

Soil Reference Value Revisions

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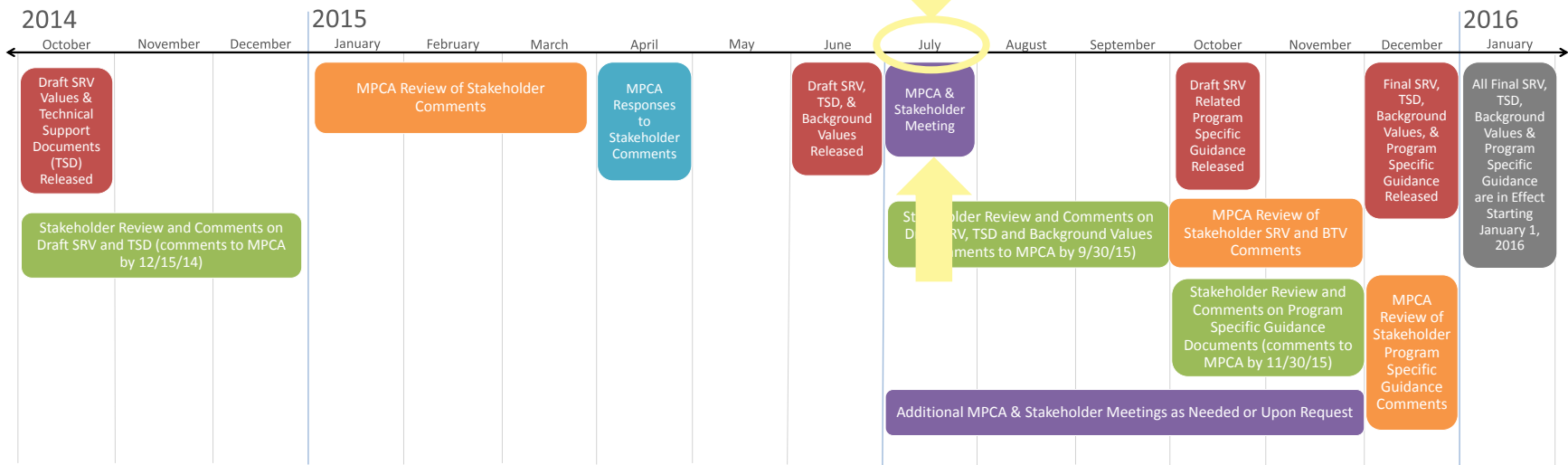
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Minnesota Pollution Control Agency

Where are we in the Timeline?

Remediation Program* Soil Reference Value (SRV) Revision Timeline



* Superfund, Site Assessment, VIC, RCRA Cleanup

Why are SRVs Revised?

- Periodically revised to incorporate new
 - Methodology
 - Exposure parameters
 - Toxicity values
 - Chemical specific parameters
- Not in response to any specific incident, project or occurrence

What Changed with this Revision?

- Methodology
 - EPA Superfund methodology
 - Addition of mass limit volatilization factor
- Exposure Parameters
 - 2014 EPA Superfund recommendations
 - Minnesota specific modifications
- Toxicity values
 - More recent values used if appropriate
- Chemical specific parameters
 - EPA Superfund hierarchy

What Documents Were Revised?

SRV Technical Support Document (TSD)

DRAFT COMPLETED

How the SRVs were derived and their intended use



SRV Spreadsheet

DRAFT COMPLETED

SRVs applicable to
any site in Minnesota

SRV Spreadsheet - Site Specific

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Used to derive SRVs
applicable to a specific site



Soil Investigation Guidance

TO BE DRAFTED

VIC, Superfund, RCRA program Specific Guidance
SRVs are one of the tools used

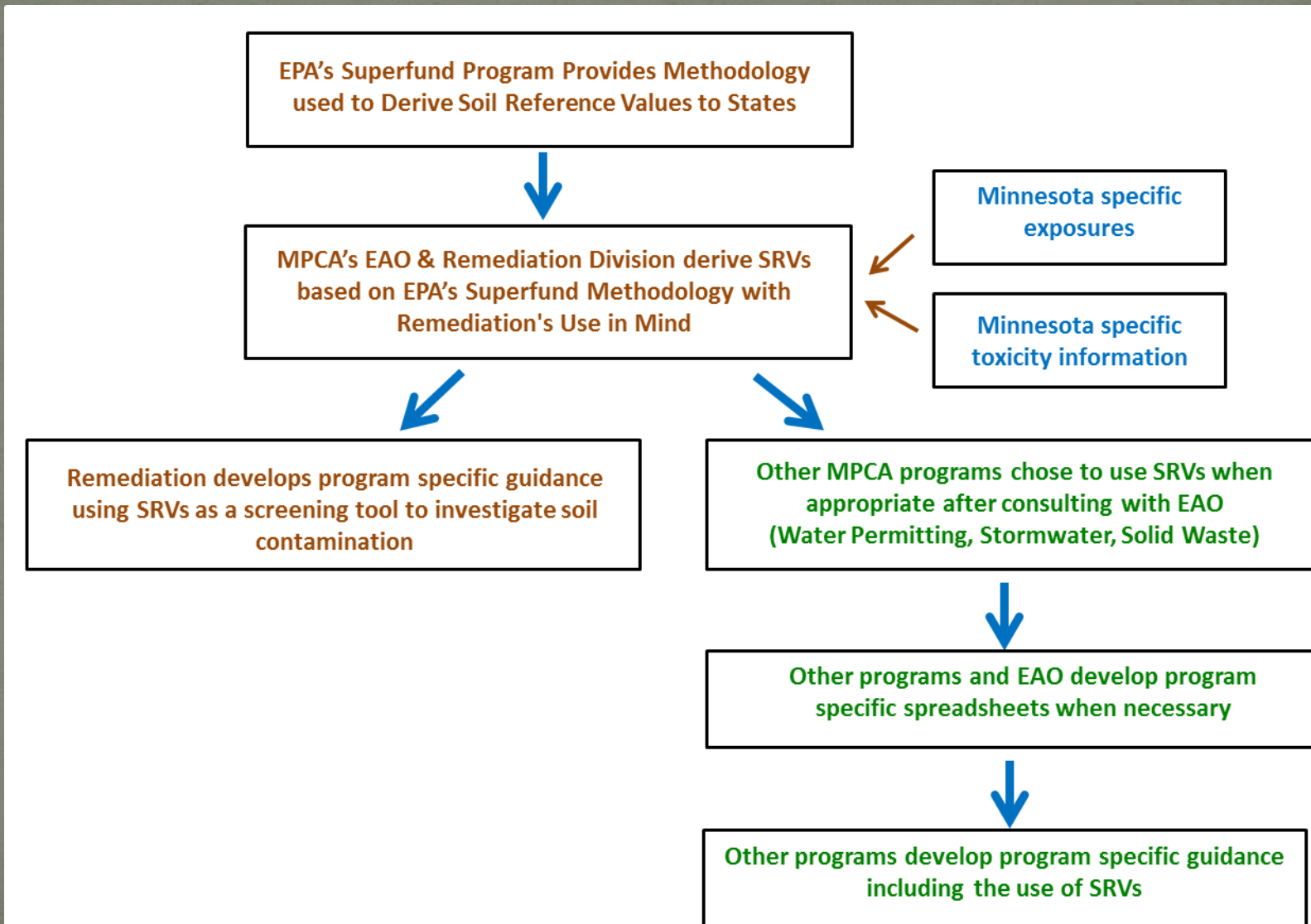
Who Was involved?

- SRV Revisions - MPCA
 - Remediation Division
 - Staff participation in work groups
 - Consultation with other staff and staff review of documents
 - Environmental Outcomes & Analysis Division
 - Remediation risk assessor participation in work groups
 - Consultation with other staff and other risk assessors/toxicologist review of documents
- Consultation and review of documents
 - MDH
 - MDA
 - EPA
 - USGS (inorganics in BTV documents only)

How are SRVs Intended to Be Used?

- VIC, Superfund, RCRA cleanup sites
- SRVs are a screening tool
 - **NOT intended to be used as Cleanup Values**
- Responsible or voluntary parties can
 - Chose to derive site specific SRVs for clean up values
 - Chose to use state wide SRVs as cleanup values

How are SRVs Intended to Be Used?



What Do SRVs Evaluate?

- Human exposures to soil on land
 - NOT ecological
 - NOT sediments
- Soil Exposure Routes
 - Ingestion
 - Dermal Contact
 - Inhalation
 - Particulates in surface soil
 - Particulate Emission Factor
 - Volatilization from soil at depth
 - Volatilization Factor (standard and mass limit)

How Did Exposure Parameters Change?

- Exposure Frequency
 - Receptor type based on soil land use category
 - Residential/Recreational
 - Commercial/Industrial
 - Soil exposure route
 - Ingestion
 - Dermal
 - Inhalation via fugitive dust
 - Inhalation via vapors
 - Type of contamination present
 - VOCs
 - Non-VOCs
 - 100 frozen and snow covered days per year eliminated from some exposure routes

How Did Exposure Parameters Change?

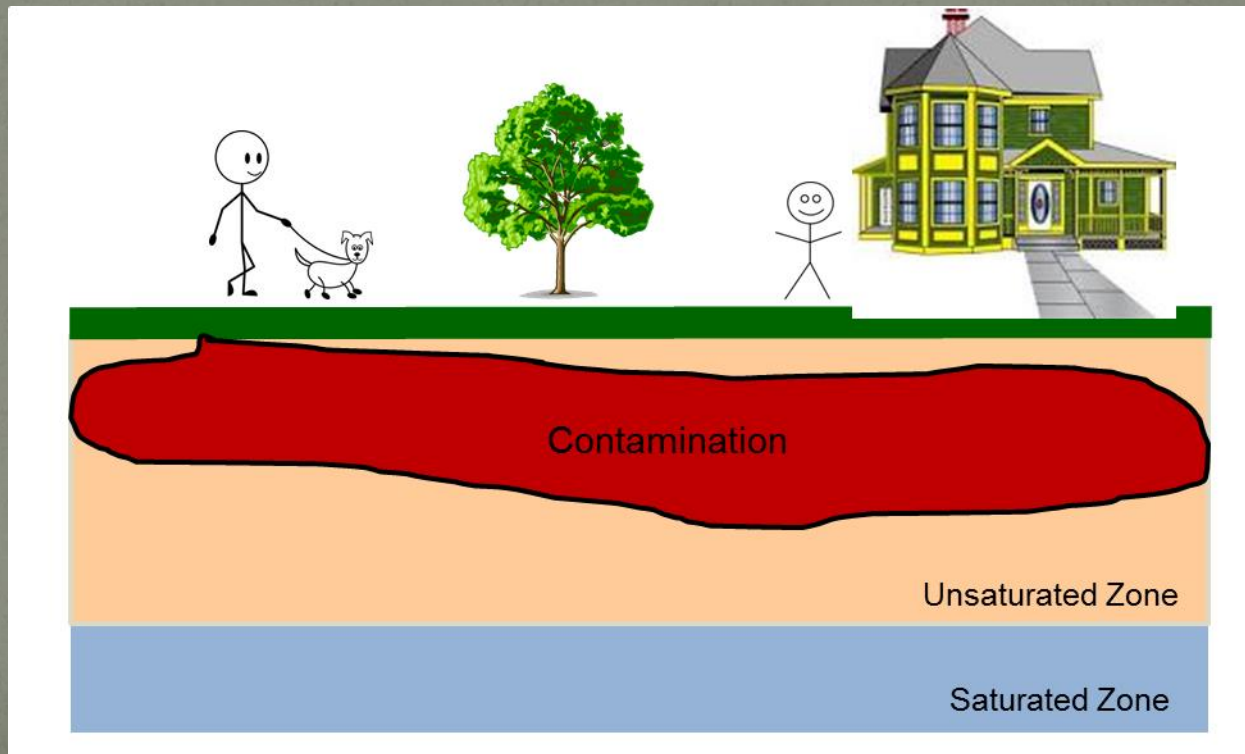
Exposure Route	VOC	Non-VOC
Ingestion	<p>Eliminate 100 days/year</p> <p>Although ingestion exposure will occur both indoor and outdoor, VOCs will not be present in indoor dust due to their volatile nature</p>	<p>Do NOT eliminate 100 days/year</p> <p>Ingestion exposure will occur both indoor and outdoor and non-VOCs will be present in indoor dust</p>
Dermal Contact	<p>NOT included for VOCs</p> <p>Dermal contact is not considered to be a significant route of exposure for VOCs due to their volatile nature</p>	<p>Eliminate 100 days/year</p> <p>Dermal contact is considered to only be a significant route of exposure outdoors and will not occur when the ground is frozen and snow covered greater than 1 inch</p>
Inhalation – Fugitive Dust	<p>NOT included for VOCs</p> <p>Inhalation of fugitive dust is not considered to be a significant route for exposure for VOCs due to their volatile nature</p>	<p>Eliminate 100 days/year</p> <p>Fugitive dust is not expected to be present outdoors when the ground is frozen and snow covered greater than 1 inch</p>
Inhalation – Vapors	<p>Eliminate 100 days/year</p> <p>Vapors are not expected to be present outdoors when the ground is frozen and snow covered greater than 1 inch</p>	<p>Eliminate 100 days/year</p> <p>Vapors are not expected to be present outdoors when the ground is frozen and snow covered greater than 1 inch</p>

How Did Exposure Parameters Change?

- Ingestion Rate
 - Previous ingestion adjusted to account for frozen days and snow covered days
 - New ingestion rate does not consider frozen and snow covered days since this is considered in exposure frequency

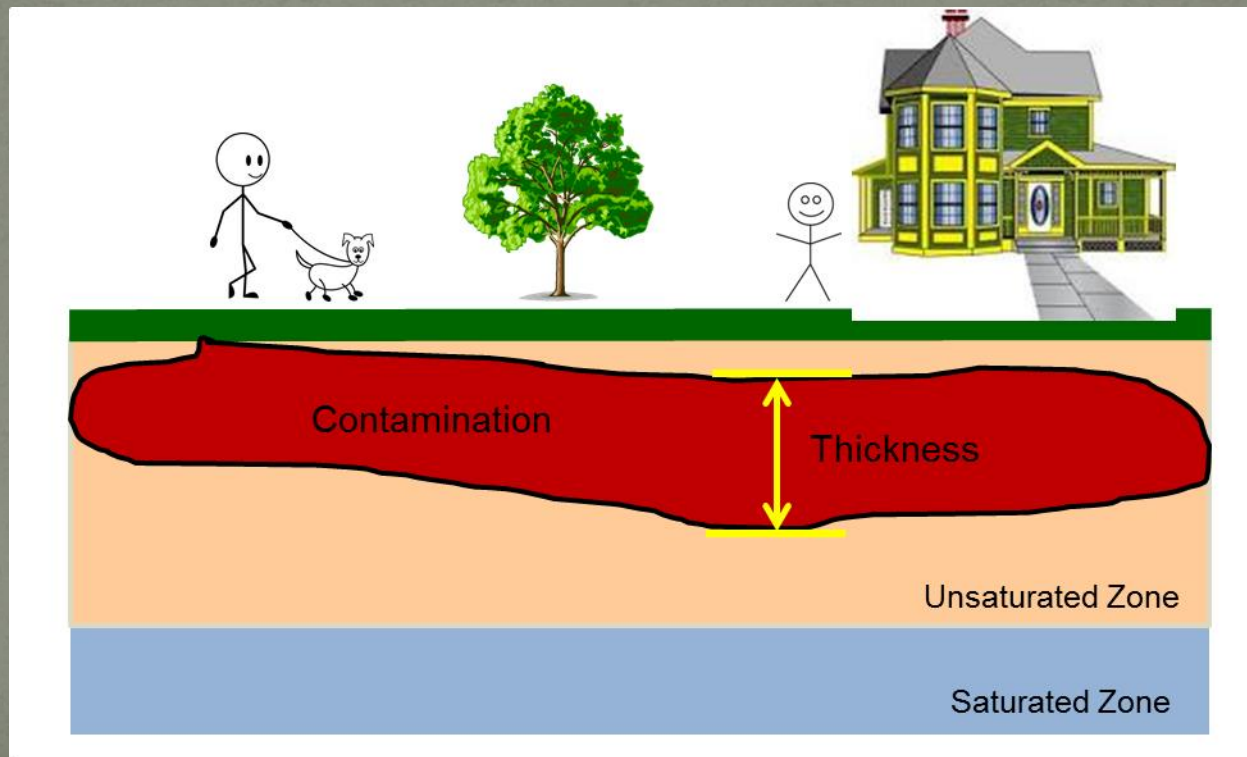
How Did Exposure Parameters Change?

- Standard volatilization factor
 - Contamination right below ground surface
 - Infinite source – may violate mass balance considerations
 - Uniform rate of volatilization based on
 - Infinite source
 - Henry's Law specific to a contaminant



How Did Exposure Parameters Change?

- Mass limit volatilization factor
 - Contamination right below ground surface
 - Finite source based on thickness of contamination
 - Uniform rate of volatilization based on
 - Finite source size



How Did Exposure Parameters Change?

Volatilization Factors

- Eliminate violation of mass balance considerations
 - 2 SRVs derived
 - 1 using standard volatilization factor
 - 1 using mass limit volatilization factor
 - SRV with highest value used
- Example
 - Chemical X SRV using standard VF = 100 mg/kg
 - Chemical X SRV using mass limit VF = 200 mg/kg
 - SRV is set at 200 mg/kg

How did Revisions Change SRVs?

- Mass limit volatilization factor
 - Net increase for impacted VOCs
- Exposure parameters
 - Residential/Recreational SRVs
 - Net slight decrease
 - Commercial/Industrial SRVs
 - Net increase
- Toxicity Values & chemical specific parameters
 - Contaminant specific

How did Revisions Change SRVs?

- SRVs potentially below soil background levels?
 - Aluminum
 - Arsenic
 - Barium
 - Chromium
 - Cobalt
 - Iron
 - Thallium
 - Vanadium
 - Benzo[a]pyrene (BaP) equivalents
 - TCDD (2,3,7,8-Tetrachlorodibenzo-p-dioxin) equivalents

Any SRVs Below Soil Background Levels?

- Evaluation to determine if SRVs are below soil background levels
- Establish a Background Threshold Value (BTV)
 - Estimate of the background level in soil
 - Background
 - Amount of a chemical that is present in soil that is NOT due to local anthropogenic sources such as a release

Any SRVs Below Soil Background Levels?

- Inorganics: aluminum, arsenic, barium, chromium, cobalt, iron, thallium, vanadium
 - USGS's 2013 Soil Survey
 - 137 samples from Minnesota
- USGS vs. EPA analytical methods
 - USGS - aggressive digestion
 - EPA - less aggressive digestion
 - Results in different concentrations
 - Specific chemical
 - Geological characteristics of the soil
 - Differences NOT consistent across Minnesota

Any SRVs Below Soil Background Levels?

- Difference between USGS and EPA's method?
 - Re-analyze 45 samples using EPA' method
- Data
 - USGS complete 137 sample dataset
 - EPA reanalyzed 45 sample dataset
- BTV Evaluation
 - Differences in concentrations across Minnesota
 - Outliers using USGS's full 137 sample dataset
 - Are background concentrations higher than SRV?
 - Differences between results of 2 methods
 - Establish BTV if necessary

Any SRVs Below Soil Background Levels?

- How was a BTV established?
 - Complete USGS 137 sample dataset
 - EPA's ProUCL software
 - Upper Tolerance Limit (UTL)
- What is a UTL₉₅₋₉₅?
 - 95% confidence limit of the 95th percentile of the dataset
- Why a UTL?
 - Large number of comparisons to BTV
 - False positive and negative errors rates minimized
- Some BTVs were established using a lower percentile
 - All BTVs used a 95% confidence limit

Any SRVs Below Soil Background Levels?

- Difference between USGS & EPA methods varies by
 - Specific inorganic
 - Geology at sample site

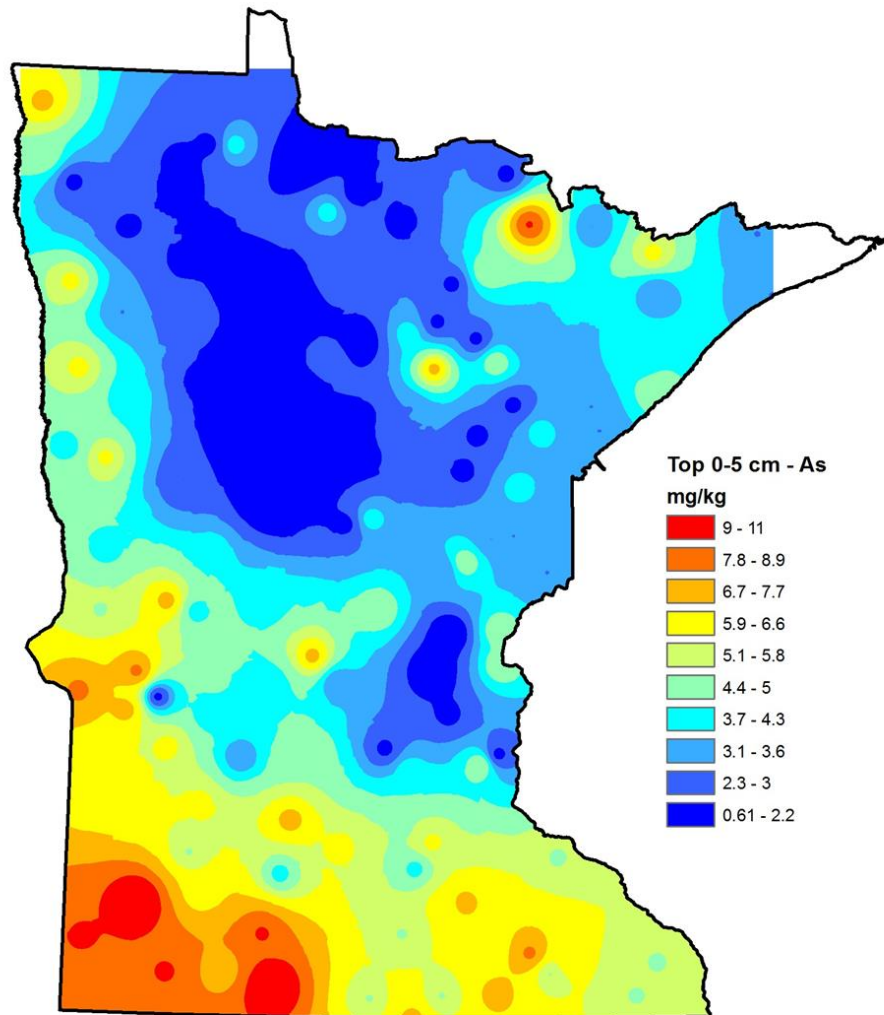
Inorganic	Minimum Difference	Maximum Difference	Upper Percentile Difference
Aluminum	-95%	-67%	-70%
Arsenic	-75%	39%	-1%
Barium	-95%	-65%	-71%
Chromium	-84%	-48%	-63%
Cobalt	-56%	21%	-19%
Iron	-65%	-2%	-32%
Thallium	-79%	-35%	-55%
Vanadium	-76%	-11%	-52%

Any SRVs Below Soil Background Levels?

Inorganic	Soil Land Use Category	EPA Method Value mg/kg	Source	USGS Method Value mg/kg	Source
Aluminum	Res/Rec Chronic			59,000	BTV, UTL95-95 from USGS dataset
	Com/Ind Chronic	100,000	Com/Ind chronic SRV		
Arsenic	Res/Rec Acute	9	BTV, UTL95-95 from USGS dataset		
	Res/Rec Chronic	9	BTV, UTL95-95 from USGS dataset		
	Com/Ind Chronic	9	BTV, UTL95-95 from USGS dataset		
Barium	Res/Rec Acute	250	Res/Rec acute SRV		
	Res/Rec Chronic	3,000	Res/Rec chronic SRV		
	Com/Ind Chronic	35,000	Com/Ind chronic SRV		
Chromium III	Res/Rec Chronic	23,000	Res/Rec chronic SRV		
	Com/Ind Chronic	100,000	Com/Ind chronic SRV		
Chromium VI	Res/Rec Chronic	11	Res/Rec chronic SRV		
	Com/Ind Chronic	57	Com/Ind chronic SRV		
Cobalt	Res/Rec Chronic	13	BTV, UTL95-95 from USGS dataset		
	Com/Ind Chronic	67	Com/Ind chronic SRV		
Iron	Res/Rec Chronic	30,000	BTV, UTL95-90 from USGS dataset		
	Com/Ind Chronic	100,000	Com/Ind chronic SRV		
Thallium	Res/Rec Chronic		Site specific BTV		
	Com/Ind Chronic	2.3	Com/Ind chronic SRV		
Vanadium	Res/Rec Chronic			121	BTV, UTL95-95 from USGS dataset
	Com/Ind Chronic			121	BTV, UTL95-95 from USGS dataset

Determining site specific background is always an option

Any SRVs Below Soil Background Levels?



Map of arsenic background concentrations in Minnesota from USGS dataset

Determining site specific background is always an option

Any SRVs Below Soil Background Levels?

- Organics: BaP equivalents, TCDD equivalents
 - Other states data
 - Data specific to other states reflecting ambient levels

Inorganic	Soil Land Use Category ¹	EPA Method Value ² mg/kg	Source ³
BaP Equivalents	Res/Rec Chronic	1	BTV, available data
	Com/Ind Chronic	14	Com/Ind chronic SRV
TCDD Equivalents	Res/Rec Chronic	4.0E-06	Res/Rec chronic SRV
	Com/Ind Chronic	2.0E-05	Com/Ind chronic SRV

How did Revisions Change SRVs?

Residential/Recreational

Decrease	89
Increase	59
No Change	1
No Previous SRV	7
Set at BTV	7
Total	163

Commercial/Industrial

Decrease	58
Increase	88
No Change	8
No Previous SRV	7
Set at BTV	2
Total	163

What are site specific SRVs?

- Applicable to VIC, RCRA & Superfund sites only
- Derived using SRV Spreadsheet – Site Specific
 - Requires approval of project manager & risk assessor
- Ability to modify exposure parameters
 - Example: Hazard Quotient (HQ)
 - Purpose – present a range of potential risks
 - Example: Exposure frequency
 - Purpose – reflect site specific conditions
 - Site Specific SRV Exposure Parameter Modifications
Table in SRV TSD, Table B-1

Reference – USGS Soil Survey

USGS 2013. Smith, D.B., Cannon, W.F., Woodruff, L.G., Solano, Federico, Kilburn, J.E., and Fey, D.L., 2013, Geochemical and mineralogical data for soils of the conterminous United States: U.S. Geological Survey Data Series 801, 19 p., <http://pubs.usgs.gov/ds/801/>.

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Questions?



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