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THE WEBINAR WILL BEGIN SOON

Background Check: The Why and How of Background Threshold Values

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ERIS WEBINARS

Background Check:
The Why and How of Background Threshold Values

Wednesday, June 12, 2024

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Field to Office

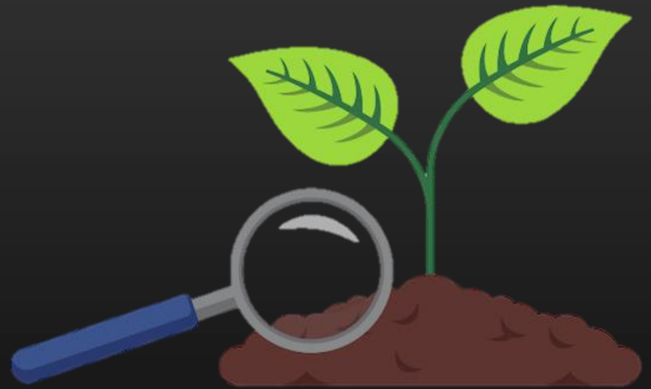
Presented by:

Kenneth S. Tramm, PhD, PE, PG, CHMM
Principal, Modern Geosciences

Melanie Veltman
Director, Research and Data, ERIS
Host

Background Check:

The *Why* and *How* of Background Threshold Values



Kenneth S. Tramm, PhD, PE, PG, CHMM

June 12, 2024

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in Modern Geosciences

A little 'Background'

- Risk-based Corrective Action (RBCA) Refresher
- Soil Sampling Scenario
- Statistical Tools & Background Threshold Value (BTV) Options
- State BTV Example (Oklahoma)
- Regional BTV Example (DFW)

REVIEW

Importance of background threshold value development within risk-based corrective action programs

Kenneth S. Tramm | Jason T. Minter | Catherine A. Seaton

The Why

Estimating Background Threshold Values for Risk Assessment

KENNETH S. TRAMM*, JASON T. MINTER, CATHERINE A. SEATON
Modern Geosciences, 5100 Thompson Terrace, Colleyville, Texas, 76034

The How

This presentation includes summary data from *the above articles* (https://doi.org/10.1002/vzj2.20294). Please refer to the articles for additional detail.

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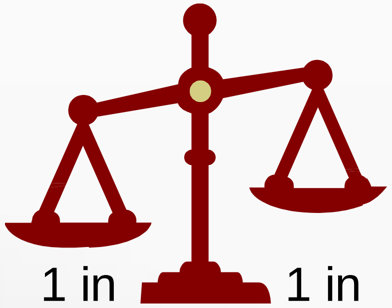
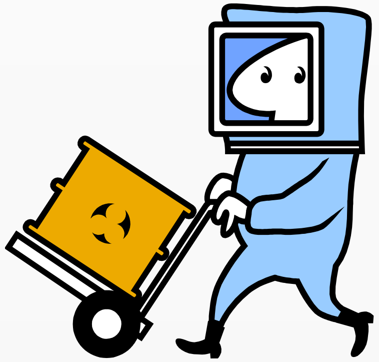
Risk Assessment

Risk = Toxicity x Exposure



1 in 10,000   1 in 1,000,000

Risk Threshold
typically a regulatory standard



Chemical-specific Properties
(URF, RfC, etc.)

Concentration at Point of Exposure

Rate of Intake (Exposure Frequency, Exposure Duration Assumptions)

Exposure routes
Ingestion, dermal contact, water, inhalation of vapors;
residential vs. commercial exposure

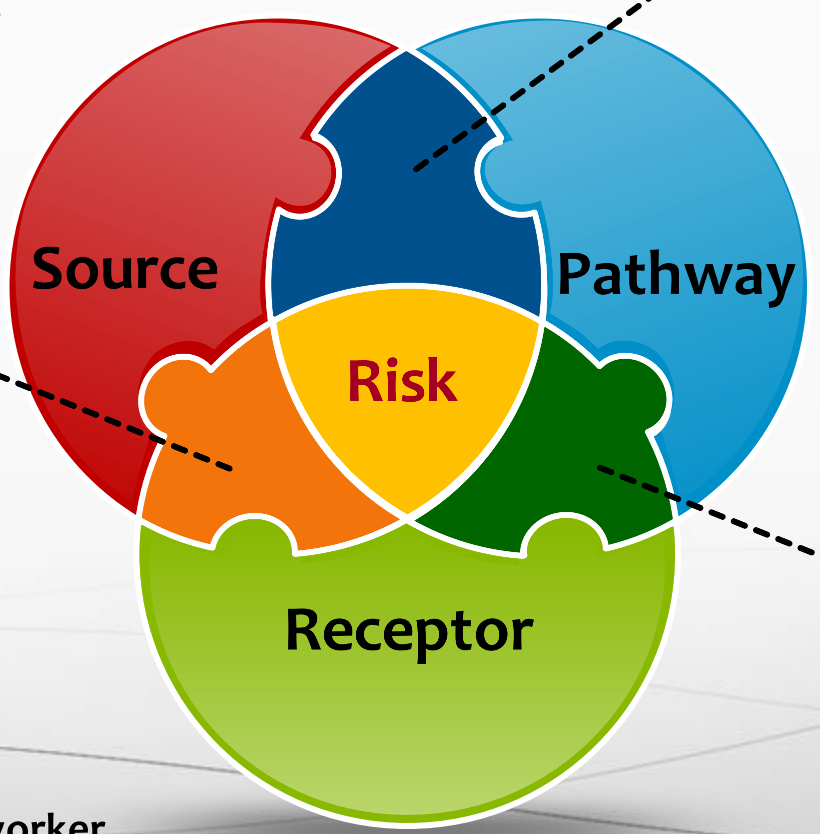
Risk Based Corrective Action

Source (Release)

- Hazardous material released into the environment

Manage Risk

- Pathway controlled through institutional or engineering mechanisms
- Ex: Groundwater use limitation or engineered cap



Manage Risk

- Receptor controlled through use limitation or institutional control
- Ex: Commercial use restriction

Exposure Pathway

- Inhalation
- Ingestion
- Dermal contact

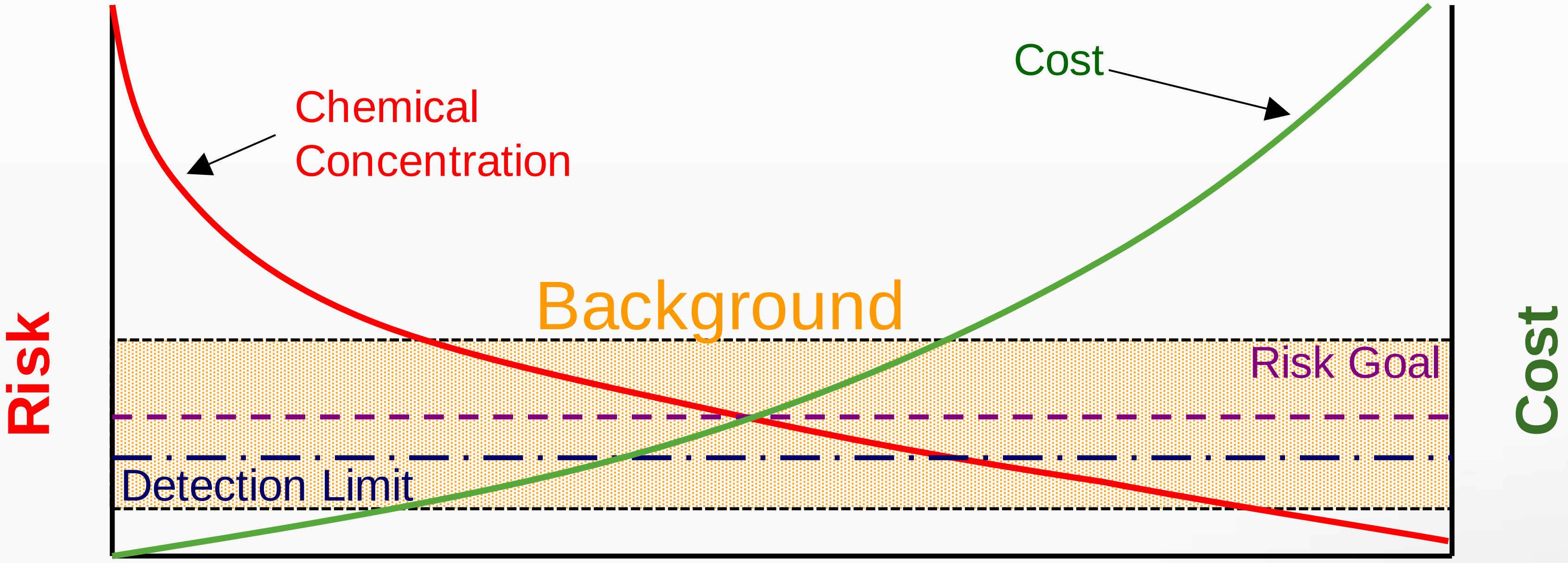
Manage Risk

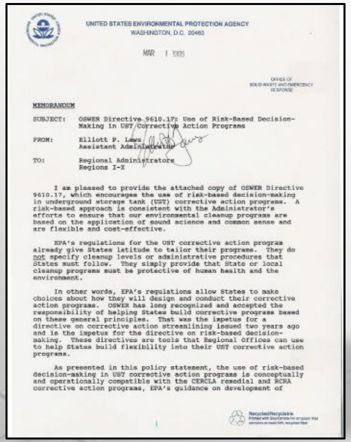
- Source controlled through removal or decontamination
- Ex: Source excavation, destruction, attenuation

Receptor

- Residential
- Commercial
- Construction worker

Risk Based Corrective Action





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 1 1995

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

MEMORANDUM

SUBJECT: OSWER Directive 9610.17: Use of Risk-Based Decision-Making in UST Corrective Action Programs

FROM: Elliott P. Laws
Assistant Administrator

TO: Regional Administrators
Regions I-X

I am pleased to provide the attached copy of OSWER Directive 9610.17, which encourages the use of risk-based decision-making in underground storage tank (UST) corrective action programs. A risk-based approach is consistent with the Administrator's efforts to ensure that our environmental cleanup programs are based on the application of sound science and common sense and are flexible and cost-effective.

EPA's regulations for the UST corrective action program already give States latitude to tailor their programs. They do not specify cleanup levels or administrative procedures that States must follow. They simply provide that State or local cleanup programs must be protective of human health and the environment.

In other words, EPA's regulations allow States to make choices about how they will design and conduct their corrective action programs. OSWER has long recognized and accepted the responsibility of helping States build corrective programs based on these general principles. That was the impetus for a directive on corrective action streamlining issued two years ago and is the impetus for the directive on risk-based decision-making. These directives are tools that Regional Offices can use to help States build flexibility into their UST corrective action programs.

As presented in this policy statement, the use of risk-based decision-making in UST corrective action programs is conceptually and operationally compatible with the CERCLA remedial and RCRA corrective action programs, EPA's guidance on development of

Recycled/Recyclable

EPA – "A risk-based approach is consistent with the Administrator's efforts to ensure that our environmental cleanup programs are based on the application of **sound science** and **common sense** and are **flexible** and **cost-effective.**" March 1995 (OSWER Directive 9610.17)

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Risk Criteria — RBCA 101

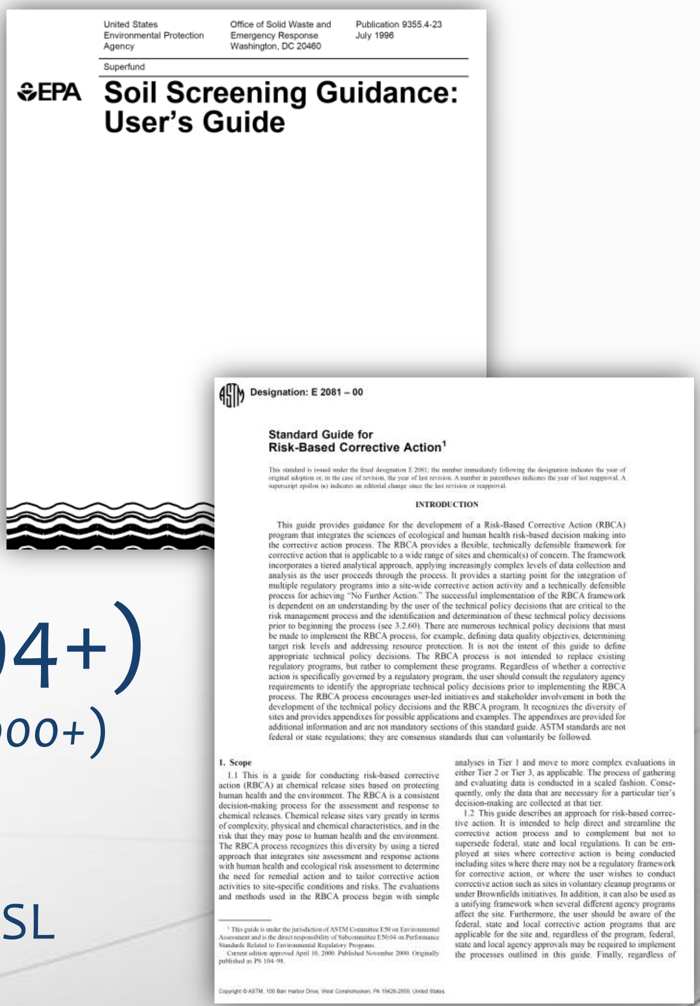
Two basic frameworks:

1- EPA: Soil Screening Guidance (1996+)

- Based on Risk Assessment Guidance for Superfund (RAGS; 1989+)
- Generic Risk-Based Soil Screening Level (SSL) Formulas/Assumptions
- Today: Expanded to **EPA Regional Screening Levels (RSLs)**

2- ASTM: Risk-Based Corrective Action (1994+)

- ES-38-94 (1994), E1739 - Petroleum (1995-2024), E2081 – All Compounds (2000+)
- Default Tier 1 risk-based Formulas/Assumptions for screening (RBSLs)
- Site-specific Tier 2 (assumptions) or Tier 3 (update formula/model/other)
- Today: State-based program use of Tiered framework incorporating EPA SSL elements/EPA Guidance



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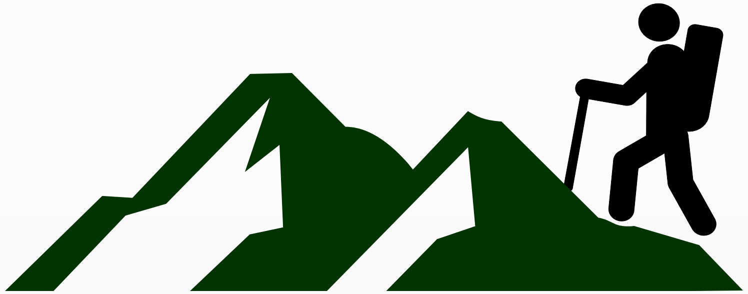
Background

Both approaches mention the importance of background values, but do not provide them or formal approaches to developing "background."

RBCA 101

Risk Criteria

Lowest of all exposure model values‡; published values by County, State or EPA (RSLs)



Background

Upper limit of expected background for the area being assessed. Some states offer values for point comparison – *most do not*

Screening value is the higher of the **Risk Criteria** or **Background** value.

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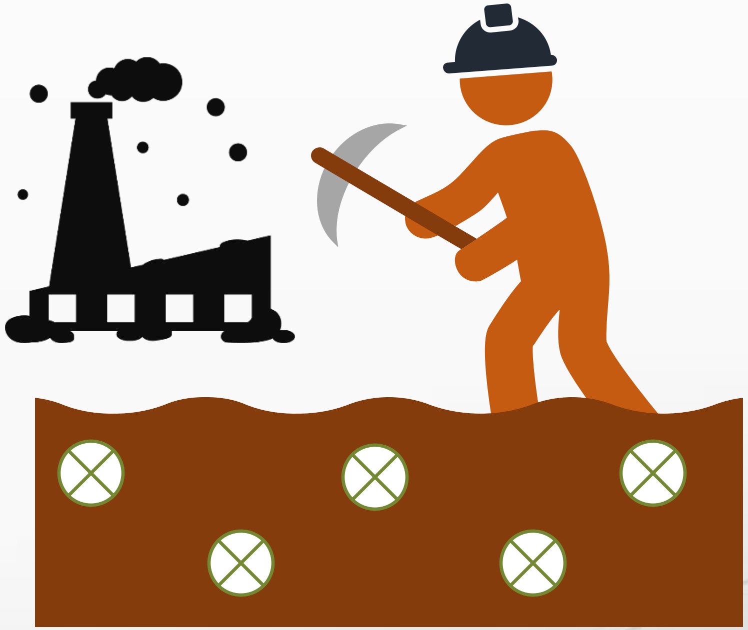
‡ Soil exposure models most commonly include soil-to-groundwater, inhalation of volatiles, dermal contact, and ingestion pathways. These are back calculated based on acceptable levels of carcinogenic (10^{-6}) and non-carcinogenic risk (0.1).

Why do we need Background?

Example Scenario:

- You perform soil sampling to evaluate for a suspected regional lead concern.
- Take 5 samples of shallow soil and analyze for lead
- Get back results. Lead ranges **from 22 to 27 mg/Kg**.
- Do you have a release?



Risk Criteria — Need this
Background — Need this
Screening Value — To get this

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Why do we need Background?

Example Scenario:

- You perform soil sampling to evaluate for a suspected regional lead concern.
- Tak… …alyze for lead
- Ge… …to 27 mg/Kg.
- Do…

Soil Screening Guidance: Technical Background Document EPA 1996

"EPA regions should use a residential soil lead RSL of 200 parts per million (ppm)" – EPA 2024

"Generally, the ground water pathway will not pose a significant risk since many lead compounds are generally not highly mobile." - EPA 1994

Risk Criteria
Background
Screening Value

APPENDIX A

Generic SSLs

OFFICE OF LAND AND EMERGENCY MANAGEMENT
WASHINGTON, D.C. 20460

January 17, 2024

MEMORANDUM

SUBJECT: Updated Residential Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities

FROM: Barry N. Breen, Principal Deputy Assistant Administrator

TO: Regional Administrators, Regions 1 - 10

PURPOSE

Reducing childhood lead exposure is an Environmental Protection Agency (EPA) priority. Consistent with the best available science, the Agency's Strategy to Reduce Lead Exposures and Disparities in U.S. Communities, and the Federal Action Plan to Reduce Childhood Lead Exposures and Associated Health Impacts, the Office of Land and …

Screening Residential Soil Lead Sites

What is a regional screening level (RSL)? RSLs are screening tools used to help identify and define areas that may need further evaluation.

What is a removal management level (RML)? RMLs are screening tools used to help prioritize and define areas that may pose the greatest threat to human health.

The RSLs and RMLs are generally not default preliminary remediation goals (See Footnote 11) and cleanup levels.

…rograms subject to CERCLA section 120, and potentially …ities delegated to them under Executive Order 12580

…contamination,[1] OLEM recommends:

Inorganics

fugitive

CAS No.					
7440-36-…					
7440-38-…					
7440-39-…					
7440-41-…					
7440-43-…					
7440-47-3	Chromium (total)	390 b	270 e	38 i	2 i
16065-83-1	Chromium (III)	7…,000 b	--- c	--- g	--- g
18540-29-9	Chromium (VI)	390 b	270 e	38 i	2 i
57-12-5	Cyanide (amenable)	1,…00 b	--- c	40	2
7439-92-1	Lead	400 k	--- k	--- k	--- k

k A screening level of 400 mg/kg has been set for lead based on *Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (U.S. EPA, 1994).

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Why do we need Background?

United States Environmental Protection Agency

Search EPA

Environmental Topics | Laws & Regulations | Report a Violation | About EPA

Risk Assessment

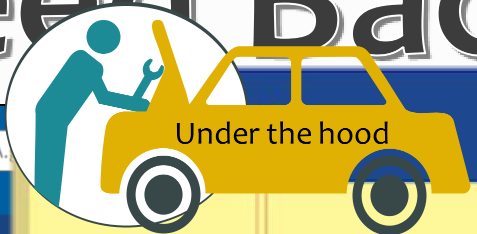
4.8.5 Determination of the Dilution Factor
"The SSL values in the download tables are based on a dilution factor of 1. If one wishes to use the calculator to calculate screening levels using the SSL guidance for a source up to 0.5 acres, then a dilution factor of 20 can be used." EPA Default SSL DAF = 20. *EPA RSL Guidance*

Regional Screening Levels (RSLs)

Regional Removal

EPA Region 3 RBC Ta… Region 9 PRG Table. … screening levels for a… cleanup standards a…

	Resident Soil (mg/kg)	key	Industrial Soil (mg/kg)	key	Res A… (ug/…	key		key		key			key	
Lead Compounds														
~Lead Phosphate	8.2E+01	c	3.8E+02	c	2.3[illegible]									
~Lead acetate	2.6E+00	c	1.1E+01	c	3.5[illegible]									
~Lead and Compounds	2.0E+02	G	8.0E+02	G	1.5E-01	G			1.5E+01	G	1.5E+01			1.4E+01
~Lead and Compounds (with other s	1.0E+02	G												
~Lead subacetate	1.4E+01	c	6.0E+01	c	2.6E-01	c	1.1E+00	c	2.1E+00	c		4.[illegible]	c	



K_d = partition (or distribution) coefficient; cm^3/g

$$SSL\left(\frac{mg}{kg}\right) = C_{gw} \cdot \left[K_d + \left[\frac{\theta_w\left(\frac{L_{water}}{L_{soil}}\right) + \theta_a\left(\frac{L_{air}}{L_{soil}}\right) \cdot H'}{\rho_b\left(\frac{g}{cm^3}\right)}\right]\right]$$

$$SSL\left(\frac{mg}{kg}\right) = 0.015 \cdot \left[\mathbf{900} + \left[\frac{0.3 + 0.134 \cdot 0}{1.5}\right]\right]$$

$$SSL\left(\frac{mg}{kg}\right) = 13.5$$

$$SSL\left(\frac{mg}{kg}\right) = 13.5 \cdot DAF \qquad SSL\left(\frac{mg}{kg}\right) = 13.5 \cdot 20$$

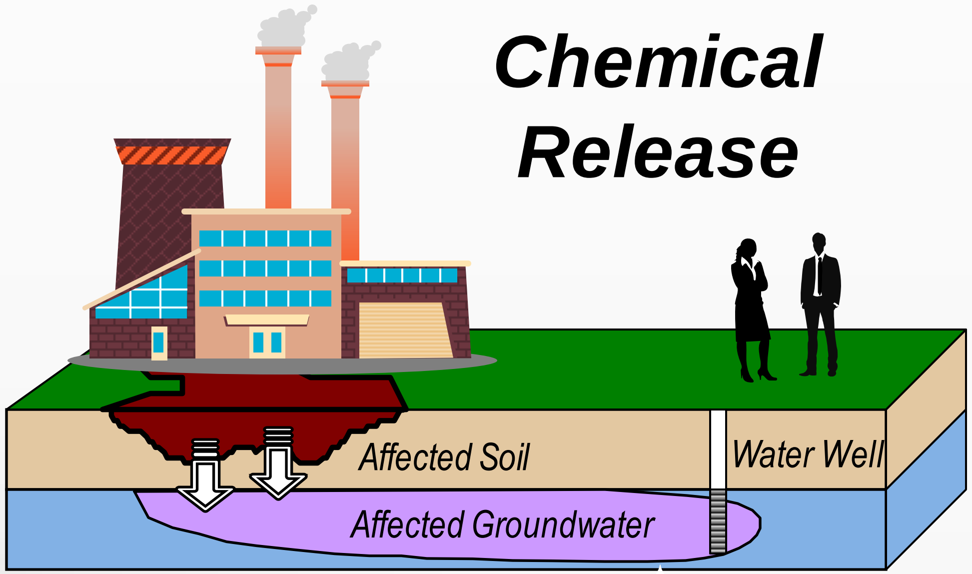
$$SSL\left(\frac{mg}{kg}\right) = \mathbf{270}$$

No risk-based RSL here

Uses a DAF of 1

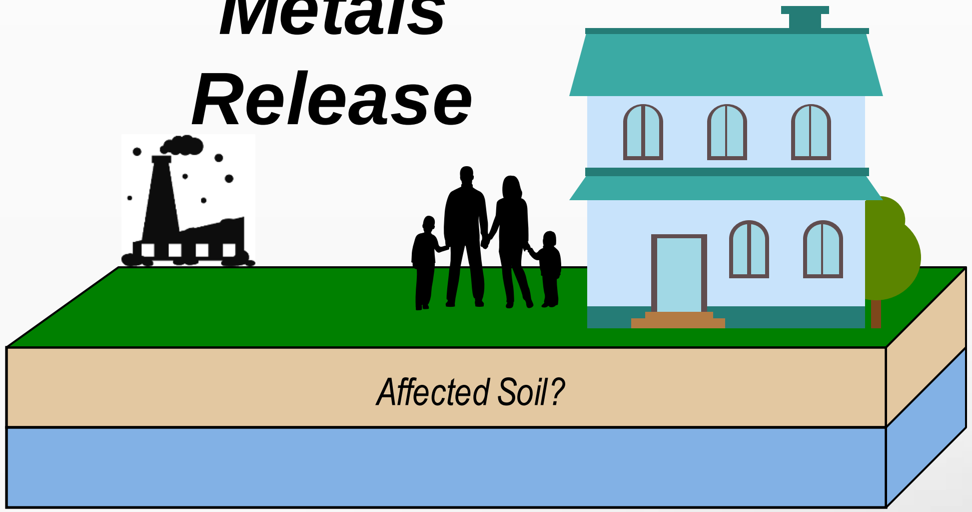
Source Size?

Chemical Release



Are results > Risk Criteria or Background?
(Not naturally occurring – no Background)

Metals Release



Are results > Risk Criteria or Background?
(Need [REALISTIC] Background)

Knowing *Background* informs when a release is suspected – or how large a source (release) may actually be.

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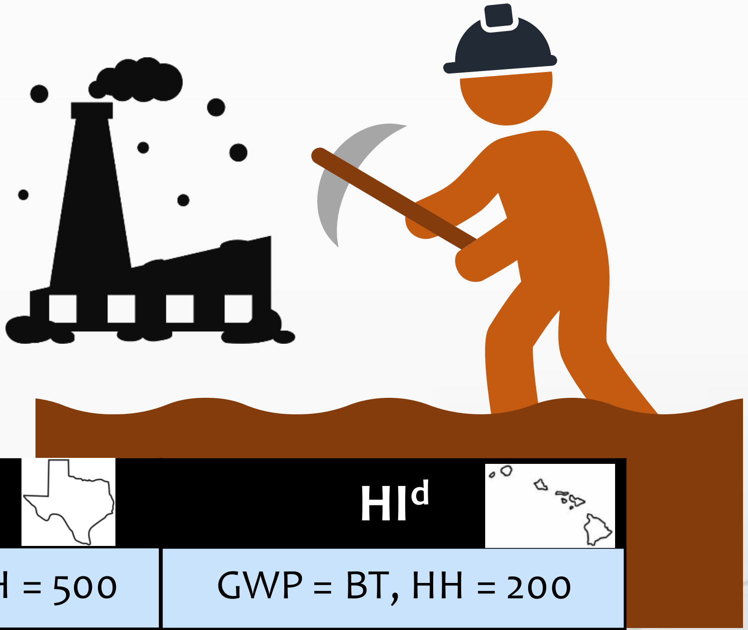
Back to work…

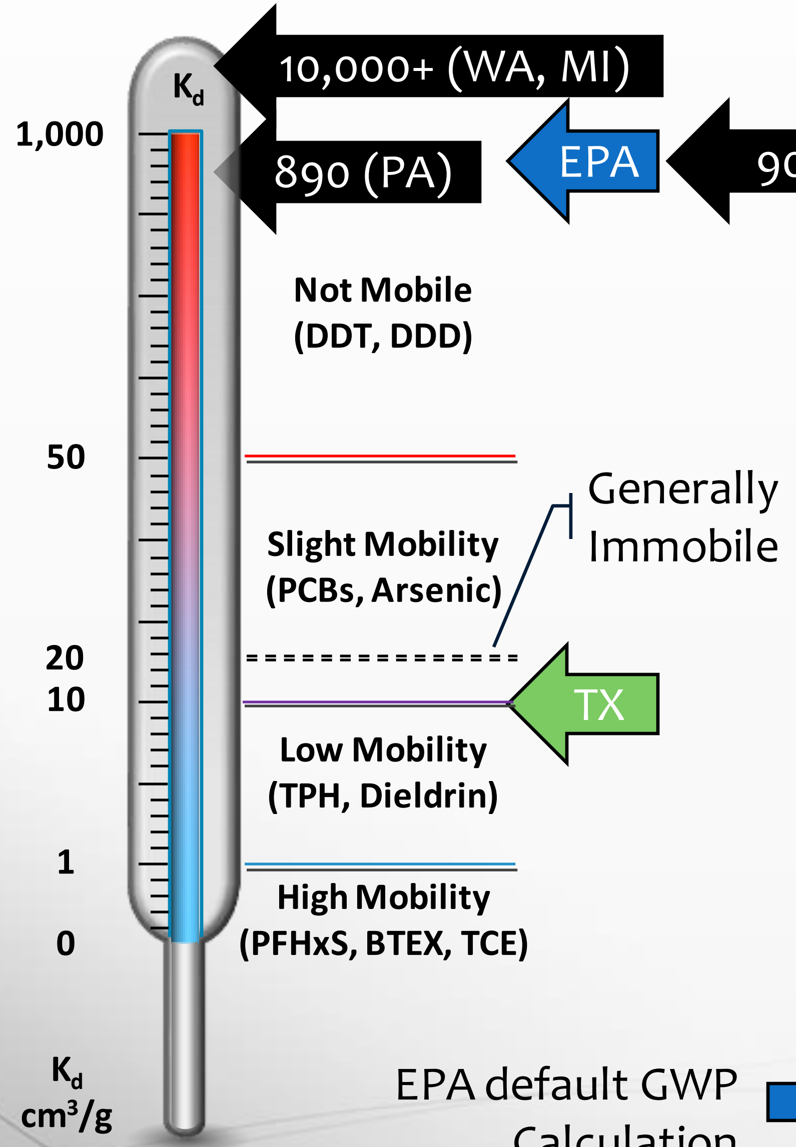
Example Scenario:

- You perform soil sampling to evaluate for a suspected regional lead emissions/release.
- Take 5 samples of shallow soil and analyze for lead
- Get back results. Lead ranges **from 22 to 27 mg/Kg.**
- Do you have a release?



	EPA RSL[a]	PA[b]	TX[c]	HI[d]
Risk Criteria	GWP = 14 (270), HH = 200	GWP = 450, HH = 500	GWP = 3.0, HH = 500	GWP = BT, HH = 200
Background	None	None	Median of 15	BTV of 73
Screening Value	*14 or (200?)*	*450*	*15*	*73*

All concentrations in mg/kg; GWP = soil-to-groundwater value; HH = human health value
a – EPA RSL Calculator [CR of 10-6; NCR = 0.1]; May 2024
b – PADEP MSCs [CR of 10-5; NCR = 1]; Note: the CSSAB references 2013 USGS data– July 2022
c – TCEQ TRRP (§350) assuming source is <0.5 acre (Tier 1 PCL) [CR of 10-5; NCR = 1]; Apr 2024 and Texas-specific Soil Background Concentrations (TSSBCs)
d – Hawaii EALs; BT= Batch Testing on a "site-by-site basis and discussed with HIDOH where necessary."



Adapted from HDOH 2007

Why is TX GWP value so low?

K_d Impacted by soil type and soil pH assumptions

EPA default GWP Calculation

$$SSL\left(\frac{mg}{kg}\right) = 0.015 \cdot \left[900 + \left[\frac{0.3 + 0.134 \cdot 0}{1.5}\right]\right]$$

TCEQ default GWP Calculation

$$^{GW}Soil\left(\frac{mg}{kg}\right) = 0.015 \cdot \left[10 + \left[\frac{0.16 + 0.21 \cdot 0}{1.67}\right]\right]$$

	DAF = 1	DAF = 20
EPA	13.5	270
TCEQ	0.15	3.0
		mg/kg

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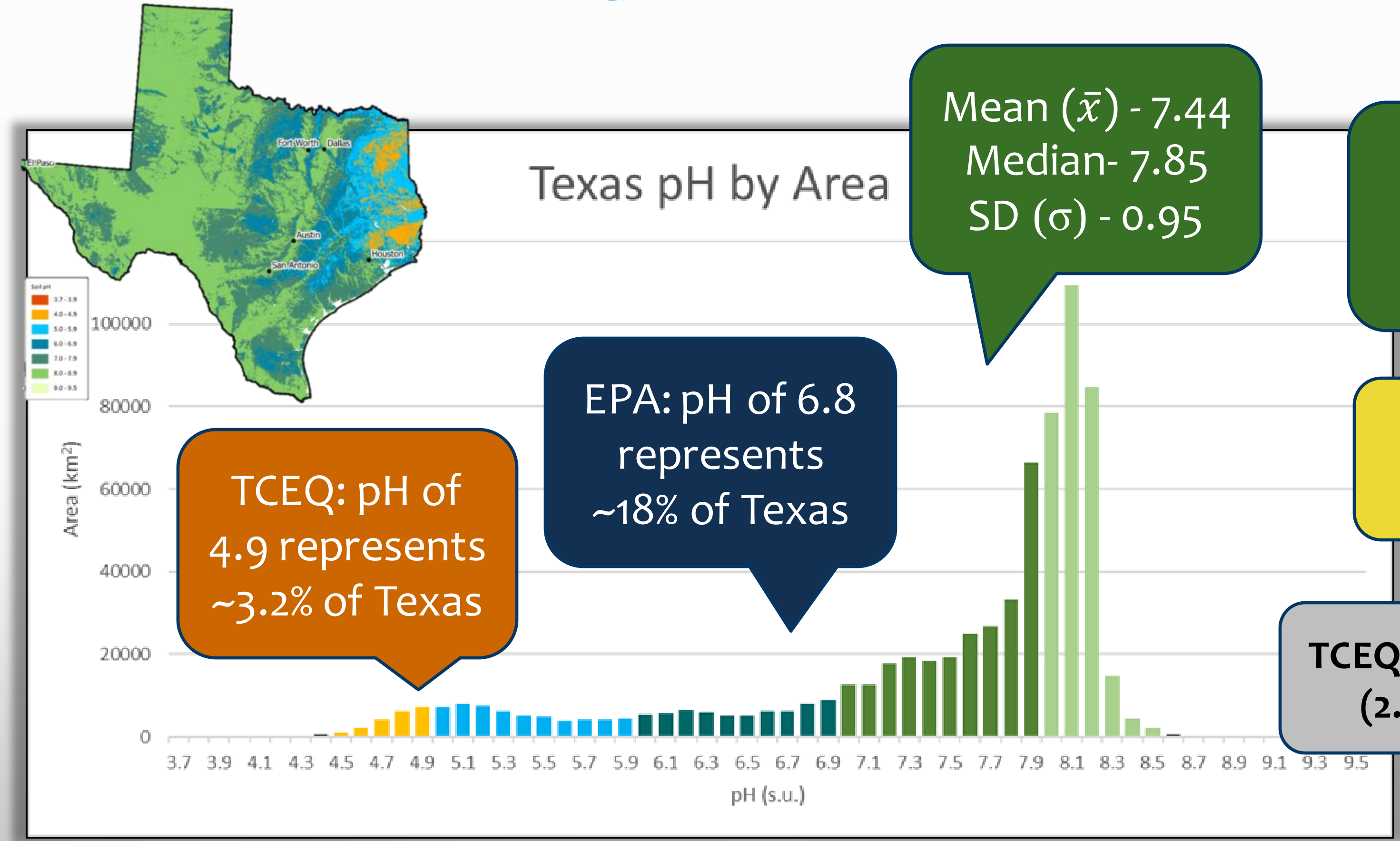
Texas K_d Assumptions: Soil pH = 4.9; Sandy Soil



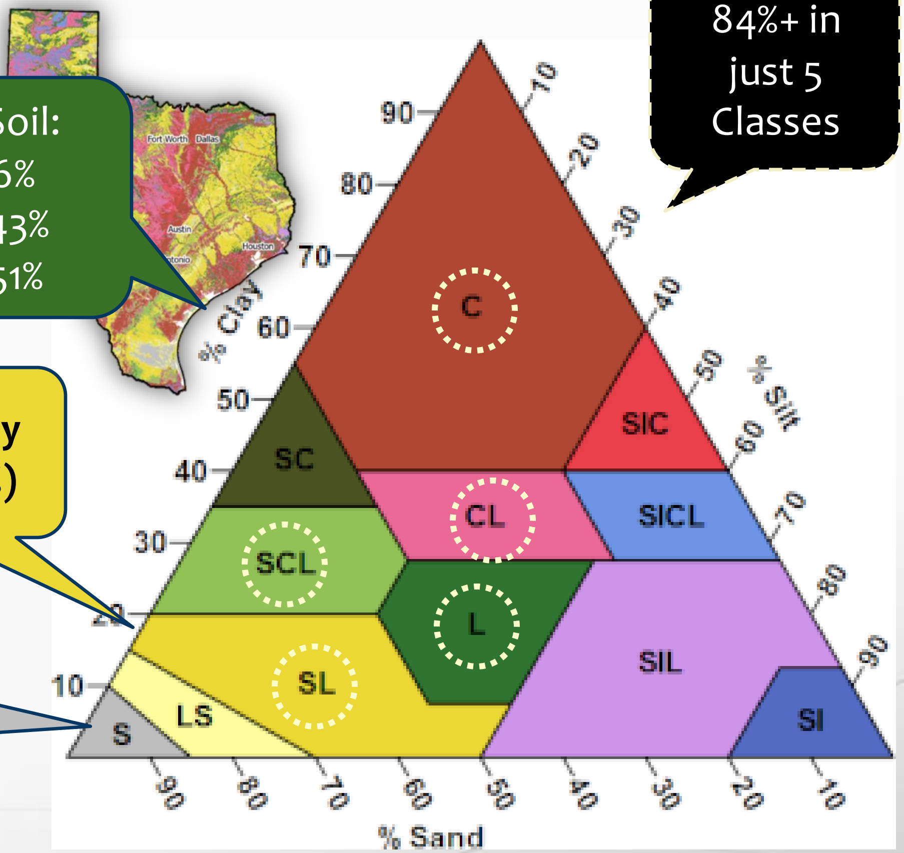
TCEQ: pH of 4.9 represents ~3.2% of Texas

EPA: pH of 6.8 represents ~18% of Texas

Mean ($\bar{x}$) - 7.44
Median- 7.85
SD (σ) - 0.95

Surface Soil:
Sandy: 6%
Loamy: 43%
Clayey: 51%

84%+ in just 5 Classes



EPA: Sandy Loam (17%)

TCEQ: Sand (2.9%)

USDA Soil Survey Manual (Agriculture Handbook No. 18); 2018

Why important? At pH >7 lead "exponentially less likely to leach to groundwater vs below pH of 7." (ORNL-5786; 1984) : *EPA- "At pH values above 6, lead is either adsorbed on clay surfaces or forms lead carbonate." (EPA 1992; 540/S-92/018)*; NRCS - Clayey soil has higher Cation Exchange Capacity (a measure of the soil's ability to hold positively charged ions) – less leaching potential (i.e., Pb+2)

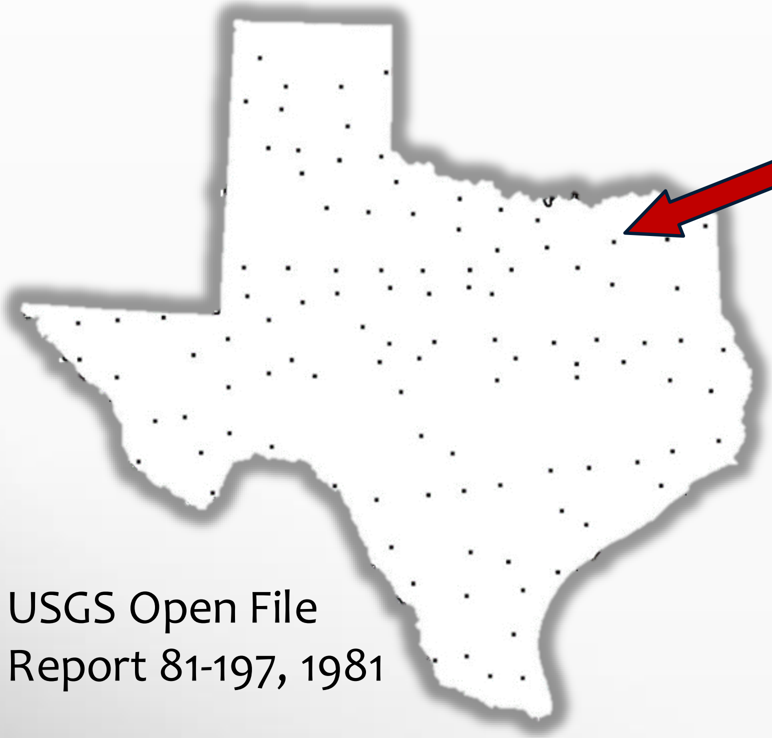
Reference: Walkinshaw, Mike, A.T. O'Geen, D.E. Beaudette. "Soil Properties." California Soil Resource Lab, 1 Oct. 2022, casoilresource.lawr.ucdavis.edu/soil-properties/.
https://casoilresource.lawr.ucdavis.edu/soilweb-apps/

Is the TX Background value too low?

Texas Sources:

1981: Up to 119 samples.

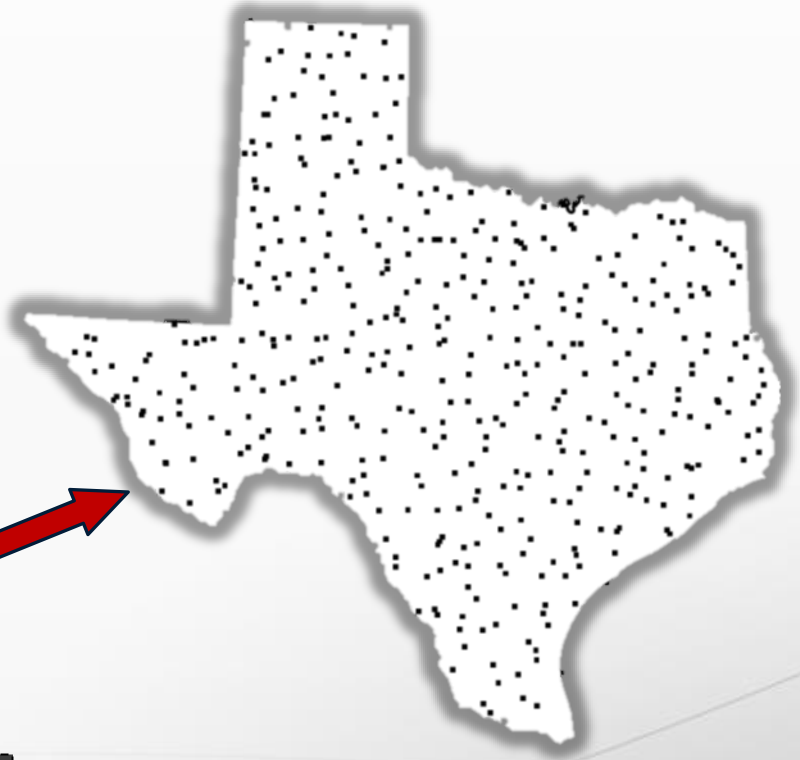
USGS Data Series 801 available here:
https://mrdata.usgs.gov/ds-801/



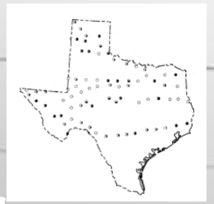
USGS Open File Report 81-197, 1981

1981 USGS Dataset*
TSSBC uses the median value from this **119 sample dataset** (all at 20cm depth)

2013 USGS Dataset
More comprehensive data now exists to allow better state and localized regional background estimates.



* TSSBC incorrectly cites USGS PP 574-F from 1975



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2013 USGS effort

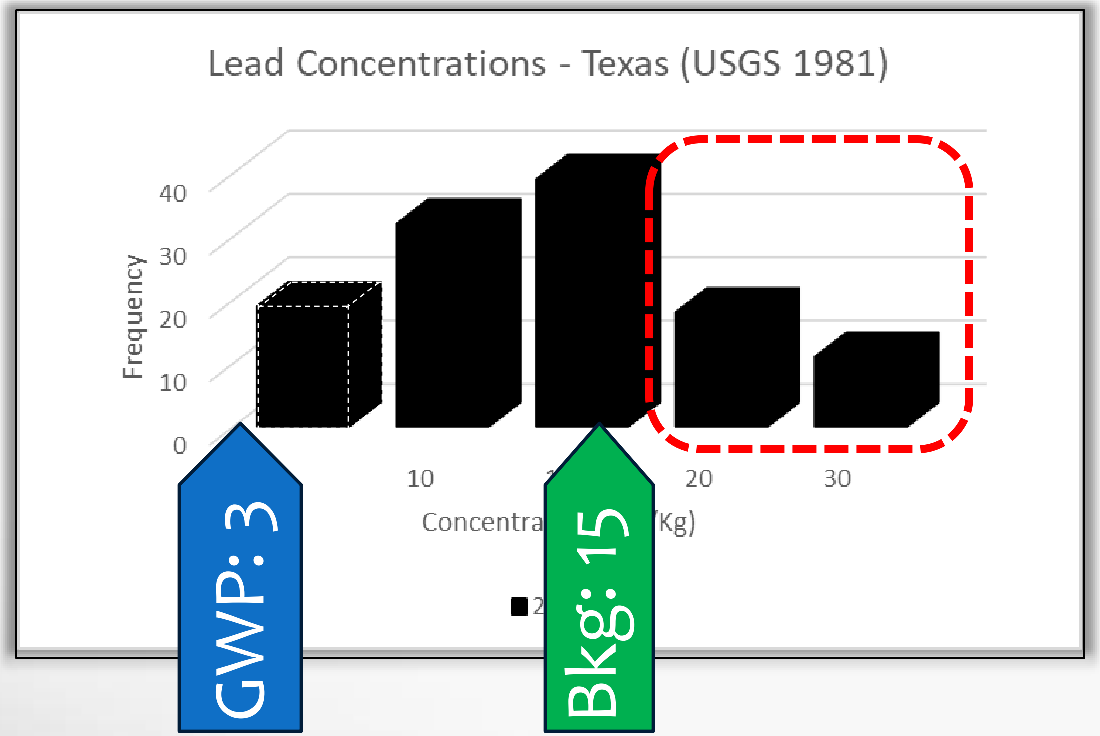
Extensive QA/QC and No samples collected:

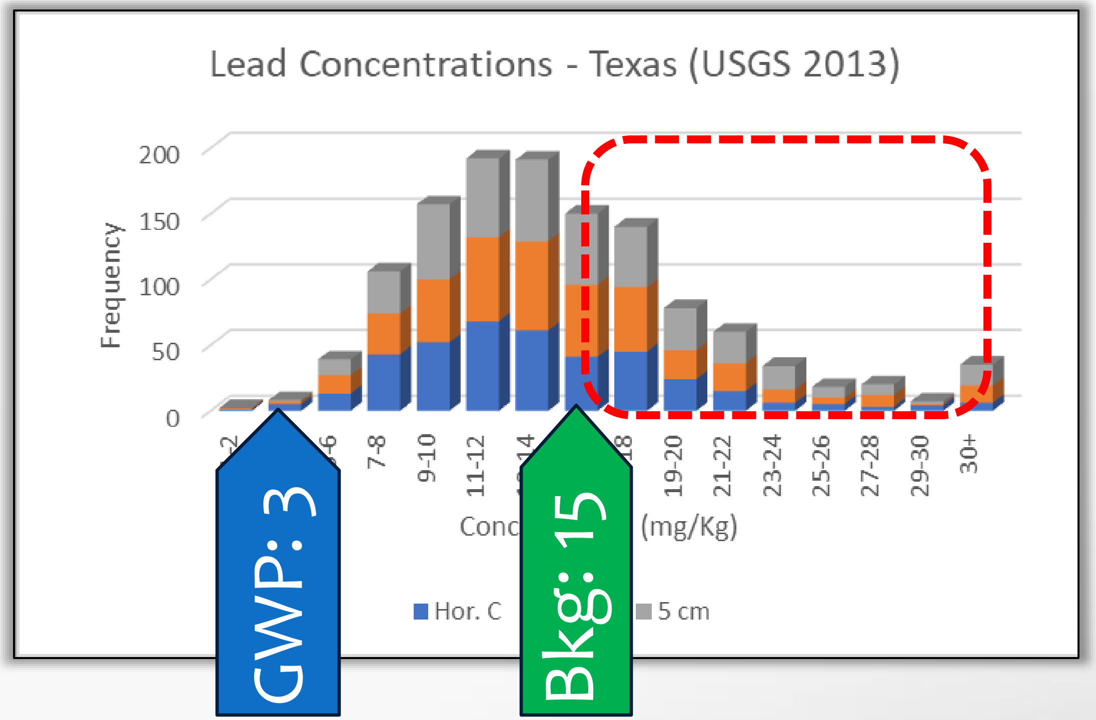
1) within 200 m of a major highway;
2) within 50 m of a rural road;
3) within 100 m of a building or structure; &
4) within 5 km downwind of industrial activities such as power plants or smelters.

2013: Number of Texas observations (n = 433). Up to 3 samples at intervals from surface to 3.3 feet below grade.

Up to **1,237 samples**.

1981 vs. 2013– Visualizing False Positives

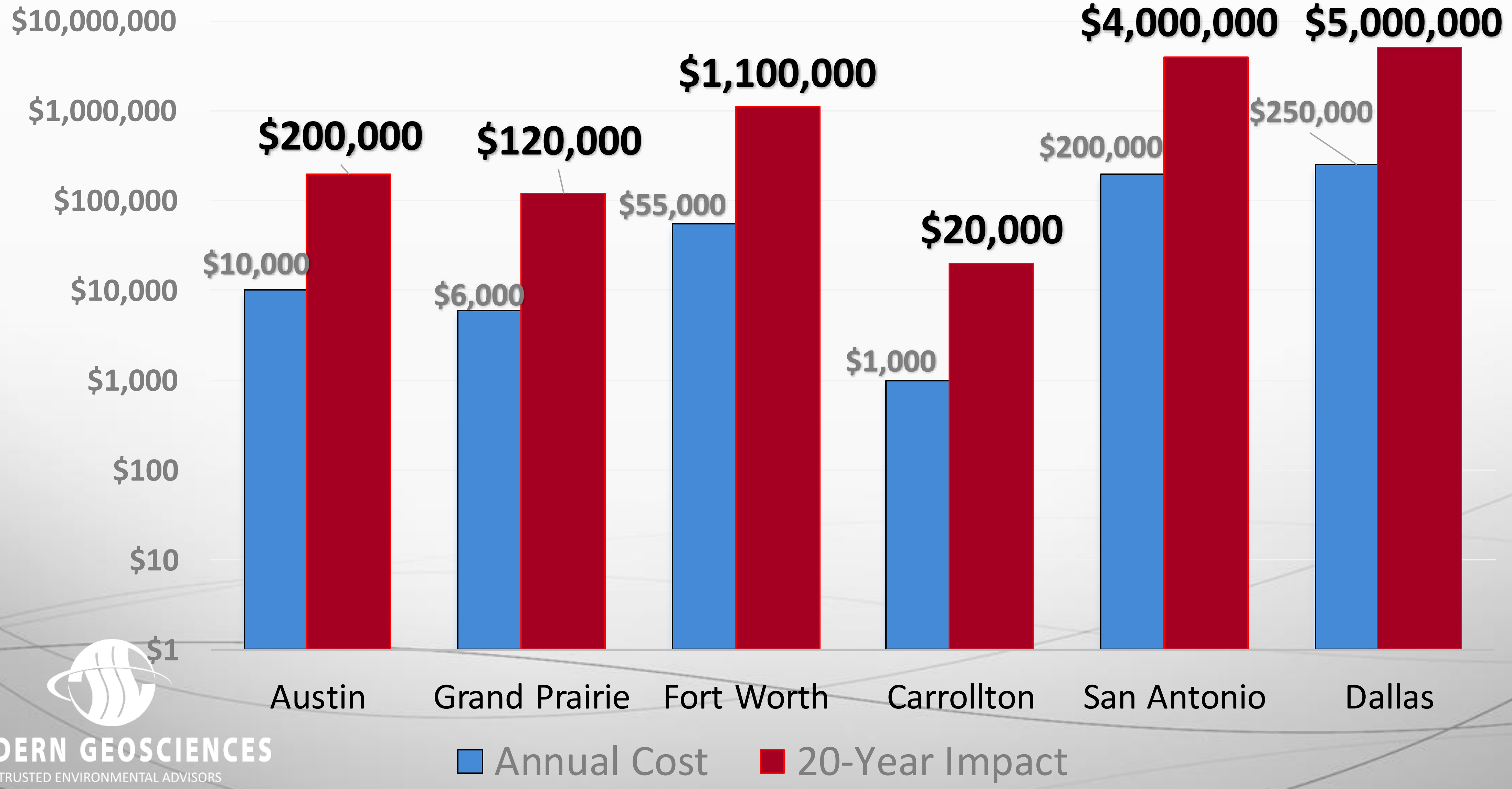




Yes. A median "Background" is too low.

Note: 1981 Lead SDL was 10 mg/Kg. Histogram includes 19 NDs as ½ SDL.

False Positive – Municipal Impact



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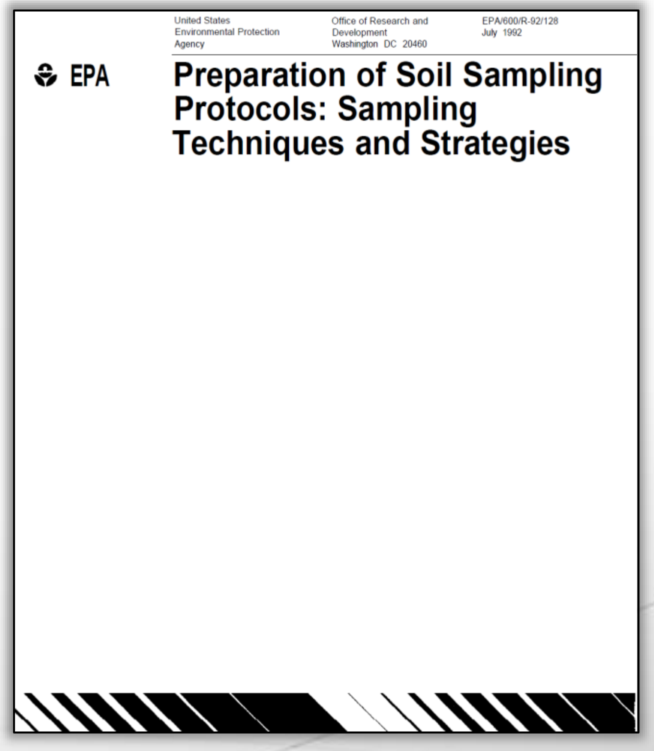
Is there a better way to represent Background?

EPA's thoughts…

"Spatial variability of soil is not an academic question. It is a real landscape attribute; our unwillingness or inability to identify it in no way decreases its magnitude or existence. . . . **As scientists we must document the magnitude and form of soil variability; accommodate its existence in models of soils**; and transmit accurately the expected pattern and implication of spatial changes to users of soil resources. Soils are not material specific; **many soil properties are not single valued**, many are transient, and many are not randomly distributed but rather systematically time and **spatially dependent.** The dilemma is that soils are not isotropic media but rather they are strongly anisotropic laterally and vertically."

-Larry Wilding (Texas A&M; 1976-2003)



United States Environmental Protection Agency | Office of Research and Development Washington DC 20460 | EPA/600/R-92/128 July 1992

EPA

Preparation of Soil Sampling Protocols: Sampling Techniques and Strategies

EPA 1992 (EPA/600/R-92/128)
Wilding, L. P. 1985

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Background Threshold Value

- **ITRC:** BTV = A single value used to represent soil background (easier to use in screening).
- **EPA:** The BTV is "representing an upper threshold of the background population…" BTVs "should be estimated by statistics representing the dominant background population represented by the majority of the data set."

United States Environmental Protection Agency | Office of Solid Waste and Emergency Response | Directive 9285.7-19FS PB94-963313 EPA/540/F-94/030 September 1995

EPA **Establishing Background Levels**

In some cases, published background levels may exist that can be applied to a specific site. The following published data sources may be consulted:

- Background sample results from other nearby CERCLA site investigations
- Local surveys by other Federal or State agencies (e.g., U.S. Geological Survey (USGS), Soil Conservation Service (SCS))
- University studies
- Tables or databases with natural concentration ranges and averages in local or regional soils (OSWER Directive 9345.1-05)

Where do we get "background?"

- EPA 1995 (EPA/540/F-94/030)
- Interstate Technology Regulatory Council (ITRC) 2022 (Soil Background and Risk Assessment)
- EPA 2022 (ProUCL 5.2 User Guide; 5.1 Technical Guide)

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EPA 2006, 2020 and ITRC 2022

Statistical Tools

Parameter		
Mean ($\bar{x}$)	$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$	Arithmetic average; a measure of central tendency Note: For right skewed distribution Mean > Median.
Median (M)	$M = \frac{x(\frac{n+1}{2})}{2}$ n is odd; $M = \frac{x\left(\frac{n}{2}\right) + x\left(\frac{n}{2}+1\right)}{2}$ n is even	Middle observation of the distribution; 50th percentile; half of data are above and Below. Not influenced by extremes of contaminant distribution. Measure of central tendency.
Mode		The value that occurs most often in the distribution; a measure of central tendency
Standard Deviation (σ)	$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$	an estimate of the degree of variability within a distribution, indicating how much the values typically vary from the average value or mean
Coefficient of Variance (CV)	$CV = \frac{\sigma}{\bar{x}}$	provides a quick and useful indication of the relative degree of variability within a data set.
Relative Percent Difference (RPD)	$\lvert RPD \rvert = \frac{(\bar{x} - M)}{\left\lvert \frac{\bar{x} + M}{2} \right\rvert} \cdot 100$	Relative difference between the mean and median. EPA – "If the mean is approximately equal to the median, then the data are distributed symmetrically." 10% RPD goal.

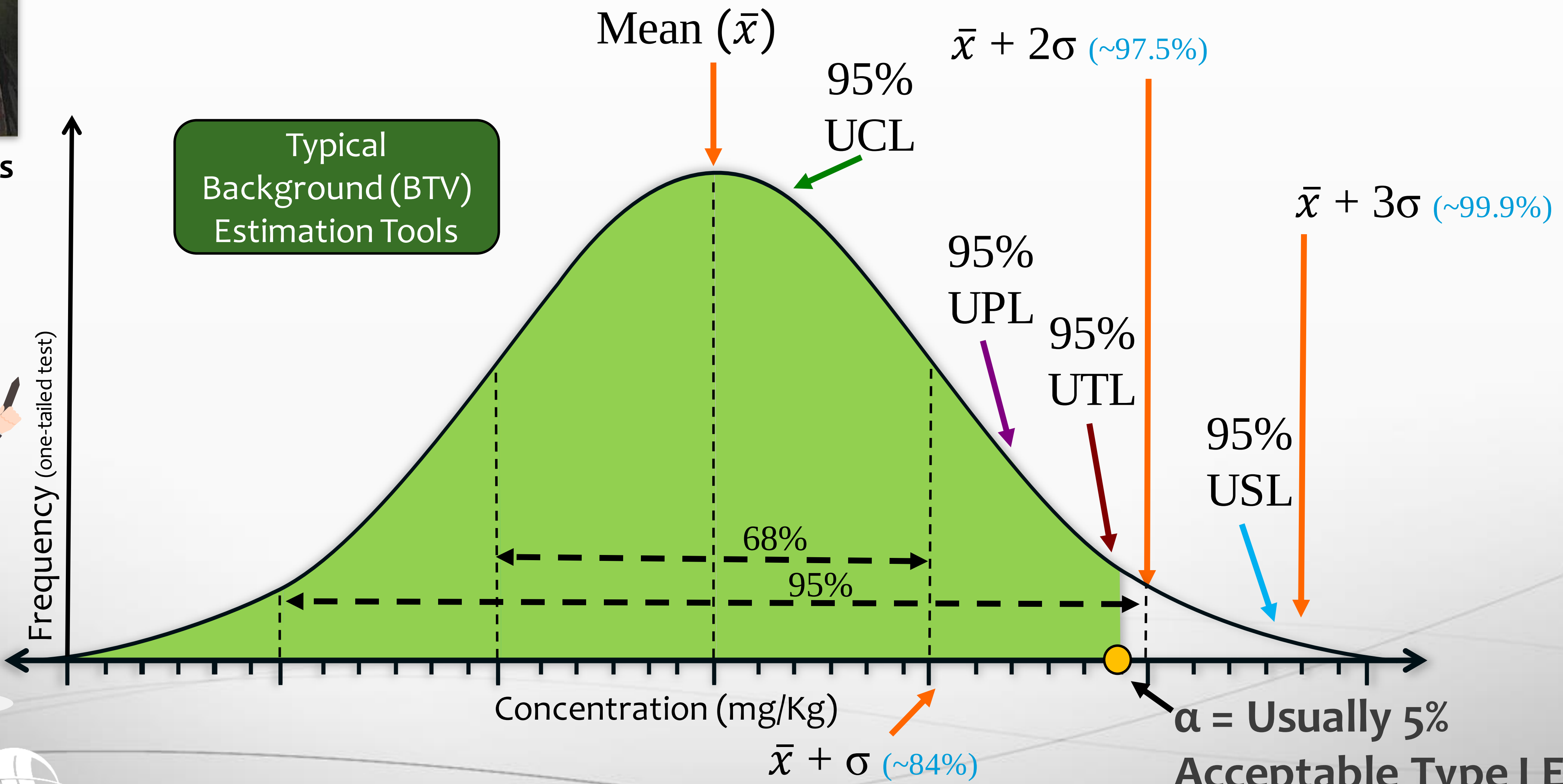
Statistical Tools

Confidence Limits	
Upper Confidence Limit (UCL): $95\%\ UCL = \bar{x} + [t \cdot \left(\frac{\sigma}{\sqrt{n}}\right)]$	The upper boundary (or limit) of a confidence interval of a parameter of interest such as the population mean. Not suggested for use in evaluating background values.
Upper Prediction Limit (UPL): $95\%\ UPL = \bar{x} + [t \cdot \sigma \cdot \sqrt{1 + \frac{1}{n}}]$	The upper boundary of a prediction interval for an independently obtained observation (or an independent future observation).
Upper Tolerance Limit (UTL) $95\%\ UTL = \bar{x} + (k \cdot \sigma)$	A confidence limit on a percentile of the population rather than a confidence limit on the mean. In other words, a 95% UTL with coverage coefficient 95% represents a 95% UCL for the 95th percentile.
Upper Simultaneous Limit (USL): $95\%\ USL = \bar{x} + \sigma\ \cdot d_{2a}^{b}$	The upper boundary of the largest value within a specified level of confidence. Only applied when no outliers are suspected in the dataset.

EPA 2020 and ITRC 2022

Normal (Gaussian) Distribution

Carl F. Gauss
1777-1855



α = Usually 5%
Acceptable Type I Error Rate ("False Positive")

Utilizes one-tailed test evaluation and empirical rule [68-95-99.7]

Mean, **Median** & Mode are equal in perfect theoretical gaussian distribution and denoted by µ (mu)

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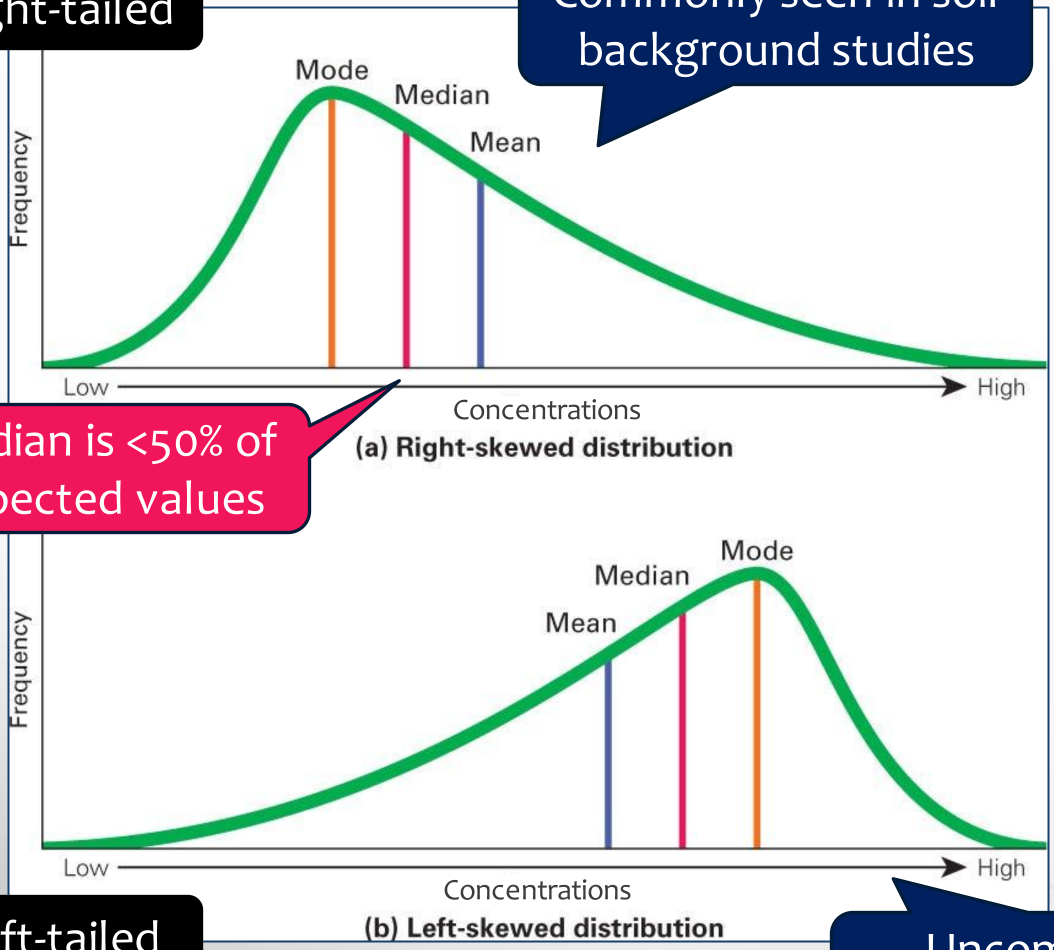
Real World Distributions

Right-tailed

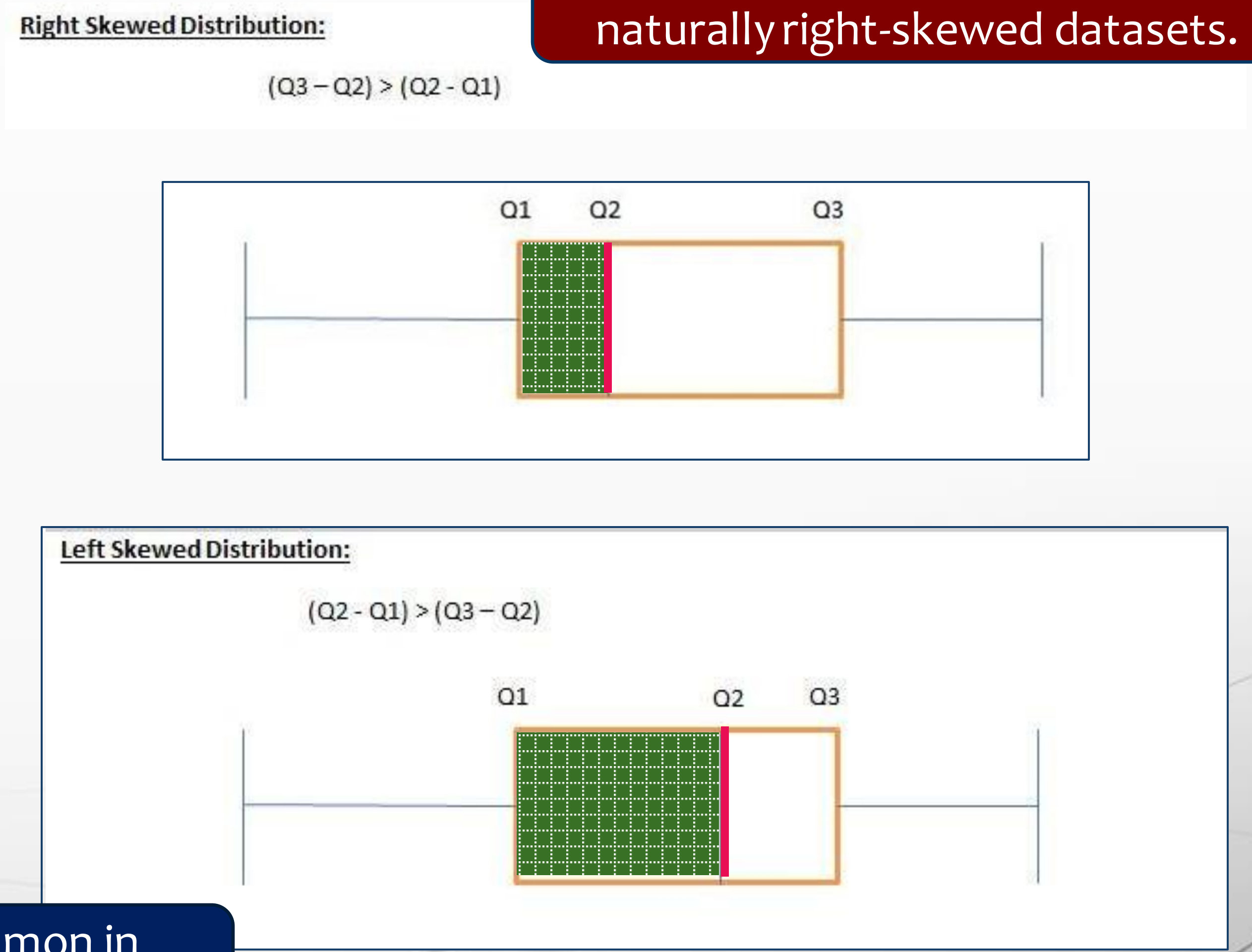
Commonly seen in soil background studies

Median is a poor statistic within naturally right-skewed datasets.



Median is <50% of expected values

Left-tailed



Uncommon in natural distributions

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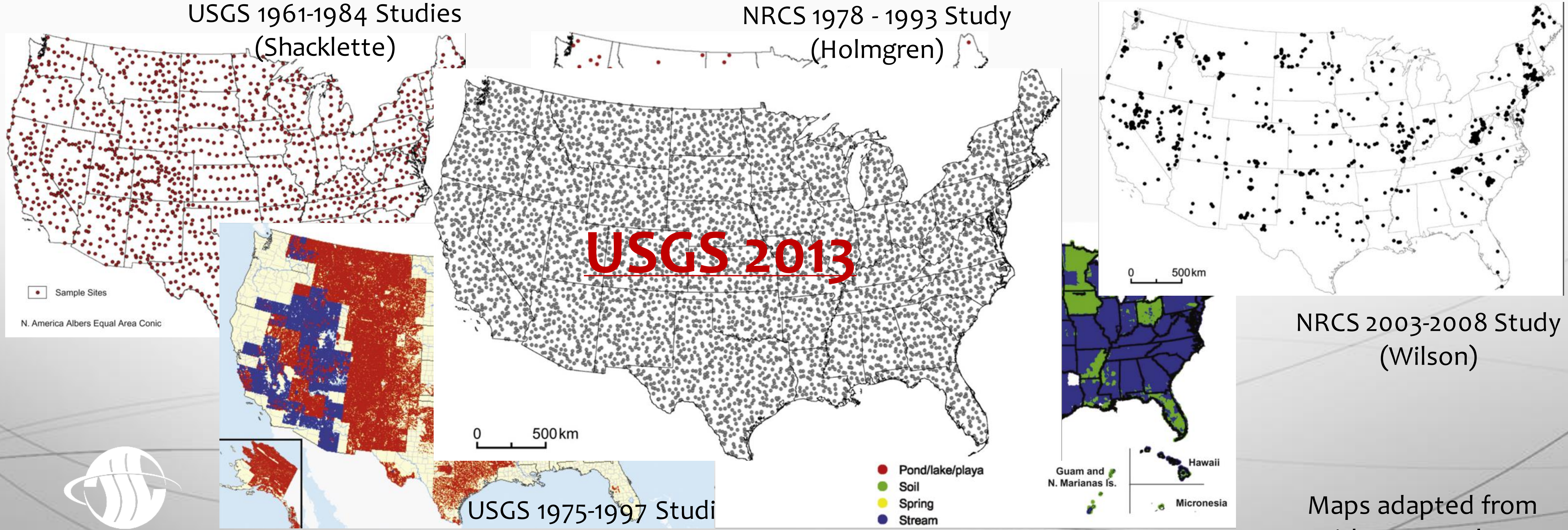
EPA 1992, EPA 2020, Medium.com 2023

What Data?

* *1-Local data always preferred – but rarely available for general screening.*
* *2-State/Local agency data – next most preferred*
* *3-USGS or similar – best alternative if you do not have Local/State data*



USGS 1961-1984 Studies (Shacklette)

NRCS 1978 - 1993 Study (Holmgren)

NRCS 2003-2008 Study (Wilson)

USGS 1975-1997 Studi (NURE-HSSR) Soil (blue), Sediment (Red)

USGS National Geochemical Survey 1997-2004 (Holmgren)

Maps adapted from Smith, D.B. et al. 2012 (*Geoscience Frontiers*)

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Which BTV Estimator?

EPA & States commonly use a CV ≤1 for acceptance of UPL or UTL. This new approach adds more requirements before consideration of any BTV Estimator.

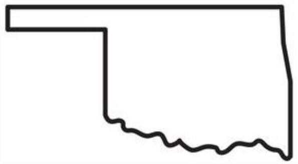
We proposed three key criteria:

* *CV of dataset*
* *R (correlation) of the Q-Q Plot*
* *Relative Percent Difference (RPD) between Mean and Median (for USL use)*

Table 1: BTV Estimator Selection			
BTV Estimator	Description	Minimum Sample Set	Normality Performance Goals
UPL	Most Conservative, Least Inclusive	8	• R of $\geq|0.7|$ and CV of ≤ 1.0
UTL	Moderately Conservative, Moderately Inclusive	8	• R of $\geq|0.85|$ and CV of ≤ 0.85
USL	Least Conservative, Most Inclusive	20	• R of $\geq|0.95|$ and CV of ≤ 0.5 • $|RPD|$ of $\bar{x}$ and M $\leq 10\%$

Note: utilize ½ of the detection limit for non-detected samples – up to 15% of dataset. Beyond this, other statistical methods would apply – and require regulatory concurrence.

Example: Oklahoma USGS Data



Oklahoma						
	Lead					
Censoring	None	<100	<50	<45	<30	
n	333	331	329	325	316	
Min	5.3	5				
Max	122	5				
Mean	16.09	1				
Median	13.40	1				
RPD	18.24	14				
std d	10.870	7.				
CV	0.676	0.				
R	0.748	0.				
BTV Estimators						
95%UPL	34.05	28				
95%UTL	35.55	29				
95%USL	55.03	42				

Total Number of Observations	333	Number of Distinct Observations	164
Minimum	5.3	First Quartile	10.9
Second Largest	109	Median	13.4
Maximum	122	Third Quartile	17.4
Mean	16.09	SD	10.87
Coefficient of Variation	0.676	Skewness	5.42
Mean of logged Data	2.664	SD of logged Data	0.432
Critical Values for Background Threshold Values (BTVs)			
Tolerance Factor K (For UTL)	1.79	d2max (for USL)	3.582
Normal GOF Test			
Shapiro Wilk Test Statistic	0.595	Normal GOF Test	
1% Shapiro Wilk P Value	0	Data Not Normal at 1% Significance Level	
Lilliefors Test Statistic	0.203	Lilliefors GOF Test	
1% Lilliefors Critical Value	0.0566	Data Not Normal at 1% Significance Level	
Data Not Normal at 1% Significance Level			
Background Statistics Assuming Normal Distribution			
95% UTL with 95% Coverage	35.55	90% Percentile (z)	30.02
95% UPL (t)	34.05	95% Percentile (z)	33.97
95% USL	55.03	99% Percentile (z)	41.38

Step 1: Select data (USGS No. 801)

Step 2: Process within EPA's ProUCL and review the BTV output (at left)

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2013 USGS Data

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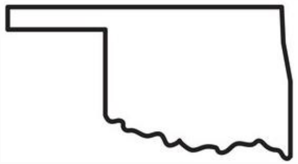
Example: Oklahoma USGS Data



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Step 1: Select data (USGS No. 801)

Step 2: Process within EPA's ProUCL and review the BTV output (at left)

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d without low
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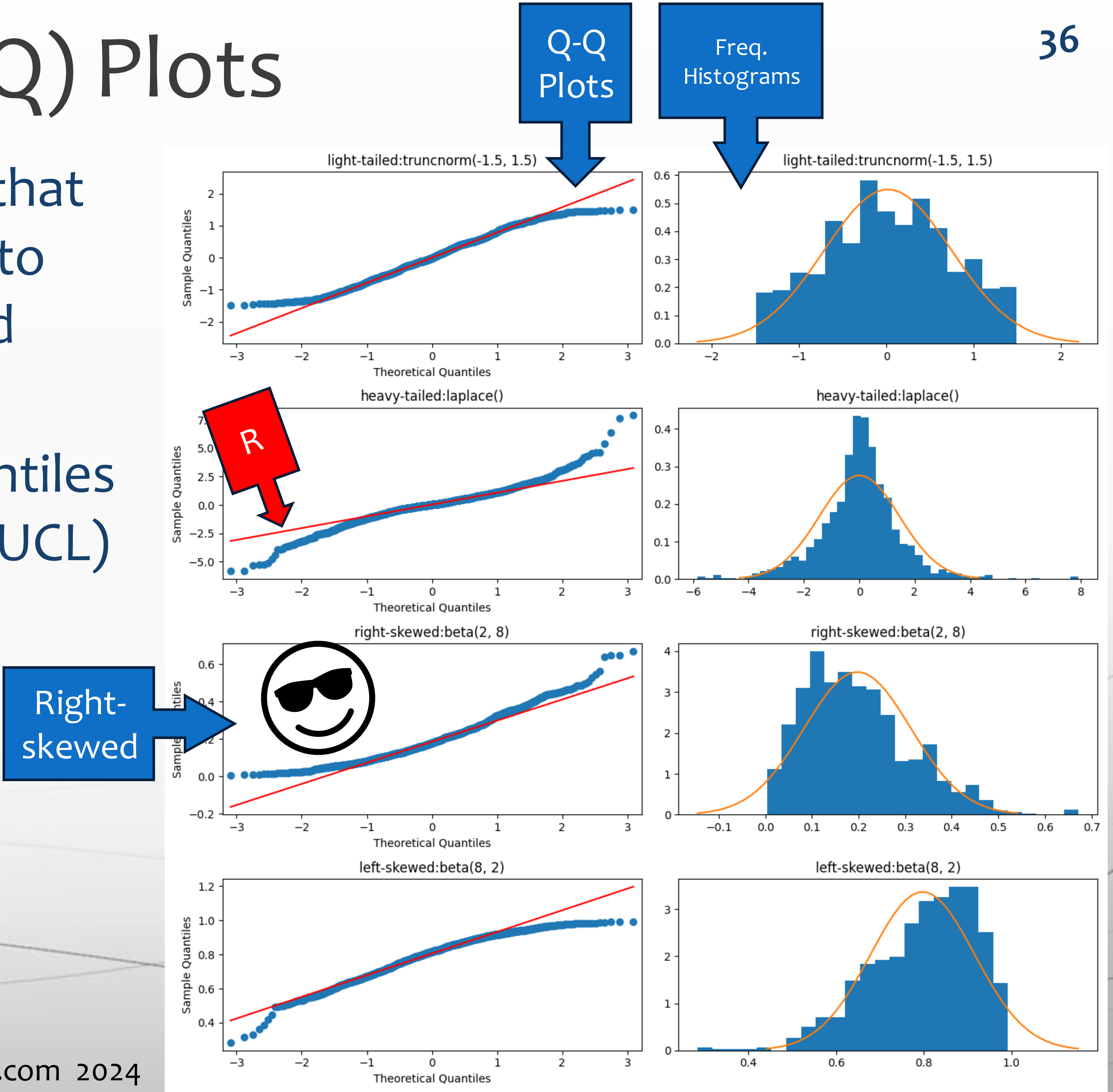
All concentrations in mg/kg

2013 USGS Data

Quantile-Quantile (Q-Q) Plots

- 2D plot of theoretical quantiles that serves as an "exploratory" tool to understand possible outliers and data distributions
- X-axis presents percentiles/quantiles of the distribution (6 bins in ProUCL)
- Y-axis presents measured concentrations
- Breaks and jumps can suggest subpopulations or outliers



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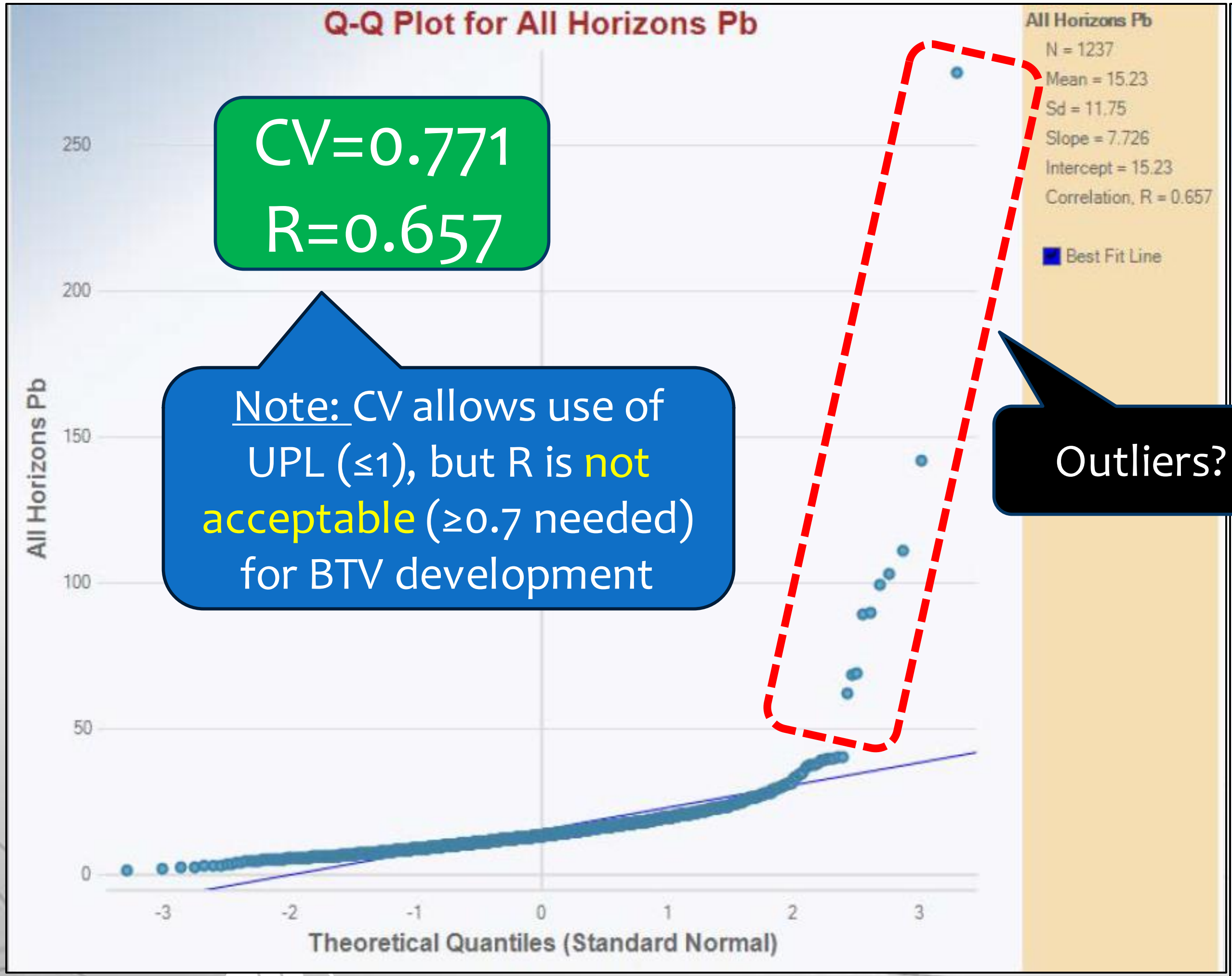
Stackexchange.com 2024

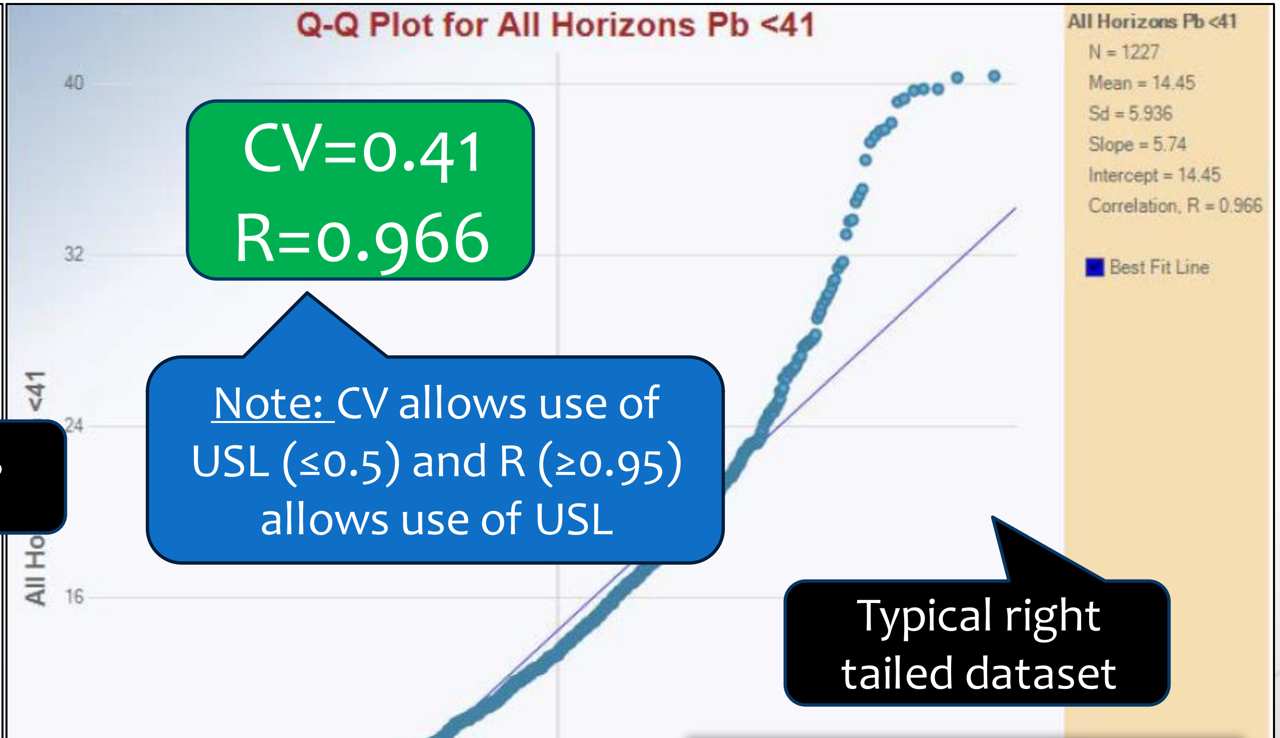
Example TX lead dataset Q-Q Plots



CV=0.771
R=0.657

Note: CV allows use of UPL (≤1), but R is not acceptable (≥0.7 needed) for BTV development

Outliers?

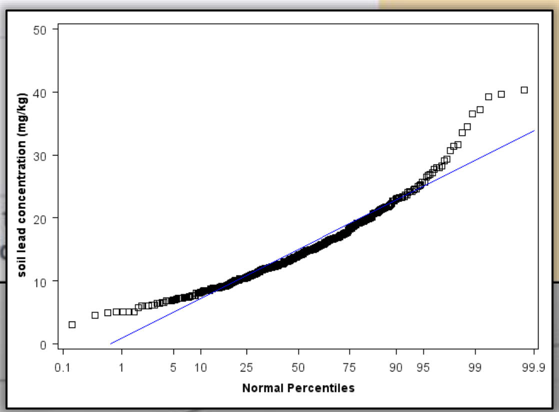


CV=0.41
R=0.966

Note: CV allows use of USL (≤0.5) and R (≥0.95) allows use of USL

Typical right tailed dataset

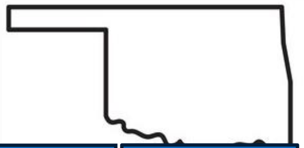
Look familiar? This is from EPA for USGS data in TX, censoring where we suggested too.

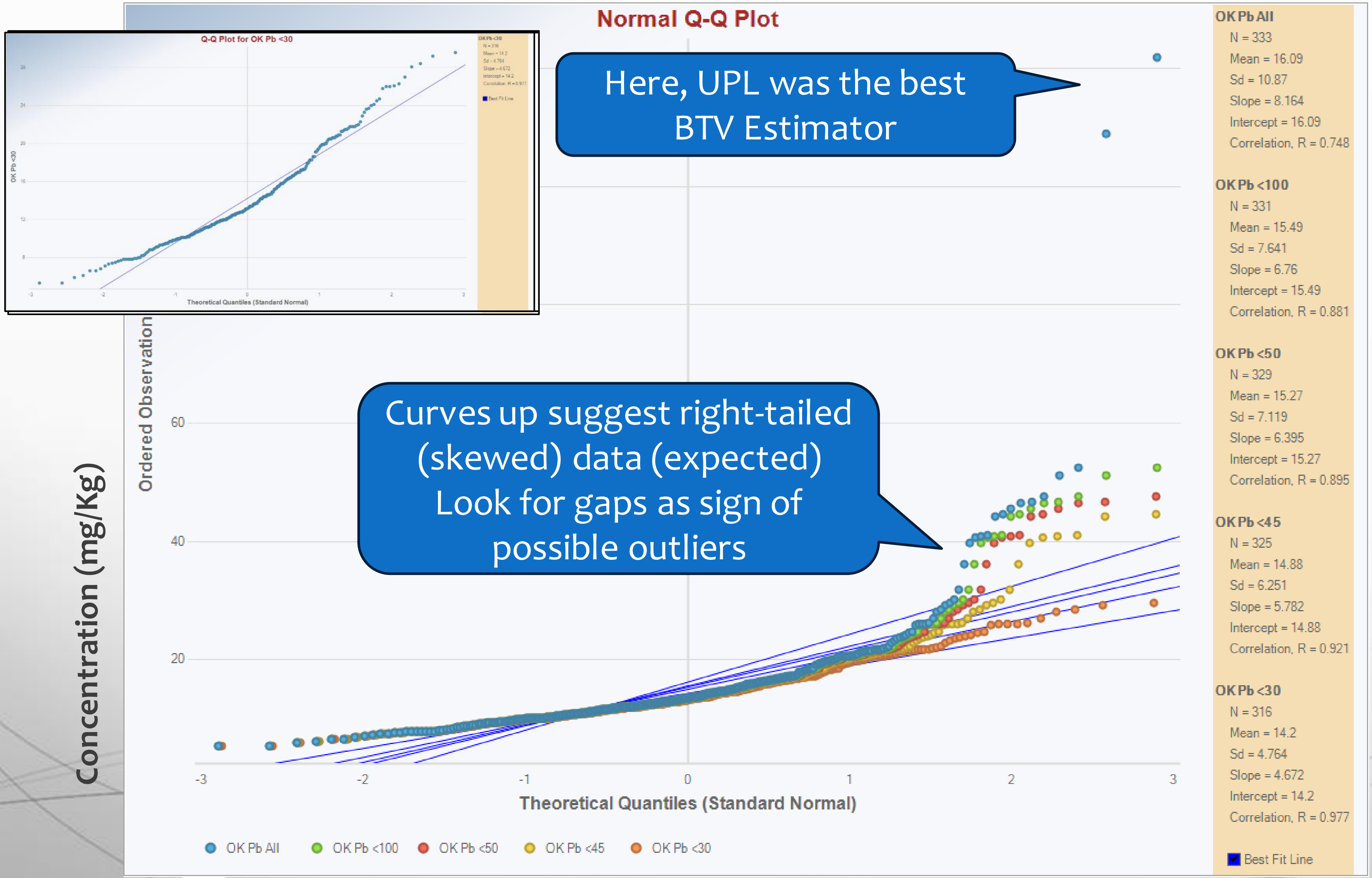


https://www.epa.gov/superfund/usgs-background-soil-lead-survey-state-data

2013 USGS Data

Example: Oklahoma USGS Data



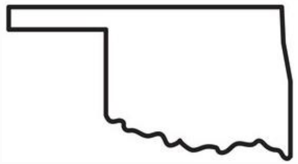


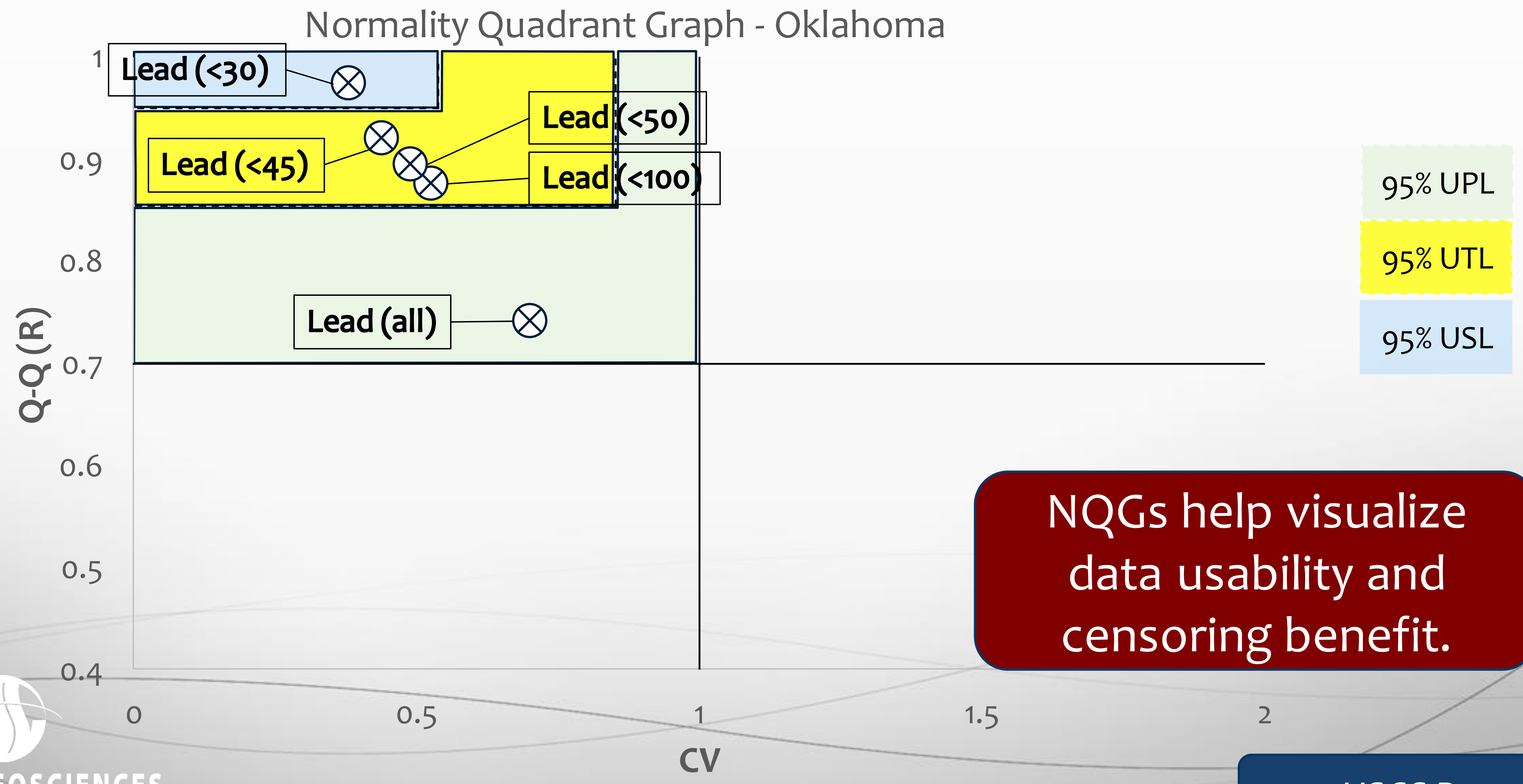
CV: 0.676 R: 0.748 RPD: 18.24	UPL: 34.05
CV: 0.493 R: 0.881 RPD: 14.47	UTL: 29.17
CV: 0.466 R: 0.895 RPD: 13.04	UTL: 28.02
CV: 0.42 R: 0.94 RPD: 10.47	UTL: 26.09
CV: 0.336 R: 0.977 RPD: 7.68	USL: 31.2

More Conservative BTV Estimator Applied

ProUCL creates 6 quantiles and plots in ascending order with median at 0

Example: Oklahoma USGS Data





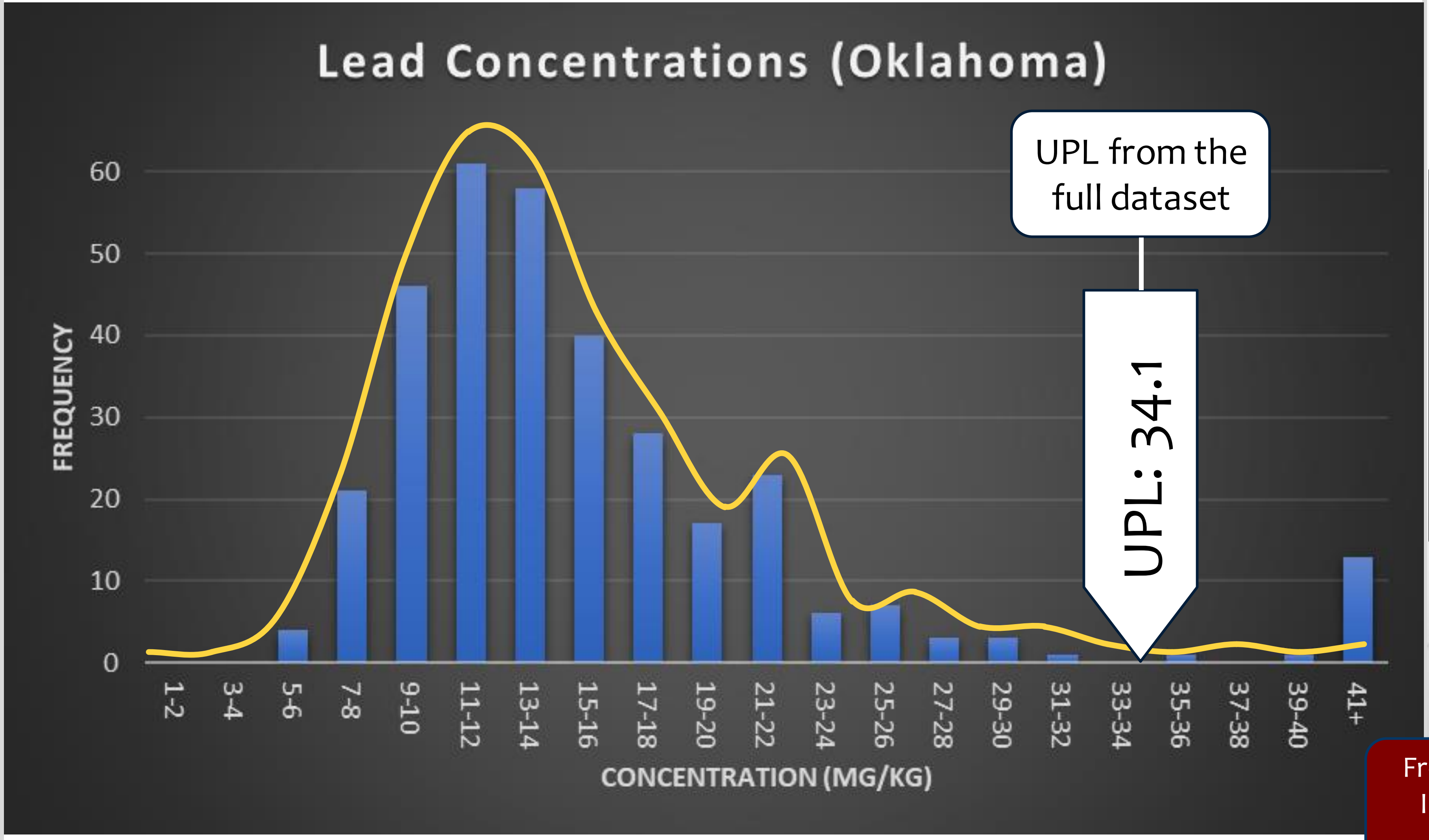
NQGs help visualize data usability and censoring benefit.

2013 USGS Data

Example: Oklahoma USGS Data

<30
$\bar{x}$: 14.2
M: 13.15
RPD: 7.68%
CV: 0.34
R: 0.98

Frequency
(# samples at this concentration)



BTV Options:
UPL –
UTL –
USL –

Frequency Histogram Improvement with censoring

2013 USGS Data

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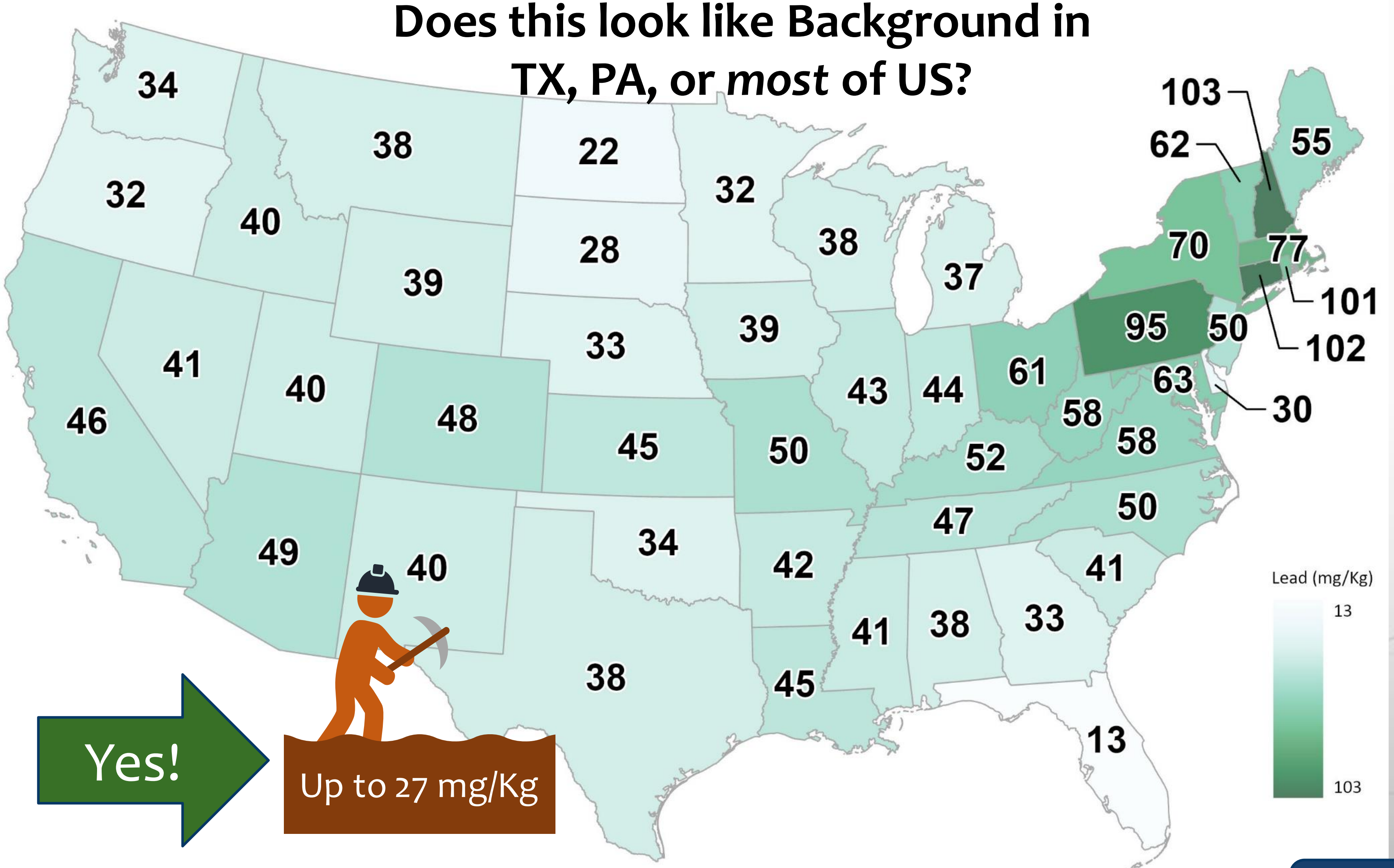
Conterminous US: Lead BTVs

Does this look like Background in TX, PA, or *most* of US?



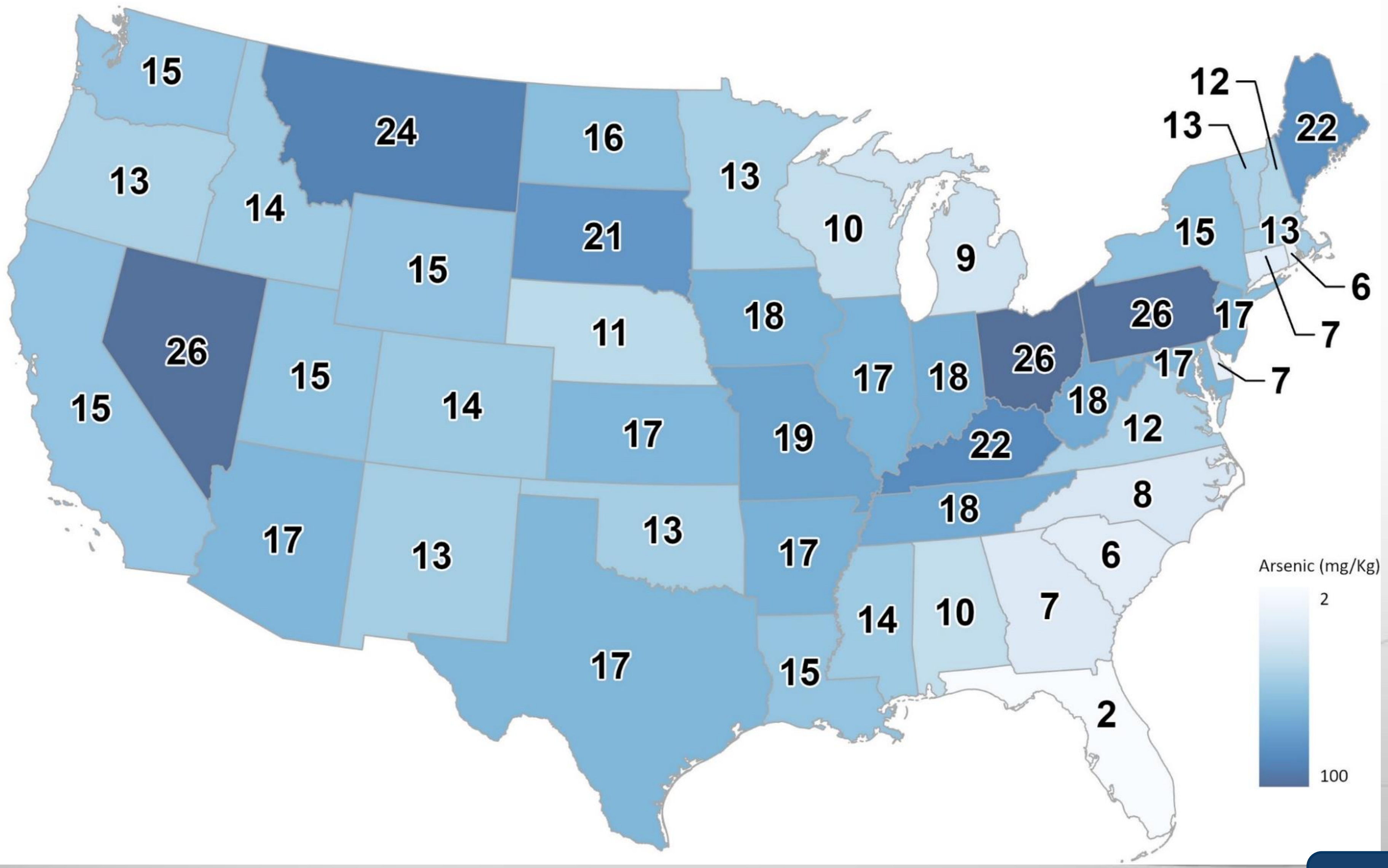
Note: DE & RI utilize one adj state data point.

Yes!

Up to 27 mg/Kg

2013 USGS Data

Conterminous US: Arsenic BTVs



Note: DE & RI utilize one adj state data point. Florida: *mean* of detections used (too many NDs for BTV est. under this method)

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2013 USGS Data

How about data for regional areas?

Note: Because of analysis method differences for USGS Data, we suggest mean value for Aluminum and 95% UCL for Barium, Chromium, and Vanadium – if EPA Methods required for risk assessment. Expect Mercury to be biased low.

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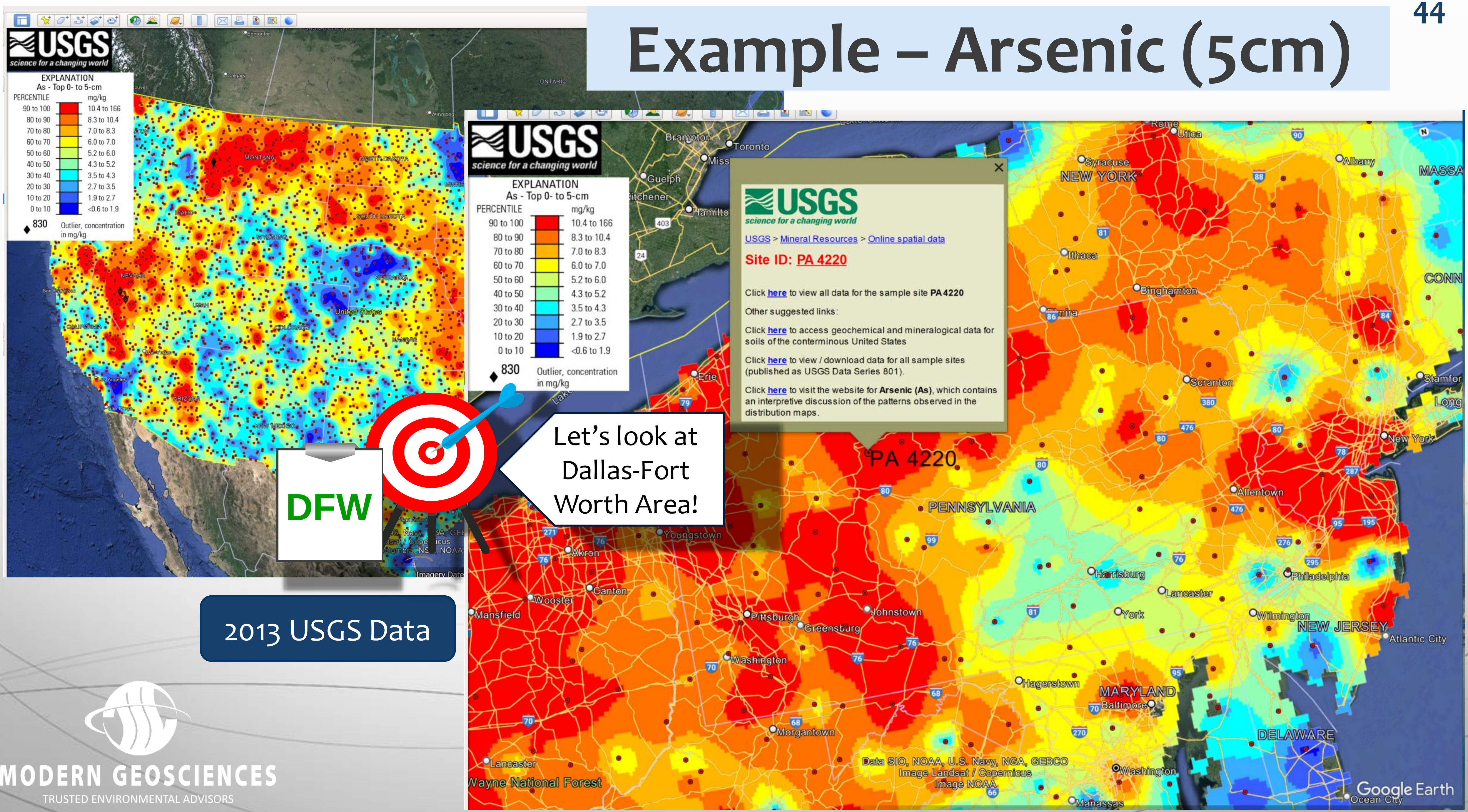
You bet ! – try to keep your dataset ≥20 samples; 40+ even better – be aware of parent material changes

Example – Arsenic (5cm)



2013 USGS Data

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Example: DFW Area

Statistics and BTV Results

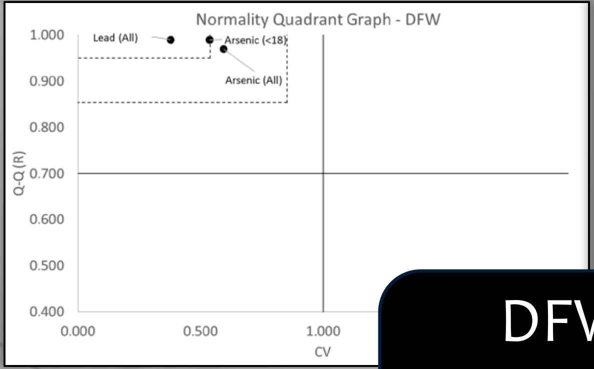
Modern utilized BTV methodology consistent with multiple TCEQ precedents and published guidance for defensible data within this area of Texas consistent with 30 TAC §350.51(l). Below are the statistics for the selected soil sample data sets.

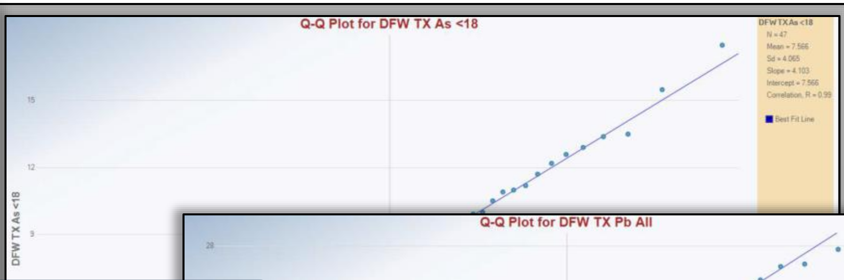
Table 2: Area USGS Arsenic and Lead Data

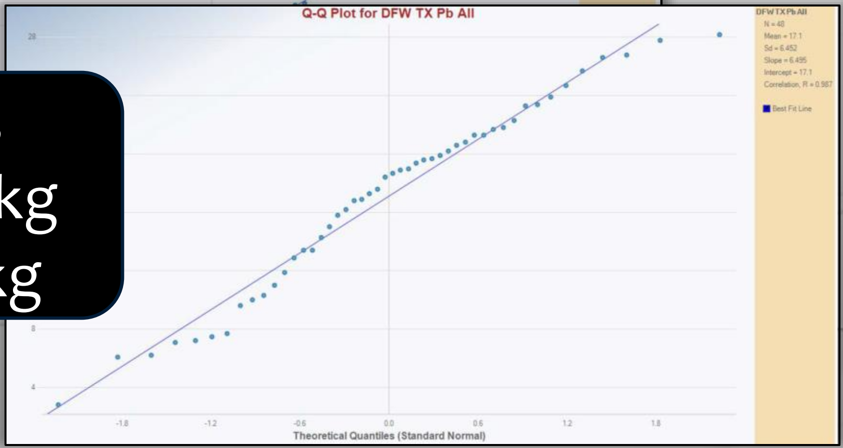
Interval	n	$\bar{x}$	σ	M	CV	R	Min	Max	RPD	UPL	UTL	USL
Arsenic												
All Intervals	48	7.92	4.69	7.3	0.6	0.97	0.9	24.3	8.08	15.87	17.62	21.71
As <18	47	7.57	4.07	7.2	0.5	0.99	0.9	17.5	4.96	14.46	16.0	19.49
Lead												
All Intervals	48	17.1	6.45	18.6	0.4	0.99	2.8	28.2	8.13	28.04	30.45	36.08

Remarks

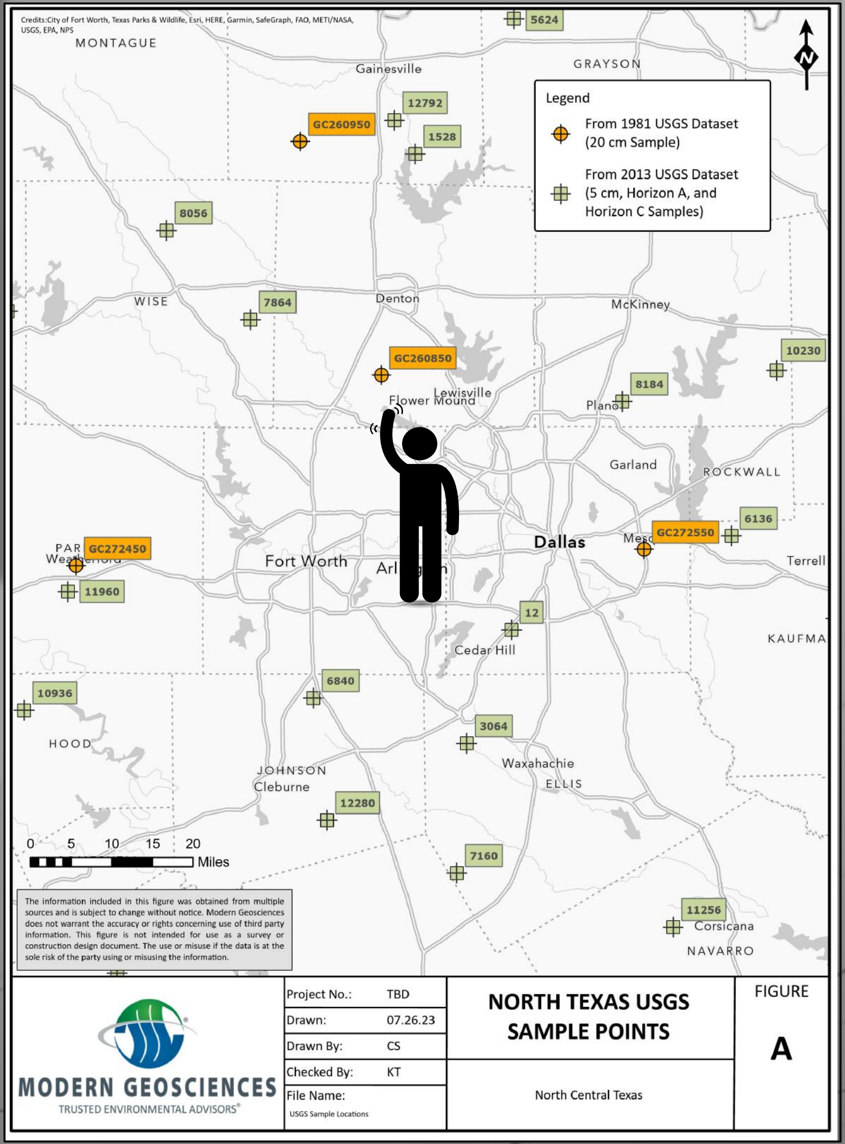
All concentrations in mg/kg







DFW BTVs
As: 19.5 mg/kg
Pb: 36 mg/kg



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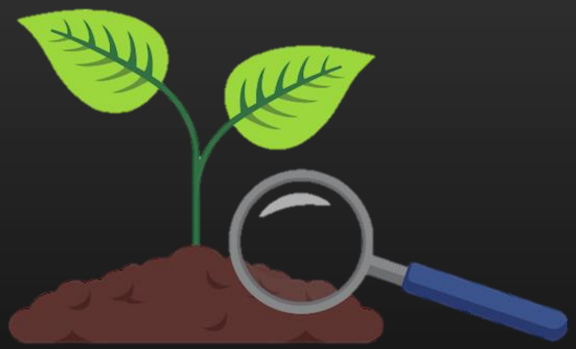
Thank you!

Questions?



Modern Geosciences

Kenneth S. Tramm, PhD, PE, PG, CHMM

ktramm@moderngeosciences.com

682-223-1322 x204

5100 Thompson Terrace

Colleyville, Texas 76034

www.moderngeosciences.com.com

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X @moderngeo

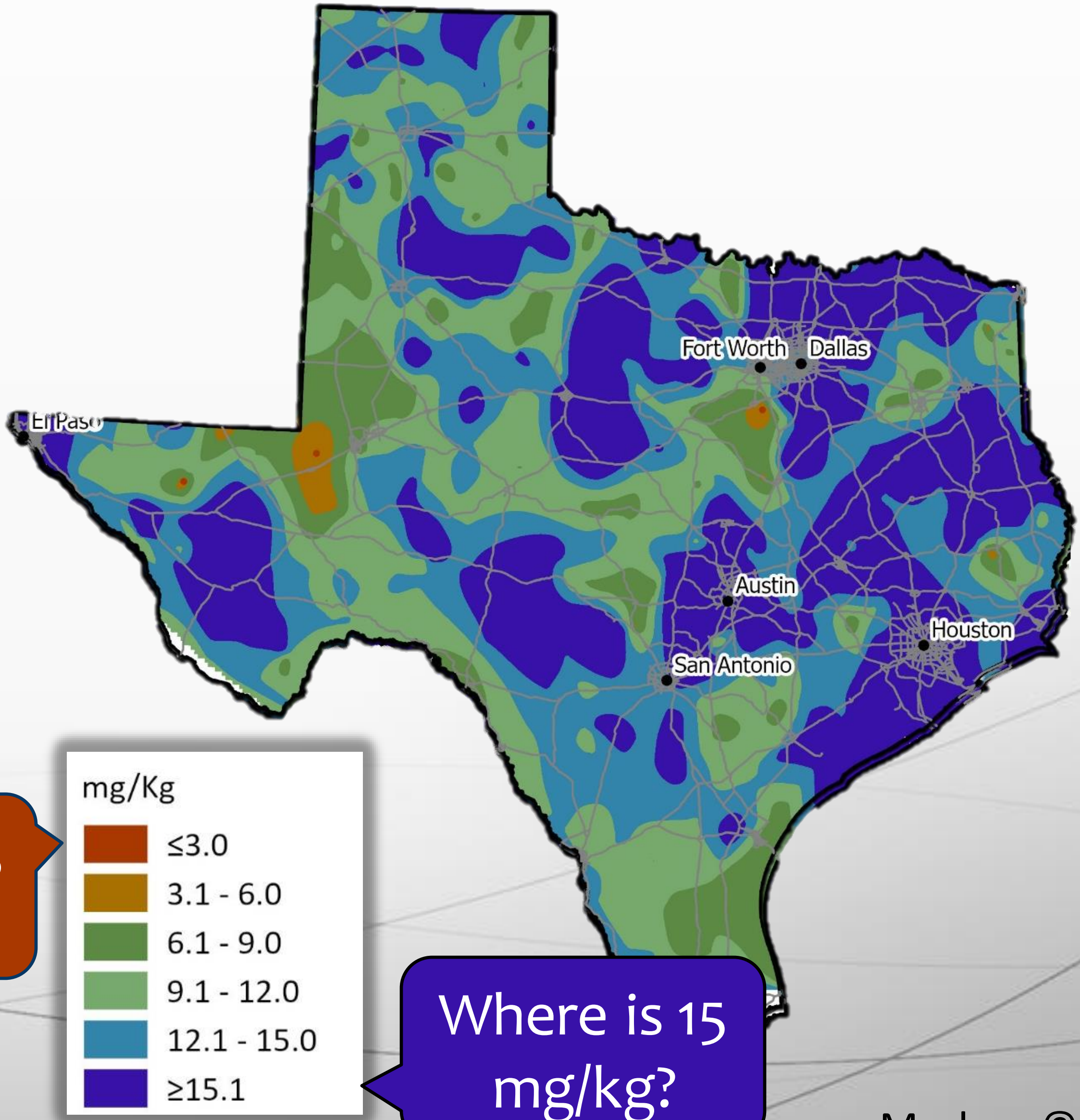
2013 USGS Data Set – Lead Concentrations

All Dark Blue exceeding Texas' Background value

5 cm	**0 samples ≤ 3 mg/kg**
A	**1 sample ≤ 3 mg/kg**
C	**3 samples ≤ 3 mg/kg**

Near 100% False Positive (Type I Error) rate expected in several regions

Where is 3 mg/kg?



Where is 15 mg/kg?

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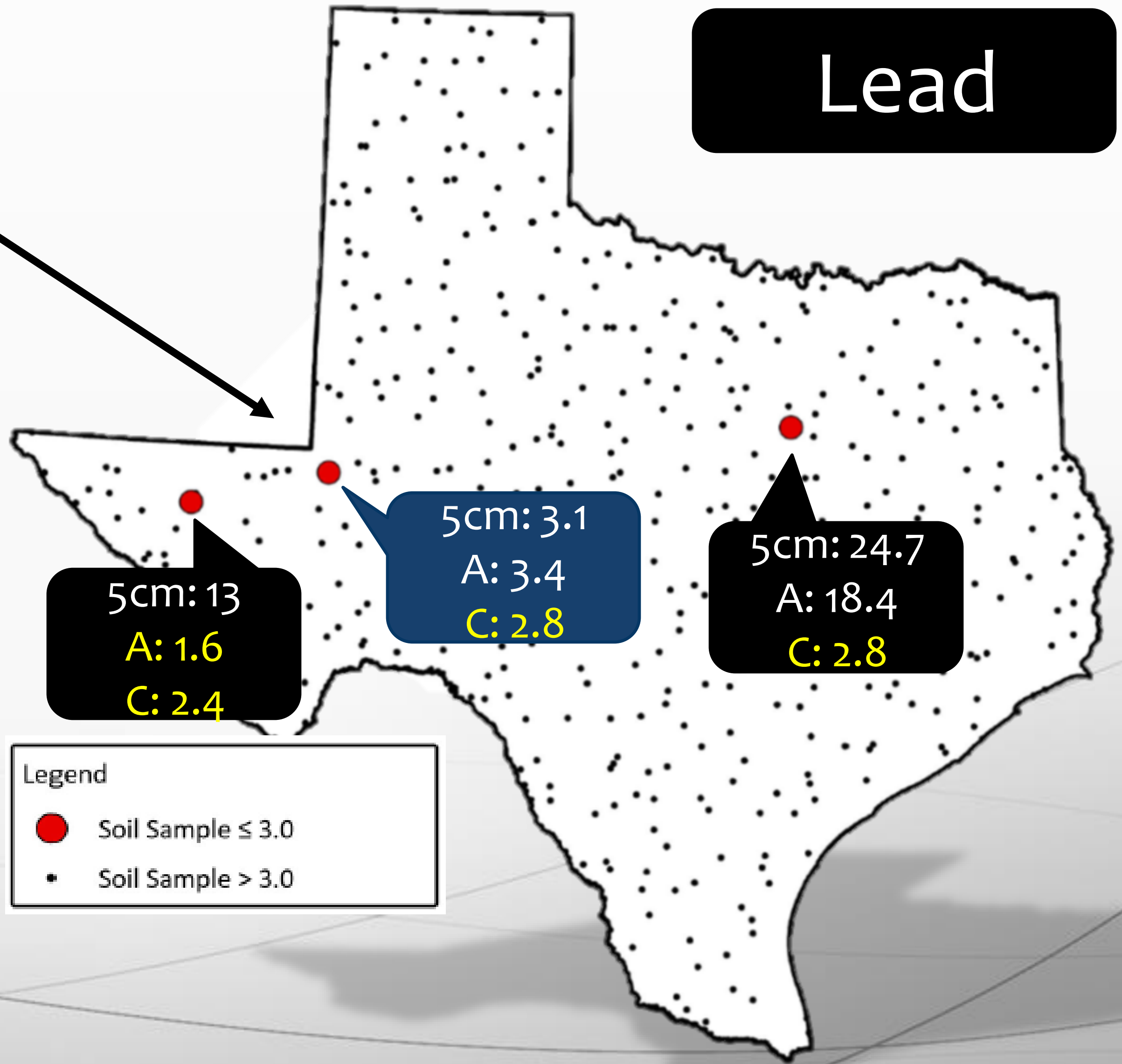
2013 USGS Data Set – Where is cPCL (3 mg/kg) met?

Source: TPWD

Just north of:

Monahans Sandhills State Park

None would meet the 30-acre source assumption → 1.5 mg/Kg



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4 of 1,237 samples meet cPCL (0.3%)

QUESTIONS?

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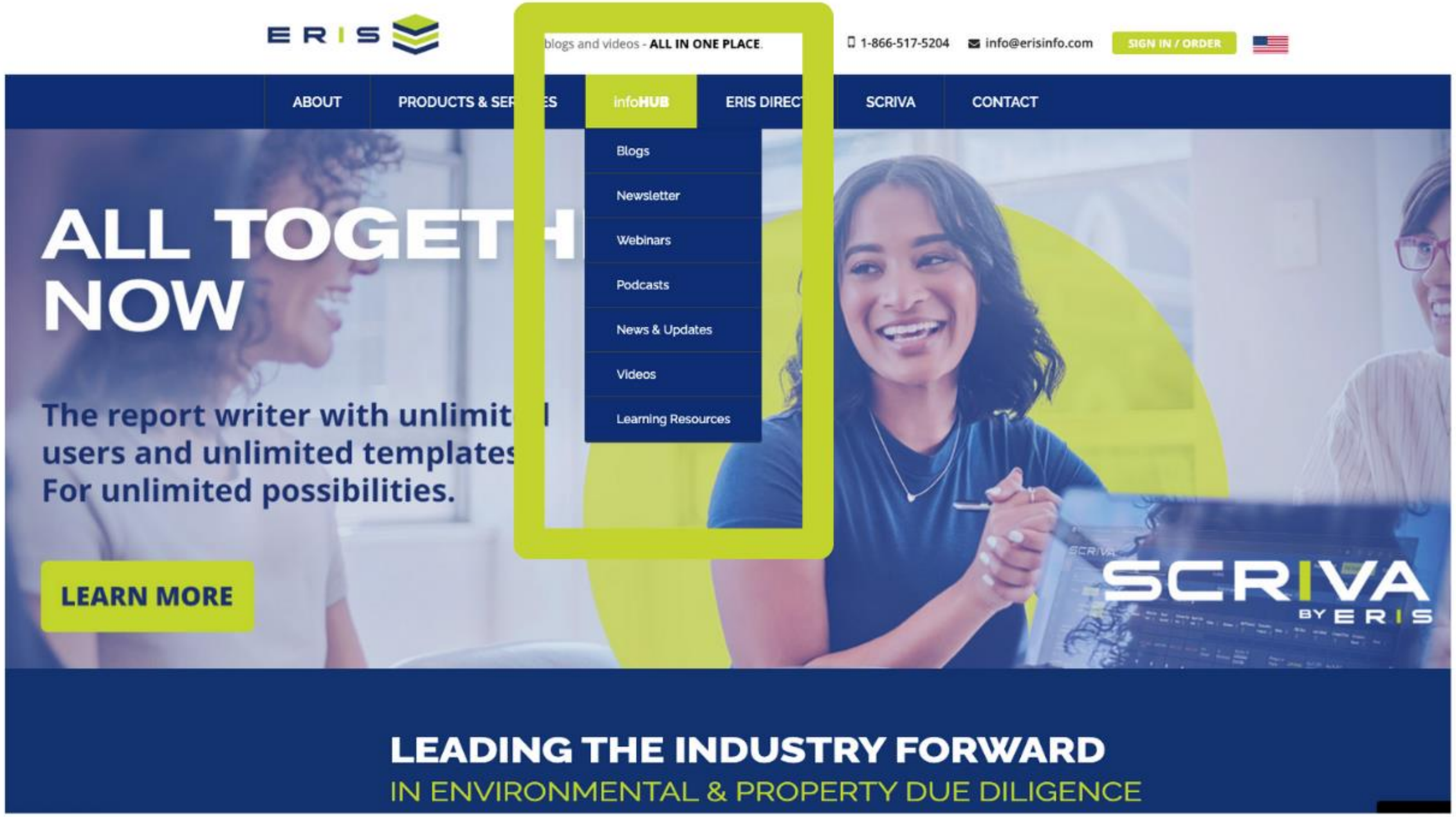

THANK YOU

Background Check: The Why and How of Background Threshold Values