



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
REGION 7**

11201 Renner Boulevard  
Lenexa, Kansas 66219

Jun 28, 2023

**MEMORANDUM**

**SUBJECT:** Proposed Soil Removal Management Levels  
Berry Wood Products  
Fredericktown, Missouri

**FROM:** Elizabeth Cole, Toxicologist  
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**TO:** Andrew Gieseke, On-Scene Coordinator  
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As requested, this memorandum provides a removal management level (RML) for pentachlorophenol in soil at the Berry Wood Products Site, located rurally, approximately 5 miles south of Fredericktown, Missouri.

**Background**

It is understood that the site operated as a wood treating facility from 1969 to 1998. Wood pressure treating and preservation processes occurred at the facility until 1996. One treatment process used a 5% pentachlorophenol and 95% diesel fuel mixture, and another used zinc naphthenate solutions to process wood logs for log home construction. After 1996, the facility operated only as a sawmill until 1998, when all operations reportedly ceased. The property was later subdivided into three parcels and sold.

Missouri Department of Natural Resources (MoDNR) conducted site sampling in December 1996. Elevated levels of pentachlorophenol were detected in surface and sub-surface soils. The data indicated that contamination had migrated from the source area down drainage pathways to the east. Only two samples were analyzed for dioxin (2,3,7,8-tetrachlorodibenzo-p-dioxin) during this investigation, and both were non-detect (less than 0.30 parts per billion [ppb]). Pentachlorophenol was not detected in groundwater samples from two wells on site.

Leachate from residual pentachlorophenol solution in storage tanks and staining of sawdust and milling waste piles, as well as evidence of combustion of these piles have been observed at the Site. Most, but not all, of the former operations buildings have since been razed. Buildings that remain are the former owner's residence, occupied by a new owner, and to the west, two former office buildings now occupied as a residence. Additionally, Parcel 1, contains the main former operations area of the site, which is also being used as a residence. The new owner is in the process of building a new home on the property while living on-site in a travel trailer.



On August 9, 2022, MoDNR referred the site to the EPA Region 7 Superfund Removal Program for further evaluation and removal action consideration. EPA subsequently tasked Tetra Tech Superfund Technical Assessment and Response Team to assist with the removal assessment. Additional samples were collected in November 2022 to further characterize the concentrations of pentachlorophenol in surface and subsurface soil, surface water, and waste materials in tanks abandoned on site. Pentachlorophenol has been identified as a primary Contaminant of Concern (COC) at the site, and other possible COCs identified were semi-volatile organic compounds, dioxin, and diesel fuel. There are no current restrictions (e.g., zoning or an environmental covenant) limiting site use (Tetrattech 2023).

The highest detected concentration of pentachlorophenol in surface soil was 570 mg/kg, from the November 2022 removal assessment sampling event. Other COCs that were detected were below a level of concern for removal action, predominantly polyaromatic hydrocarbons (PAHs), were co-located with the pentachlorophenol contamination. All dioxin samples collected during these sampling activities were waste samples and not from environmental media (Tetrattech 2023).

The objective of this memorandum is to propose pentachlorophenol RMLs for evaluation of the available soil data at this site, in support of a proposed removal action. Based on the presence of residential homes and current lack of use restrictions, RMLs are proposed for residential use scenario in which residents are exposed to pentachlorophenol in site surface soil daily, for many years, via incidental ingestion, dermal contact, and inhalation.

### **Derivation of Removal Management Levels**

Soil RMLs for a residential scenario were derived using EPA's Regional RML calculator (EPA 2023), based on a non-cancer hazard quotient (HQ) of 1 and an excess individual lifetime cancer risk of 1E-04, which is the upper end of EPA's target cancer risk range as directed by the National Contingency Plan (EPA, 1991a). To be protective for both cancer and non-cancer health effects, the final selected cleanup goal for any individual constituent cannot exceed an excess cancer risk of 1E-04 or an HQ of 1. Further, EPA assumes that both cancer risks and non-cancer hazards posed by exposure to multiple compounds are additive. If the total cancer risk posed by exposure to all Site contaminants exceeds 1E-04, even if the concentrations of the individual contaminants are less than their respective RMLs, removal action may be warranted.

In general, the equations used in the RML calculator to calculate aggregate exposure, incidental ingestion, and dermal absorption are from Risk Assessment Guidance for Superfund, Volume I, Part B (EPA, 1991b), while those for inhalation exposure are from Risk Assessment Guidance for Superfund, Volume I, Part F (EPA, 2009) and the EPA's Supplemental Soil Screening Guidance (EPA, 2002). The EPA's standard default exposure parameters (EPA, 2014) were used in the equations to best represent the reasonable maximum exposure scenario, which is defined as the highest exposure that is reasonably expected to occur at a site for the resident (EPA, 1989). The toxicity values for pentachlorophenol were selected according to the hierarchy presented in EPA (2003).

### **Site Specific RMLs**

Table 1, below, presents the surface soil RMLs for a residential scenario. The yellow highlighted cell indicates the lower of the RML value based on excess cancer risk or non-cancer hazard. Thus, the pentachlorophenol RML identified for removal action cannot exceed 100 mg/kg, which poses an excess individual lifetime cancer risk of 1E-04. However, as previously mentioned, removal action could be

warranted in a location where pentachlorophenol is less than its respective RML, if the total excess cancer risk were to exceed 1E-04.

<b>Table 1. Surface Soil Removal Management Levels for a Resident at Berry Wood Products Site</b>		
	<b>Removal Management Level (RML)</b>	
	<b>Excess Individual Lifetime Cancer Risk = 1E-04</b>	<b>Non-Cancer Hazard Quotient = 1</b>
Pentachlorophenol	<b>100 mg/kg</b>	<b>250 mg/kg</b>

RMLs for a residential scenario typically apply only to surface soil, which may be defined as shallow as the top two centimeters of soil. However, without restrictions prohibiting disturbance of site soils, it is possible that deeper soils could be brought to the surface in the future. It is recommended to apply the residential RML to both the surface and subsurface soil contamination, to reduce potential health risks associated with direct contact to subsurface soils that could be brought to the surface.

The output files from the EPA's RML calculator for residential RMLs are provided in the Attachment. If you have any questions or need further assistance, please contact me at x7188.

Attachments

## **References**

- Tetrattech. 2023. Removal Assessment Report with Data Summary Berry Wood Products Site, Fredericktown, Missouri. Superfund Technical Assessment and Response Team (START). April 12, 2023.
- U.S. EPA. 1989. *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual - Part A*. Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002.
- U.S. EPA. 1991a. *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*. Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9355.0-30.
- U.S. EPA. 1991b. *Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)*. Office of Emergency and Remedial Response, Washington, D.C. EPA/540/R-92/003.
- U.S. EPA. 2002. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Publication 9355.4-2.
- U.S. EPA. 2003. *Human Health Toxicity Values in Superfund Risk Assessments*. Office of Superfund Remediation and Technology Innovation, Washington, D.C. OSWER Directive 9285.7-53.
- U.S. EPA. 2009. *Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)*. Office of Superfund Remediation and Technology Innovation, Washington, D.C. OSWER Publication 9285.7-82.
- U.S. EPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. Office of Solid Waste and Emergency Response, Washington, D.C. OSWER Directive 9200.1-120.
- U.S. EPA. 2023. Regional Removal Management Level Calculator. May. [https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl\\_search?tool=rml](https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search?tool=rml)

# Default Resident Soil Inputs

Variable	Value
THQ (target hazard quotient) unitless	1
TR (target risk) unitless	0.0001
LT (lifetime) years	70
ET <sub>roc</sub> (exposure time) hours/day	24
ET <sub>roc,r</sub> (child exposure time) hours/day	24
ET <sub>roc,a</sub> (adult exposure time) hours/day	24
ET <sub>0.2</sub> (mutagenic exposure time) hours/day	24
ET <sub>2.6</sub> (mutagenic exposure time) hours/day	24
ET <sub>6.16</sub> (mutagenic exposure time) hours/day	24
ET <sub>16.76</sub> (mutagenic exposure time) hours/day	24
ED <sub>roc</sub> (exposure duration) years	26
ED <sub>roc,r</sub> (exposure duration - child) years	6
ED <sub>roc,a</sub> (exposure duration - adult) years	20
ED <sub>0.2</sub> (mutagenic exposure duration) years	2
ED <sub>2.6</sub> (mutagenic exposure duration) years	4
ED <sub>6.16</sub> (mutagenic exposure duration) years	10
ED <sub>16.76</sub> (mutagenic exposure duration) years	10
BW <sub>roc,r</sub> (body weight - child) kg	15
BW <sub>roc,a</sub> (body weight - adult) kg	80
BW <sub>0.2</sub> (mutagenic body weight) kg	15
BW <sub>2.6</sub> (mutagenic body weight) kg	15
BW <sub>6.16</sub> (mutagenic body weight) kg	80
BW <sub>16.76</sub> (mutagenic body weight) kg	80
SA <sub>roc,r</sub> (skin surface area - child) cm <sup>2</sup> /day	2373
SA <sub>roc,a</sub> (skin surface area - adult) cm <sup>2</sup> /day	6032
SA <sub>0.2</sub> (mutagenic skin surface area) cm <sup>2</sup> /day	2373
SA <sub>2.6</sub> (mutagenic skin surface area) cm <sup>2</sup> /day	2373
SA <sub>6.16</sub> (mutagenic skin surface area) cm <sup>2</sup> /day	6032
SA <sub>16.76</sub> (mutagenic skin surface area) cm <sup>2</sup> /day	6032
EF <sub>roc</sub> (exposure frequency) days/year	350
EF <sub>roc,r</sub> (exposure frequency - child) days/year	350
EF <sub>roc,a</sub> (exposure frequency - adult) days/year	350
EF <sub>0.2</sub> (mutagenic exposure frequency) days/year	350

# Default Resident Soil Inputs

Variable	Value
EF <sub>7,6</sub> (mutagenic exposure frequency) days/year	350
EF <sub>6,16</sub> (mutagenic exposure frequency) days/year	350
EF <sub>16,36</sub> (mutagenic exposure frequency) days/year	350
IFS <sub>rec-adj</sub> (age-adjusted soil ingestion factor) mg/kg	36750
IFSM <sub>rec-adj</sub> (mutagenic age-adjusted soil ingestion factor) mg/kg	166833.3
IRS <sub>rec</sub> (soil intake rate - child) mg/day	200
IRS <sub>rec</sub> (soil intake rate - adult) mg/day	100
IRS <sub>rec-3</sub> (mutagenic soil intake rate) mg/day	200
IRS <sub>7,6</sub> (mutagenic soil intake rate) mg/day	200
IRS <sub>6,16</sub> (mutagenic soil intake rate) mg/day	100
IRS <sub>16,36</sub> (mutagenic soil intake rate) mg/day	100
AF <sub>rec-3</sub> (skin adherence factor - adult) mg/cm <sup>2</sup>	0.07
AF <sub>rec</sub> (skin adherence factor - child) mg/cm <sup>2</sup>	0.2
AF <sub>7,6</sub> (mutagenic skin adherence factor) mg/cm <sup>2</sup>	0.2
AF <sub>6,16</sub> (mutagenic skin adherence factor) mg/cm <sup>2</sup>	0.2
AF <sub>16,36</sub> (mutagenic skin adherence factor) mg/cm <sup>2</sup>	0.07
DFS <sub>rec-adj</sub> (age-adjusted soil dermal factor) mg/kg	103390
DFSM <sub>rec-adj</sub> (mutagenic age-adjusted soil dermal factor) mg/kg	428260
AT <sub>rec</sub> (averaging time - resident carcinogenic)	365
City (PEF Climate Zone) Selection	Default
A <sub>e</sub> (PEF acres)	0.5
Q/C <sub>wind</sub> (g/m <sup>2</sup> -s per kg/m <sup>3</sup> )	93.77
PEF (particulate emission factor) m <sup>3</sup> /kg	1359344438
A (PEF Dispersion Constant)	16.2302
B (PEF Dispersion Constant)	18.7762
C (PEF Dispersion Constant)	216.108
V (fraction of vegetative cover) unitless	0.5
U <sub>m</sub> (mean annual wind speed) m/s	4.69
U <sub>t</sub> (equivalent threshold value)	11.32
F(x) (function dependent on U <sub>m</sub> /U <sub>t</sub> ) unitless	0.194
City (VF Climate Zone) Selection	Default
A <sub>s</sub> (VF acres)	0.5

# Default Resident Soil Inputs

Variable	Value
$Q/C_{vol}$ (g/m <sup>2</sup> -s per kg/m <sup>3</sup> )	68.18
foc (fraction organic carbon in soil) g/g	0.006
$p_h$ (dry soil bulk density) g/cm <sup>3</sup>	1.5
$p_c$ (soil particle density) g/cm <sup>3</sup>	2.65
$n$ (total soil porosity) $L_{non-aq}/L_{soil}$	0.43396
Theta <sub>a</sub> (air-filled soil porosity) $L_{air}/L_{soil}$	0.28396
Theta <sub>w</sub> (water-filled soil porosity) $L_{water}/L_{soil}$	0.15
T (exposure interval) s	819936000
A (VF Dispersion Constant)	11.911
B (VF Dispersion Constant)	18.4385
C (VF Dispersion Constant)	209.7845
$d_s$ (depth of source) m	.
T <sub>w</sub> (groundwater temperature) Celsius	25

Default

Resident Risk-Based Removal Management Levels (RML) for Soil

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = OW; W = TEF applied; E = RPF applied; G = see user guide; U = user provided; ca = cancer; nc = noncancer; \* = where: nc SL < 100X ca SL; \*\* = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF <sub>0</sub> (mg/kg-day) <sup>-1</sup>	SF <sub>0</sub> Ref <sub>0</sub> (ug/m <sup>3</sup> ) <sup>-1</sup>	IUR	IUR Ref	RfD	RfD Ref	RfC	RfC Ref	GIABS	ABS	RBA
Pentachlorophenol	87-86-5	No	No	Organics	4.00E-01	I	5.10E-06	C	5.00E-03	I	-	-	1	0.25	1

Soil Saturation Concentration (mg/kg)	S (mg/L)	K <sub>oc</sub> (cm <sup>3</sup> /g)	K <sub>d</sub> (cm <sup>3</sup> /g)	HLC (atm-m <sup>3</sup> /mole)	Henry's Law Constant Used in Calcs		Normal Boiling Point		Critical Temperature		T <sub>c</sub> \ Ref	Chemical Type	D <sub>10</sub> (cm <sup>2</sup> /s)	D <sub>100</sub> (cm <sup>2</sup> /s)
					H` and HLC Ref	Calcs (unitless)	BP (K)	BP (K)	T <sub>c</sub> (K)	Temperature				
-	1.40E+01	5.92E+02	-	2.45E-08	1.00E-06	PHYSPROP	582.65	EPI	-	-	HERB	2.95E-02	8.01E-06	

D \ (cm <sup>2</sup> /s)	Particulate Emission Factor (m <sup>3</sup> /kg)	Volatilization		Volatilization Factor	Selected (m <sup>3</sup> /kg)	Ingestion SL	Dermal SL	Inhalation SL	Carcinogenic SL	Ingestion SL	Dermal SL	Inhalation SL
		Factor Unlimited Reservoir (m <sup>3</sup> /kg)	Mass Limit (m <sup>3</sup> /kg)			TR=0.0001 (mg/kg)	TR=0.0001 (mg/kg)	TR=0.0001 (mg/kg)	TR=0.0001 (mg/kg)	THQ=1 (mg/kg)	THQ=1 (mg/kg)	THQ=1 (mg/kg)
-	1.36E+09	-	-	-	-	1.74E+02	2.47E+02	7.48E+07	1.02E+02	3.91E+02	6.59E+02	-

Noncarcinogenic SL	Child THI=1 (mg/kg)	Ingestion SL Adult THQ=1 (mg/kg)	Dermal SL Adult THQ=1 (mg/kg)	Inhalation SL Adult THQ=1 (mg/kg)	Noncarcinogenic SL Adult THI=1 (mg/kg)	Screening Level (mg/kg)
2.45E+02	4.17E+03	3.95E+03	-	-	2.03E+03	1.02E+02 ca