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Comparison of 2021 and 2017 Soil Remediation Standards for the Ingestion-Dermal Exposure Pathway

Contaminant	CAS No.	2017 Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)	2021 Adopted Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)	2017 Non-Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)	2021 Adopted Non-Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)
Acenaphthene	83-32-9	3,400	3,600	37,000	50,000
Acenaphthylene	208-96-8	NA	NR	NA	NR
Acetone (2-Propanone)	67-64-1	70,000	70,000	NA	NA ⁽¹⁾
Acetophenone	98-86-2	6,100	7,800	68,000	130,000
Acrolein	107-02-8	39	NR	570	NR
Acrylonitrile	107-13-1	1	NR	6	NR
Aldrin	309-00-2	0.04	0.041	0.2	0.21
Aluminum (total)	7429-90-5	78,000	78,000	NA	NA ⁽¹⁾
Anthracene	120-12-7	17,000	18,000	180,000	250,000
Antimony (total)	7440-36-0	31	31	450	520
Arsenic (total)	7440-38-2	19	19 ⁽²⁾	19	19 ⁽²⁾
Atrazine	1912-24-9	210	220	2,400	3,200
Barium (total)	7440-39-3	16,000	16,000	230,000	260,000
Benzaldehyde	100-52-7	6,100	170	68,000	910
Benzene	71-43-2	3	3.0	14	16
Benzidine	92-87-5	0.7	NR	0.008	NR
Benzo(a)anthracene (1,2-Benzanthracene)	56-55-3	5	5.1	17	23
Benzo(a)pyrene	50-32-8	0.5	0.51	2	2.3
Benzo(b)fluoranthene (3,4-Benzofluoranthene)	205-99-2	5	5.1	17	23
Benzo(ghi)perylene	191-24-2	NA	NR	NA	NR
Benzo(k)fluoranthene	207-08-9	45	51	170	230
Beryllium	7440-41-7	16	160	230	2,600
1,1'-Biphenyl	92-52-4	61	87	240	450
Bis(2-chloroethoxy)methane	111-91-1	NR	190	NR	2,700
Bis(2-chloroethyl)ether	111-44-4	0.4	0.63	2	3.3
Bis(2-ethylhexyl)phthalate	117-81-7	35	39	140	180
Bromodichloromethane (Dichlorobromomethane)	75-27-4	10	11	51	59
Bromoform	75-25-2	81	88	400	460
Bromomethane (Methyl bromide)	74-83-9	110	110	1,600	1,800
2-Butanone (Methyl ethyl ketone) (MEK)	78-93-3	3,100	47,000	44,000	780,000
Butylbenzyl phthalate	85-68-7	1,200	290	14,000	1,300
Cadmium	7440-43-9	78	71	1,100	1,100
Caprolactam	105-60-2	31,000	32,000	340,000	460,000
Carbazole	86-74-8	24	NR	96	NR

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Carbon disulfide	75-15-0	7,800	NA	110,000	NA
Carbon tetrachloride	56-23-5	7	7.6	35	40
Chlordane (alpha and gamma forms summed)	57-74-9	0.2	0.27	1	1.4
4-Chloroaniline	106-47-8	NR	2.7	NR	13
Chlorobenzene	108-90-7	510	510	7,400	8,400
Chloroethane (Ethyl chloride)	75-00-3	220	NA	1,100	NA
Chloroform	67-66-3	780	780	11,000	13,000
Chloromethane (Methyl chloride)	74-87-3	NA	NA	NA	NA
2-Chloronaphthalene	91-58-7	NR	4,800	NR	67,000
2-Chlorophenol (o-Chlorophenol)	95-57-8	310	390	3,400	6,500
Chrysene	218-01-9	450	510	1,700	2,300
Cobalt (total)	7440-48-4	1,600	23	23,000	390
Copper (total)	7440-50-8	3,100	3,100	45,000	52,000
Cyanide	57-12-5	47	47	680	780
Cyclohexane	110-82-7	NR	NA	NR	NA
4,4'-DDD (p,p'-TDE)	72-54-8	3	2.3	13	11
4,4'-DDE (p,p'-DDX)	72-55-9	2	2.0	9	11
4,4'-DDT	50-29-3	2	1.9	8	9.5
Dibenz(a,h)anthracene	53-70-3	0.5	0.51	2	2.3
Dibromochloromethane (Chlorodibromomethane)	124-48-1	8	8.3	38	43
1,2-Dibromo-3-chloropropane	96-12-8	0.3	0.87	1	4.5
1,2-Dibromoethane (Ethylene dibromide)	106-93-4	0.008	0.35	0.04	1.8
1,2-Dichlorobenzene (o-Dichlorobenzene)	95-50-1	5,300	6,700	59,000	110,000
1,3-Dichlorobenzene (m-Dichlorobenzene)	541-73-1	5,300	6,700	59,000	110,000
1,4-Dichlorobenzene (p-Dichlorobenzene)	106-46-7	610	780	6,800	13,000
3,3'-Dichlorobenzidine	91-94-1	1	1.2	4	5.7
Dichlorodifluoromethane (Freon 12)	75-71-8	16,000	16,000	230,000	260,000
1,1-Dichloroethane	75-34-3	510	120	7,400	640
1,2-Dichloroethane	107-06-2	5	5.8	26	30
1,1-Dichloroethene (1,1-Dichloroethylene)	75-35-4	11	11	160	180
1,2-Dichloroethene (cis) (c-1,2-Dichloroethylene)	156-59-2	780	780	11,000	13,000
1,2-Dichloroethene (trans) (t-1,2-Dichloroethylene)	156-60-5	1,300	1,300	19,000	22,000
2,4-Dichlorophenol	120-83-2	180	190	2,100	2,700
1,2-Dichloropropane	78-87-5	9	19	47	98
1,3-Dichloropropene (total)	542-75-6	6	7.0	32	36
Dieldrin	60-57-1	0.04	0.034	0.2	0.16
Diethylphthalate	84-66-2	49,000	51,000	550,000	730,000
2,4-Dimethylphenol	105-67-9	1,200	1,300	14,000	18,000
Di-n-butyl phthalate	84-74-2	6,100	6,300	68,000	91,000

Contaminant	CAS No.	2017 Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)	2021 Adopted Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)	2017 Non-Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)	2021 Adopted Non-Residential Soil Remediation Standard for the Ingestion-Dermal Exposure Pathway (mg/kg)
4,6-Dinitro-2-methylphenol) (4,6-Dinitro-o-cresol)	534-52-1	6	NR	68	NR
2,4-Dinitrophenol	51-28-5	120	130	1,400	1,800
2,4-Dinitrotoluene	121-14-2	0.7	NR	3	NR
2,6-Dinitrotoluene	606-20-2	0.7	NR	3	NR
2,4-Dinitrotoluene/2,6-Dinitrotoluene (mixture)	25321-14-6	0.7	0.80	3	3.8
Di-n-octyl phthalate	117-84-0	2,400	630	27,000	9,100
1,4-Dioxane	123-91-1	NR	7.0	NR	36
1,2-Diphenylhydrazine	122-66-7	0.6	NR	2	NR
Endosulfan I and Endosulfan II (alpha and beta) (summed)	115-29-7	470	470	6,800	7,800
Endosulfan Sulfate	1031-07-8	470	NR	6,800	NR
Endrin	72-20-8	23	19	340	270
Ethylbenzene	100-41-4	7,800	7,800	110,000	130,000
Extractable Petroleum Hydrocarbons (No. 2 Fuel Oil and Diesel)	various	NR	5,300 ⁽³⁾	NR	75,000 ⁽³⁾
Extractable Petroleum Hydrocarbons (Other)	various	NR	Sample-specific ⁽⁴⁾	NR	Sample-specific ⁽⁴⁾
Fluoranthene	206-44-0	2,300	2,400	24,000	33,000
Fluorene	86-73-7	2,300	2,400	24,000	33,000
alpha-HCH (alpha-BHC)	319-84-6	0.1	0.086	0.5	0.41
beta-HCH (beta-BHC)	319-85-7	0.4	0.30	2	1.4
Heptachlor	76-44-8	0.1	0.15	0.7	0.81
Heptachlor epoxide	1024-57-3	0.07	0.076	0.3	0.40
Hexachlorobenzene	118-74-1	0.3	0.43	1	2.3
Hexachloro-1,3-butadiene	87-68-3	6	8.9	25	47
Hexachlorocyclopentadiene	77-47-4	370	470	4,100	7,800
Hexachloroethane	67-72-1	12	17	48	91
n-Hexane	110-54-3	NR	NA	NR	NA
2-Hexanone	591-78-6	NR	390	NR	6,500
Indeno(1,2,3-cd)pyrene	193-39-5	5	5.1	17	23
Isophorone	78-59-1	510	570	2,000	2,700
Isopropylbenzene	98-82-8	NR	7,800	NR	130,000
Lead (total)	7439-92-1	400	400 ⁽⁵⁾	800	800 ⁽⁶⁾
Lindane (gamma-HCH)(gamma-BHC)	58-89-9	0.4	0.57	2	2.8
Manganese (total)	7439-96-5	11,000	1,900	160,000	31,000
Mercury (total)	7439-97-6	23	23	340	390
Methoxychlor	72-43-5	390	320	5,700	4,600
Methyl acetate	79-20-9	78,000	78,000	NA	NA
Methylene chloride (Dichloromethane)	75-09-2	46	50	230	260
2-Methylnaphthalene	91-57-6	230	240	2,400	3,300
4-Methyl-2-pentanone (MIBK)	108-10-1	NR	NA	NR	NA

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2-Methylphenol (o-cresol)	95-48-7	310	320	3,400	4,600
4-Methylphenol (p-cresol)	106-44-5	31	630	340	9,100
Methyl tert-butyl ether (MTBE)	1634-04-4	780	780	11,000	13,000
Naphthalene	91-20-3	2,400	2,500	25,000	34,000
Nickel (total)	7440-02-0	1,600	1,600	23,000	26,000
2-Nitroaniline	88-74-4	NA	NR	NA	NR
4-Nitroaniline	100-01-6	NR	27	NR	130
Nitrobenzene	98-95-3	120	160	1,400	2,600
N-Nitrosodimethylamine	62-75-9	0.7	NR	0.06	NR
N-Nitrosodi-n-propylamine	621-64-7	0.2	0.17 ⁽⁷⁾	0.3	0.36
N-Nitrosodiphenylamine	86-30-6	99	110	390	520
2,2'-oxybis(1-chloropropane)	108-60-1	2,400	3,100	27,000	52,000
Pentachlorophenol	87-86-5	0.9	1.0	3	4.4
Phenanthrene	85-01-8	NA	NR	NA	NR
Phenol	108-95-2	18,000	19,000	210,000	270,000
Polychlorinated biphenyls (PCBs)	1336-36-3	0.2	0.25	1	1.1
Pyrene	129-00-0	1,700	1,800	18,000	25,000
Selenium (total)	7782-49-2	390	390	5,700	6,500
Silver (total)	7440-22-4	390	390	5,700	6,500
Styrene	100-42-5	16,000	16,000	230,000	260,000
Tertiary butyl alcohol (TBA)	75-65-0	1,400	1,400	20,000	23,000
1,2,4,5-Tetrachlorobenzene	95-94-3	NR	23	NR	390
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	NR	0.000051 ⁽⁸⁾	NR	0.00081 ⁽⁸⁾
1,1,2,2-Tetrachloroethane	79-34-5	3	3.5	16	18
Tetrachloroethene (PCE) (Tetrachloroethylene)	127-18-4	300	330	1,500	1,700
2,3,4,6-Tetrachlorophenol	58-90-2	NR	1,900	NR	27,000
Toluene	108-88-3	6,300	6,300	91,000	100,000
Toxaphene	8001-35-2	0.6	0.49	3	2.3
1,2,4-Trichlorobenzene	120-82-1	73	780	820	13,000
1,1,1-Trichloroethane	71-55-6	160,000	160,000	NA	NA ⁽¹⁾
1,1,2-Trichloroethane	79-00-5	31	12	440	64
Trichloroethene (TCE) (Trichloroethylene)	79-01-6	14	15	69	79
Trichlorofluoromethane (Freon 11)	75-69-4	23,000	23,000	340,000	390,000
2,4,5-Trichlorophenol	95-95-4	6,100	6,300	68,000	91,000
2,4,6-Trichlorophenol	88-06-2	19	49	74	230
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon TF)	76-13-1	NR	NA	NR	NA
1,2,4-Trimethylbenzene	95-63-6	NR	780	NR	13,000
Vanadium (total)	7440-62-2	78	390	1,100	6,500
Vinyl chloride	75-01-4	2	0.97	8	5.0
Xylenes (total)	1330-20-7	12,000	12,000	170,000	190,000
Zinc (total)	7440-66-6	23,000	23,000	340,000	390,000

NA = Appropriate toxicological information not available or standard no applicable

NR = Compound Not Regulated

1 – Standard not applicable because health-based criterion exceeds one million mg/kg

2 – Standard is based on natural background

3 – Special calculation for EPH

4 – Sample-specific calculation using EPH calculator

5 – Standard based on the Integrated Exposure Uptake Biokinetic (IEUBK) model for lead in children

6 – Standard based on the Adult Lead Methodology (ALM)

7 – Standard set at soil reporting limit

8 – This standard is used for comparison to site soil data that have been converted to sample-specific TCDD-TEQ values through application of the Toxicity Equivalence Factor Methodology (USEPA 2010) and using the WHO 2005 Mammalian Toxic Equivalency Factors (TEFs).

Soil Remediation Standards -Soil Ingestion/Dermal Exposure Pathway - Residential Exposure Scenario

2017 soil remediation standard existed but no 2021 soil remediation standard was proposed

14

10
4

2017 numeric soil remediation standard existed
2017 soil remediation standard was "NA"

2021 soil remediation standard was adopted but no 2017 soil remediation standard existed

17

13
4

2021 numeric soil remediation standard adopted
2021 adopted soil remediation standard is "NA"

2017 soil remediation standard existed and a 2021 soil remediation standard adopted

121

1

2017 soil remediation standard was "NA" and 2021 adopted soil remediation standard is "NA"

0

2017 soil remediation standard was "NA" and a 2021 numeric soil remediation standard adopted

2

2017 numeric soil remediation standard existed but 2021 adopted soil remediation standard is "NA"

18

2021 adopted numeric soil remediation standard is less than the 2017 soil remediation standard

16 - Difference is less than an order of magnitude

2 - Difference is an order of magnitude or greater

32

2021 adopted numeric soil remediation standard is equal to the 2017 soil remediation standard

68

2021 adopted numeric soil remediation standard is greater than the 2017 soil remediation standard

Soil Remediation Standards -Soil Ingestion/Dermal Exposure Pathway - Non Residential Exposure Scenario

2017 soil remediation standard existed but no 2021 soil remediation standard was proposed



10
4

2017 numeric soil remediation standard existed
2017 soil remediation standard was "NA"

2021 soil remediation standard was adopted but no 2017 soil remediation standard existed



13
4

2021 numeric soil remediation standard adopted
2021 adopted soil remediation standard is "NA"

2017 soil remediation standard existed and a 2021 soil remediation standard adopted

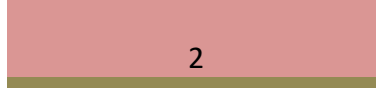
121



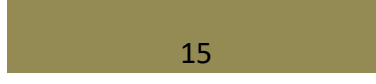
2017 soil remediation standard was "NA" and 2021 adopted soil remediation standard is "NA"



2017 soil remediation standard was "NA" and a 2021 numeric soil remediation standard adopted



2017 numeric soil remediation standard existed but 2021 adopted soil remediation standard is "NA"



2021 adopted numeric soil remediation standard is less than the 2017 soil remediation standard

11 - Difference is less than an order of magnitude

4 - Difference is an order of magnitude or greater



2021 adopted numeric soil remediation standard is equal to the 2017 soil remediation standard

96

2021 adopted numeric soil remediation standard is greater than the 2017 soil remediation standard

**Order of Magnitude Contaminants - Soil ingestion - Dermal and Soil Inhalation Exposure Pathways[†]
Residential Exposure Scenario**

Contaminant	CAS #	2017 soil remediation standard (mg/kg)	2021 adopted soil remediation standard (mg/kg)
Benzaldehyde	100-52-7	6,100 (ingestion-dermal)	170 (ingestion-dermal)
Caprolactam	105-60-2	31,000 (ingestion-dermal)	290 (inhalation)
Cobalt (total)	7440-48-4	1,600 (ingestion-dermal)	23 (ingestion-dermal)*
Cobalt (total)	7440-48-4	9,100 (inhalation)	520 (inhalation)*
Ethylbenzene	100-41-4	7,800 (ingestion-dermal)	10 (inhalation)
Hexachlorocyclopentadiene	77-47-4	45 (inhalation)	2.7 (inhalation)
Nickel (total)	7440-02-0	360,000 (inhalation)	20,000 (inhalation)**

* ingestion-dermal is the driving exposure pathway for cobalt

**ingestion-dermal is the driving exposure pathway for nickel (1,600 mg/kg)

† Given that the former direct contact soil remediation standards were based on the lower of the ingestion-dermal or inhalation exposure pathway, both are provided in the order of magnitude evaluation

**Order of Magnitude Contaminants - Soil Ingestion - Dermal and Soil Inhalation Exposure Pathways[†]
Non-Residential Exposure Scenario**

Contaminant	CAS #	2017 soil remediation standard (mg/kg)	2021 adopted soil remediation standard (mg/kg)
Benzaldehyde	100-52-7	68,000 (ingestion-dermal)	910 (ingestion-dermal)
Butylbenzyl phthalate	85-68-7	14,000 (ingestion-dermal)	1,300 (ingestion-dermal)
Caprolactam	105-60-2	340,000 (ingestion-dermal)	1,300 (inhalation)
Cobalt (total)	7440-48-4	23,000 (ingestion-dermal)	390 (ingestion-dermal)*
Ethylbenzene	100-41-4	110,000 (ingestion-dermal)	48 (inhalation)
1,1-Dichloroethane	75-34-3	7,400 (ingestion-dermal)	640 (ingestion-dermal)**

* The 2017 driving soil remediation standard for cobalt was for the soil inhalation exposure pathway (590 mg/kg). The 2021 adopted soil remediation for cobalt for the soil inhalation exposure pathway is 2,500 mg/kg. The 2021 adopted soil remediation standard for cobalt for the soil ingestion-dermal exposure pathway is 390 mg/kg. While the 390 mg/kg soil remediation standard for cobalt is the driving standard, it is not more than an order of magnitude lower than the 2017 soil inhalation exposure pathway remediation standard for cobalt. As such, the order of magnitude trigger is not applicable.

** The 2017 driving soil remediation standard for 1,1-dichloroethane was for the soil inhalation exposure pathway (24 mg/kg). The 2021 adopted soil remediation for 1,1-dichloroethane for the soil inhalation exposure pathway is "not applicable". As such, the 2021 adopted soil remediation standard for 1,1-dichloroethane (640 mg/kg) for the soil ingestion-dermal exposure pathway becomes the default soil remediation standard. While there is more than an order of magnitude difference between the prior ingestion-dermal soil criterion and adopted ingestion-dermal soil remediation standard, the order of magnitude provision is not applicable.

† Given that the former direct contact soil remediation standards were based on the lower of the ingestion-dermal or inhalation exposure pathway, both are provided in the order of magnitude evaluation