



# Remediation and Redevelopment Program

## Issues & Trends 2016

August 3, 2016  
12:00 p.m. – 1:00 p.m.

Dial: 1-855-947-8255  
Passcode: 6612 745#

**Mute \*6**  
**Unmute #6**

# Soil Contaminant Background Level Determination

**Judy Fassbender**

Chief

Policy & Technical Resources Section

**608-266-7278**





## RR-721 DNR Guidance

- How to determine the background concentrations of contaminants of concern in soil at hazardous substance discharge sites.



# RR-721 DNR Guidance

- How to select locations for sampling soil to determine background and site-related contaminant concentrations.
- How to evaluate the collected soil data for the background.



# Definitions

- Soil - NR 700.03(58)
- Background Soil Quality - NR 700.03(2)



# Soil

## NR 700.03(58)

- Unsaturated organic material, derived from vegetation and unsaturated, loose, incoherent rock material, of any origin, that rests on bedrock other than foundry sand, debris and any industrial waste.



# Background Soil Quality NR 700.03(2)

(a) Soil quality attributable to parent material and natural processes, or from atmospheric deposition.

- Includes lead, PAHs, PCBs
- Not attributable to hazardous substance discharges (s. 283.01, Stats.)



# Background Soil Quality NR 700.03(2)

## (b) Soil quality

- at or proximal to the site,
- at similar depth of remediation area,
- in the same soil layer and
- in area unaffected by hazardous substances discharges or the discharge of pollutants.



# Background Soil Quality NR 700.03(2)

The requirements of both (a) and (b) must be satisfied to meet the Soil quality definition.



# Atmospheric Deposition

"Atmospheric deposition" only refers to the ubiquitous, widespread deposition of contaminants from the air that can't be traced to a specific source.

Contaminants from known sources are excluded from the definition.



# Rule Requirements

- NR 716.07(11) – An SI must include background soil samples, if appropriate
- NR 720.07(3) allows the background concentration to be used as the residual contaminant level (RCL) for the direct contact pathway



# Appropriate Contaminants of Concern

- Naturally occurring metals, including lead
- Some ubiquitous organics from widespread atmospheric deposition  
- PAHs and PCBs.
- Not VOCs



# Appropriate Contaminants of Concern

Areas impacted by discharges are assumed to be above background unless the background concentration is found to be above the RCL.



# Not Representative of Background

Contaminants from other sources

- Surface run-off - parking lots & storage facilities
- Railroad tie-related impacts (ie. creosote)
- Spills at railroad facilities and in railroad rights-of-way



# Not Representative of Background

- Roads and rail lines with vehicle emissions related impacts
- Air emissions-related to specific sources.
- Areas near buildings contaminated by paint chips



# Not Representative of Background

Waste fills and landfills

RCLs don't apply to waste, but do  
apply to imported soil fill



# Background Reference Sites

- Location
  - Similar as possible
  - Exclude other discharges
  - May include widespread contamination from non-specific sources in urban areas
  - Each soil type/horizon of concern for DC at discharge site



# Background Reference Sites

- Number of Samples - at least 4 samples for each soil type/horizon of direct contact concern
- Typically a statistically valid number of sampling location will be required.



# Background Reference Sites

- Reference sites should match the contaminated site characteristics for:
  - geographical characteristics (e.g. location, topography, size/area, etc.),
  - soil physical/chemical characteristics
  - hydrology
  - soil sampling depth



# Background Reference Sites

- The background reference site should not have:
  - Areas of added or imported fill
  - Road terraces or boulevards
  - Near buildings, paint chip sources
  - industrial or other contaminant generating activities known
  - Air deposition sources with deposited metals or other contaminants on soil



# Background Reference Sites

- Within cities, preference to vacant land with no imported fill, naturally wooded areas, parks or large residential lots
- Avoid areas with obvious vegetation damage
- Evaluate history of reference site and adjacent land, including current and previous activities



# Sampling and Analysis Methods

- Same methods as contaminated site characterization
- Discreet sampling is typically required (NR716.13(4))
- Adjustments for lab methods may be necessary to characterize low background concentrations



# Determination of Background

- Three Methods
  - Mean level of sample concentrations
  - Upper 95% confidence limit for the mean (UCL)
  - Background Threshold Value



# Mean Concentration

- Rarely Accepted
- Evaluated with limited data available
- Requires sufficiently similar results (no outliers) from each soil type/horizon



## Upper Confidence Limit for the Mean

- Statistical comparison of whole data sets (not point-to-point)
- Useful for quick comparison of populations (UCL-background vs UCL-site), but point exceedances may still be hidden
- UCL does not define upper limit of background



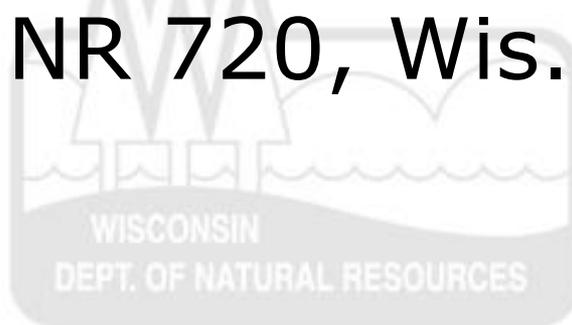
# Background Threshold Value

- Recommended method
- Requires statistically valid number of samples
- Document single population represented (Q-Q Plot)
- Provides best basis for agency acceptance

# Background Threshold Value

The BTV is the value to use for point-to-point comparison

RR-991- Compliance Averaging of Soil Contaminant Concentration Data Under Ch. NR 720, Wis. Adm. Code



# Estimation of Background Levels of Contaminants

Anita Singh,<sup>2</sup> Ashok K. Singh,<sup>3</sup> and George Flatman<sup>4</sup>

Author,

ProUCL

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*Samples from hazardous waste site investigations frequently come from two or more statistical populations. Assessment of "background" levels of contaminants can be a significant problem. This problem is being investigated at the U.S. Environmental Protection Agency's Environmental Monitoring Systems Laboratory in Las Vegas. This paper describes a statistical approach for assessing background levels from a dataset. The elevated values that may be associated with a plume or contaminated area of the site are separated from lower values that are assumed to represent background levels. It would be desirable to separate the two populations either spatially by Kriging the data or chronologically by a time series analysis, provided an adequate number of samples were properly collected in space and/or time. Unfortunately, quite often the data are too few in number or too improperly designed to support either spatial or time series analysis. Regulations*

Count	Soil-Cd	Count	Soil-Cd
1	26.2	26	31.68
2	27.55	27	12.39
3	445.01	28	614.53
4	30.77	29	639.52
5	486.31	30	116.24
6	513.79	31	119.43
7	112.81	32	111.6
8	159.3	33	10.29
10	6.68	34	1.68
11	33.72	35	3.34
12	35.01	36	10.47
13	10.99	37	11.74
14	22.05	38	10.32
16	125.07	39	122.3
17	40.84	40	283.03
18	345.52	41	265.08
19	384.8	42	125.49
20	183.04	43	131.06
23	260.27	44	47.9
24	32.09	45	119.34
25	166.16		

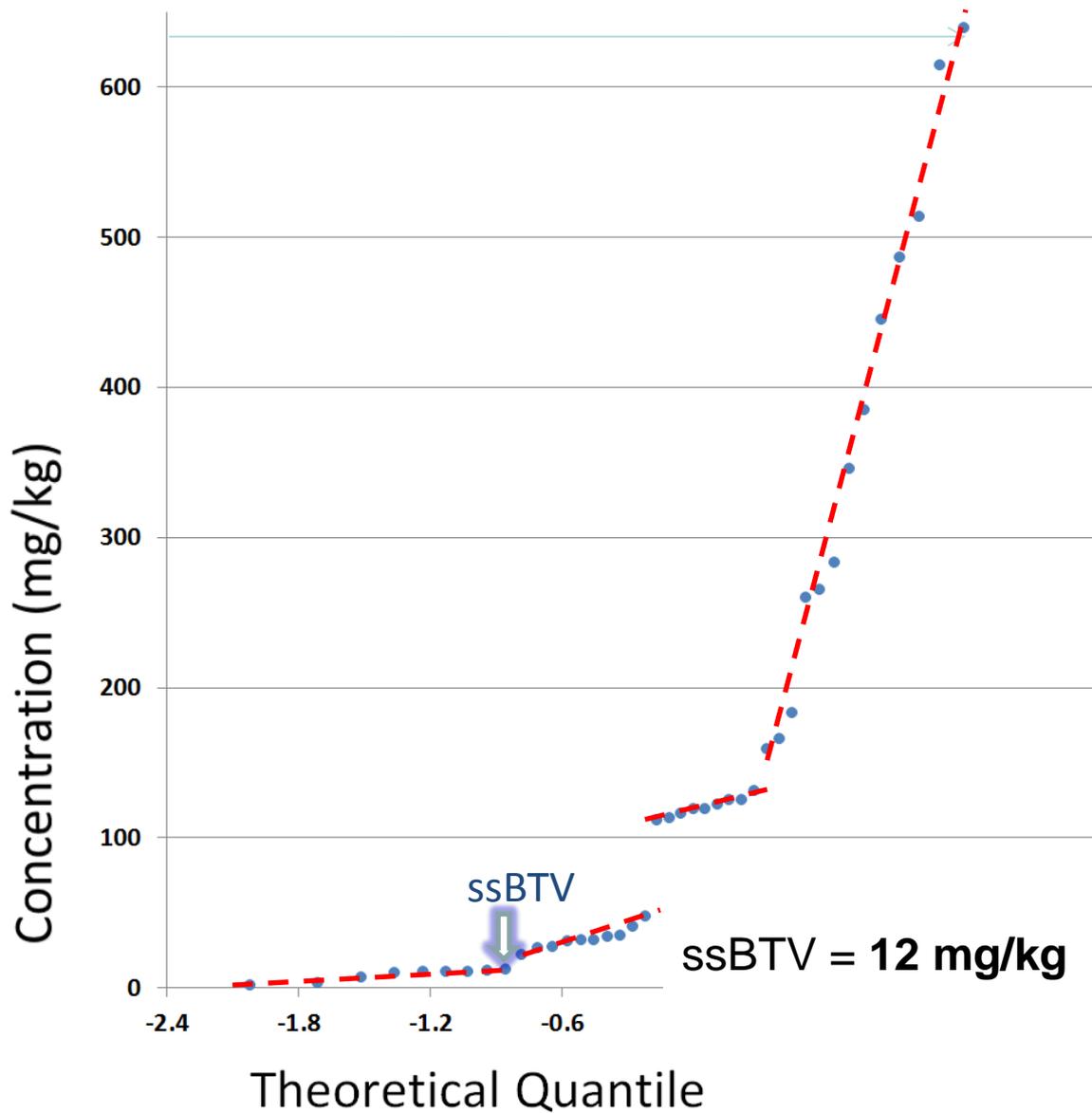
## Soil Concentrations

Range: **1.7 - 2,300 mg/kg**

### To Determine Background

- 1. Arrange data from lowest to highest**
- 2. Q-Q plot (Normal probability plot)**
- 3. Identify statistical population subsets by looking for:**
  - **Gaps/Jumps in the Q-Q plot**
  - **Change in slope**
- 4. Typically, background values will be in the subset with the least slope.**

# Q-Q Plot





# Collecting Background Dataset

- Approved Design
- Plentiful Data ( $> 10$  samples)
  
- Identify Outliers
- Generally, Do NOT Include Outliers
  
- Procedure in Statewide BTVs for soil metals:  
eliminate outliers.  
**BTV = Max** value from 650+ samples

# ProUCL Chapters on BTV

## CHAPTER 3

Computing **Upper Limits** to Estimate Background Threshold Values Based Upon Uncensored Data Sets without Nondetect Observations

## CHAPTER 5

Computing **Upper Limits** to Estimate Background Threshold Values Based Upon Data Sets Consisting of Nondetect (ND) Observations

**Upper Limit (so BTV) may be one of the following:**

- 1.) Maximum**
- 2.) 90<sup>th</sup> or 95<sup>th</sup> Percentile**
- 3.) Upper Tolerance Limit (confidence limit on 95<sup>th</sup> percentile)**
- 4.) Upper Prediction Limit (unobserved value)**



# Determination of Background

- Recommend DNR concurrence on planned methodology prior to sample collection
- Work with Project Manager for concurrence.
- Technical Assistance Form and Fee for concurrence



# Questions?

Overall Coordination - Project Manager

General Process - Judy Fassbender

608-266-7278

Criteria and Reference Sites - Gary Edelstein

608-267-7563

Calculation Method Details - Aristeo (Resty) Pelayo

608-267-3539



# Issues & Trends 2016

**September 7 - 12:00 p.m.**

## **LNAPL Recoverability and Residual Saturation Concepts**

Audio and information from today's presentation and future *Issues & Trends Series* events can be found on the RR Program Training Webpage at:

[Http://dnr.wi.gov/topic/Brownfields/Training.html](http://dnr.wi.gov/topic/Brownfields/Training.html)

Questions/Comments/Suggestions regarding the  
Issues & Trends Series can be submitted to:

**DNRRRComments@wisconsin.gov**

