		78.3	70.8 - 118.2
Beryllium	192	156.5		mg/Kg		81.5	69.8 - 116.7
Cadmium	61.5	49.35		mg/Kg		80.2	68.6 - 114.3
Chromium	104	84.94		mg/Kg		81.7	67.8 - 126.0
Lead	126	113.5		mg/Kg		90.1	70.9 - 127.

LCSs will be reported in data package.

- Each method
- Each day of analysis/extraction
- Percent recoveries for all target analytes reported in samples

Laboratory Control Sample (LCS) Evaluation

- Were **all** target analytes reported?
- Were all recoveries within the acceptance limits?
- **If LCS recoveries are outside limits:**
  - POTENTIAL LOW BIAS or
  - POTENTIAL HIGH BIAS

Affects the whole batch of samples prepared with the LCS.

Potentially unusable results:

- Organic methods: if recoveries are <10%
- Inorganic methods: if recoveries are <30%

Question

If naphthalene recovers at 25% in the LCS (criteria are 40-140%),
which of the following is true?

A. Naphthalene concentrations in the associated samples are biased high.

B. Naphthalene concentrations in the associated samples are biased low.

C. Naphthalene results are unusable.

Reminders

Laboratory Performance	Field Performance	Matrix Interferences
Method Blanks	Field Blanks	Surrogates
Lab Control Samples	Sample Preservation	Internal Standards*
Holding Times	Field Duplicates	Matrix Spikes
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Tunes*		

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Sample-Specific	Batch-Specific
Holding Times	Method Blanks
Sample Preservation	Lab Control Samples
Field Duplicates	Calibrations*
Surrogates	Tunes*
Internal Standards*	Field Blanks
Matrix Spikes	
Laboratory Duplicates	

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Matrix Spikes/Matrix Spike Duplicates (MS/MSDs)

- What are these?
- Were these analyses performed on a project sample?

MS/MSDs not applicable to the air matrix

Matrix spikes especially important for inorganic parameters:

- **Metals**
- **Hexavalent chromium**
- **Total cyanide**

MS/MSD Data in Your Data Package

Lab Sample ID: XXXXXX-7 MS
Matrix: Solid
Analysis Batch: 516280

Client Sample ID: -SS-04-TOP Prep
Type: Total/NA
Prep Batch: 515713

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
Antimony	ND	F1	51.8	39.06	F1	mg/Kg	☼	74	75 - 125
Arsenic	5.34		51.8	50.51		mg/Kg	☼	87	75 - 125
Barium	46.1	F1	51.8	113.6	F1	mg/Kg	☼	130	75 - 125
Beryllium	0.431		51.8	47.64		mg/Kg	☼	91	75 - 125
Cadmium	0.391		51.8	47.00		mg/Kg	☼	90	75 - 125
Chromium	17.8		51.8	67.55		mg/Kg	☼	96	75 - 125
Lead	60.0		51.8	105.9		mg/Kg	☼	89	75 - 125
Nickel	10.8		51.8	60.19		mg/Kg	☼	95	75 - 125
Selenium	ND		51.8	45.63		mg/Kg	☼	86	75 - 125
Silver	ND		12.9	11.59		mg/Kg	☼	90	75 - 125
Molybdenum	ND		51.8	49.26		mg/Kg	☼	94	75 - 125
Thallium	ND		51.8	49.67		mg/Kg	☼	96	75 - 125
Vanadium	26.2		51.8	77.90		mg/Kg	☼	100	75 - 125
Zinc	140		51.8	182.5		mg/Kg	☼	82	75 - 125

Lab Sample ID: XXXXXX-7 MS
Matrix: Solid
Analysis Batch: 515698

Client Sample ID: -SS-04-TOP Prep
Type: Total/NA
Prep Batch: 515744

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec. Limits
1,1,1-Trichloroethane	ND	F2	163	141.0		ug/Kg	☼	86	77 - 121
1,2-Dichlorobenzene	ND	F1 F2	163	68.64	F1	ug/Kg	☼	42	75 - 120
1,1,2,2-Tetrachloroethane	ND	F1 F2	163	96.08	F1	ug/Kg	☼	59	80 - 120
1,1,2-Trichloroethane	ND	F1 F2	163	112.8	F1	ug/Kg	☼	69	78 - 122
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	F2	163	125.3		ug/Kg	☼	77	60 - 140
1,1-Dichloroethane	ND	F2	163	140.2		ug/Kg	☼	86	73 - 126
1,1-Dichloroethene	ND	F2	163	138.5		ug/Kg	☼	85	59 - 125
1,2,4-Trichlorobenzene	ND	F1	163	35.79	F1	ug/Kg	☼	22	64 - 120
1,2-Dibromo-3-Chloropropane	ND	F1 F2	163	77.10	F1	ug/Kg	☼	47	63 - 124
1,2-Dichloroethane	ND	F2	163	132.4		ug/Kg	☼	81	77 - 122
1,2-Dichloropropane	ND	F2	163	130.8		ug/Kg	☼	80	75 - 124
1,3-Dichlorobenzene	ND	F1 F2	163	70.89	F1	ug/Kg	☼	43	74 - 120

Was it performed on a sample from your project?

MS/MSDs will be reported in data package.

- Each method, if performed
- Percent recoveries for all target analytes reported in samples

Matrix Spikes/Matrix Spike Duplicates (MS/MSDs)

- Were **all** target analytes reported?
- Were all recoveries within the acceptance limits? ➡ **ACCURACY**

- Were all RPDs within the acceptance limits? ➡ **PRECISION**

- **If MS recoveries are outside limits:**
  - POTENTIAL LOW BIAS or
  - POTENTIAL HIGH BIAS

Organics: Affects the sample that was spiked.

Inorganics: Affects all samples in data set of similar matrix

Potentially unusable results:
- Organic methods: if recoveries are <10%
- Inorganic methods: if recoveries are <30%

Question

If arsenic recovers at 25% in the MS (criteria are 75-125%), which of the following is true?

A. Arsenic concentration in the associated sample is biased high.

B. Arsenic concentration in the associated sample is biased low.

C. Arsenic result in the associated sample is unusable.

Reminders

Laboratory Performance	Field Performance	Matrix Interferences
Method Blanks	Field Blanks	Surrogates
Lab Control Samples	Sample Preservation	Internal Standards*
Holding Times	Field Duplicates	Matrix Spikes
Calibrations*		Laboratory Duplicates
Tunes*		

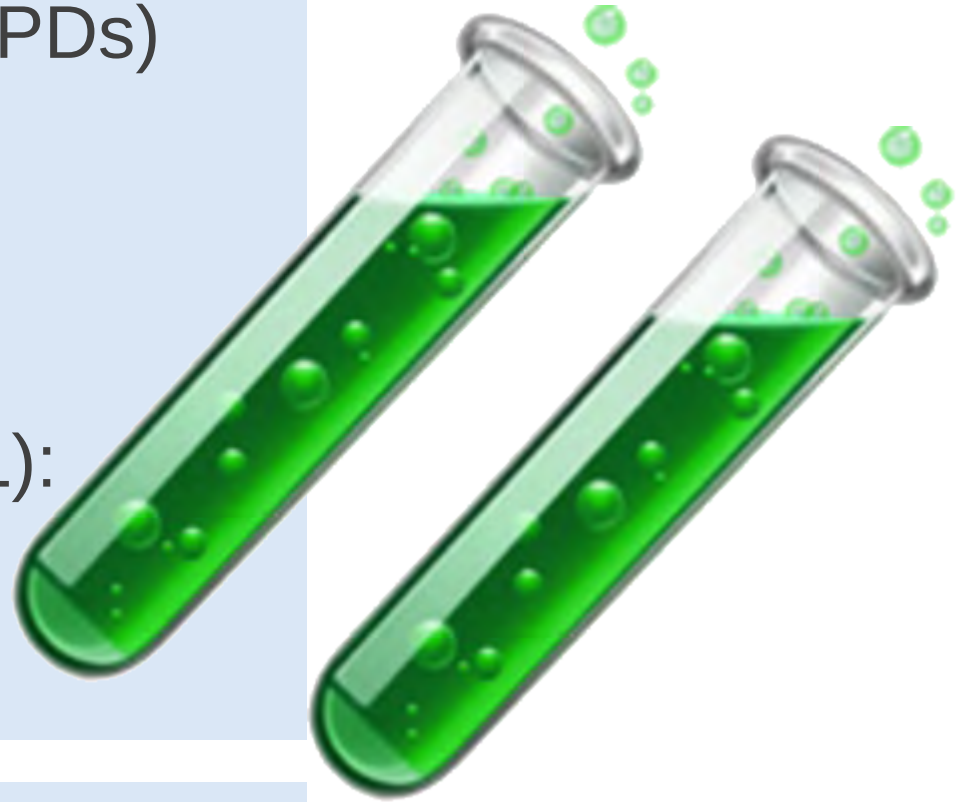
*Not typically provided in Level 2 deliverables

Sample-Specific	Batch-Specific
Holding Times	Method Blanks
Sample Preservation	Lab Control Samples
Field Duplicates	Calibrations*
Surrogates	Tunes*
Internal Standards*	Field Blanks
Matrix Spikes	
Laboratory Duplicates	

*Not typically provided in Level 2 deliverables

Field Duplicates

- Were relative percent differences (RPDs) within the acceptance criteria?
- What are the acceptance criteria?
- Typical (when results are >2x the RL):
  - RPD ≤30 for aqueous and air samples
  - RPD ≤50 for solid samples



RPD = |X1 – X2| / (Average X1, X2) * 100
RPD = |Difference between two results|/ (Average of two results)* 100

Some Potential Field Duplicate Scenarios

Both results <2x the RL: aqueous or air samples

Compound	RL (ug/L)	Sample (ug/L)	Field Dup (ug/L)	RPD
Benzene	1	1.8	0.3 J	52.6

When both results are <2x the RL, look at the absolute difference between the results.
Acceptable absolute difference: <RL
1.8 – 0.3 = 1.5: UNACCEPTABLE

Both results <2x the RL: soil/sediment samples

Analyte	RL (mg/kg)	Sample (mg/kg)	Field Dup (mg/kg)	RPD
Lead	2	3.9	2.1	60

When both results are <2x the RL, look at the absolute difference between the results.
Acceptable absolute difference: <2x the RL
3.9 – 2.1 = 1.8: ACCEPTABLE

One detected result and one nondetect result

Analyte	RL (mg/kg)	Sample (mg/kg)	Field Dup (mg/kg)	RPD
Benzene	0.01	0.2	0.01 U	NC
Lead	2	3	2.0 U	NC

Benzene: absolute difference: 0.2 – 0.01 = 0.19 (>2xRL so UNACCEPATABLE)
Lead: 3 – 2 = 1 (<2x RL so ACCEPTABLE)

Field Duplicate Reporting Recommendations

Scenario	Reporting Recommendations
Both results nondetect	Use the lower of the two RLs
One result detected and one result not detected	Use the detected result
Both results detected and precision acceptable	Use the average or higher of the two results
Both results detected and precision not acceptable	Use the higher of the two results

Where is Variability Coming From?

- Sample Non-homogeneity
- Sampling Variability
- Laboratory Variability

Reminders

Laboratory Performance	Field Performance	Matrix Interferences
Method Blanks	Field Blanks	Surrogates
Lab Control Samples	Sample Preservation	Internal Standards*
Holding Times	Field Duplicates	Matrix Spikes
Calibrations*		Laboratory Duplicates
Tunes*		

*Not typically provided in Level 2 deliverables

Sample-Specific	Batch-Specific
Holding Times	Method Blanks
Sample Preservation	Lab Control Samples
Field Duplicates	Calibrations*
Surrogates	Tunes*
Internal Standards*	Field Blanks
Matrix Spikes	
Laboratory Duplicates	

*Not typically provided in Level 2 deliverables

Surrogates (Organic Analyses Only)

What are they?

Examples:
VOCs: Toluene-d8
SVOCs: Phenol-d5
PCBs: Decachlorobiphenyl

Surrogate Data in Your Data Package

Method: 8260C - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL
Isopropylbenzene	ND		8.52	
Methyl acetate	ND		42.6	
Methyl tert-butyl ether	ND		8.52	
Methylcyclohexane	ND		8.52	
Methylene Chloride	ND		8.52	
Styrene	ND		8.52	
Tetrachloroethene	ND		8.52	
Toluene	ND		8.52	
trans-1,2-Dichloroethene	ND		8.52	
trans-1,3-Dichloropropene	ND		8.52	
Trichloroethene	ND		8.52	
Trichlorofluoromethane	ND		8.52	
Vinyl chloride	ND		8.52	
Xylenes, Total	ND		17.0	

Surrogate	*%Recovery*	*Qualifier*	*Limits*
Toluene-d8 (Surr)	*98*		*71 - 125*
1,2-Dichloroethane-d4 (Surr)	*106*		*64 - 126*
4-Bromofluorobenzene (Surr)	*95*		*72 - 126*
Dibromofluoromethane (Surr)	*107*		*60 - 140*

Actual %Rs

Acceptance limits

Method: 8270D - Semivolatile Organic Compounds (GC/MS) (Co

Analyte	Result	Qualifier	RL
Di-n-octyl phthalate	ND		1090
Dibenz(a,h)anthracene	ND		1090
Dibenzofuran	ND		1090
Diethyl phthalate	ND		1090
Dimethyl phthalate	ND		1090
Fluoranthene	305	J	1090
Fluorene	ND		1090
Hexachlorobenzene	ND		1090
Hexachlorobutadiene	ND		1090
Hexachlorocyclopentadiene	ND		1090
Hexachloroethane	ND		1090
Indeno[1,2,3-cd]pyrene	175	J	1090
Isophorone	ND		1090
N-Nitrosodi-n-propylamine	ND		1090
N-Nitrosodiphenylamine	ND		1090
Naphthalene	ND		1090
Nitrobenzene	ND		1090
Pentachlorophenol	ND		2120
Phenanthrene	ND		1090
Phenol	ND		1090
Pyrene	278	J	1090

Surrogate	*%Recovery*	*Qualifier*	*Limits*	
2,4,6-Tribromophenol	*105*		*54 - 120*	Acid
2-Fluorobiphenyl	*94*	B/N	*60 - 120*	
2-Fluorophenol	*92*		*52 - 120*	Acid
Nitrobenzene-d5	*75*	B/N	*53 - 120*	
p-Terphenyl-d14	*106*	B/N	*79 - 130*	
Phenol-d5	*88*		*54 - 120*	Acid

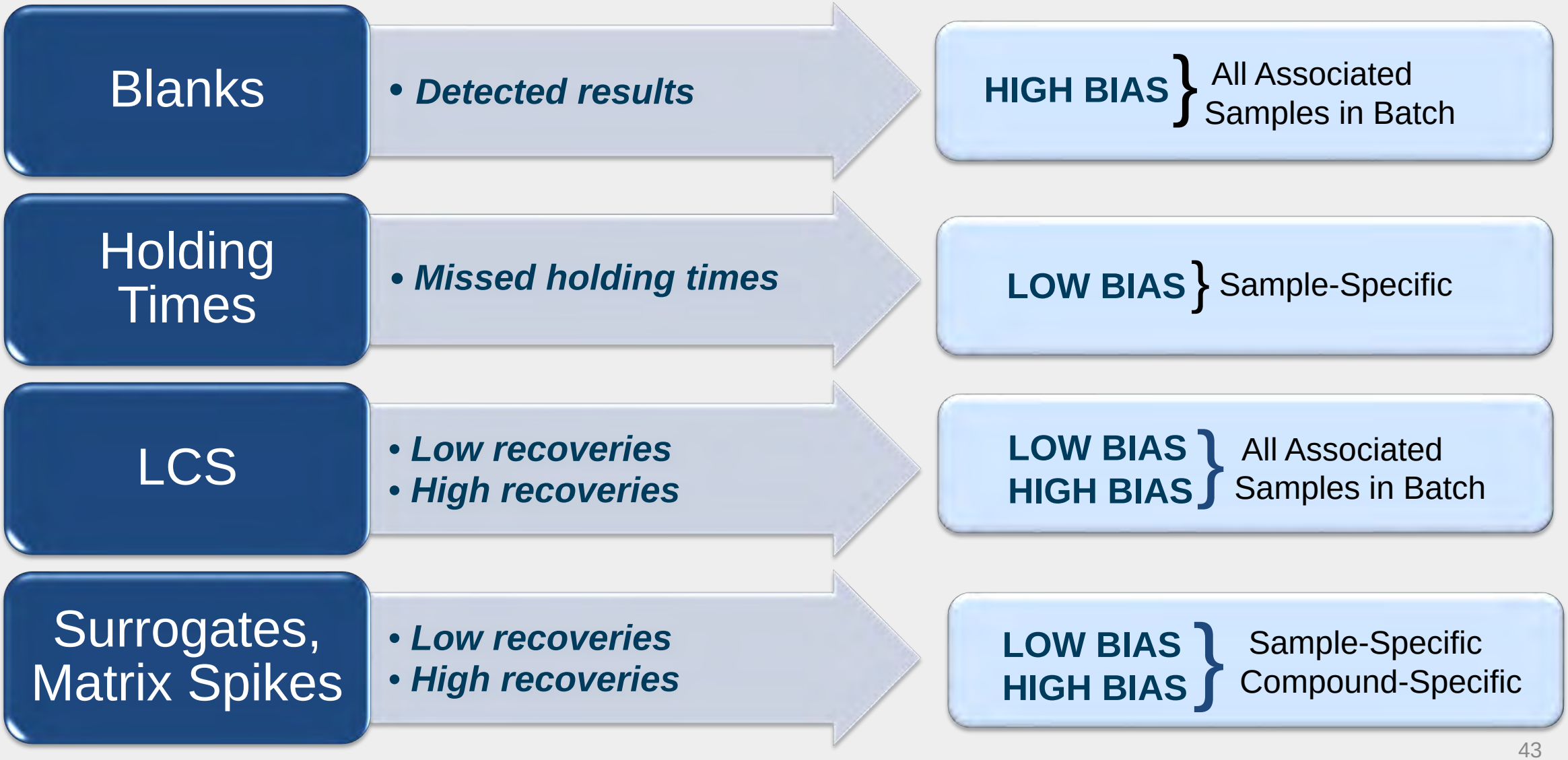
Biases Due to Surrogate Recoveries

- Were all recoveries within the acceptance limits?
- **If surrogate recoveries are outside limits:**
  - POTENTIAL LOW BIAS or
  - POTENTIAL HIGH BIAS
- **Sample-specific**
- **Effect on results dependent on method**

Method	Effect on Data
VOCs	If 1 surrogate out: affects all target VOCs
SVOCs	If ≥ 2 B/N surrogates out but ≥10%: affects all B/N compounds If ≥ 2 acid surrogates out but ≥10%: affects all acid compounds If 1 B/N or 1 acid surrogate <10%: affects associated compounds
Pesticides & PCBs	Affects all target pesticides or PCBs: dependent on which column surrogate is outside limits

- **Potentially unusable results: if recoveries are <10%**

Let's Summarize Potential Biases



Data Presentation

Data Presentation Overview

Goals

- Supplement the text
- Information is accessible and easy to digest
- Concepts and conclusions are clear

Your audience matters!

Data Tables

Anatomy of a Basic Analytical Data Table

1. Title
2. Sample Information
3. Analysis (method) & individual analytes
4. Units
5. Regulatory Criteria
6. Analytical Data (Results) including qualifiers
7. Notes

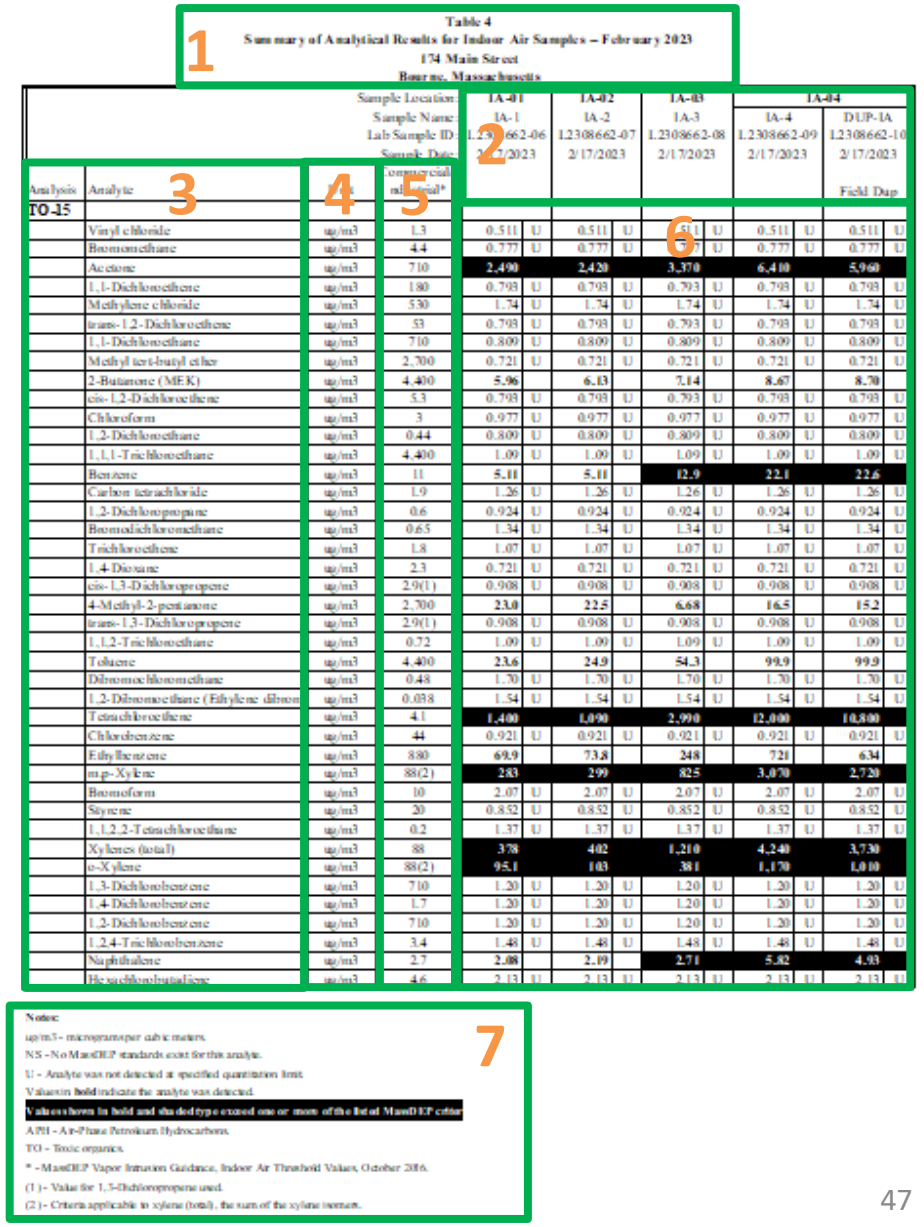


Table 4
Summary of Analytical Results for Indoor Air Samples – February 2023
174 Main Street
Bourne, Massachusetts

				Sample Location:	IA-01		IA-02		IA-03		IA-04			
				Sample Name:	IA-1		IA-2		IA-3		IA-4		DUP-IA	
				Lab Sample ID:	L2308662-06		L2308662-07		L2308662-08		L2308662-09		L2308662-10	
				Sample Date:	2/17/2023		2/17/2023		2/17/2023		2/17/2023		2/17/2023	
Analysis	Analyte	Units	Commercial Industrial*										Field Dup	
TO-15														
	Vinyl chloride	ug/m3	1.3	0.511	U	0.511	U	0.511	U	0.511	U	0.511	U	
	Bromomethane	ug/m3	4.4	0.777	U	0.777	U	0.777	U	0.777	U	0.777	U	
	Acetone	ug/m3	710	2,490		2,420		3,370		6,410		5,960		
	1,1-Dichloroethene	ug/m3	180	0.793	U	0.793	U	0.793	U	0.793	U	0.793	U	
	Methylene chloride	ug/m3	530	1.74	U	1.74	U	1.74	U	1.74	U	1.74	U	
	trans-1,2-Dichloroethene	ug/m3	53	0.793	U	0.793	U	0.793	U	0.793	U	0.793	U	
	1,1-Dichloroethane	ug/m3	710	0.809	U	0.809	U	0.809	U	0.809	U	0.809	U	
	Methyl tert-butyl ether	ug/m3	2,700	0.721	U	0.721	U	0.721	U	0.721	U	0.721	U	
	2-Butanone (MEK)	ug/m3	4,400	5.96		6.13		7.14		8.67		8.70		
	cis-1,2-Dichloroethene	ug/m3	5.3	0.793	U	0.793	U	0.793	U	0.793	U	0.793	U	
	Chloroform	ug/m3	3	0.977	U	0.977	U	0.977	U	0.977	U	0.977	U	
	1,2-Dichloroethane	ug/m3	0.44	0.809	U	0.809	U	0.809	U	0.809	U	0.809	U	
	1,1,1-Trichloroethane	ug/m3	4,400	1.09	U	1.09	U	1.09	U	1.09	U	1.09	U	
	Benzene	ug/m3	11	5.11		5.11		12.9		22.1		22.6		
	Carbon tetrachloride	ug/m3	1.9	1.26	U	1.26	U	1.26	U	1.26	U	1.26	U	
	1,2-Dichloropropane	ug/m3	0.6	0.924	U	0.924	U	0.924	U	0.924	U	0.924	U	
	Bromodichloromethane	ug/m3	0.65	1.34	U	1.34	U	1.34	U	1.34	U	1.34	U	
	Trichloroethene	ug/m3	1.8	1.07	U	1.07	U	1.07	U	1.07	U	1.07	U	
	1,4-Dioxane	ug/m3	2.3	0.721	U	0.721	U	0.721	U	0.721	U	0.721	U	
	cis-1,3-Dichloropropene	ug/m3	2.9(1)	0.908	U	0.908	U	0.908	U	0.908	U	0.908	U	
	4-Methyl-2-pentanone	ug/m3	2,700	23.0		22.5		6.68		16.5		15.2		
	trans-1,3-Dichloropropene	ug/m3	2.9(1)	0.908	U	0.908	U	0.908	U	0.908	U	0.908	U	
	1,1,2-Trichloroethane	ug/m3	0.72	1.09	U	1.09	U	1.09	U	1.09	U	1.09	U	
	Toluene	ug/m3	4,400	23.6		24.9		54.3		99.9		99.9		
	Dibromochloromethane	ug/m3	0.48	1.70	U	1.70	U	1.70	U	1.70	U	1.70	U	
	1,2-Dibromoethane (Ethylene dibromi	ug/m3	0.088	1.54	U	1.54	U	1.54	U	1.54	U	1.54	U	
	Tetrachloroethene	ug/m3	4.1	1,400		1,090		2,990		12,000		10,800		
	Chlorobenzene	ug/m3	44	0.921	U	0.921	U	0.921	U	0.921	U	0.921	U	
	Ethylbenzene	ug/m3	880	69.9		73.8		248		721		634		
	m,p-Xylene	ug/m3	88(2)	283		299		825		3,070		2,720		
	Bromoform	ug/m3	10	2.07	U	2.07	U	2.07	U	2.07	U	2.07	U	
	Styrene	ug/m3	20	0.852	U	0.852	U	0.852	U	0.852	U	0.852	U	
	1,1,2,2-Tetrachloroethane	ug/m3	0.2	1.37	U	1.37	U	1.37	U	1.37	U	1.37	U	
	Xylenes (total)	ug/m3	88	378		402		1,210		4,240		3,730		
	o-Xylene	ug/m3	88(2)	95.1		103		381		1,170		1,010		
	1,3-Dichlorobenzene	ug/m3	710	1.20	U	1.20	U	1.20	U	1.20	U	1.20	U	
	1,4-Dichlorobenzene	ug/m3	1.7	1.20	U	1.20	U	1.20	U	1.20	U	1.20	U	
	1,2-Dichlorobenzene	ug/m3	710	1.20	U	1.20	U	1.20	U	1.20	U	1.20	U	
	1,2,4-Trichlorobenzene	ug/m3	3.4	1.48	U	1.48	U	1.48	U	1.48	U	1.48	U	
	Naphthalene	ug/m3	2.7	2.08		2.09		2.71		5.82		4.93		
	Hexachlorobutadiene	ug/m3	4.6	2.13	U	2.13	U	2.13	U	2.13	U	2.13	U	

Notes:
ug/m3 - micrograms per cubic meters.
NS - No MassDEP standards exist for this analyte.
U - Analyte was not detected at specified quantitation limit.
Values in **bold** indicate the analyte was detected.
Values shown in bold and shaded type exceed one or more of the listed MassDEP criteria.
APH - Air-Phase Petroleum Hydrocarbons.
TO - Toxic organics.
* - MassDEP Vapor Intrusion Guidance, Indoor Air Threshold Values, October 2016.
(1) - Value for 1,3-Dichloropropene used.
(2) - Criteria applicable to xylene (total), the sum of the xylene isomers.

Using Shading to Convey Information

Analysis	Analyte	Sample Location:			A-2.5		A-5	B-3							BC-6		CD-6-1							
		Sample ID:			A-2.5		A5-12.5'	B3-12'	B3-14'	B-3					BC-6 (3)	BC-6	CD-6-1							
		Sample Depth (ft.):			0-1	1-3	12.5	12	14	0-1	1-3	4-6	6-8		3	0-1	0-0.5	0.5-1	1-2	2-3	3-5	5-6	6-7	7-9
		Sample Date:			1/24/2012	1/24/2012	7/17/2007	7/19/2007	7/19/2007	1/24/2012	1/24/2012	1/24/2012	1/24/2012		2/25/2009	1/24/2012	10/18/2011	10/18/2011	10/18/2011	10/18/2011	10/18/2011	10/18/2011 Hot Spot	10/18/2011	10/18/2011
		S-1/GW-2	S-2/GW-2	S-3/GW-2																				
EPH (mg/kg)	C9-C18 Aliphatics	1,000	3,000	5,000	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	C19-C36 Aliphatics	3,000	5,000	5,000	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	C11-C22 Aromatics**	1,000	3,000	5,000	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Acenaphthene	1,000	3,000	5,000	0.22 U	3.0	0.33 U	2.4	0.33 U	0.21 U	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Acenaphthylene	600	600	600	0.32	0.21	0.33 U	0.77	0.33 U	0.21 U	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Anthracene	1,000	3,000	5,000	0.39	9.6	0.33 U	0.93	0.33 U	0.21 U	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Benzo(a)anthracene	7	40	300	1.5	53	0.38	1.6	0.54	0.62	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Benzo(a)pyrene	2	7	30	1.2	39	0.38	0.86	0.35	0.57	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Benzo(b)fluoranthene	7	40	300	1.7	54	0.62	2.1	0.66	0.89	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Benzo(g,h,i)perylene	1,000	3,000	5,000	0.45	12	0.33 U	0.33	0.33 U	0.30	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Benzo(k)fluoranthene	70	400	3,000	0.64	9.0	0.33 U	0.74	0.33 U	0.33	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Chrysene	70	400	3,000	1.6	55	0.58	2.8	1.0	0.75	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Dibenzo(a,h)anthracene	0.7	4	30	0.22 U	3.7	0.33 U	0.33 U	0.33 U	0.21 U	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Fluoranthene	1,000	3,000	5,000	2.4	120	1.2	6.3	1.5	1.1	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Fluorene	1,000	3,000	5,000	0.26	3.1	0.33 U	1.3	0.33 U	0.21 U	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Indeno(1,2,3-cd)pyrene	7	40	300	0.54	24	0.33 U	0.44	0.33 U	0.36	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Methylnaphthalene, 2-	80	80	80	0.22 U	0.66	0.33 U	1.4	0.33 U	0.21 U	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Naphthalene	20	20	20	0.22 U	1.3	0.36	1.5	0.33 U	0.21 U	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Phenanthrene	500	1,000	3,000	2.5	88	1.1	3.7	0.89	0.53	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Pyrene	1,000	3,000	5,000	1.8	130	1	4.8	1.3	0.80	0.18 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PCBs (mg/kg)	Total PCBs	1	4	4	0.13 U	0.14	0.2 U	0.15 U	0.12	0.12 U	0.11 U	NA	NA		1.3	NA	0.12 U	0.11 U	0.16	0.33	34	3,100	61	4.5
Metals, total (mg/kg)	Antimony	20	30	30	3.2 U	3.1 U	1.6 U	5.4 U	5.3 U	3.0 U	2.7 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Arsenic	20	20	50	5.3	25	2.3	32	26	22	2.7 U	5.5 U	4.7		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Barium	1,000	3,000	5,000	NA	NA	51	31	51	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Beryllium	90	200	200	NA	NA	0.36	0.29	0.38	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Cadmium	70	100	100	0.32 U	3.2	0.33 U	0.36 U	0.68	0.76	0.27 U	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Chromium (III)	1,000	3,000	5,000	12	14	13	11	17	13	13	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Lead	200	600	600	61	320	22	84	200	76	24	NA	NA		NA	240	NA	NA	NA	NA	NA	NA	NA	NA
	Mercury	20	30	30	NA	NA	0.0662	0.206	0.481	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Nickel	600	1,000	1,000	10	14	9	10	33	9.1	12	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Silver	100	200	200	NA	NA	0.33 U	0.36 U	0.35 U	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Vanadium	400	700	700	NA	NA	24	25	25	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Zinc	1,000	3,000	5,000	NA	NA	38	62	190	NA	NA	NA	NA		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
ug/kg - milligrams per kilogram (dry weight) or parts per million (ppm).
NA - Sample not analyzed for the listed analyte.
N/A - Not applicable.
NS - No MassDEP standards exist for this analyte.
U - Compound was not detected at specified quantitation limit.
Values in Bold indicate the compound was detected.
Values shown in Bold and shaded type exceed one or more of the listed MassDEP standards/criteria.
VPH - Volatile Petroleum Hydrocarbon.
EPH - Extractable Petroleum Hydrocarbon.
PCBs - Polychlorinated Biphenyls.
** - C11-C22 Aromatics unpaired results are listed for 2006, 2007, and 2009 samples.

Represents a sample considered to be beyond the horizontal or vertical extent of the site boundary
Represents a sample that will be excavated or capped as part of the wetland mitigation, or for MCP or TSCA compliance
PCB hot spot (excavated)
Additional risk driving locations that need to be addressed before MCP closure (capped).

Represents a sample considered to be beyond the horizontal or vertical extent of the site boundary
Represents a sample that will be excavated or capped as part of the wetland mitigation, or for MCP or TSCA compliance
PCB hot spot (excavated)
Additional risk driving locations that need to be addressed before MCP closure (capped).

Field Data Tables: Example 1 – Drain Investigation

TABLE 2 – Drain Investigation Summary

Drain ID	Drain Type	Location	Connection	Notes
D-303	Floor	First Floor	D-303B / MH #1	None.
D-303A	Floor	First Floor	D-303B / MH #1	2 pipes: 4" top pipe blocked; 6" bottom pipe connects to MH #1.
D-303B	Trench	First Floor	MH #1	None.
D-304	Floor	First Floor	Unknown	Drain located under debris pile and could not be inspected. Likely connects to D-303A.
D-305	Floor	First Floor	Sealed	None.
D-2019-1	Floor	Basement (Pump Room)	MH #00 / Outfall #2	None.
D-2019-2	Floor	Basement (Turbine Room)	MH #5 / Outfall #2	None.
D-2019-3	Floor	Basement (Turbine Room)	MH #5 / Outfall #2	None.
R-1	Roof	First Floor	MH #00	None.
R-2	Roof	First Floor	D-303B / MH #1	None.

Field Data Tables: Example 2 – Well Data

Table 4
Monitoring Well Construction Information and Groundwater Elevation Data
Former Pad-Mounted Electrical Transformer
214 16th Street
Charlestown, Massachusetts

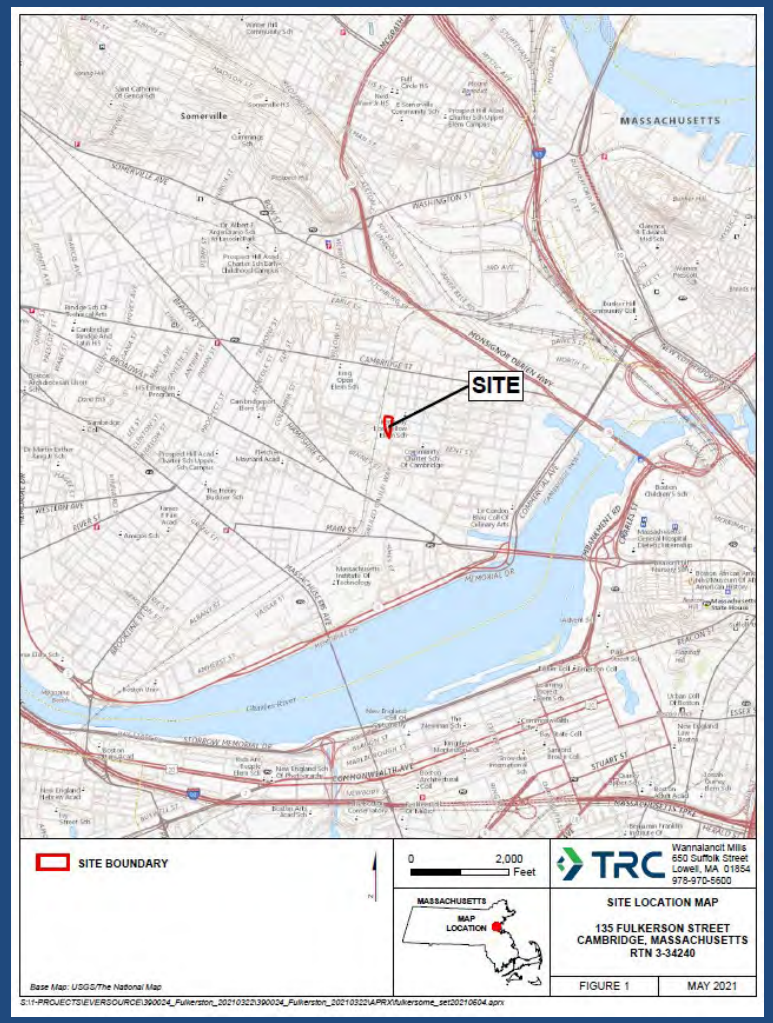
Well ID	Total Depth (ft bgs)	Screened Interval (ft bgs)	Monitoring Well Elevation (top of PVC riser)*	Measurement Date	Depth to Groundwater (ft btor)	Groundwater Elevation
MWSB-2	14	4-14	99.40	6/29/2020	11.75	87.65
				7/10/2020	13.30	86.10
				12/2/2020	9.50	89.90
				3/2/2021	13.60	85.80
				6/9/2021	9.05	90.35
MWSB-3	15	5-15	100.00	6/29/2020	11.68	88.32
				7/10/2020	11.60	88.40
				12/2/2020	10.08	89.92
				3/2/2021	12.85	87.15
				6/9/2021	10.63	89.37
MWSB-6	15	5-15	99.50	6/29/2020	14.05	85.95
				7/10/2020	13.87	85.63
				12/2/2020	7.55	91.95
				3/2/2021	14.00	85.50
				6/9/2021	9.61	89.89
MWSB-8/MWSB-8R**	12	2-12	100.00	6/29/2020	12.05	87.95
				7/10/2020	12.00	88.00
				12/2/2020	9.50	90.50
				3/2/2021	13.35	86.65
				6/9/2021	9.32	90.68

Notes:
* Elevation data are relative to an arbitrary on-Site benchmark assigned an elevation of 100 feet.
** Monitoring well MWSB-8 was destroyed during LRA activities in August 2020 and was replaced with monitoring well MWSB-8-R, which was installed in the same location in November 2020.
ft: feet
bgs: below ground surface
btor: below top of (PVC) riser
PVC: polyvinyl chloride

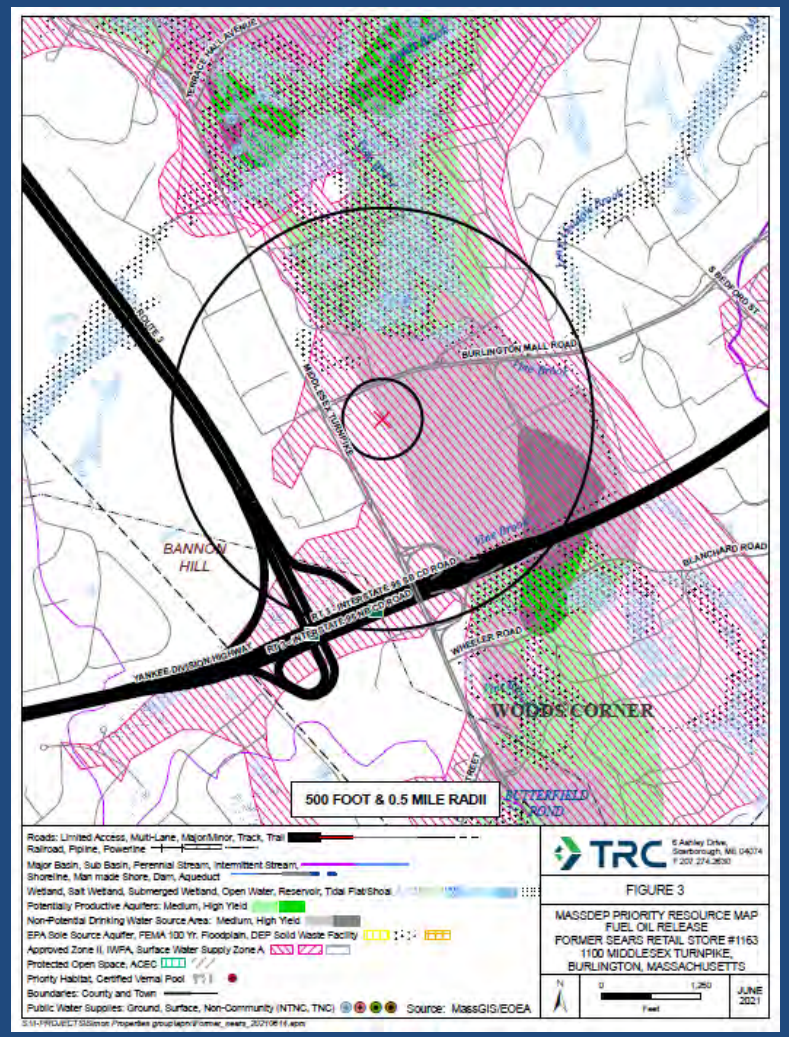
Figures & Visuals

Typical Assessment Figures: The Usual Suspects

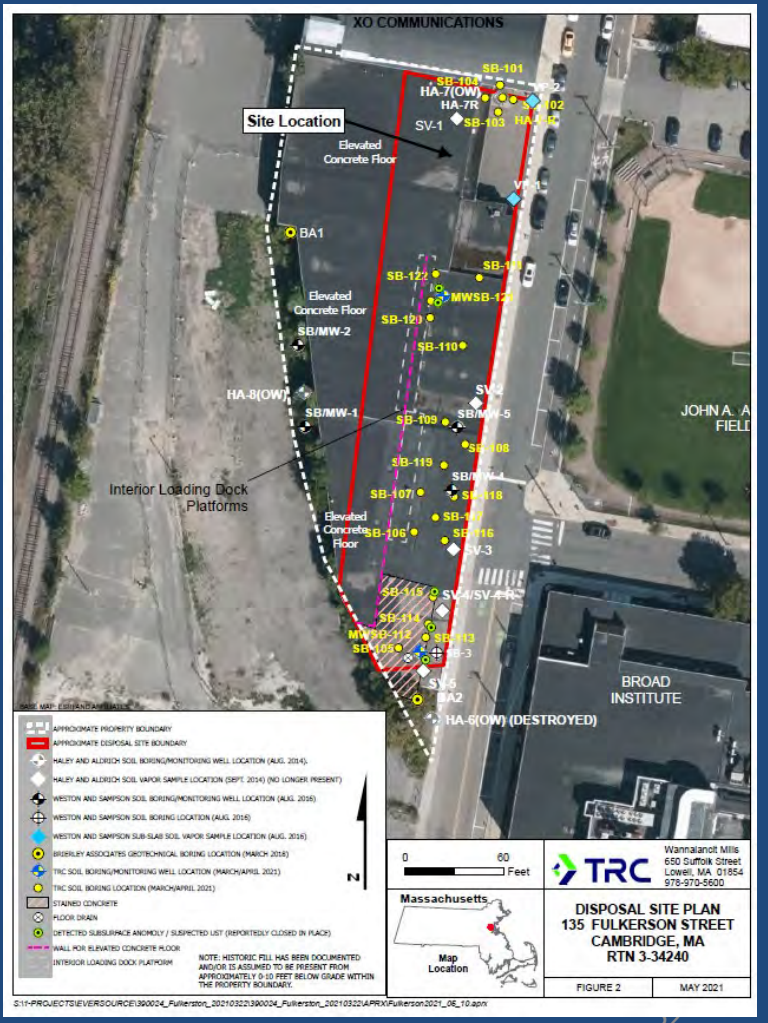
Site Locus Map



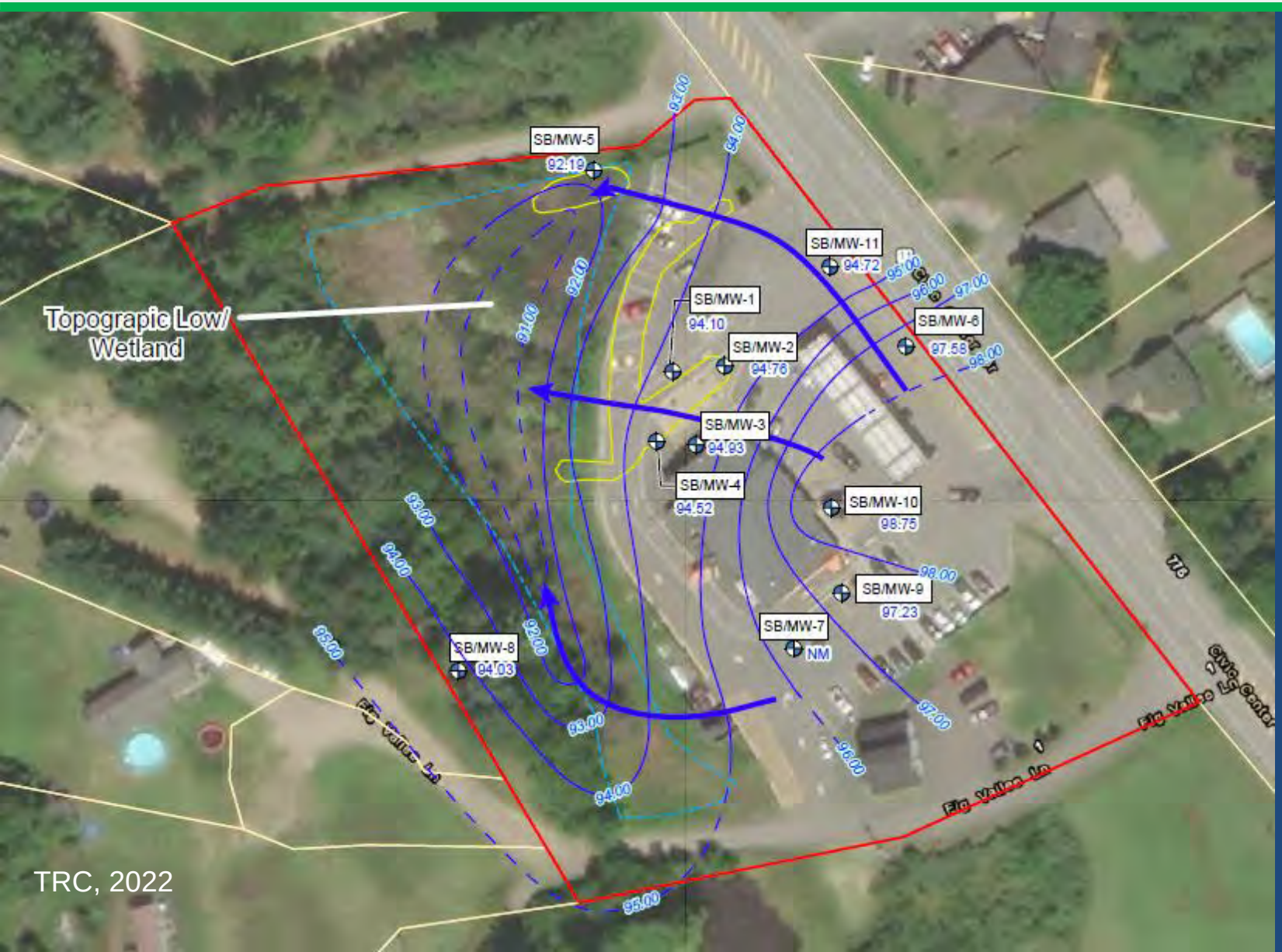
Sensitive Receptors Map



Site Plan



Groundwater Contour Plan



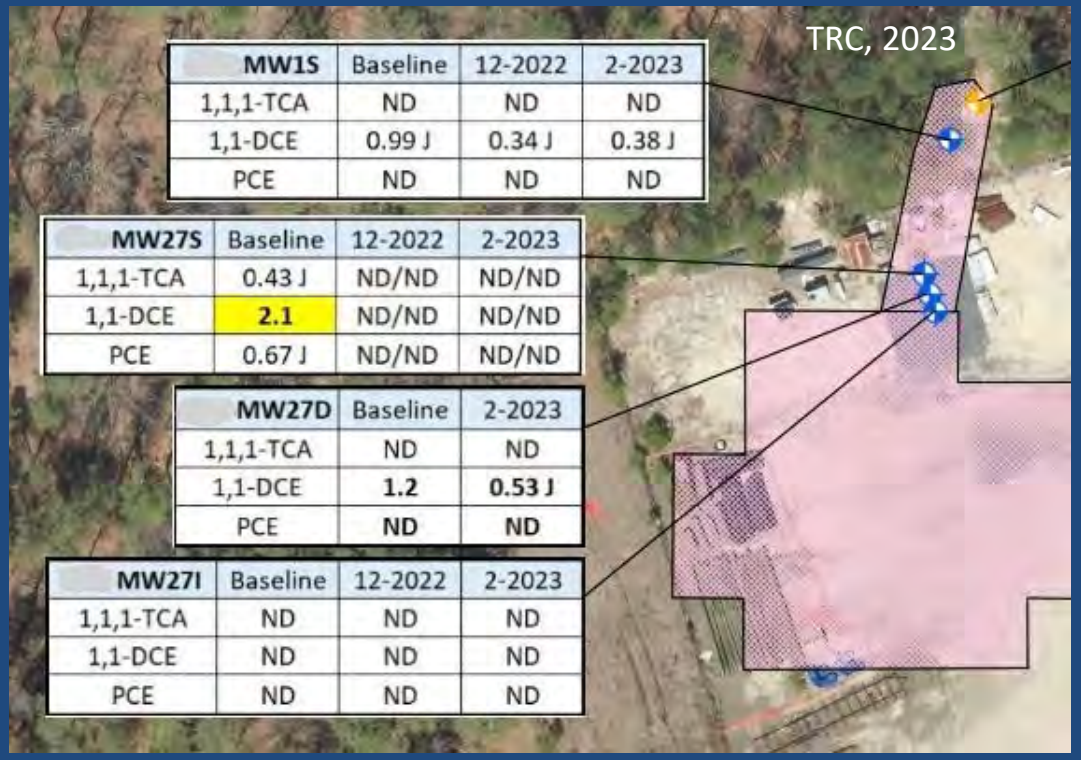
- Further refine the CSM
- Review in tandem with analytical data
- Informs & guides additional assessment activities
- Identify potential exposures

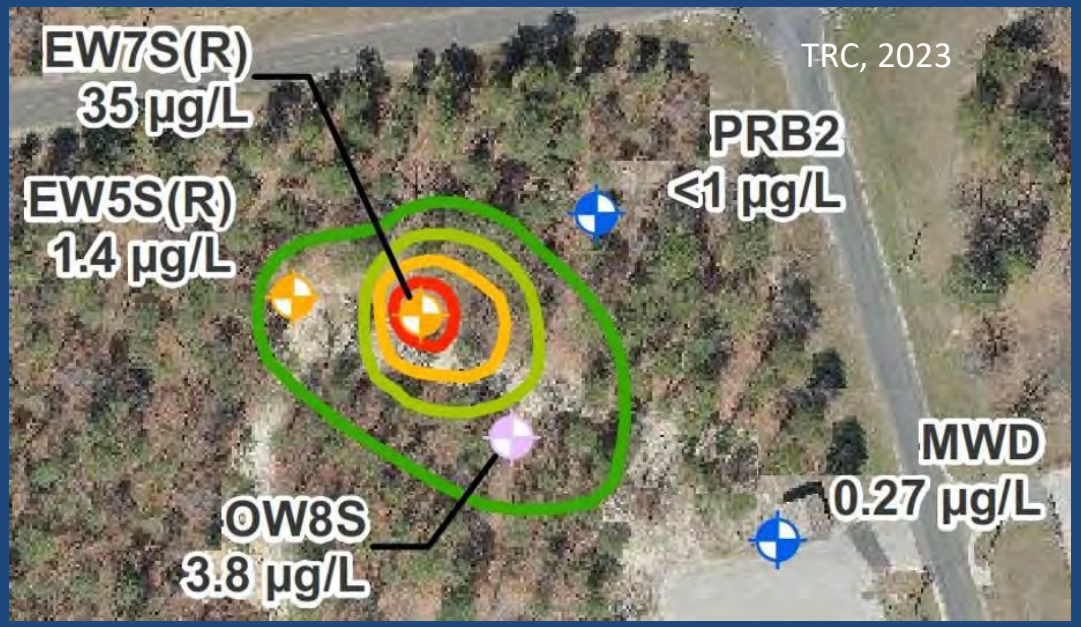
TRC, 2022

Color-Coded Sample Locations

- Above or below a particular threshold
- Easily discern the areas of concern and extent of impacts
- Useful for most types of sampling media

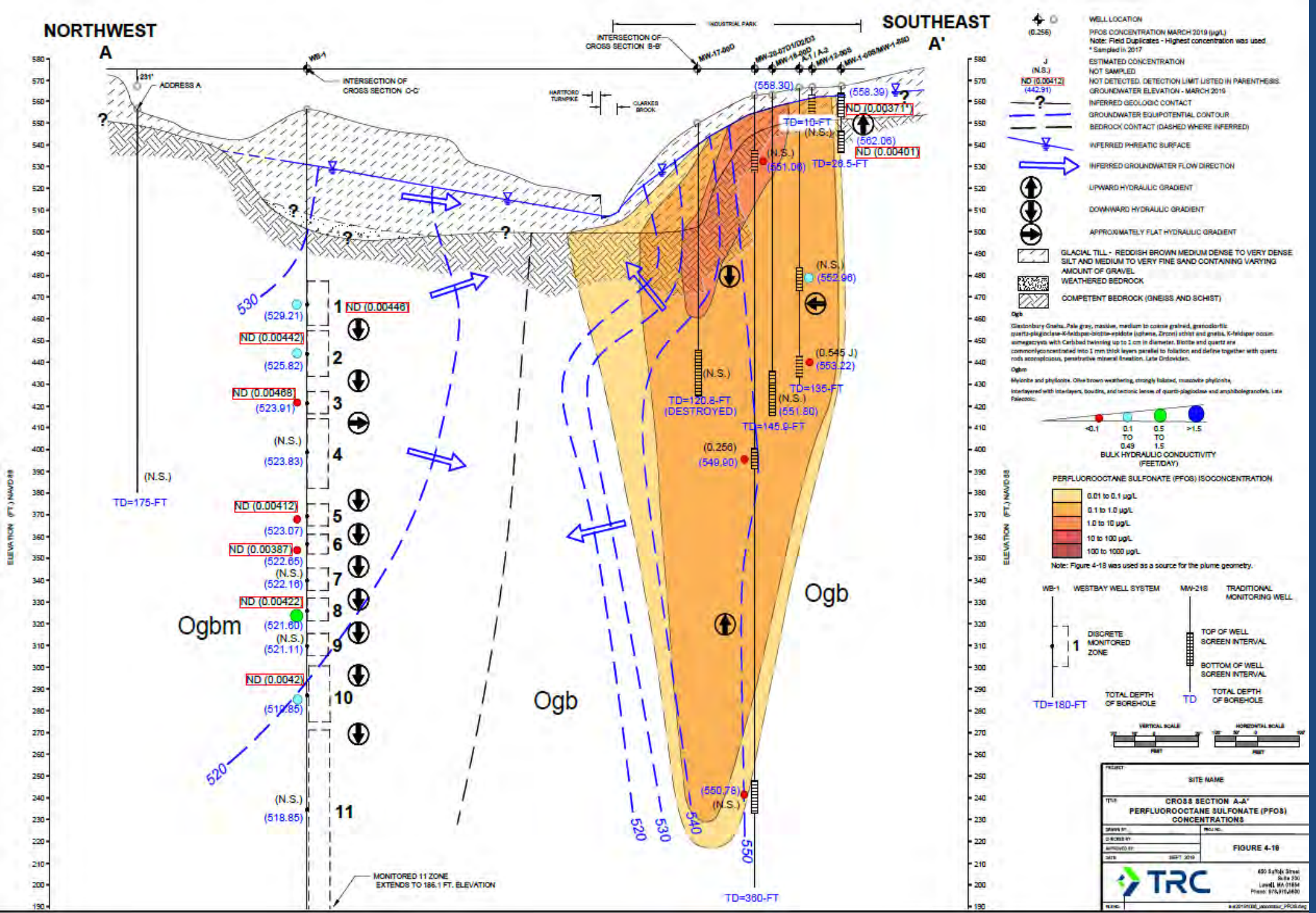
TRC, 2021





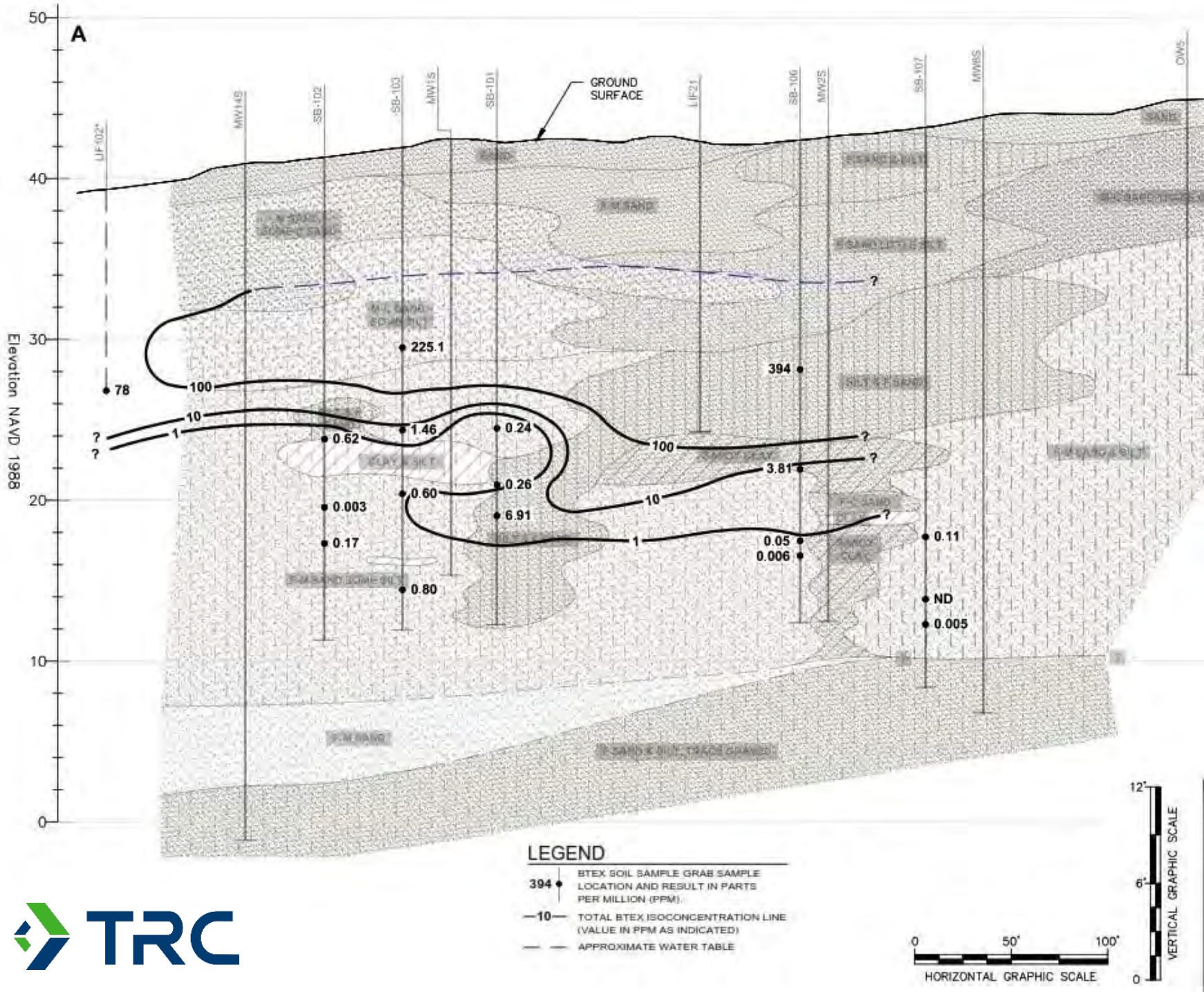
Data Boxes & Isopleths

- Present analytical data and site layout information in one visual
- Easily discern the areas of concern and extent of impacts
- Useful for soil & groundwater



Cross-Sections: Example 1 – PFOS Plume in GW

Cross-Sections: Example 2 – BTEX in Soil



TRC

TRC

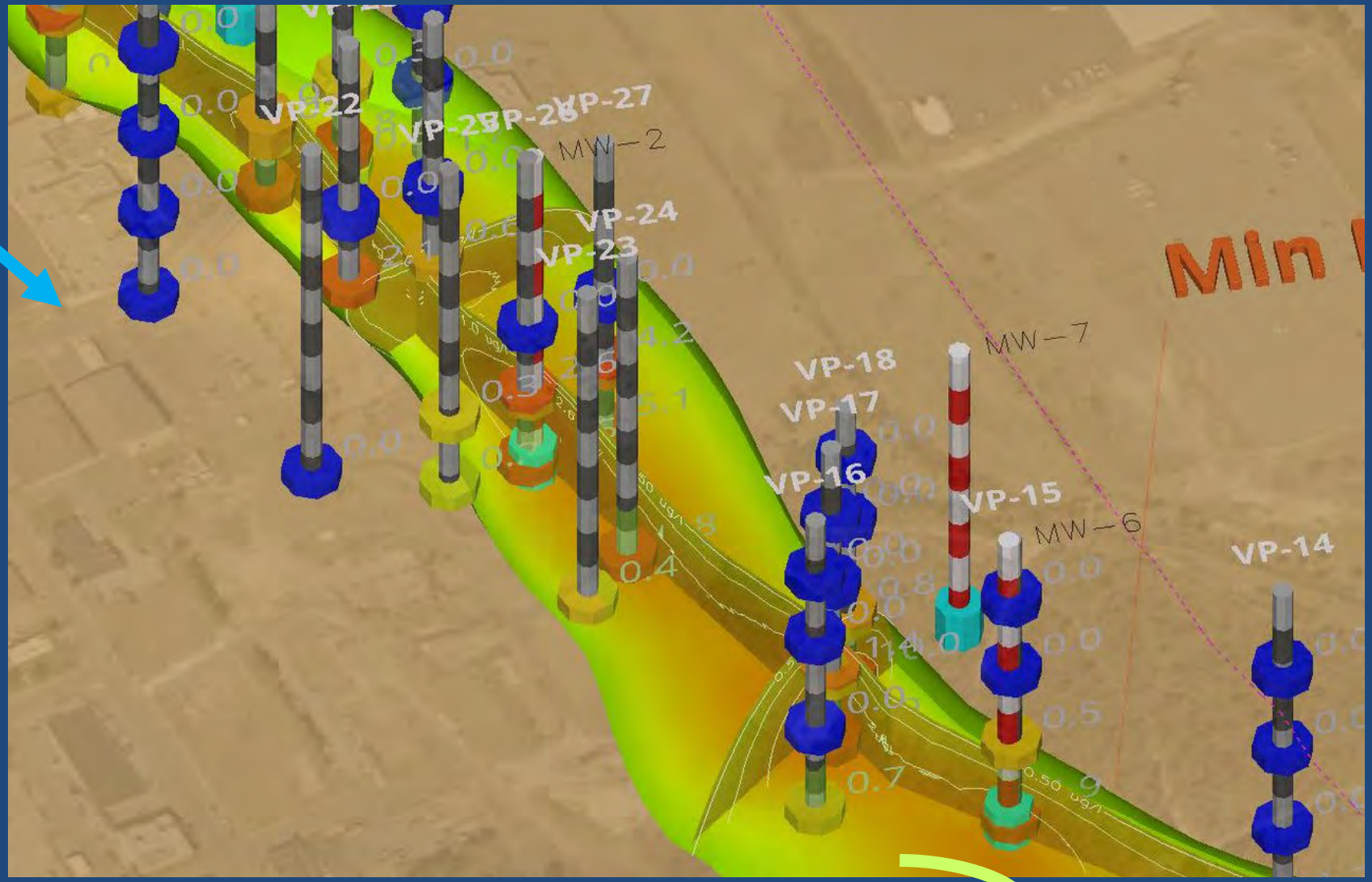
Well-defined upgradient extent

3D Mapping – Plume in GW

Plume continues

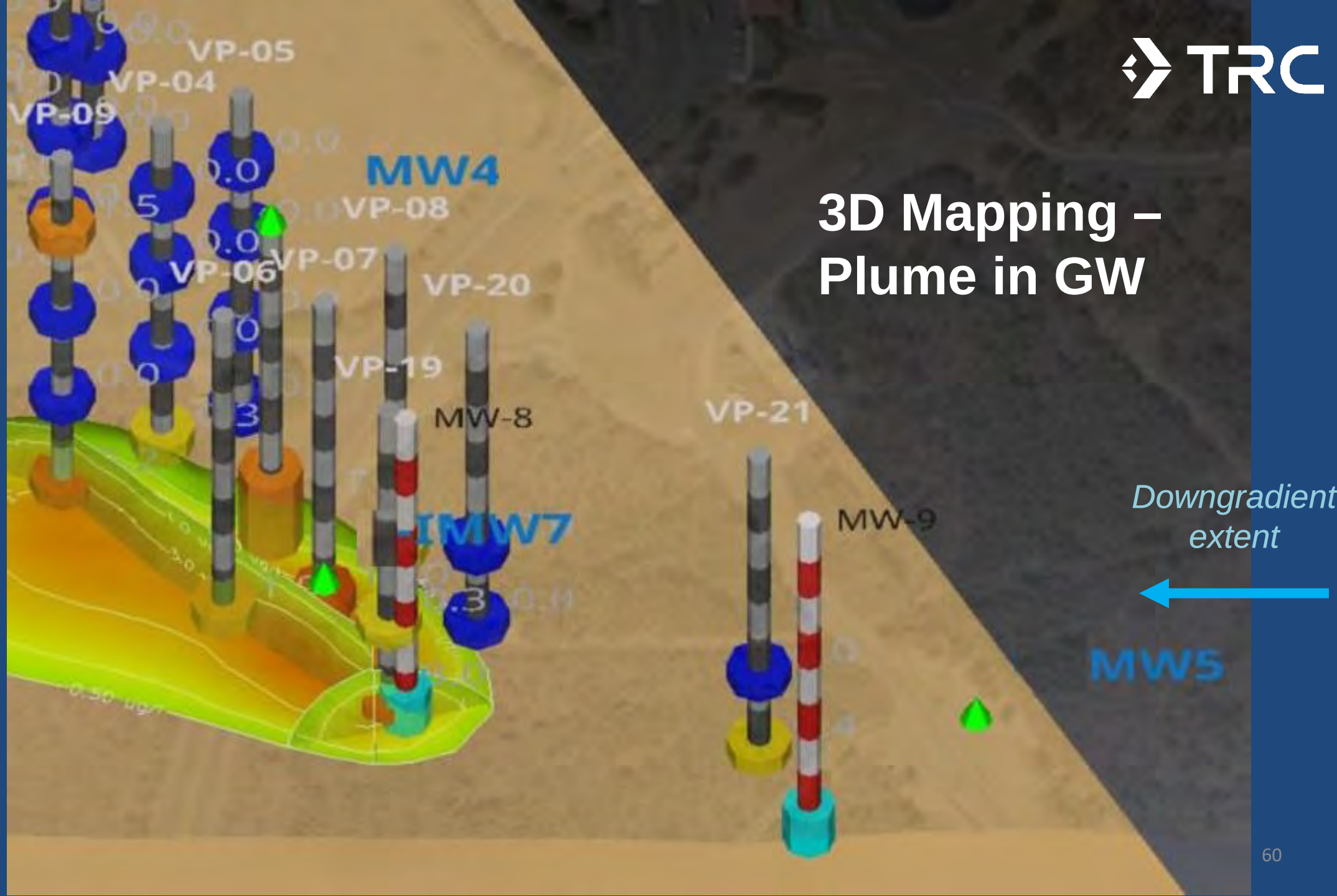
3D Mapping – Plume in GW

Lateral extent



Plume continues

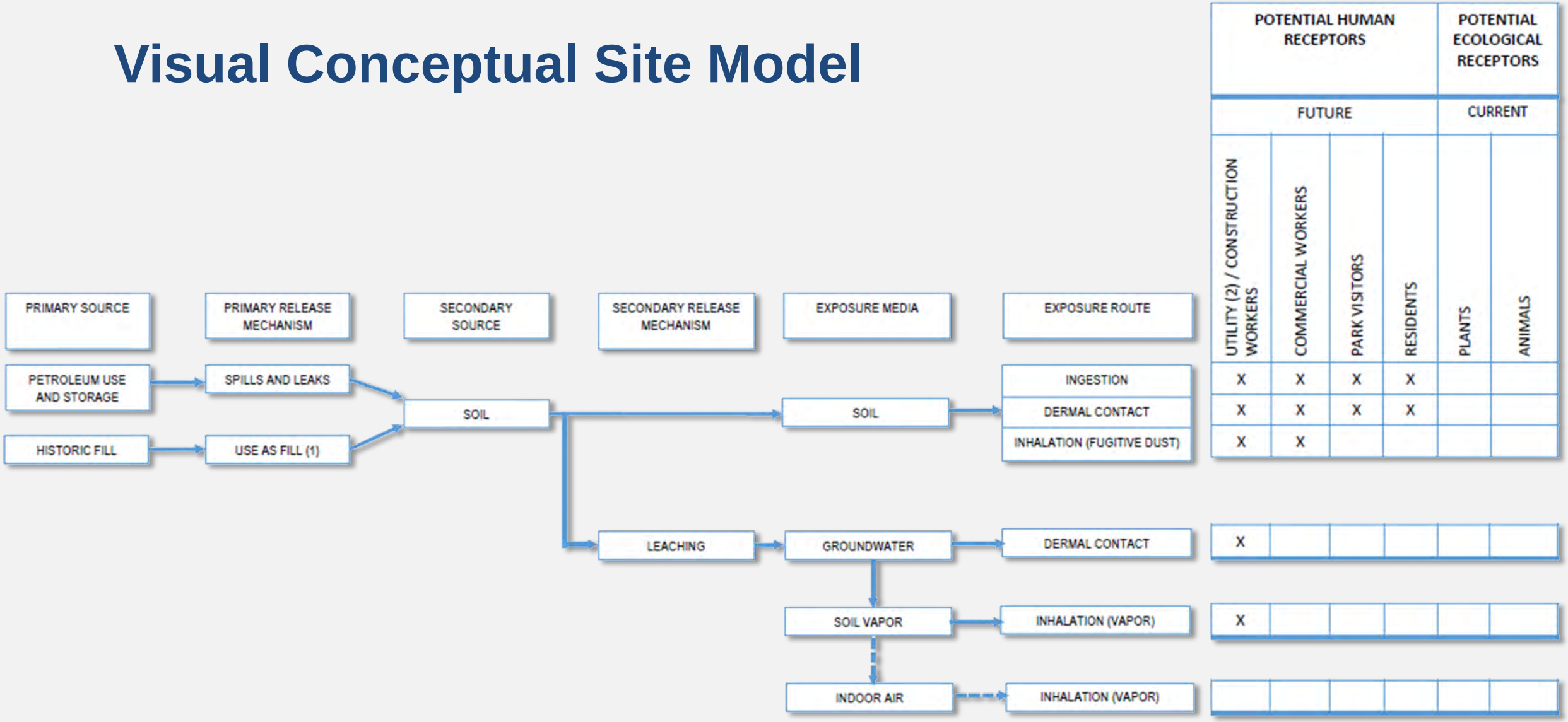
3D Mapping – Plume in GW



Plume continues

Downgradient extent

Visual Conceptual Site Model



Questions?

Elizabeth Denly, ASQ CMQ/OE
P: 978-656-3577 | **E:** *EDenly@TRCCompanies.com*
www.TRCcompanies.com

Emily Wassmer, PG/LG, LSP
P: 207-298-0785 | **E:** *EWassmer@TRCCompanies.com*
www.TRCcompanies.com