
GES
Groundwater & Environmental Services, Inc.

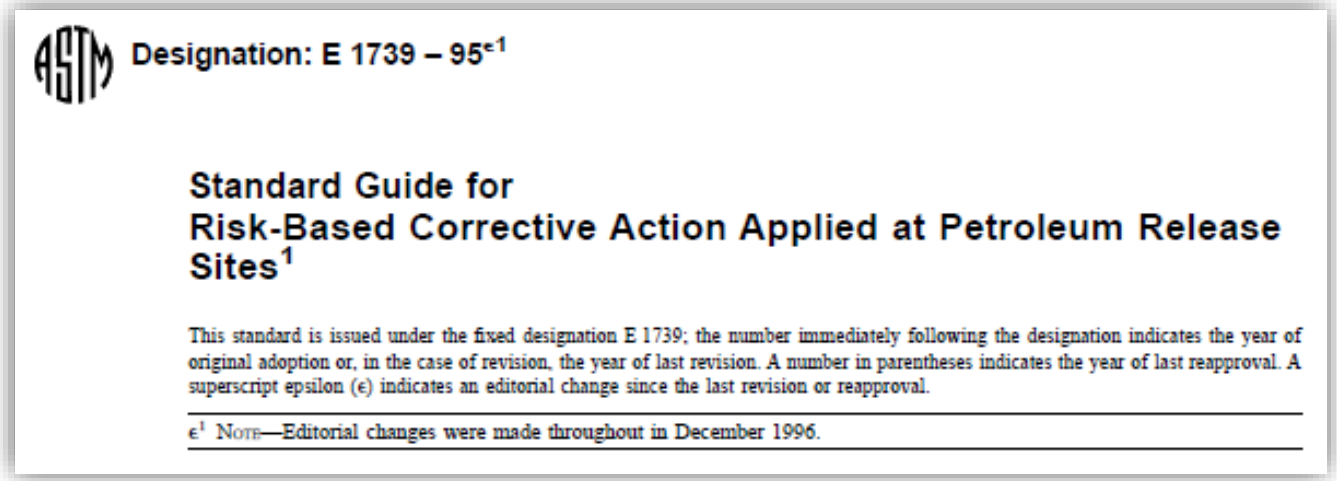
ENVIRONMENTAL
EXPERTISE
FROM THE
GROUND UP

How Useful is Field Screening Data?

National Tanks Conference, Sept 23, 2025

Background

- A portfolio of 66 retail fuel sites was enrolled in a RBCA program in 2022
  - RBCA = Risk Based Corrective Action
  - Defined by ASTM in 1995 (E-1739-95) for petroleum release sites
  - Used in some form by most states and US territories
- Most of the 66 sites had no environmental activity after 2005
- Existing site data was incomplete and outdated
- Existing data did not meet RBCA requirements
  - COPC list did not match historical data
  - TBA and naphthalene added, TPH removed
  - Other SVOCs added
  - Vapor Intrusion pathway added



Designation: E 1739 – 95$^{\epsilon 1}$

Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites[1]

This standard is issued under the fixed designation E 1739; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

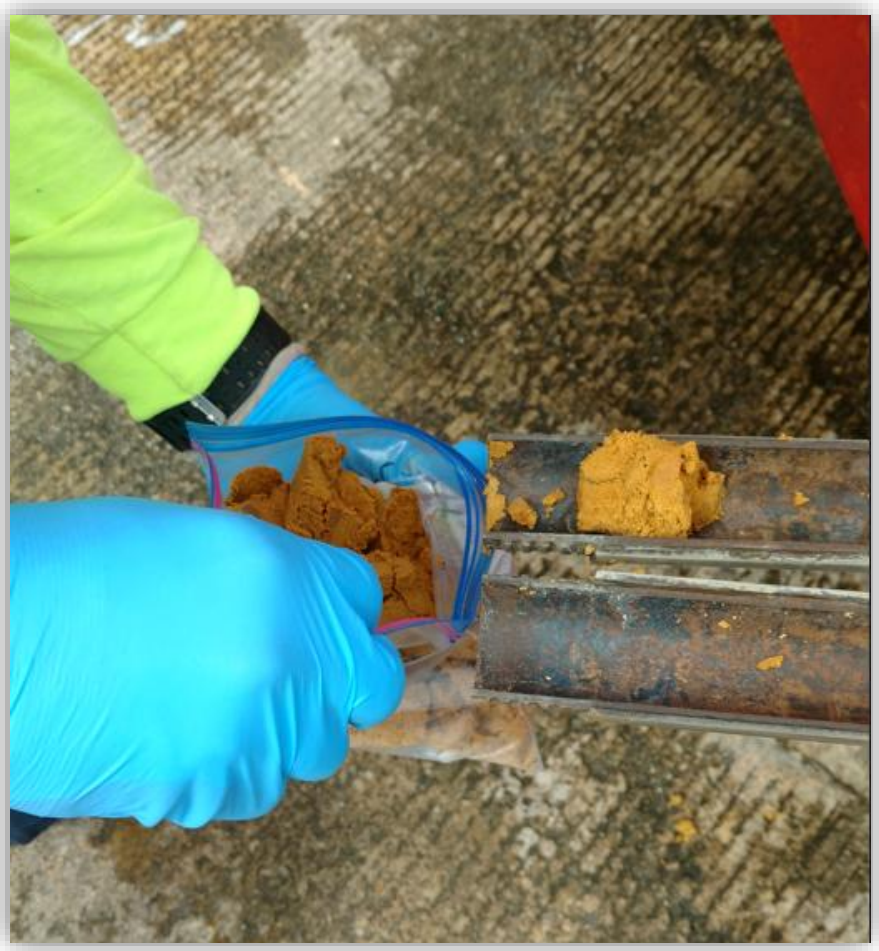
ϵ^1 NOTE—Editorial changes were made throughout in December 1996.

Establish RBCA Baseline

- Data Gaps were identified for each site to include:
  - Full delineation for COPCs (full suite VOCs and SVOCs in soil and groundwater)
  - Identify potential exposure pathways - including future use
  - Initial analysis for residential use scenarios
    - Uses Tier 1 “look up” values – or risk-based screening levels (RBSLs)
  - RBSLs are low for some compounds (drivers)
    - Naphthalene (3.8 mg/kg in soil, 0.12 ug/L in gw)
    - Ethylbenzene (6.4 mg/kg in soil)
  - Each site had a unique investigation plan to meet identified data gaps

Site Investigation

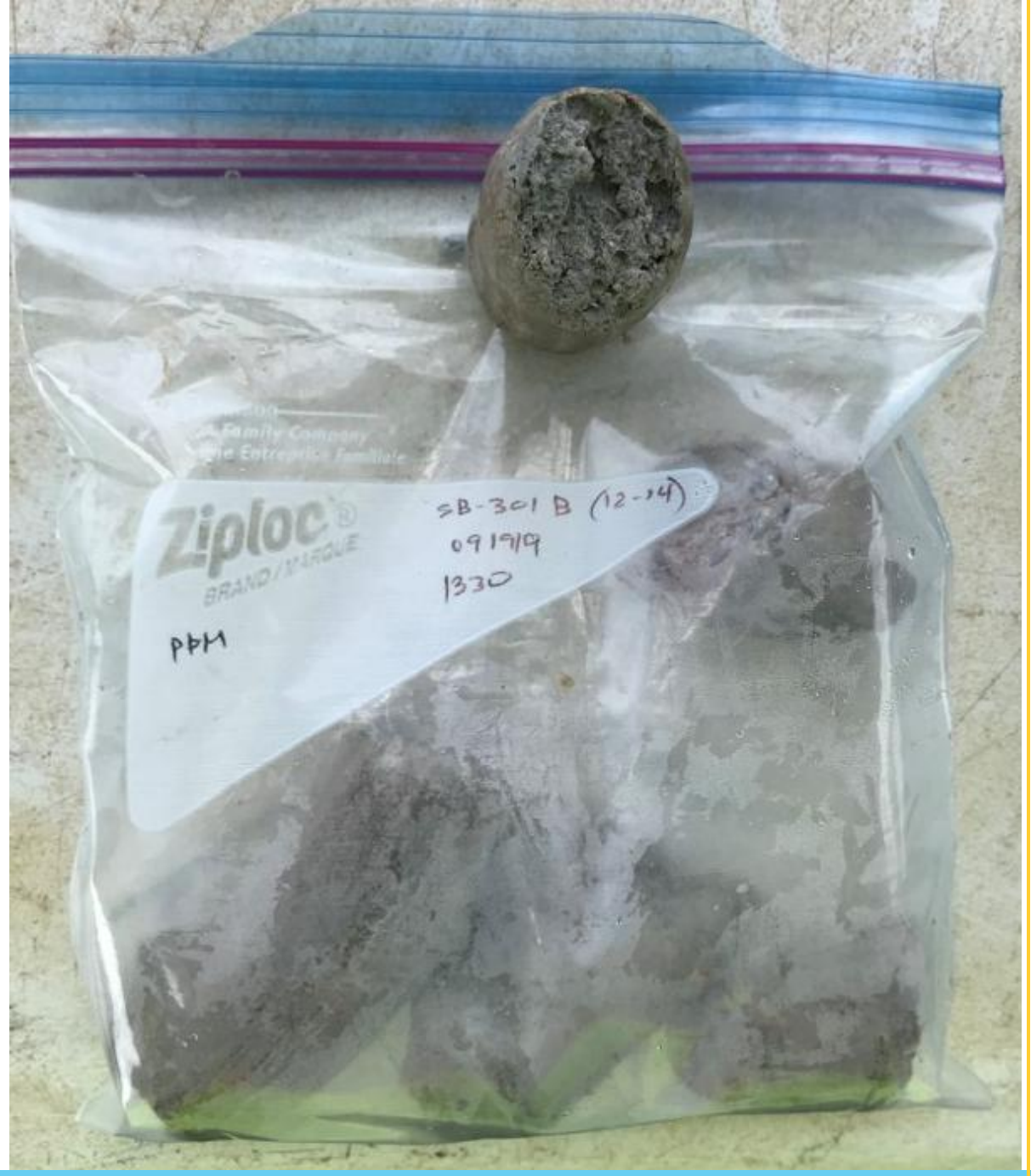
- Representative soil and groundwater samples to be collected and analyzed for list of COPCs relative to source (gasoline, gasoline and diesel, motor oil, waste oil)
- No field preservation requirement for soil sample collection
- Soil sample collection to include:
  - Highest PID response from vadose zone
  - Highest PID response from saturated zone
  - Zone yielding odor or staining
  - Depth matching nearby non-compliant (historical) soil result
  - Bottom of boring
- Minimum of 3 soil samples per boring – could be more



Field Screening

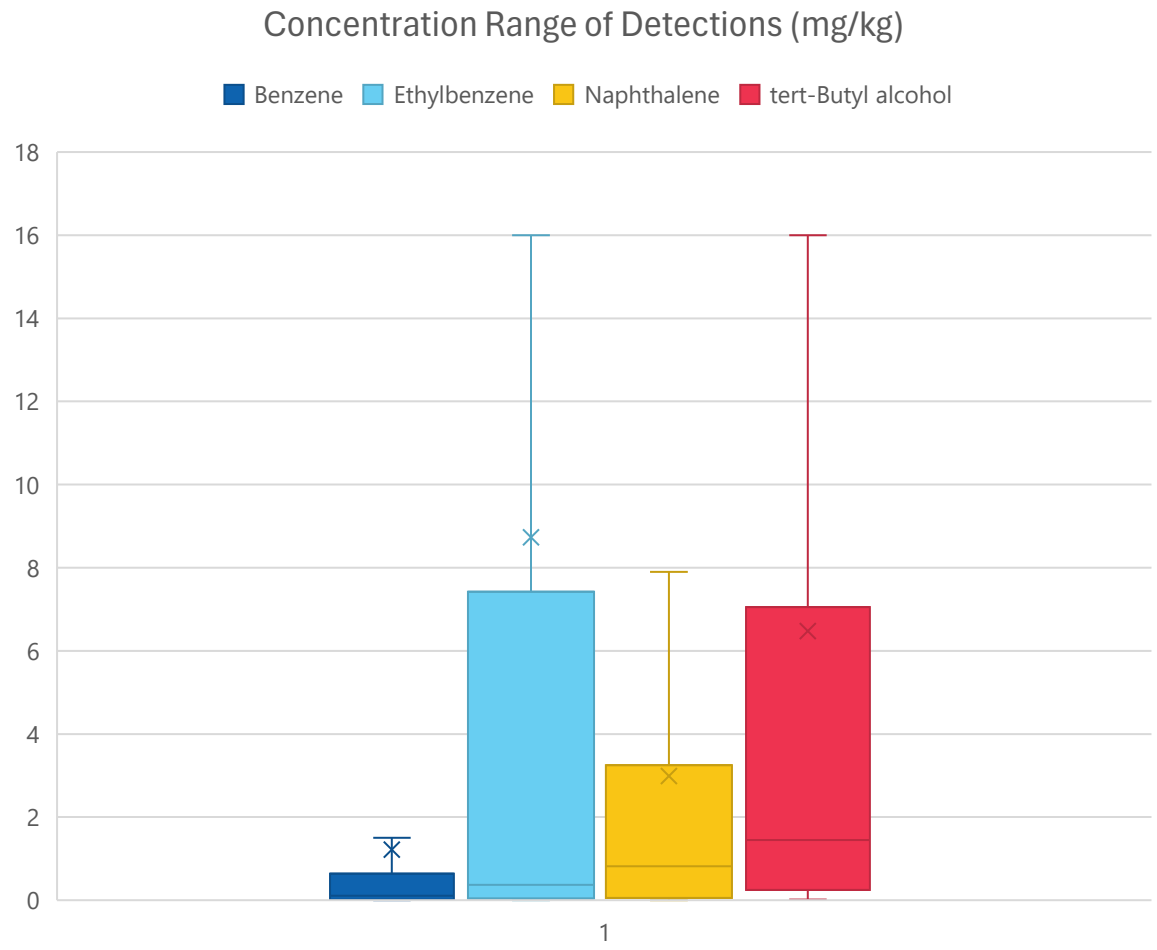
- Field Screening completed during drilling with a PID – per SOP
- PID calibrated daily per manufacturer specifications

1. Collect soil from each location to be analyzed (screened) and place into a sealed plastic bag (half fill bag with soil)
2. Collect a 2nd sample from soil core at the same time and place into lab-provided bottle and put on ice – a determination as to which is sent to the lab will be made upon boring completion
3. After sealing the plastic bag, shake well to mix the soil
4. After allowing to equilibrate for approx. 10 minutes, analyze headspace within resealable plastic bag using PID
5. Record the highest meter response in the field book and/or on the field forms

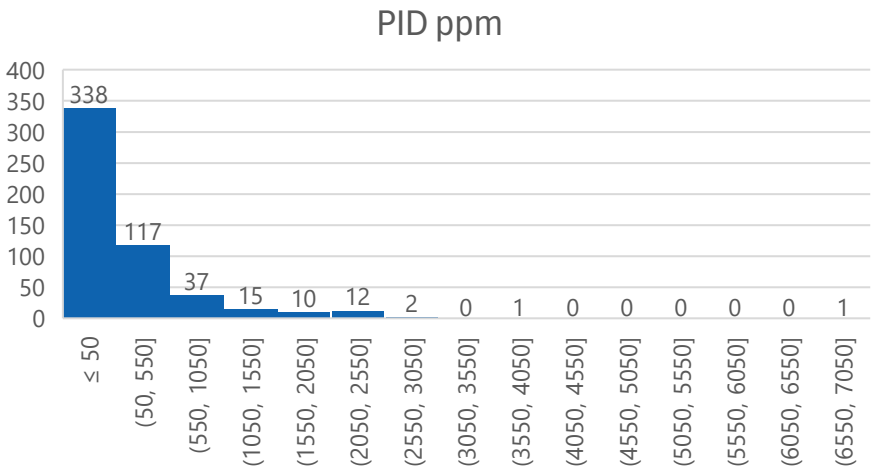


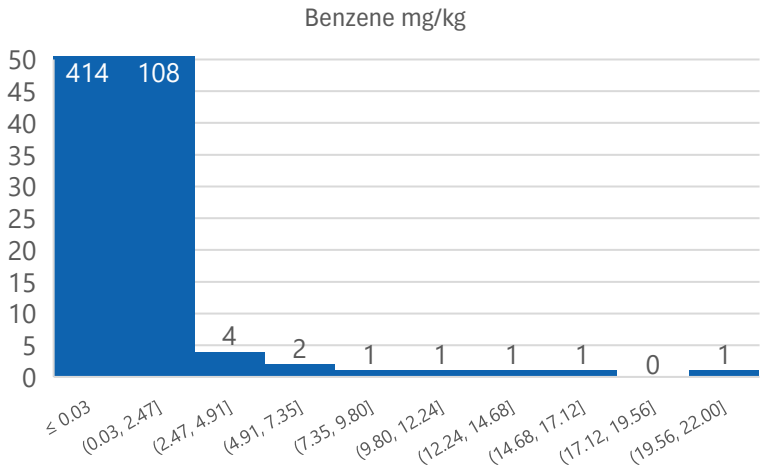
Site Selection

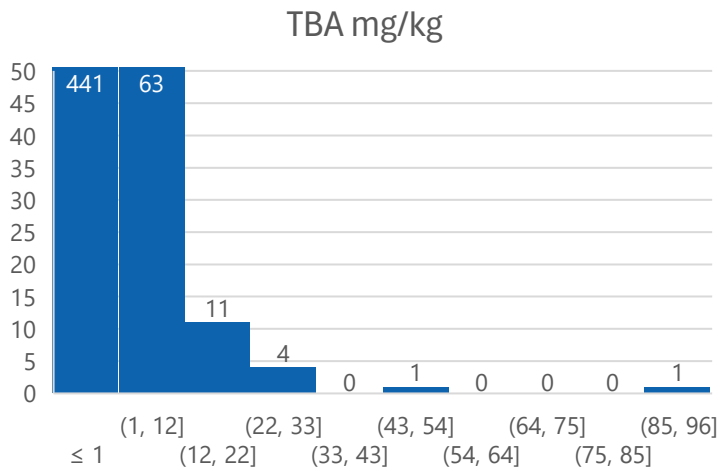
- Sites identified within the program: 66
  - Sites eliminated from this study if:
    - no additional sampling was required to close data gap
    - No soil or groundwater lab results exceeded applicable RBSLs
    - All PID responses were below 50 ppm
  - Sites meeting data requirements for analysis: 23
- From these sites:
  - Borings: 184
  - Soil Samples: 533
  - Borings with PID responses
    - > 50 ppm: 99 (54%)
    - > 100 ppm: 84 (46%)
    - > 500 ppm: 52 (28%)
    - > 1,000 ppm: 46 (24%)

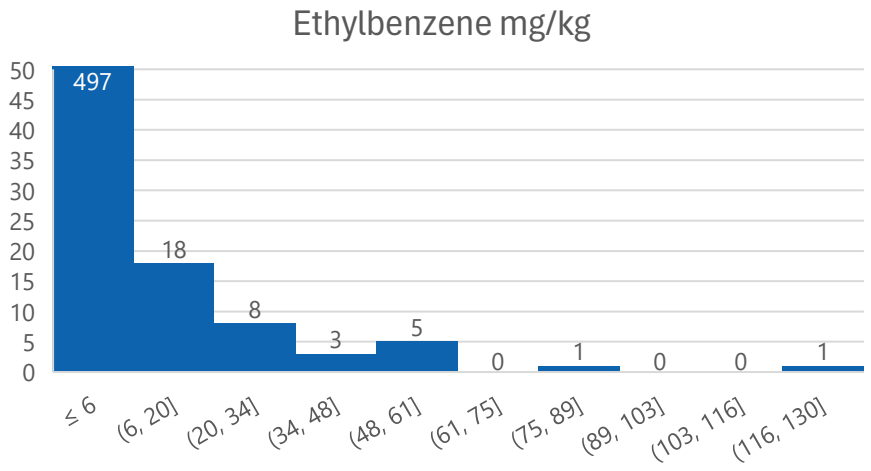


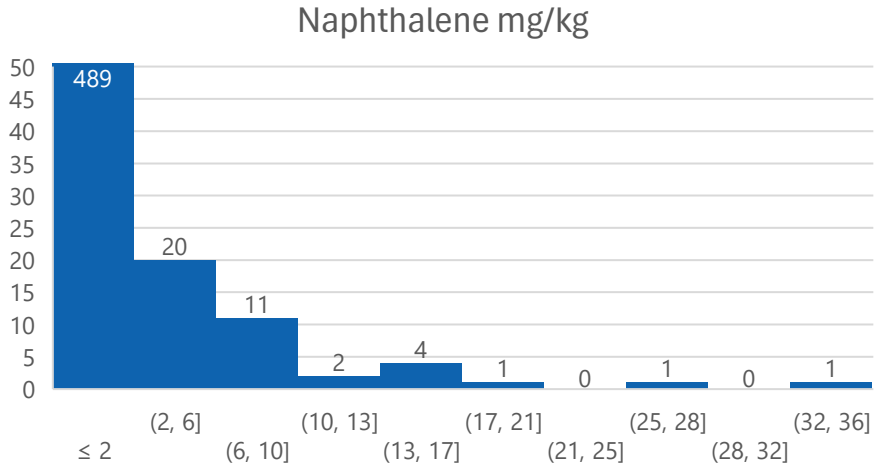
Distribution of PID and Analytical Results - Soils



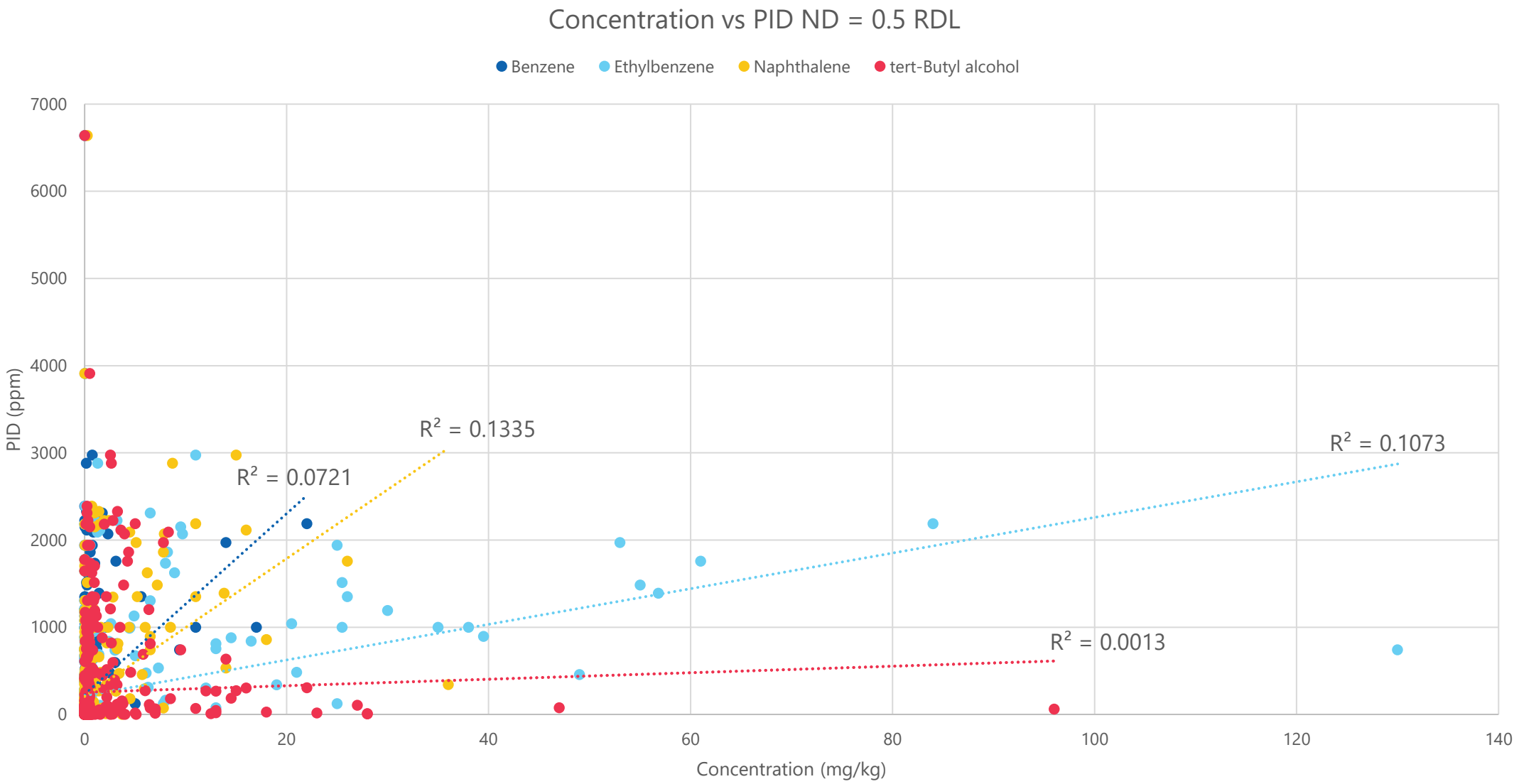








Concentration versus PID Response by Analyte

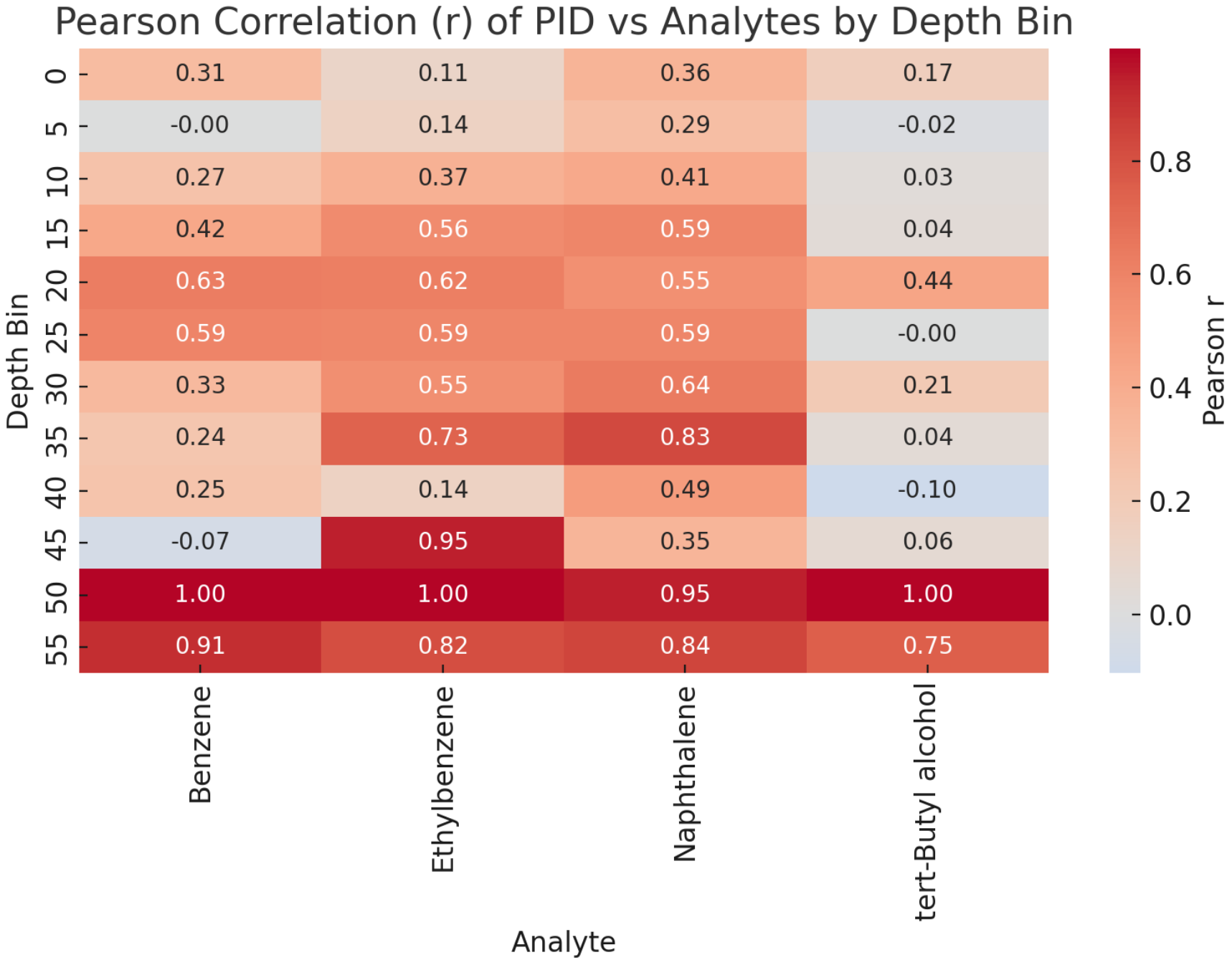


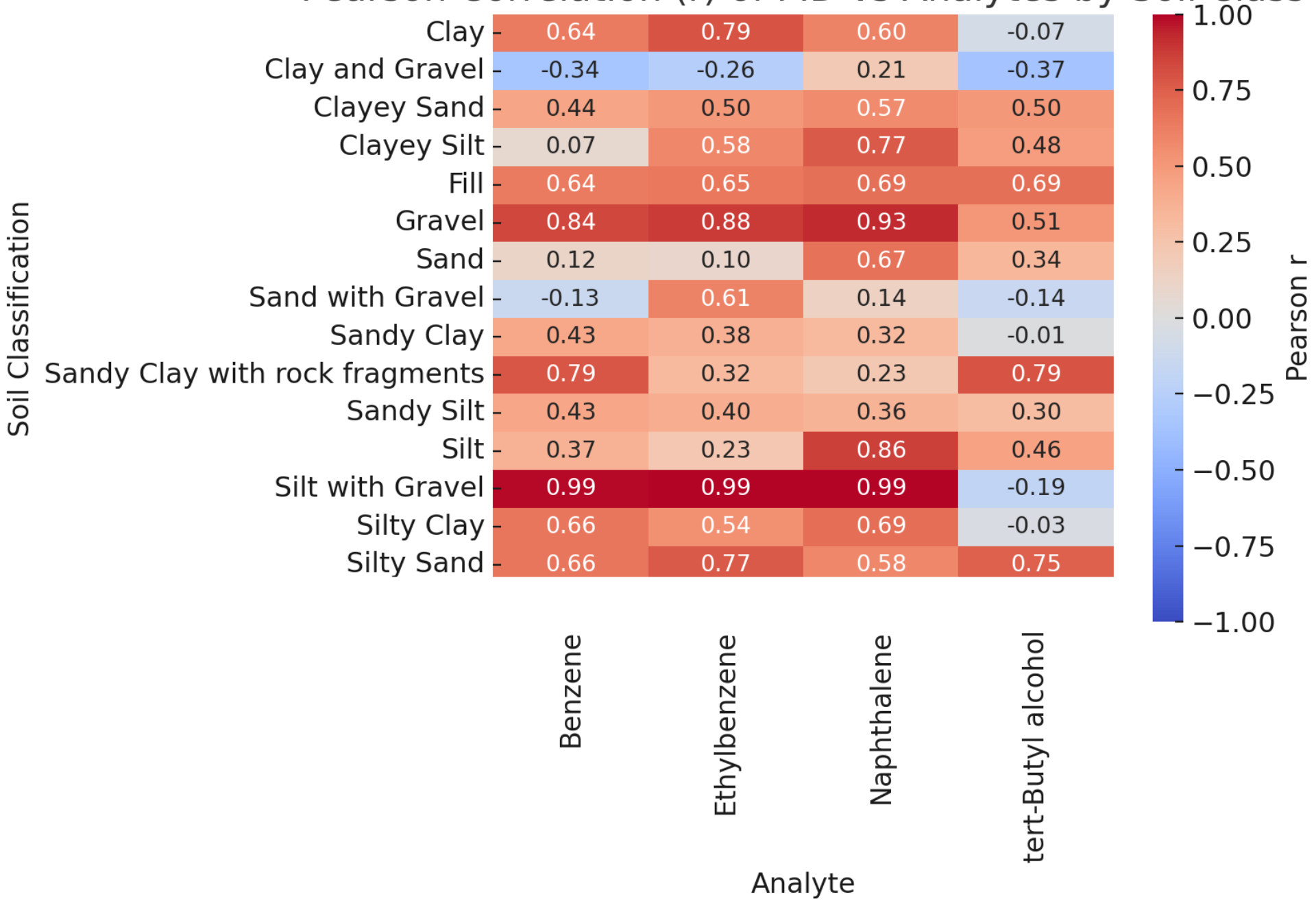
Data Correlation

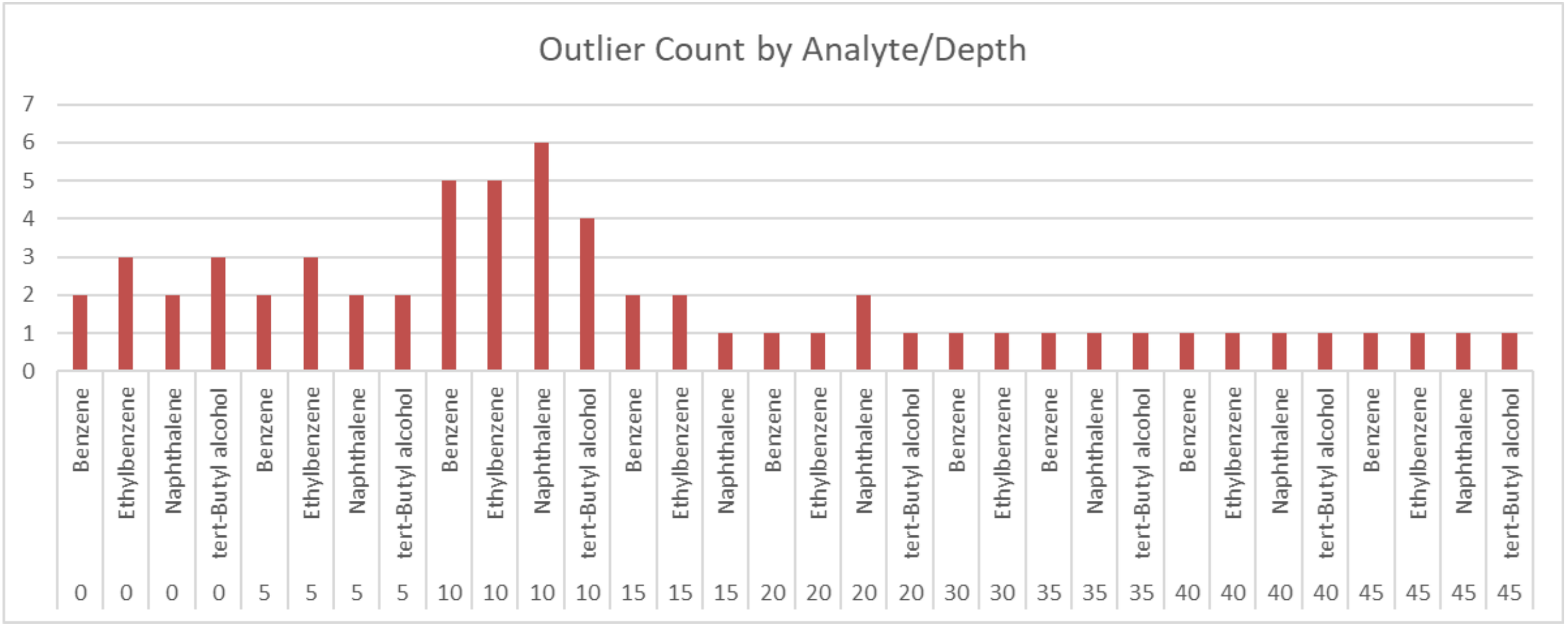
- When evaluating the dataset as a whole, a Pearson Correlation Coefficient was calculated.
  - Non-detect analytical results were evaluated, recognizing the wide variability of reporting detection limits in individual samples. The Pearson coefficient was calculated for each analyte using only detections, all non-detect results as 0, and half of the reporting detection limit

	Pearson Correlation Coefficient			
	tert-Butyl alcohol	Ethylbenzene	Naphthalene	Benzene
Detects Only	0.015	0.265	0.233	0.414
ND = 0	-0.025	0.348	0.378	0.238
ND= 0.5 RDL	**0.036**	**0.328**	**0.365**	**0.269**

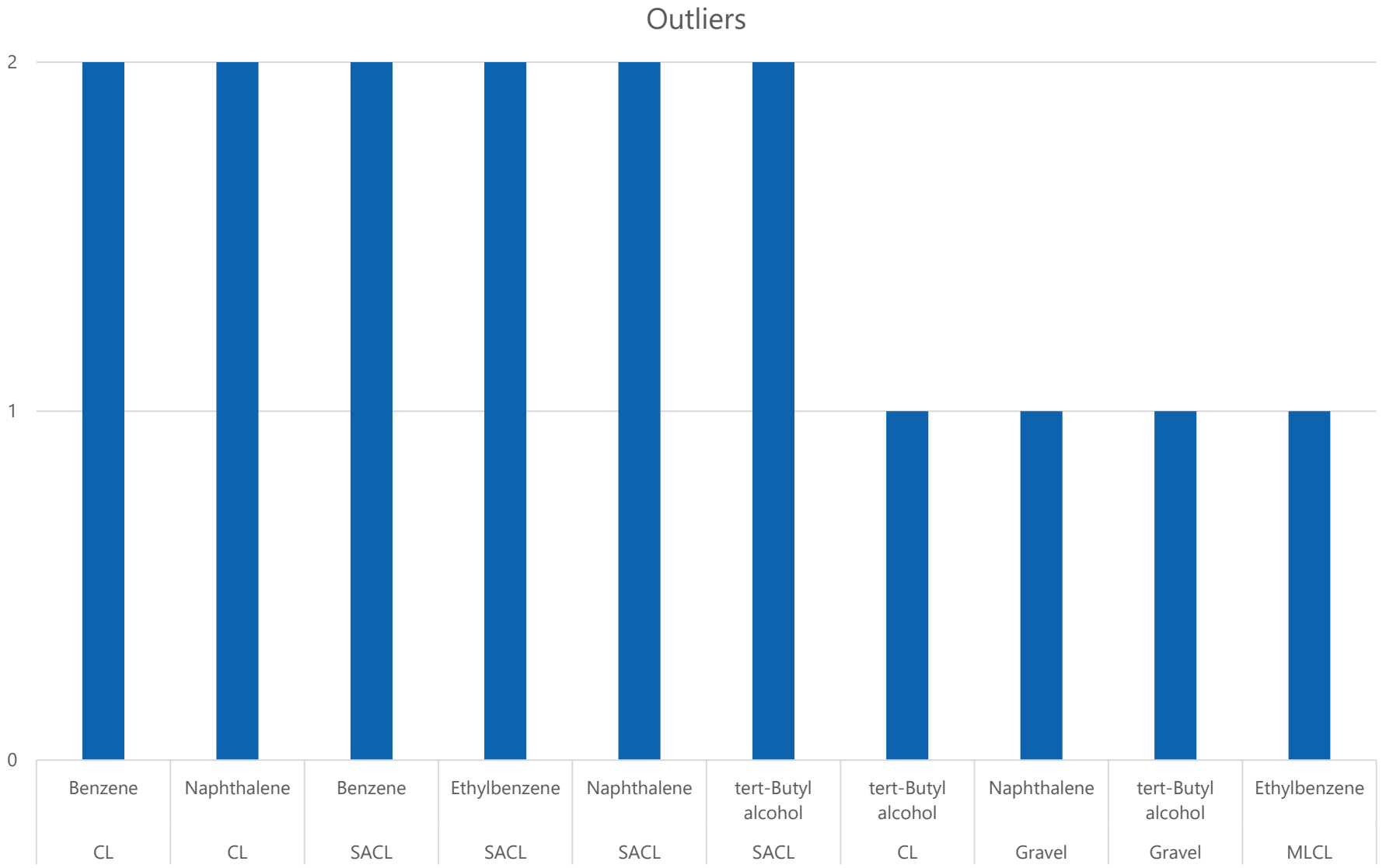
  - Pearson indicates very weak to negative correlation for TBA, moderate correlation for other analytes
  - Additional evaluation was performed to see if controlling conditions may be identified including sample depth or soil type
    - Calculated correlation may be influenced by sample count (no set number for given depths)
  - Outliers (residuals >3 units) were identified when grouped by depth and by soil type


Pearson Correlation (r) of PID vs Analytes by Depth Bin
Depth Bin
0
5
10
15
20
25
30
35
40
45
50
55
0.31 0.11 0.36 0.17
-0.00 0.14 0.29 -0.02
0.27 0.37 0.41 0.03
0.42 0.56 0.59 0.04
0.63 0.62 0.55 0.44
0.59 0.59 0.59 -0.00
0.33 0.55 0.64 0.21
0.24 0.73 0.83 0.04
0.25 0.14 0.49 -0.10
-0.07 0.95 0.35 0.06
1.00 1.00 0.95 1.00
0.91 0.82 0.84 0.75
Benzene
Ethylbenzene
Naphthalene
tert-Butyl alcohol
Analyte
Pearson r
0.0
0.2
0.4
0.6
0.8


Pearson Correlation (r) of PID vs Analytes by Soil Class
Soil Classification
Clay 0.64 0.79 0.60 -0.07
Clay and Gravel -0.34 -0.26 0.21 -0.37
Clayey Sand 0.44 0.50 0.57 0.50
Clayey Silt 0.07 0.58 0.77 0.48
Fill 0.64 0.65 0.69 0.69
Gravel 0.84 0.88 0.93 0.51
Sand 0.12 0.10 0.67 0.34
Sand with Gravel -0.13 0.61 0.14 -0.14
Sandy Clay 0.43 0.38 0.32 -0.01
Sandy Clay with rock fragments 0.79 0.32 0.23 0.79
Sandy Silt 0.43 0.40 0.36 0.30
Silt 0.37 0.23 0.86 0.46
Silt with Gravel 0.99 0.99 0.99 -0.19
Silty Clay 0.66 0.54 0.69 -0.03
Silty Sand 0.66 0.77 0.58 0.75
Benzene
Ethylbenzene
Naphthalene
tert-Butyl alcohol
Analyte
Pearson r
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00


Outlier Count by Analyte/Depth
7
6
5
4
3
2
1
0
Benzene 0
Ethylbenzene 0
Naphthalene 0
tert-Butyl alcohol 0
Benzene 5
Ethylbenzene 5
Naphthalene 5
tert-Butyl alcohol 5
Benzene 10
Ethylbenzene 10
Naphthalene 10
tert-Butyl alcohol 10
Benzene 15
Ethylbenzene 15
Naphthalene 15
Benzene 20
Ethylbenzene 20
Naphthalene 20
tert-Butyl alcohol 20
Benzene 30
Ethylbenzene 30
Benzene 35
Naphthalene 35
tert-Butyl alcohol 35
Benzene 40
Ethylbenzene 40
Naphthalene 40
tert-Butyl alcohol 40
Benzene 45
Ethylbenzene 45
Naphthalene 45
tert-Butyl alcohol 45

Outliers by Soil Classification



Groundwater Data Summary

- Of the 184 soil borings, 99 were completed as monitoring wells
  - This determination was not based solely on PID response
    - existing data and data gap needs considered
- Most recent sampling showed 57 of 99 wells had at least one RBSL exceedance (58%)
  - Naphthalene is the compound that most frequently exceeds the RBSL, followed by TBA, Benzene and MTBE, in that order
  - RBSLs, Koc and proclivity toward biodegradation likely drive these results. RBSLs:
    - Naphthalene = 0.12 ug/L
    - TBA = 150 ug/L
    - Benzene = 5 ug/L
    - MTBE = 14 ug/L
  - Overall correlation between elevated PID response and dissolved phase RBSL non-compliance is much better for groundwater than for soils. Of the 57 groundwater samples with one or more RBSL exceedance, 38 (67%) came from wells where soil screening returned a PID response >50ppm

Findings

- Correlation of all soil results indicate that TBA is the least correlated to PID readings.
- Including the soil classification provided the strongest correlation by analyte and presented the least number of outliers.
- Based upon the ratio of PID reading to Analytical result by soil classification, the average outlier ratio is:

Analyte	Min of Ratio	Max of Ratio	Average Ratio
Benzene	64.40	16,032.48	8,048.44
Ethylbenzene	26.98	10,614.54	5,320.76
Naphthalene	128.81	391,272.73	130,864.18
tert-Butyl alcohol	35.97	956.89	476.82

- If not accounting for soil classification, the ratios are much higher

Analyte	Average Ratio
Benzene	90,121.82
Ethylbenzene	22,533.53
Naphthalene	122,105.23
tert-Butyl alcohol	38,318.61

Findings (Cont'd)

- Groundwater results appear to correlate better with field soil screening, but the data analysis was much less rigorous
- A side-by-side comparison of correlation between field screening results and lab results for soil and groundwater isn't possible for this data set – too may gaps
- Soil heterogeneity offers challenges for comparison of field vs lab results
- Compliance is driven by the Tier 1 RBSL - which ranges over three orders of magnitude for common gasoline constituents
  - This may exceed the range of variation in field PID response
- Compound properties including volatility, solubility and affinity for water vs soil (Koc) also determine correlation between field screening and lab concentration in both soil and groundwater
- Statistical tools can help determine where re-analysis may be warranted (high outlier count)
- Field screening of soils with a PID incorporates a wide range of factors and may not be as useful or reliable as other available screening techniques

Thoughts About Further Study

- Compare lab results for field-preserved versus non-field-preserved soil samples
- A more controlled study could be undertaken. Some possibilities:
  - Sample selection from similar soil types
  - Sample selection correlation to soil moisture
  - Better control/correlation with depth
  - Use of a field Gas Chromatogram for better compound quantitation

Questions?

I would like to acknowledge my colleague, David Cleland
for his contributions to this work