

3D Data Visualization for Contaminated Sites

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Vt GeoDataSci Conference 2018, Burlington, VT

June 7, 2018

Contaminated sites

Residual contamination can exist at many types of sites.

- Industrial Manufacturing
- Military Facilities
- Former Landfills
- Dry Cleaners
- Many more



Contaminants of Concern

- Chlorinated Solvents
- Metals
- PCBs
- Emerging Contaminants

Understanding Contamination

Researchers need to create a “Conceptual Site Model”

- What was the source of contamination?
- What is there and how much?
- How deep/far has the contamination reached?
- What are the best ways to clean up?



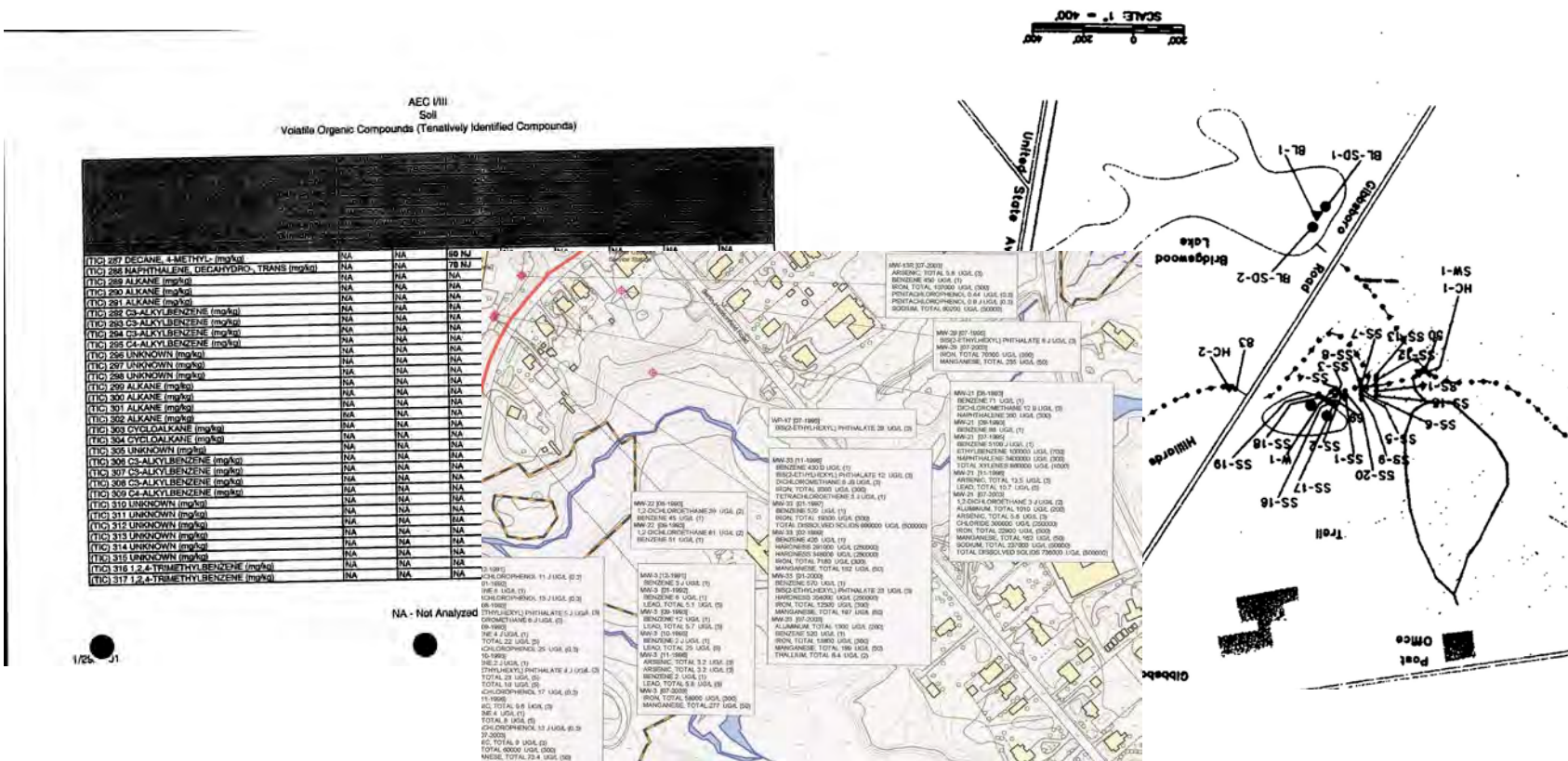
How do we study these sites?

- Drilling – soil borings and monitoring wells
- Testing soil, groundwater, air, concrete, many other substances
- Measuring groundwater flow
- Understanding the geology and hydrology of the site

The Problem: Lots of Data!

One study can generate thousands of data points – soil, water, sediment, etc..

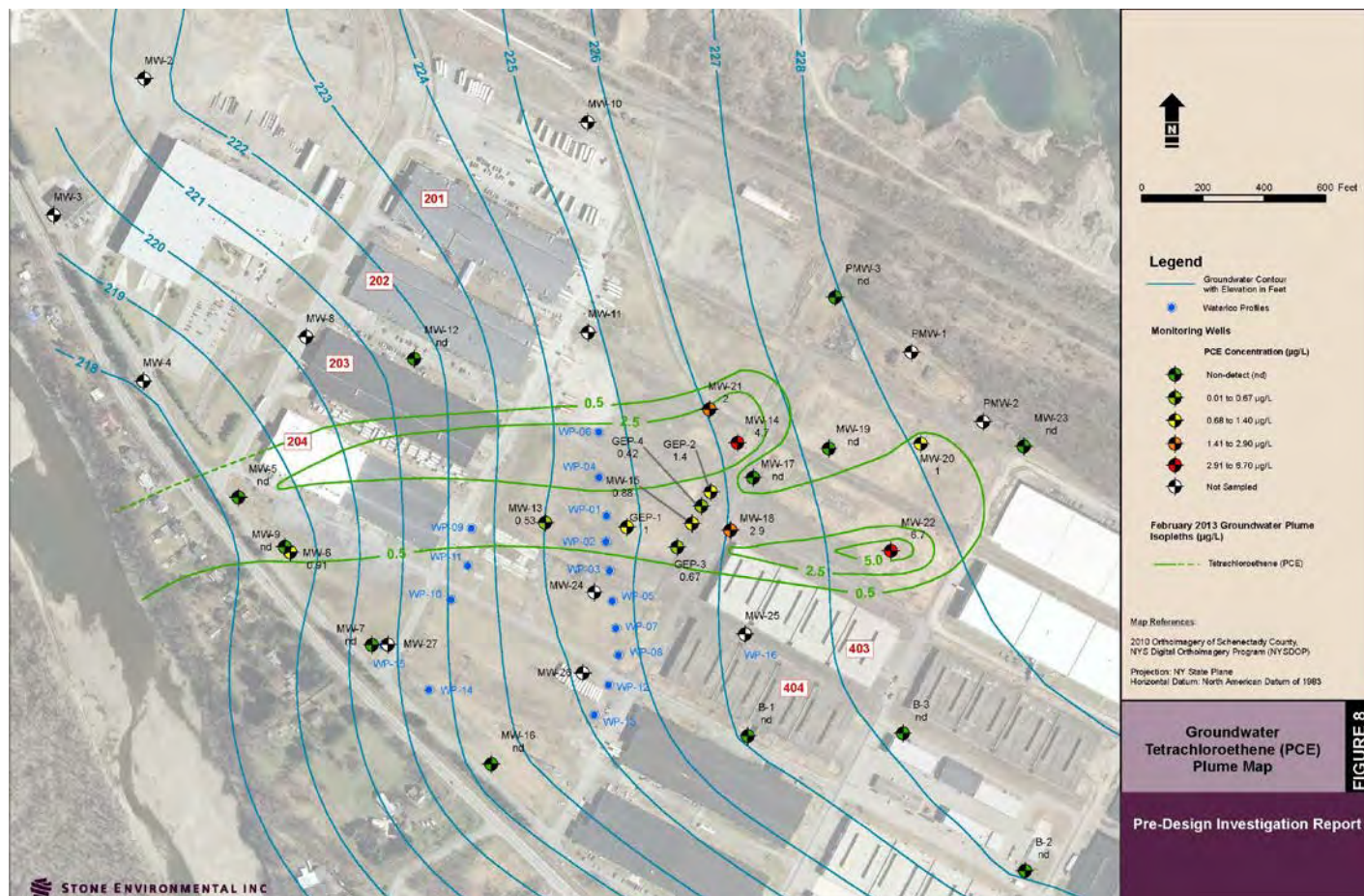
- Tables and reports are difficult to interpret
- Many contaminated sites across the country have been studied for decades
- Historic data are often scattered through many reports, maps, etc, with varying quality



The Problem: 2D Visualization of 3D Data

Underground contaminant plume are a 3D system

- Visualizing 3D data is inherently difficult in 2D
 - Stakeholders may not be used to interpreting 2D map data like contours, geologic maps, etc.



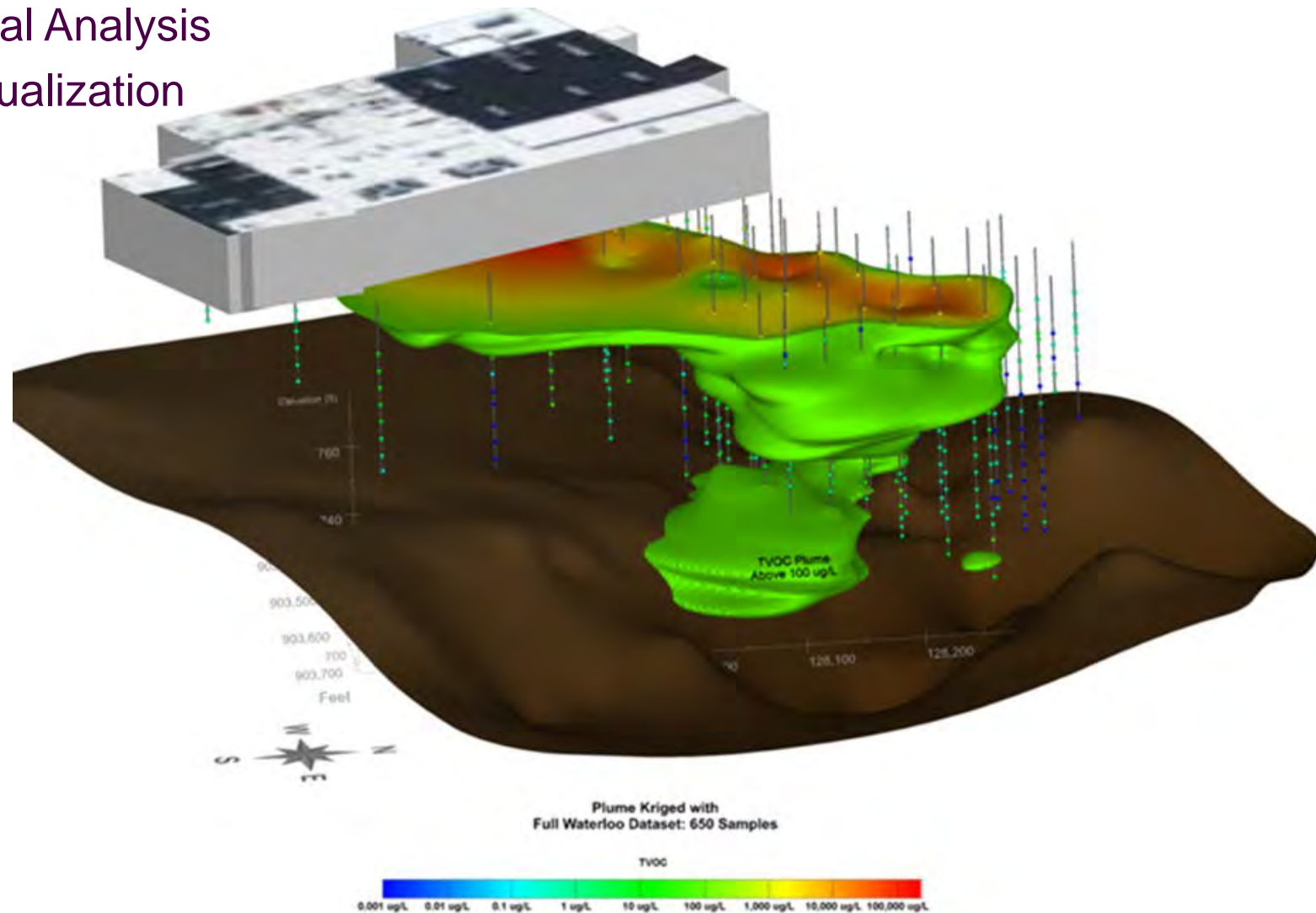
The Solution: 3D Visualization

Step 1: Historic Data Compilation

Step 2: New Data Collection

Step 3: Geospatial Analysis

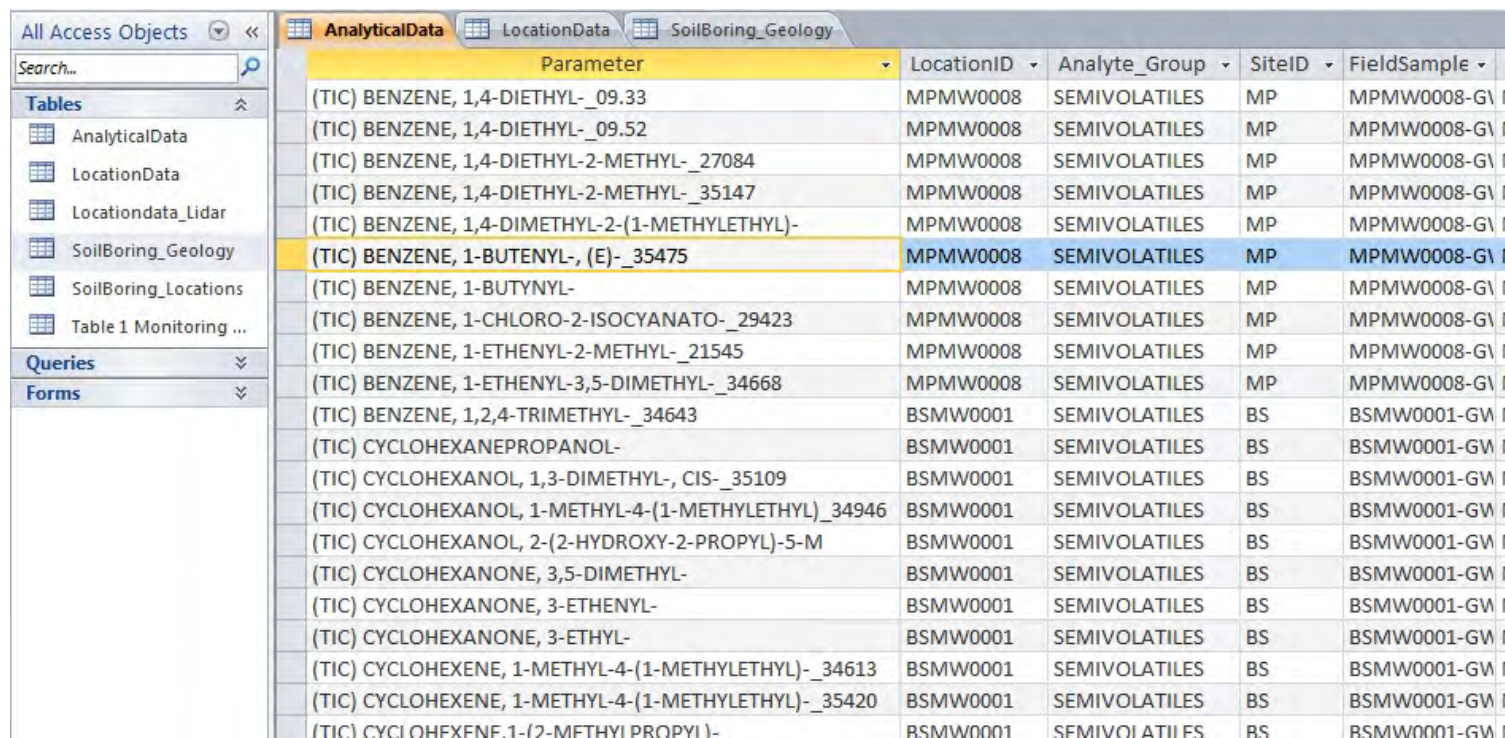
Step 4: Data Visualization



Step 1: Historic Data Compilation

Comb through all available documents and import the data into a single database

- Standardized formats (chemical names, etc)
- Searchable
- Exhaustive – All the data is in one place!

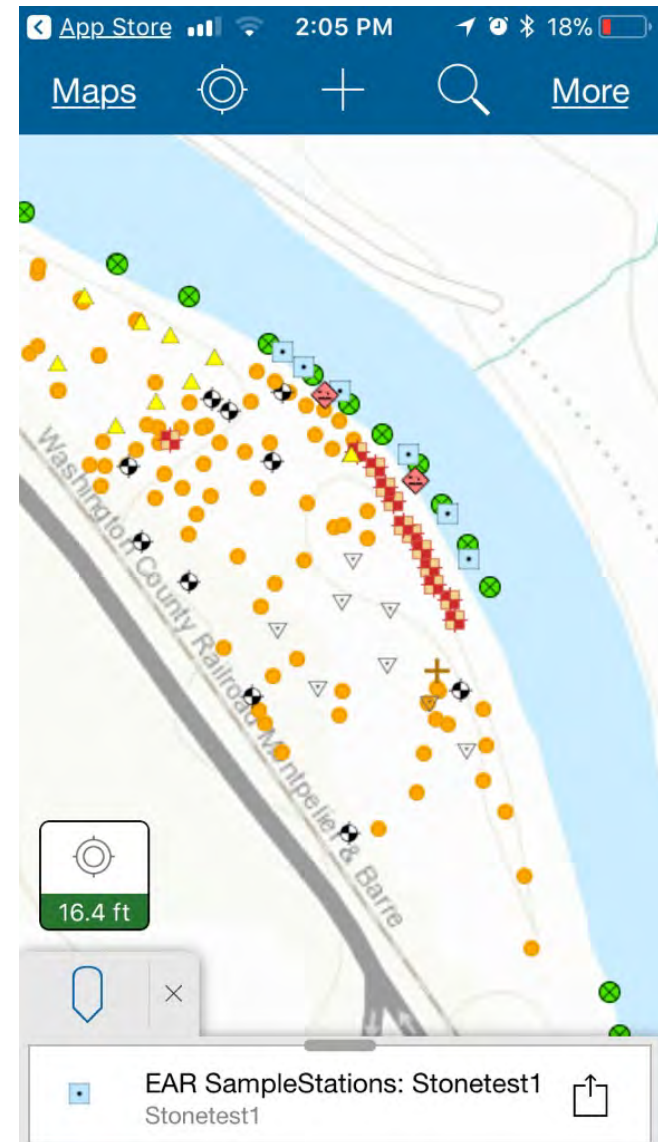
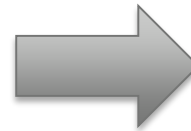
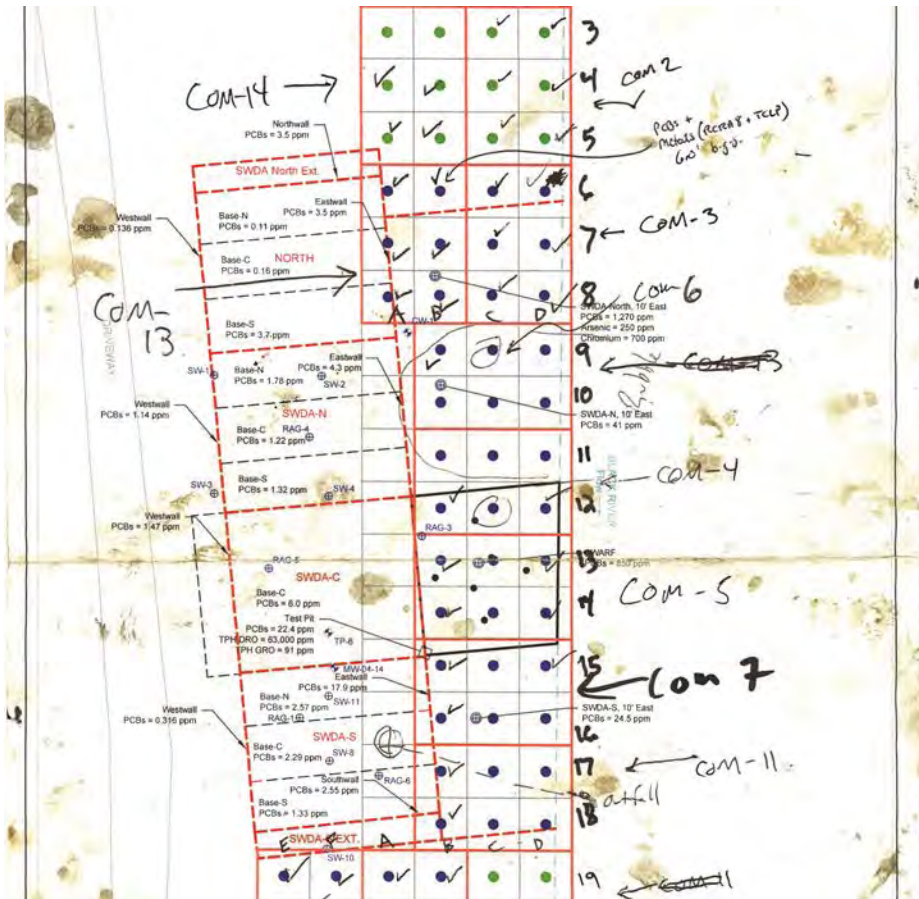


Parameter	LocationID	Analyte_Group	SiteID	FieldSample
(TIC) BENZENE, 1,4-DIETHYL- _09.33	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1,4-DIETHYL- _09.52	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1,4-DIETHYL-2-METHYL- _27084	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1,4-DIETHYL-2-METHYL- _35147	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1,4-DIMETHYL-2-(1-METHYLETHYL)-	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1-BUTENYL-, (E)- _35475	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1-BUTYNYL-	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1-CHLORO-2-ISOCYANATO- _29423	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1-ETHENYL-2-METHYL- _21545	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1-ETHENYL-3,5-DIMETHYL- _34668	MPMW0008	SEMIVOLATILES	MP	MPMW0008-GV I
(TIC) BENZENE, 1,2,4-TRIMETHYL- _34643	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXANEPROPANOL-	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXANOL, 1,3-DIMETHYL-, CIS- _35109	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXANOL, 1-METHYL-4-(1-METHYLETHYL) _34946	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXANOL, 2-(2-HYDROXY-2-PROPYL)-5-M	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXANONE, 3,5-DIMETHYL-	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXANONE, 3-ETHENYL-	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXANONE, 3-ETHYL-	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXENE, 1-METHYL-4-(1-METHYLETHYL)- _34613	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXENE, 1-METHYL-4-(1-METHYLETHYL)- _35420	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I
(TIC) CYCLOHEXENE, 1-(2-METHYL-PROPYL)-	BSMW0001	SEMIVOLATILES	BS	BSMW0001-GV I

Step 2: Field Data Collection

Utilize ArcGIS online and Collector app to store new data

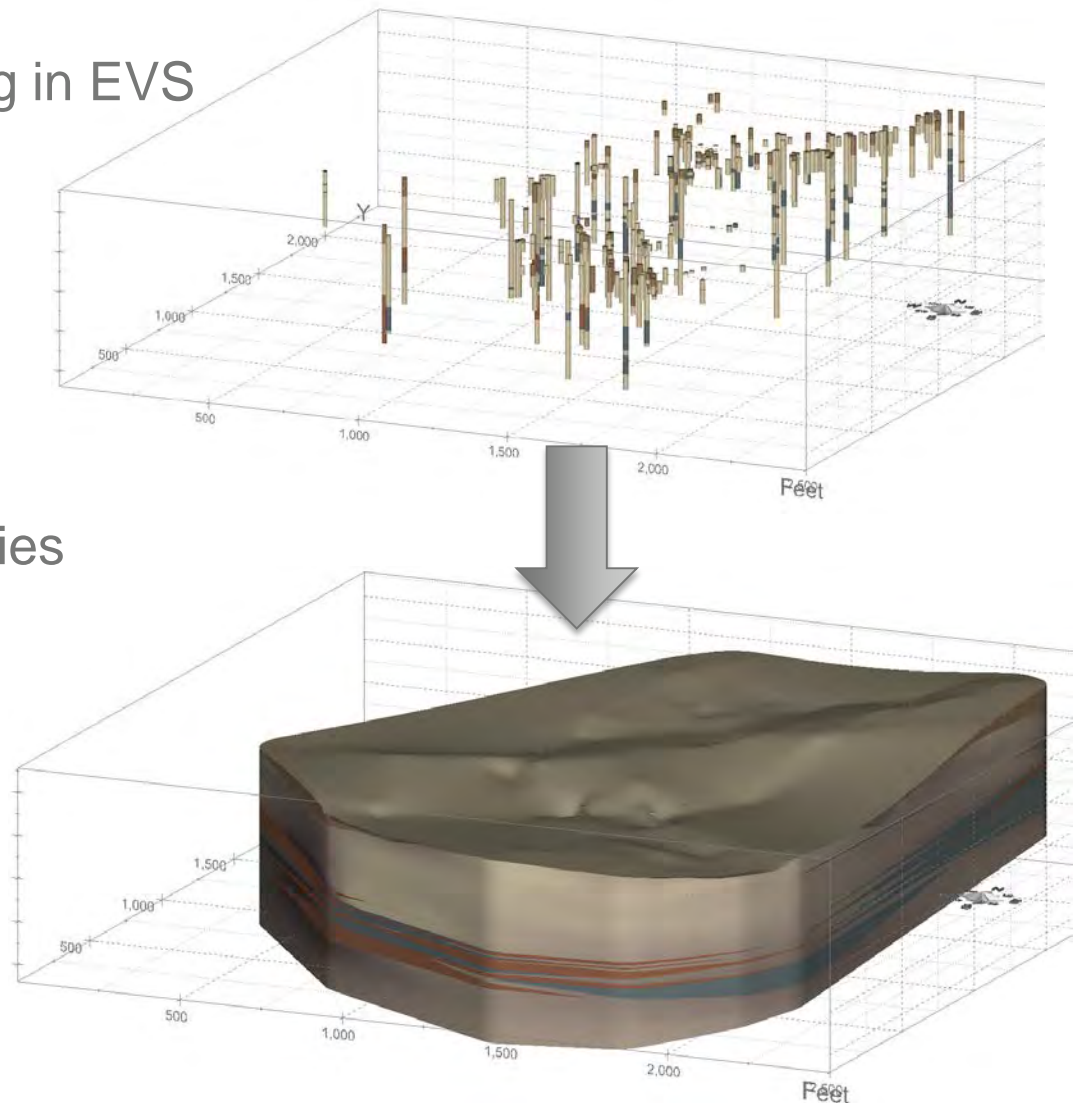
- Multiple users, offline mapping
- Data moves directly to the cloud
- No more creating messy datasets!



Geospatial Analysis

Combines datasets into a cohesive conceptual framework

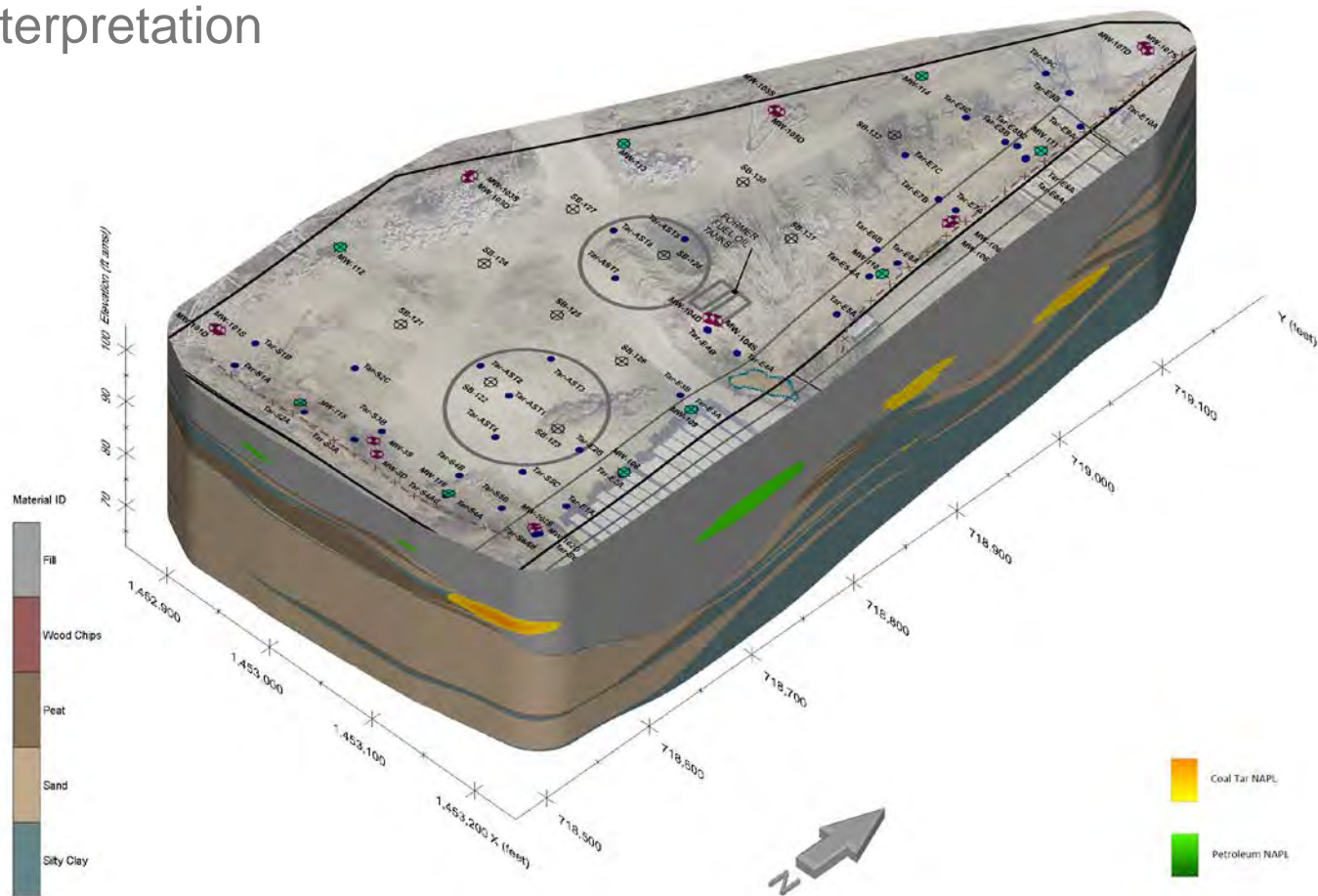
- Mapping in ArcGIS
- 3D kriging and geologic modeling in EVS
- Create a conceptual site model
 - Hydrology
 - Geology
 - Contaminant Pathways
 - Identify data gaps
 - Recommend clean up strategies



Data Visualization

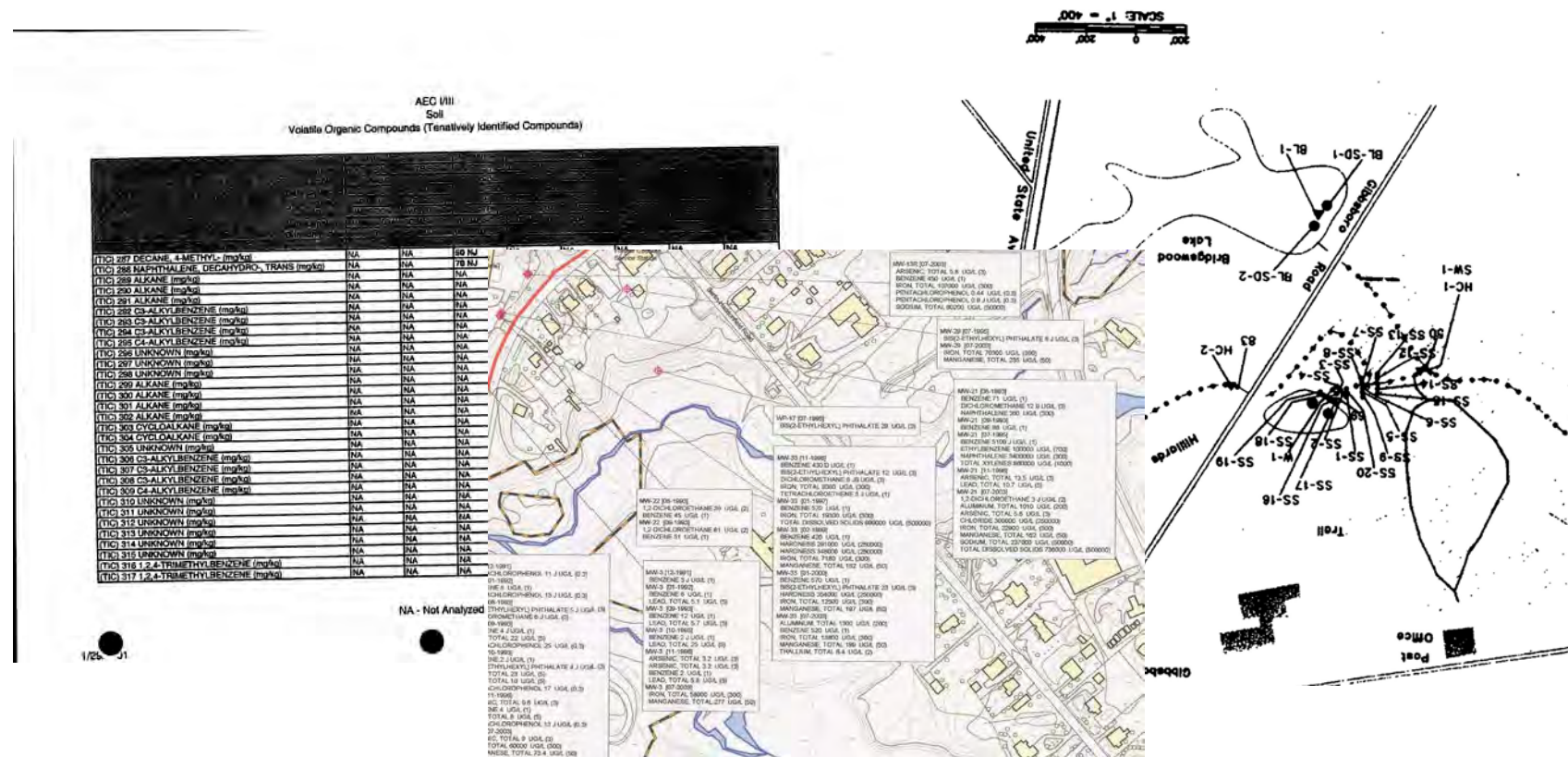
Visualize highly complex sites in intuitive and data-rich formats

- Visually compare contaminant concentrations with geology, hydrology, etc.
 - 3D visualization with Earth Volumetric Studio
 - Interactive, shareable maps with ArcGIS online
 - Interpretation

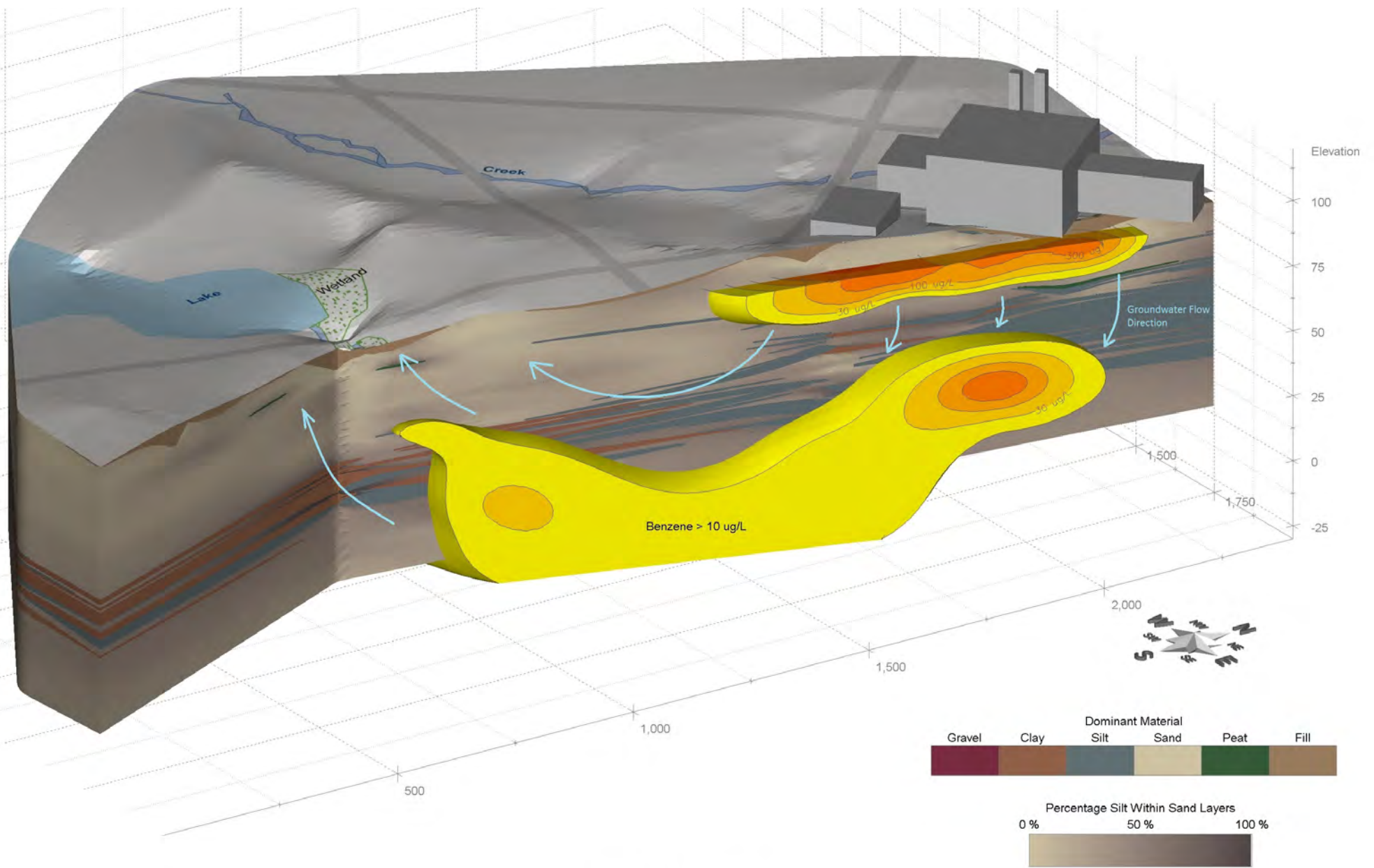


Stone was tasked with creating a conceptual site model for a superfund site

- Data going back to 1979
- More than 250 soil borings and wells
- Thousands of individual datapoints
- Data scattered between 115 different files



Example 1: Superfund Site



Benzene in Groundwater

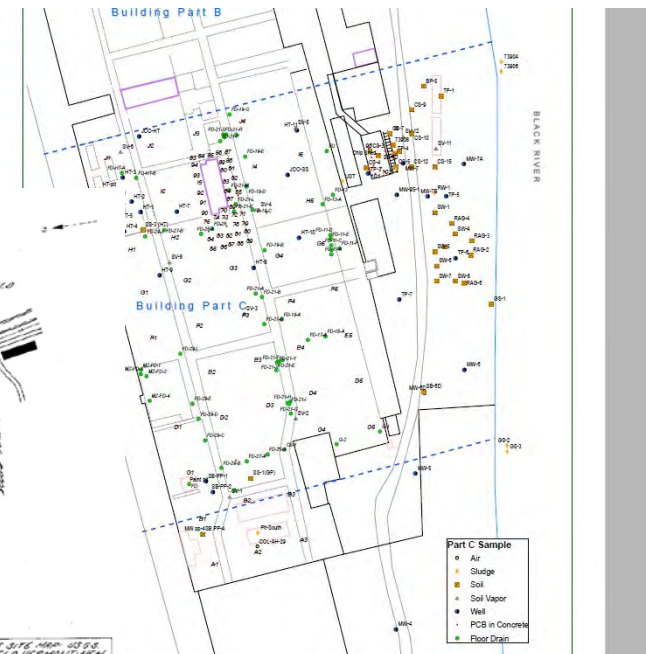
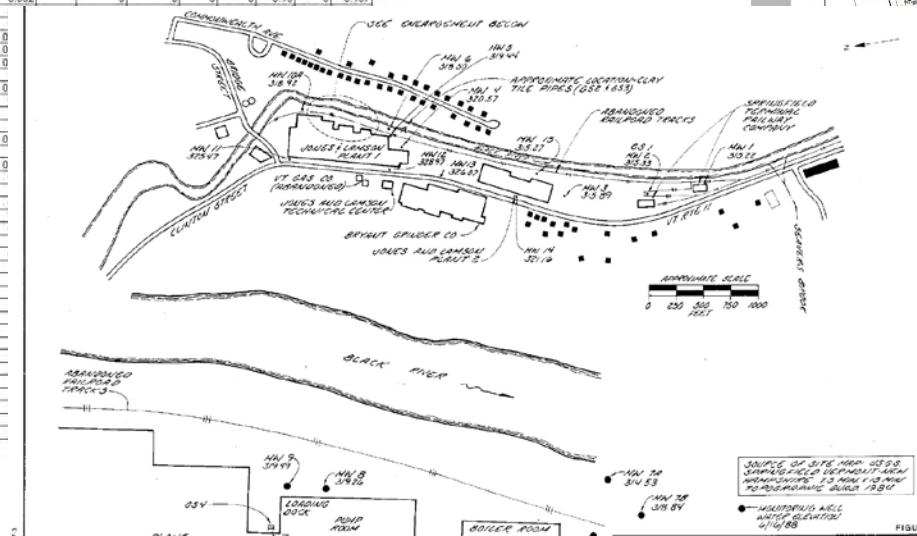
Example 2: Brownfields Site

Stone is collecting data at a Brownfields site in southern VT

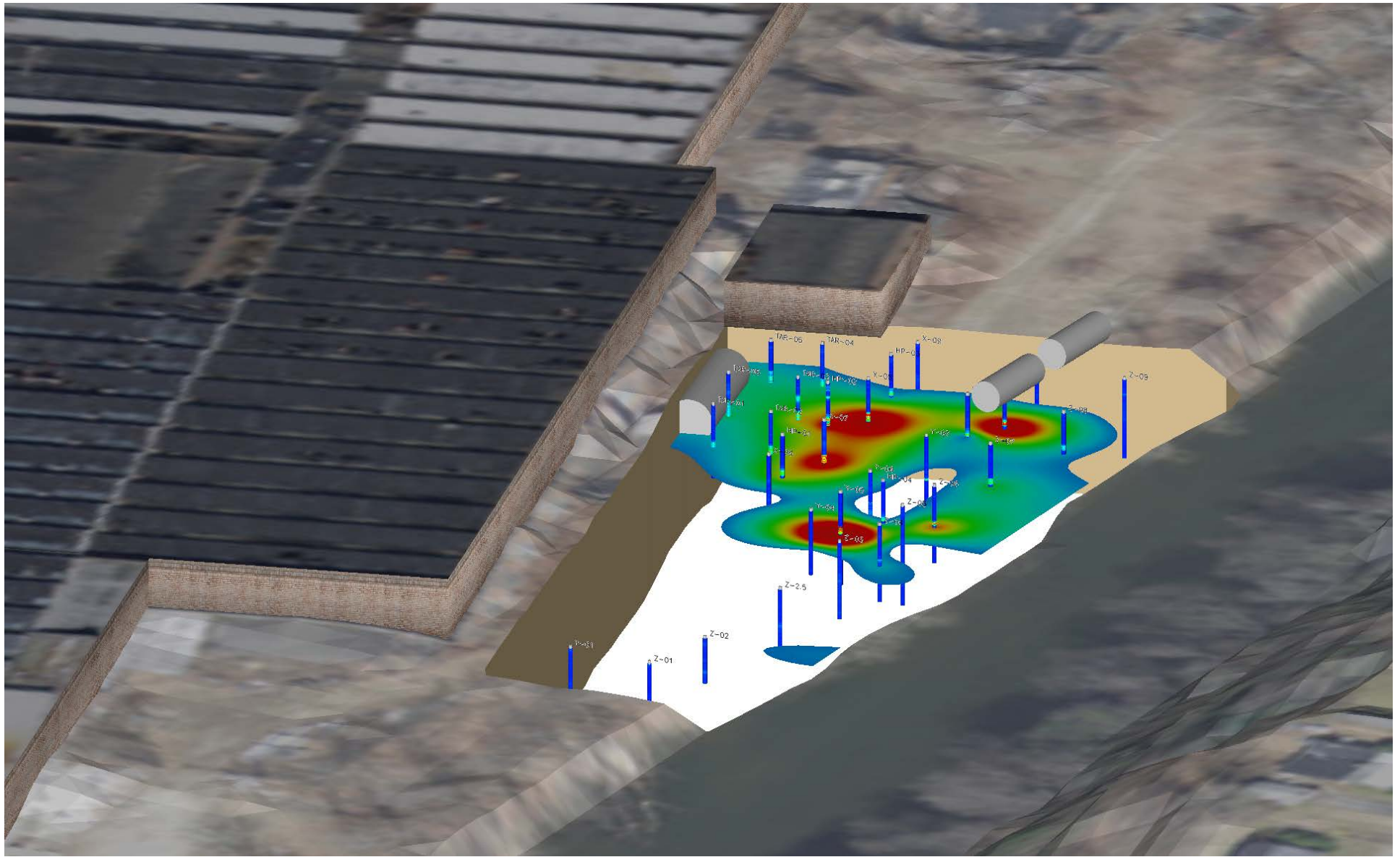
- Data going back to 1988
- 1014 Individual sample locations
- >15,000 individual data points
- Data scattered between 240 source documents

Table 1. Groundwater Quality Summary
Jones and Lamson Plant #1 Part C, Springfield, VT JCO Project 3-1928-5

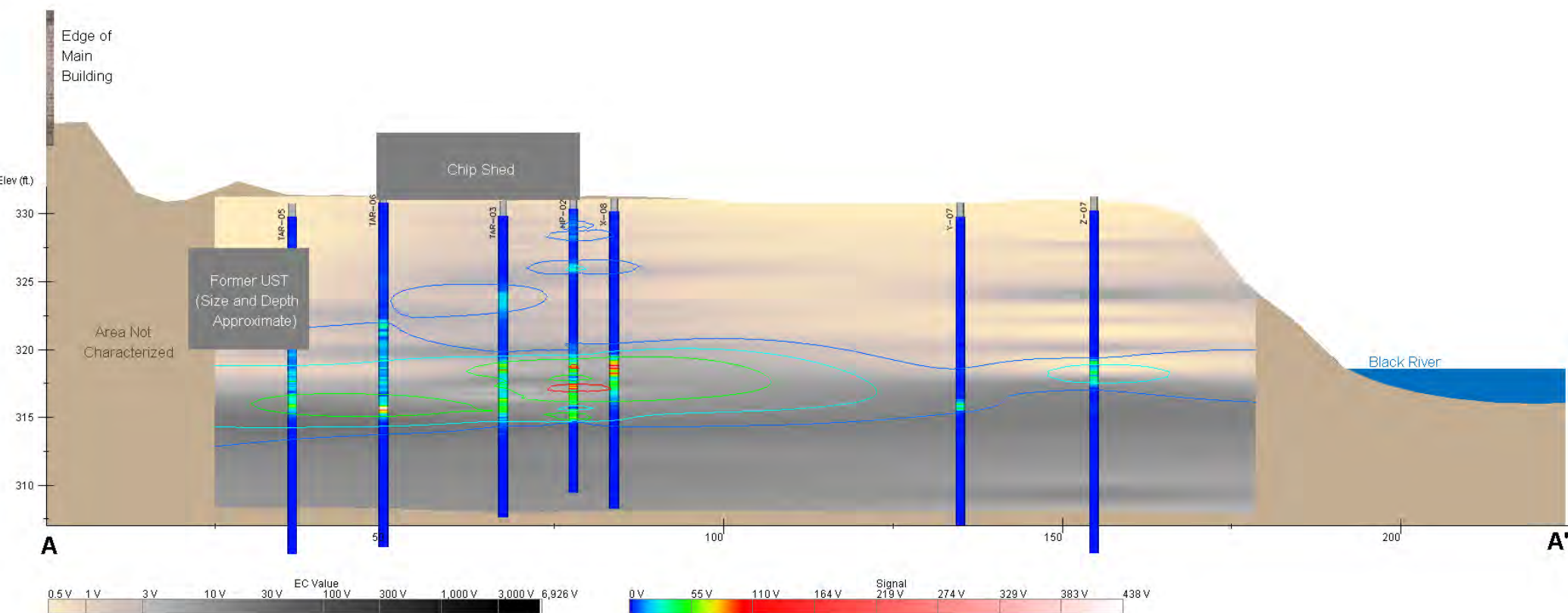
	Date	Fluorene (ug/L)	1-Methylnaphthalene (ug/L)	2-Methylnaphthalene (ug/L)	Phenanthrene (ug/L)	Pyrene (ug/L)	TPH (mg/L)	Aluminum (mg/L)	Arsenic (mg/L)	Barium (mg/L)	Beryllium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Manganese (mg/L)
VGES		280																
MW-6	9/18/2003							2.38	0.038	0.145		0	0	0	0.019	41.6	0.008	1.79
MW-6D	9/18/2003							9.4	0.085	0.158		0	0	0	0.025	20.7	0.007	1.58
MW-7	9/18/2003							14.3	0.084	0.144			0.024	0.016	0.135	42.2	0.062	1.81
MW-7A	9/18/2003																	
MW-7D	9/18/2003							0.134	0.002	0.093		0	0	0	0	19.3	0	1.92
MW-8	9/18/2003							1.8	0.005	0.055		0	0	0	0	5.86	0.006	0.209
MW-8D	9/18/2003							0.13	0	0.062		0	0	0	0	0.16	0	0.187
MW-9	9/18/2003							8.08	0.085									
MW-C80	9/18/2003							0.442	0									
HT-1	3/31/2005							2.6	0	0								
HT-2	3/31/2005							3	0.464	0								
HT-3	3/31/2005							2	0.28	0								
HT-4	3/31/2005							0.6	6.77	0								
HT-5	3/31/2005							1.5	3.78	0								
HT-6	3/31/2005	0	0	0	0	0	44.7	6.66	0									
HT-7	3/31/2005	0	0	0	0	0	13.8											
MW-7	3/31/2005	0	0	0	0	0	5.8											
MW-9	3/31/2005	0	0	0	0	0	0	0	0	0								
MW-SS-1	3/31/2005						10.4											
SB-PP-1	3/31/2005						0	32.2	0.0089	0								
SB-PP-2	3/31/2005						0	76.6	0.5158	0								
TP-2	3/31/2005	0	0	0	0	0	0.3											
TP-5	3/31/2005	0	0	0	0	0	4.6	0										
TP-6	3/31/2005	0	0	0	0	0	10.3	0										
TP-7	3/31/2005	0	13.1	0	0	0	0.6	0										
TP-11	4/1/2005	6.95	0	0	6.69	0	0.9											
TP-3	4/1/2005	0	0	0	0	0	3.2											
SBHT-6	9/13/2005						100000											
HT-10	9/19/2005	3.4	51.1	0	0	0	0											
HT-11	9/19/2005	0	0	0	0	0	0											
HT-9	9/19/2005	0	15.6	0	0	0	0											
MW-SS-4	9/19/2005	0	0	0	0	0	0											
MW-12	9/19/2005	37.2	428	410	41.2	15.4	172000											
MW-13	9/19/2005	15.7	25.6	0	6.69	4.8												
MW-14	9/19/2005	0	0	0	0	0	0											
HT-8	8/22/2005																	
MW-SS-4	9/22/2005																	
JCO-HIT	6/29/2006	0	0	0	0	0	0											
JCO-LS	6/29/2006							0	0	0								
JCO-NE	6/29/2006							0	0.23	0								
JCO-SS	6/29/2006																	



Example 2: Brownfields Site



Example 2: Brownfields Site



Example 3: Area Wide Redevelopment

Analyzed and mapped historic uses of parcels in Bennington, VT

- Historic maps and directories
- Presented in ArcGIS Online

[Bennington Story Map](#)

Thank You!

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