CONSULTANTS' DAY 2015

20th Anniversary
DNR's Remediation & Redevelopment Program

Soil Standard Determination Methods & Processes

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Wisconsin DNR

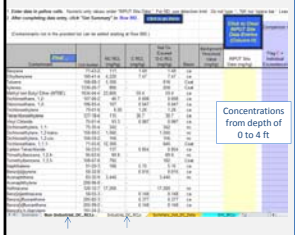
Hosted by DNR's Remediation & Redevelopment Program

Key Points

- Soil Cleanup Standards (NR 720.10 or NR 720.12) – RCL
- Regional Screening Level - RSL
- Background Threshold Values – BTV
- Averaging – UCL

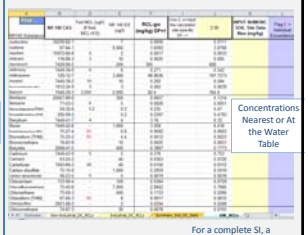
RR's Spreadsheet of Soil RCLs

Direct-Contact RCLs



Concentrations from depth of 0 to 4 ft

Groundwater-Protective RCLs



Concentrations Nearest or At the Water Table

For a complete SI, a separate assessment of groundwater quality (via sampling) is needed.

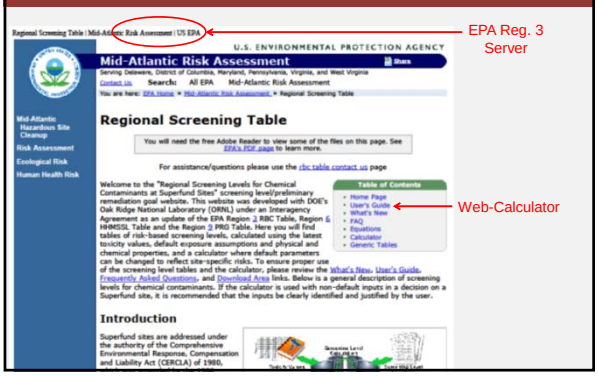
Available at RR's "Resources for Environmental Professionals" Webpage
http://dnr.wi.gov/topic/Brownfields/Professionals.html

Where did RCLs come from?

- U.S. EPA RSL Web-Calculator

http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

RCLs from EPA RSL Website



Where did RCLs come from?

BTVs from USGS Report

http://pubs.usgs.gov/sir/2011/5202/

BTVs from USGS Report

Title: Distribution and Variation of Arsenic in Wisconsin Surface Soils, With Data on Other Trace Elements

Table 1–Z. Statistical summary, including 95-percent upper confidence limit of the mean (95% UCL), of trace elem
Wisconsin. Summaries are for the entire dataset after outliers were removed. (*For the element molybdenum, the
for the censored-data methods that were used in this report. None of the summary statistics were calculated for t

[Statistics are for concentrations in milligrams per kilogram]

BTV

Trace element	Number of samples	Non-detects (%)	Minimum detected value	Maximum detected value	Median	Mean	95% UCL of the mean
Aluminum	662	0	610	28,721	8,282	9,147	9,479
Arsenic	654	32.3	1.0	8.3	1.8	2.3	2.4
Barium	658	0	3.53	364	92.0	101	105
Calcium	607	0	22.9	14,536	1,931	2,831	3,025
Cadmium	642	38	0.10	1.07	0.15	0.23	0.25
Cobalt	661	1.5	0.51	22.0	6.34	6.61	6.87
Chromium	659	0	0.95	43.5	12.5	13.7	14.2

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RR's Spreadsheet of Soil RCLs

Direct-Contact RCLs

If concentration < BTV, direct contact is ignored.

Available at RR's "Resources for Environmental Professionals" WebPage
http://dnr.wi.gov/topic/Brownfields/Professionals.html

Soil Data Summary Table

BRRTS #: 02-73-00/107
SITE NAME: Leysamarte Inn
SITE ADDRESS: Leysamarte, WI

BORING #	B-1	B-1	B-2		B-3		B-4
Date Collected	11/11/13	11/11/13	11/11/13	11/11/13	11/11/13	11/11/13	11/11/13
DEPTH (ft BGS)	2.5 - 4.5	5 - 7	2.5 - 4.5	5 - 7	0 - 4	6 - 8	2 - 4
	Soil Concentrations in mg/kg (or ppm)						
Benzene	0.75	< 0.005	2.	0.5	1.	1.	1.
Ethylbenzene	5.6	< 0.005	8.	2.	< 0.005	1.	1.
Toluene	800.	0.05	10.	2.	< 0.005	2.	2.
Xylene	250.	3.	10.	4.	< 0.005	50.	50.
PCE	2.	< 0.005	2.	0.5	< 0.005	7.	7.
Naphthalene	1.	< 0.005	2.	3.	< 0.005	3.	3.
Benzo(a)pyrene	< 0.01	< 0.01	0.1	0.5	0.4	0.3	0.3
Arsenic	5.	< 0.5	10.	5.	< 0.5	8.	8.
Lead	240.	25.	100.	50.	< 1	50.	50.

Soil RCLs (mg/kg)				
Calculated 06/2014			Background	Lab
Non-Industrial Direct Contact	Soil to GW	Surficial BTV		Detection Limit (mg/kg)
1.49	0.005	-		0.005
7.47	1.57	-		0.005
818.	1.107	-		0.005
258.	3.94	-		0.005
30.7	0.005	-		0.005
5.15	0.659	-		0.005
0.015	0.47	-		0.01
0.613	0.584	8.		0.5
400.	27.	52.		1

Soil Data Summary Table

BRRTS #: *02-73-007107*
SITE NAME: *Leysamarte Inn*
SITE ADDRESS: *Leysamarte, WI*

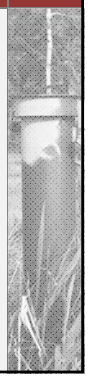
BORING #	*B-1*	B-1	B-2		B-3		B-4	...			
DEPTH to Water Table (ft BGS)		6	7		6		8				
Date Collected		11/11/13	11/11/13	11/11/13	11/11/13	11/11/13	11/11/13				
DEPTH (ft BGS)	2.5 - 4.5	5 - 7	2.5 - 4.5	5 - 7	0 - 4	6 - 8	2 - 4	Soil RCLs (mg/kg)			
SOIL TYPE	clay	peat	clay	silty clay	soil fill	waste fill	sandy silt	Calculated 06/2014		Background	Lab
Soil Concentrations in mg/kg (or ppm)								Non-Industrial Direct Contact	Soil to GW	Surficial BTV	Detection Limit (mg/kg)
Benzene	0.75	< 0.005	2.	*0.3*	1.	*2.*	1.	1.49	0.005	-	0.005
Ethylbenzene	2.6	< 0.005	6.	*2.*	< 0.005	1.	1.	7.47	1.57	-	0.005
Toluene	800.	0.05	10.	*2.*	< 0.005	*2.*	2.	818.	1.107	-	0.005
Xylene	250.	3.	10.	*4.*	< 0.005	*50.*	50.	258.	3.94	-	0.005
PCE	2.	*< 0.005*	2.	*0.3*	< 0.005	*7.*	7.	30.7	0.005	-	0.005
Naphthalene	1.	< 0.005	2.	*3.*	< 0.005	*3.*	3.	5.15	0.659	-	0.005
Benzo[a]pyrene	< 0.01	< 0.01	**0.1**	*0.3*	**0.4**	0.3	**0.3**	0.015	0.47	-	0.01
Arsenic	5.	< 0.5	**10.**	*5.*	< 0.5	*8.*	8.	0.613	0.584	8.	0.5
Lead	240.	25.	100.	*50.*	< 1	*50.*	50.	400.	27.	52.	1
No. of Individual Exceedances (DC)	0		**4**		**1**		**1**				
Cumulative Hazard Index (DC)	**1.063**		0.603		0.009		0.143				
Cumulative Cancer Risk (DC)	2.19E-06		**2.59E-05**		**2.27E-05**		**2.19E-05**	HI and CCR are from the DC_RCL Worksheet			

"Soil" Terms

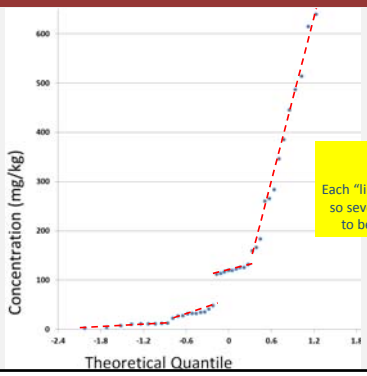
- ~~RCL – Cleanup level in soil (mostly calculated)~~
- ~~RSL – Has algorithm for RCL calculation~~
- ~~BTV – Background that may become RCL~~
- UCL – (Statistics)

UCL

- Upper 95% Confidence Limit for the Mean
- Applies to a single population
  - –adequate no. of sample
  - –hotspots
- Can be compared to DC-RCL



Multiple Populations?



Yes.

Each "line" has its UCL, so several UCLs need to be calculated.

UCL – DC-RCL Comparison

Data for Contaminant **X**
(RCL for X is **10** mg/kg.)
Red font indicates RCL exceedance.

Sample#	Soil-**X** (mg/kg)
1	8.5
2	9.7
3	10.
4	9.
5	8.
6	10.
7	9.1
8	10.5
9	11.
10	10.2
11	9.4
12	9.6
13	9.4

Soil-X (mg/kg)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	11
		Number of Missing Observations	0
Minimum	8	Mean	9.569
Maximum	11	Median	9.6
SD	0.812	Std. Error of Mean	0.225
Coefficient of Variation	0.0848	Skewness	-0.227

Normal GOF Test

Shapiro Wilk Test Statistic	0.99	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.11	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.246	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	9.971	95% Adjusted-CLT UCL (Chen-1995)	9.924
		95% Modified-t UCL (Johnson-1978)	9.968

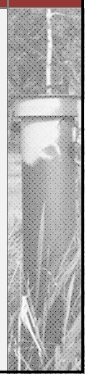
Suggested UCL to Use

95% Student's-t UCL	9.971

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Summary of Key Points

- RCL – Residual Contaminant Level
- RSL – Regional Screening Level
- BTV – Background Threshold Values
- UCL – Upper 95% Confidence Limit



Questions & Contacts

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Thank you for attending Consultants' Day