



## CHEMICAL UPDATE WORKSHEET

<b>Chemical Name:</b>	<b>Ethylbenzene</b>
<b>CAS #:</b>	<b>100-41-4</b>
<b>Revised By:</b>	RRD Toxicology Unit
<b>Revision Date:</b>	September 16, 2015

### (A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
<b>Molecular Weight (g/mol)</b>	106.17	106.17	EPI	EXP
<b>Physical State at ambient temp</b>	Liquid	Liquid	MDEQ	
<b>Melting Point (°C)</b>	---	-94.90	EPI	EXP
<b>Boiling Point (°C)</b>	136.1	136.10	EPI	EXP
<b>Solubility (ug/L)</b>	1.69E+5	169000	EPI	EXP
<b>Vapor Pressure (mmHg at 25°C)</b>	9.88	9.60E+00	EPI	EXP
<b>HLC (atm-m<sup>3</sup>/mol at 25°C)</b>	7.88E-3	7.88E-03	EPI	EXP
<b>Log Kow (log P; octanol-water)</b>	3.14	3.15	EPI	EXP
<b>Koc (organic carbon; L/Kg)</b>	367	446.1	EPI	EST
<b>Ionizing Koc (L/kg)</b>		NR	NA	NA
<b>Diffusivity in Air (Di; cm<sup>2</sup>/s)</b>	0.075	6.85E-02	W9	EST
<b>Diffusivity in Water (Dw; cm<sup>2</sup>/s)</b>	7.8E-6	8.46E-06	W9	EST
<b>Soil Water Partition Coefficient (Kd; inorganics)</b>	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	55 F	21	CRC	EXP
Lower Explosivity Level (LEL; unitless)	0.008	0.008	CRC	EXP
Critical Temperature (K)		6.17E+02	EPA2004	EXP
Enthalpy of Vaporization (cal/mol)		8.50E+03	EPA2004	EXP
Density (g/mL, g/cm <sup>3</sup> )		0.8626	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm <sup>2</sup> )	2.51E-05	2.69E-05	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm <sup>2</sup> )	5.44E-05	6.17E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm <sup>2</sup> )	3.52E-05	4.24E-05	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm <sup>2</sup> )	7.40E-05	9.49E-05	EMSOFT	EST

**(B) Toxicity Values/Benchmarks**

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
<b>Reference Dose (RfD) (mg/kg/day)</b>	9.7E-2	4.0E-2	ATSDR, 2010	
<b>RfD details</b>	Rat sub chronic - chronic (182-day) gavage study; Critical effect = liver and kidney toxicity (Wolf et al., 1956). CCD/RRD date: 5/20/1995	<p><b>Tier 2 Source:</b>  <b>ATSDR:</b>  <b>Basis:</b> ATSDR is a more current assessment than IRIS. MDEQ applied an additional UF = 10 to account for subchronic to chronic extrapolation and derived a final RfD = 4.0E-2. PPRTV (2009) derived a subchronic p-RfD based on the same study (Mellert et al., 2007).  <b>ATSDR</b> intermediate oral MRL = 4.0E-1 mg/kg-day. No oral chronic MRL at this time.  <b>Critical Study:</b> Mellert, W., K. Deckardt, W. Kaufmann et al. 2007. Ethylbenzene: 4- and 13-week rat oral toxicity. Arch. Toxicol. 81:361–370.  <b>Method(s):</b> Groups of 10 male and 10 female Wister rats were administered ethylbenzene (no vehicle) by oral gavage at doses of 0, 75, 250, or 750 mg/kg/day for 13 weeks. The total daily dose of ethylbenzene was administered as split morning/evening half doses.  <b>Critical effect:</b> hepatotoxicity (increased serum liver enzyme activity, absolute and relative liver weights, and incidence of centrilobular hepatocyte hypertrophy in male rats  <b>End point or Point of Departure (POD):</b> BMDL = 6.61 µmol/L (a MCL dose metric); HED = 10.68 mg/kg-day                      (Note: HED was calculated using a reference human body weight of 70 kg and the assumption that the daily dose was delivered in 16 dose splits/24 hours)  <b>Uncertainty Factors:</b> UF = 30 (10 each for intraspecies variability and 3 for interspecies extrapolation)  <b>Source and date:</b> ATSDR, 11/2010</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (6/01/1991), RfD = 1.0E-1 mg/kg-day.  <b>Critical Study:</b> Wolf, M.A., V.K. Rowe, D.D. McCollister, R.L. Hollingsworth and F. Oyen. 1956. Toxicological studies of certain alkylated benzenes and benzene.</p>	ATSDR, 2010	Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>Arch. Ind. Health. 14: 387-398.</p> <p><b>Method(s):</b> Albino female rats (10 /dose and 20 controls) were exposed to 0, 13.6, 136, 408, or 680 mg/kg/day ethylbenzene in olive oil by gavage 5 days/week for 182 days.</p> <p><b>Critical effect:</b> histopathologic changes in liver and kidney</p> <p><i>End point or Point of Departure (POD):</i> NOAEL = 135 mg/kg-day; NOAEL<sub>ADJ</sub> = 97.1 mg/kg/day. LOAEL = 408 mg/kg/day (converted to 291 mg/kg/day)</p> <p><b>Uncertainty Factors:</b> UF = 1,000 (10 each for intraspecies variability, interspecies extrapolation and use of a sub chronic study)</p> <p><b>Source and date:</b> IRIS, Last revision date - 6/01/1991</p> <p><b>PPRTV:</b> PPRTV (9/10/2009) sub chronic p-RfD = 0.05 mg/kg-day:</p> <p><b>Critical Study:</b> Mellert, W., K. Deckardt, W. Kaufmann et al. 2007. Ethylbenzene: 4- and 13-week rat oral toxicity. Arch. Toxicol. 81:361–370.</p> <p><b>Method(s):</b> Groups of 10 male and 10 female Wister rats were administered ethylbenzene (no vehicle) by oral gavage at doses of 0, 75, 250, or 750 mg/kg/day for 13 weeks. The total daily dose of ethylbenzene was administered as split morning/evening half doses.</p> <p><b>Critical effect:</b> centrilobular hepatocyte hypertrophy in male rats</p> <p><b>End point or Point of Departure (POD):</b> BMDL = 48 mg/kg-day</p> <p><b>Uncertainty Factors:</b> UF = 1,000 (10 each for intraspecies variability, interspecies extrapolation and database deficiencies)</p> <p><b>Source and date:</b> PPRTV, 9/10/2009</p> <p><b>Tier 3 Source:</b></p> <p><b>MDEQ:</b> Per DEQ-CCD/RRD (5/20/1985), RfD = 9.7E-2 mg/kg-day. WRD RfD = 9.7E-2 (9/16/2004). See Part 201 Value RfD details.</p>		
Oral Cancer Slope Factor (CSF) (mg/kg-day) <sup>-1</sup>	--	1.1E-2	CALEPA, 2011	
CSF details	NA	<p><b>Tier 3 Source:</b></p> <p><b>CALEPA:</b></p> <p><b>Basis:</b> CALEPA (2011) value is derived from the inhalation cancer potency, which is</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>based on the NTP (1999) study. NYSDEC (2006) also used the route to route extrapolation approach using a different IUR value. MDEQ (2004) derived an almost similar value (1.07E-2) using the NTP study. Minnesota adopted CALEPA CSF. See details below.</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (8/1/1991), no value at this time. Ethylbenzene was classified as D or “not classifiable as to human carcinogenicity” due to lack of animal bioassays and human studies.  <b>PPRTV:</b> Per PPRTV (9/10/2009), no value at this time.  <b>MRL:</b> NA; MRLs are for non-cancer effects only.  <b>Carcinogen Weight-of-Evidence (WOE) Class:</b> The IARC (Vol.: 77. 2000, p. 227) has concluded that there is inadequate evidence to classify ethylbenzene as a carcinogen in humans and sufficient evidence in experimental animals (Group 2B). An NTP (1999) bioassay exposed male and female rats and mice to 0, 75, 250, or 750 ppm ethylbenzene for up to 2 years. NTP reported that ethylbenzene showed clear evidence of carcinogenic activity in male rats based on increased incidences of renal tubule neoplasms and testicular adenomas, some evidence of carcinogenic activity in female rats based on increased incidences of renal tubule adenomas, some evidence of carcinogenic activity in male mice based on increased incidences of alveolar/bronchiolar neoplasms, and some evidence of carcinogenic activity in female mice based on increased incidences of hepatocellular neoplasms.</p> <p><b>Tier 3 Sources:</b>  <b>MDEQ:</b> MDEQ/WRD (9/16/2004) CSF = 1.07E-2 (mg/kg-day)<sup>-1</sup> :  <b>Basis:</b> Based on the NTP (1999) inhalation study.  <b>Critical Study:</b> NTP. 1999. NTP technical report on the toxicology and carcinogenesis studies of ethylbenzene in F344/N rats and B6C3F1 mice (inhalation studies). Research Triangle Park, NC: National Toxicology Program, U.S. Department of Health and Human Services. NTP TR 466.  <b>Method(s):</b> F344/N rats (50/sex/ group) were exposed to 0, 75, 250, or 750 ppm</p>		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>ethylbenzene by inhalation for 6 hours/day, 5 days/week for 104 weeks. An absorption factor of 0.523 was assumed.</p> <p>1) <i>Dose response data: Tumor Type</i> - renal tubule tumors; <i>Test Species</i> - male F344 rats; <i>Route</i> - inhalation</p> <p>2) <i>Extrapolation method:</i></p> <p><b>Source and Date:</b> MDEQ-CCD/WRD - 9/16/2004</p> <p><b>California DTSC (CALEPA):</b> CSF= 0.011 (1.1E-2) mg/kg-day<sup>-1</sup>. Basis: Calculated from male rat renal tumor data (NTP, 1999), using the linearized multistage (LMS) methodology with lifetime weighted average (LTWA) doses. OEHHA concluded that the limited data do not conclusively establish any particular MOA for ethylbenzene carcinogenesis. However, one or more genotoxic processes appear at least plausible and may well contribute to the overall process of tumor induction. Therefore, the default linear approach was used for extrapolating the dose-response curve to low doses. The oral cancer potency is derived from the inhalation cancer potency by multiplying by the ratio of uptake factors (1/0.77):  <math display="block">P_{\text{human\_oral}} = 0.0083 \text{ (mg/kg-day)}^{-1} \times (1/0.77) = 0.011 \text{ (mg/kg-day)}^{-1}</math> Source: OEHHA 2009. Technical Support Document for Cancer Potency Factors, Appendix B. Updated 2011 (p.B300-302)</p> <p><b>Minnesota PCA:</b> CSF= 1.10E-02 (mg/kg-day)<sup>-1</sup> based on CAL EPA.</p> <p><b>New York DEC:</b> CSF= 3.5E-3 (mg/kg-day)<sup>-1</sup>.  <b>Basis:</b> Route to route extrapolation; The inhalation unit risk for ethylbenzene is <math>1 \times 10^{-6}</math> per <math>\mu\text{g}/\text{m}^3</math> is used to derive a cancer potency factor of <math>3.5 \times 10^{-3}</math> per mg/kg/day assuming a 70 kg adult continuously exposed and breathing <math>20 \text{ m}^3</math> of air per day.  Source: New York State Brownfield Cleanup Program, Development of Soil Cleanup Objectives: Technical Support Document, 2006, Appendix A, p.A-421.</p> <p><b>Other Tier 3:</b> No value is available at this time from these Tier 3</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		sources/databases: HEAST, NTP ROC, health and environmental agencies of Massachusetts, New Jersey and Texas, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), ECHA (REACH) and OECD HPV.		
<b>Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (<math>\mu\text{g}/\text{m}^3</math>)</b>	1.0E+3	2.6E+2	ATSDR, 2010	
<b>RfC/ITSL details</b>	Based on EPAs RfC, from Andrew et al 1981 and Hardin et al 1981. CCD/AQD date: 12/20/1990	<p><b>Tier 2 Source:</b>  <b>ATSDR:</b>  <b>Basis:</b> ATSDR is a more current assessment than IRIS.  <b>ATSDR inhalation chronic MRL</b> = 0.06 ppm or 2.6E-1 mg/m<sup>3</sup>.  <b>Critical Study:</b> NTP. 1999. NTP technical report on the toxicology and carcinogenesis studies of ethylbenzene in F344/N rats and B6C3F1 mice (inhalation studies). Research Triangle Park, NC: National Toxicology Program, U.S. Department of Health and Human Services. NTP TR 466.  <b>Methods:</b> F344/N rats (50/sex/ group) were exposed to 0, 75, 250, or 750 ppm ethylbenzene by inhalation for 6 hours/day, 5 days/week for 104 weeks.  <b>Critical effect:</b> increased severity of chronic progressive nephropathy in female rats  <b>End point or Point of Departure (POD):</b> LOAEL<sub>HEC</sub> = 17.45 ppm  <b>Uncertainty Factors:</b> UF = 300 (10 each for intraspecies variability and use of a LOAEL and 3 for interspecies extrapolation)  <b>Additional data:</b> ATSDR acute MRL (5ppm) and intermediate MRLs (2 ppm) are based on neurological effects (Cappaert et al., 1999 and Gagnaire et al., 2007, respectively).  <b>Source and date:</b> ATSDR, 11/2010</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (1991), chronic RfC = 1.0 mg/m<sup>3</sup>:  <b>Critical Studies:</b>                      1) Andrew, F.D., R.L. Buschbom, W.C. Cannon, R.A. Miller, L.F. Montgomery, D.W.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>Phelps, et al. 1981. Teratologic assessment of ethylbenzene and 2- ethoxyethanol. Battelle Pacific Northwest Laboratory, Richland, WA. PB 83- 208074., 108.</p> <p>2) Hardin, B.D., G.P. Bond, M.R. Sikov, F.D. Andrew, R.P. Beliles and R.W. Niemeier. 1981. Testing of selected workplace chemicals for teratogenic potential. Scand. J. Work Environ. Health. 7(suppl 4): 66-75.</p> <p><b>Methods:</b> Inhalation experiments were conducted with Wistar rats (78-107/group) and New Zealand white rabbits (29-30/group) exposed 6 to 7 hours/day, 7 days/week during days 1-19 and 1-24 of gestation, respectively, to nominal concentrations of 0, 100, or 1000 ppm (434 or 4342 mg/cu.m)</p> <p><b>Critical effect:</b> developmental toxicity</p> <p><b>End point or Point of Departure (POD):</b> NOAEL = 434 mg/m<sup>3</sup> (100 ppm); NOAEL<sub>(HEC)</sub>: 434 mg/m<sup>3</sup></p> <p><b>Uncertainty Factors:</b> UF = 300 (10 each for intraspecies variability and database deficiencies and 3 for interspecies extrapolation)</p> <p><b>Source and date:</b> IRIS, Last revision date – 3/01/1991</p> <p><b>PPRTV:</b> Per PPRTV (9/10/2009), no chronic RfC value at this time. A sub chronic p-RfC = 9.0 mg/m<sup>3</sup> is available:</p> <p><b>Critical Study:</b> Gagnaire, F., C. Langlais, S. Grossmann et al. 2007. Ototoxicity in rats exposed to ethylbenzene and to two technical xylene vapors for 13 weeks. Arch. Toxicol. 81(2):127–143.</p> <p><b>Methods:</b> 14 male Sprague-Dawley rats were exposed to ethylbenzene vapors (whole body exposure) at concentrations of 0, 200, 400, 600, or 800 ppm 6 hours/day, 6 days/week for 13 weeks followed by 8 untreated weeks</p> <p><b>Critical effect:</b> ototoxicity (loss of outer hair cells)</p> <p><b>End point or Point of Departure (POD):</b> LOAEL<sub>HEC</sub> = 868 mg/m<sup>3</sup></p> <p><b>Uncertainty Factors:</b> UF = 100 (10 for intraspecies variability and 3 each for interspecies (toxicodynamic) difference and use of a LOAEL)</p> <p><b>Source and date:</b> PPRTV, 9/10/2009</p> <p><b>Tier 3 Source:</b></p> <p><b>MDEQ:</b> Per DEQ-CCD (12/20/1990), AQD adopted IRIS RfC. See Part 201 Value</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		RfC/ITSL details		
<b>Inhalation Unit Risk Factor (IURF) ((<math>\mu\text{g}/\text{m}^3</math>)<sup>-1</sup>)</b>	3.1E-7	2.5E-6	CALEPA, 2011	
<b>IURF details</b>	Based on F344 rat/B6C3F1 mouse inhalation bioassays. There was clear evidence of carcinogenic activity of ethylbenzene in male F344 rats based on increased incidences of renal tubule neoplasms. The incidences of testicular adenoma were also increased. There was some evidence of carcinogenic activity of ethylbenzene in female F344 rats based on increased incidences of	<p><b>Tier 3 Source:</b>  <b>CALEPA:</b>  <b>Basis:</b> CALEPA IUR is based on a 2011 assessment using different models and dose metrics. The final value is based on the most appropriate model. CALEPA, MDEQ and NY used the same key study but the models used to derive the values varied. Minnesota and New Jersey adopted the CALEPA value. See details below.</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS:</b> Per IRIS (8/1/1991), no value at this time. Ethylbenzene was classified as D or “not classifiable as to human carcinogenicity” due to lack of animal bioassays and human studies.  <b>PPRTV:</b> Per PPRTV (9/10/2009), no value at this time.  <b>MRL:</b> NA; MRLs are for non-cancer effects only.</p> <p><b>Carcinogen Weight-of-Evidence (WOE) Class:</b> The IARC (Vol.: 77. 2000, p. 227) has concluded that there is inadequate evidence to classify ethylbenzene as a carcinogen in humans and sufficient evidence in experimental animals (Group 2B). An NTP (1999) bioassay exposed male and female rats and mice to 0, 75, 250, or 750 ppm ethylbenzene for up to 2 years. NTP reported that ethylbenzene showed clear evidence of carcinogenic activity in male rats based on increased incidences of renal tubule neoplasms and testicular adenomas, some evidence of carcinogenic activity in female rats based on increased incidences of renal tubule adenomas, some evidence of carcinogenic activity in male mice based on increased incidences of alveolar/bronchiolar neoplasms, and some evidence of carcinogenic activity in female mice based on increased incidences of hepatocellular neoplasms.</p> <p><b>Tier 3 Sources:</b></p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
	<p>renal tubule adenomas. There was some evidence of carcinogenic activity of ethylbenzene in male B6C3F1 mice based on increased incidence of alveolar/bronchiolar neoplasms. There was some evidence of carcinogenic activity of ethylbenzene in female B6C3F1 mice based on increased incidences of hepatocellular neoplasms. CCD/AQD date: 5/28/2002</p>	<p><b>MDEQ:</b> AQD (5/28/2002) IURF = 3.1E-7  <b>Basis:</b> F344 rat/B6C3F1 mouse inhalation bioassays  <b>Critical Study:</b> NTP. 1999. NTP technical report on the toxicology and carcinogenesis studies of ethylbenzene in F344/N rats and B6C3F1 mice (inhalation studies). Research Triangle Park, NC: National Toxicology Program, U.S. Department of Health and Human Services. NTP TR 466.  <b>Methods:</b> male and female rats and mice to 0, 75, 250, or 750 ppm ethylbenzene for up to 2 years.            1) <i>Dose response data: Tumor Type</i> - renal tubule neoplasms and testicular adenomas ; <i>Test Species</i> - rats; <i>Route</i> - inhalation            2) <i>Extrapolation method:</i> Linear  <b>Source and Date:</b> MDEQ-CCD/AQD, 5/28/2002</p> <p><b>California DTSC (CALEPA):</b> IURF= 0.0000025 or 2.5E-6 (µg/m<sup>3</sup>)<sup>-1</sup>.            Using either the LMS or BMD with different dose metrics, the 95% upper confidence bound on the unit risk value for purposes of calculating cancer risks associated with exposure to ethylbenzene is in the range 5.5 x 10<sup>-4</sup> to 6.6 x 10<sup>-3</sup> (mg/m<sup>3</sup>)<sup>-1</sup>, based on the incidence data from the NTP (1999). The unit risk value of 2.5 x10<sup>-3</sup> (mg/m<sup>3</sup>)<sup>-1</sup>, or 2.5 x10<sup>-6</sup> (µg/m<sup>3</sup>)<sup>-1</sup>, based on the renal tubule carcinoma or adenoma incidence data in male rats and using the LMS methodology applied to LTWA doses is considered most appropriate.            Key study: National Toxicology Program (NTP), 1999. Toxicology and Carcinogenesis Studies of Ethylbenzene (CAS No. 100-41-4) in F344/N Rats and in B6C3F1 Mice (Inhalation Studies). Technical Report Series No. 466. NIH Publication No. 99-3956. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health. NTP, Research Triangle Park, NC.</p> <p><b>Minnesota PCA:</b> IURF= 2.50E-06 (µg/m<sup>3</sup>)<sup>-1</sup> based on CAL EPA.  <b>New Jersey DEP:</b> IURF= 2.5E-06 (µg/m<sup>3</sup>)<sup>-1</sup> based on CAL EPA.  <b>New York DEC:</b> IURF= 1.0E-6 (µg/m<sup>3</sup>)<sup>-1</sup>.</p>		



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>A two-year inhalation bioassay (NTP, 1999) showed clear evidence of carcinogenicity based on renal tubule neoplasms in male and female rats. Other observed cancer affects included alveolar/bronchiolar adenomas and carcinomas in male mice, and hepatocellular adenomas and carcinomas in female mice. Based on the increased incidence of renal tubular adenomas and carcinomas in male rats, and in the absence of a unit risk from authoritative bodies, the NYS Department of Health derived a unit risk of <math>1.0 \times 10^{-6}</math> per mcg/m<sup>3</sup> for ethylbenzene. The point of departure was the 95% lower confidence limit on the air concentration associated with a 10% excess risk, calculated using the linearized multistage model (extra risk) and the default pharmacokinetic adjustment (equal to 1) for effects of a systemic gas when blood: air partitioning coefficients are unknown or when the animal: human partitioning coefficient ratio is greater than 1.</p> <p>Source: NYS DOH; New York State Brownfield Cleanup Program, Development of Soil Cleanup Objectives: Technical Support Document, 2006, Appendix A, A-426.</p> <p><b>Other Tier 3:</b> No value is available at this time from these Tier 3 sources/databases: HEAST, NTP ROC, health and environmental agencies of Massachusetts and Texas, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), ECHA (REACH) and OECD HPV.</p>		
<b>Mutagenic Mode of Action (MMOA)? (Y/N)</b>	--	NO	USEPA, 2015	
<b>MMOA Details</b>	--	NA Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
<b>Developmental or Reproductive Effector? (Y/N)</b>	No	No. the RfD or RfC is not based on a reproductive-developmental effect; however, a developmental inhalation study exists (Andrew et al., 1981). See the RfC section for details.	MDEQ, 2015	
<b>Developmental or Reproductive Toxicity Details</b>	NA	NA		



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
<b>State Drinking Water Standard (SDWS) (ug/L)</b>	7E+2	7E+2	SDWA, 1976	
<b>SDWS details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
<b>Secondary Maximum Contaminant Level (SMCL) (ug/L)</b>	--	NO	SDWA, 1976 and USEPA SMCL List	
<b>SMCL details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
<b>Is there an aesthetic value for drinking water? (Y/N)</b>	NO	Yes	NA	
<b>Aesthetic value (ug/L)</b>	--	74	ABB, 1991	
<b>Aesthetic Value details</b>		Determination of Threshold Odor Numbers for Six Substances. December 1991. ABB Environmental Services, Inc.		
<b>Phytotoxicity Value? (Y/N)</b>	NO	Not evaluated.	NA	
<b>Phytotoxicity details</b>	NA	NA		
<b>Others</b>	--	--	NA	

**(C) Chemical-specific Absorption Factors**

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS <sub>gi</sub> )	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS <sub>gi</sub> details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AE <sub>d</sub> )	---	0.1	MDEQ, 2015	
AE <sub>d</sub> details				
Ingestion Absorption Efficiency (AE <sub>i</sub> )		1.0	MDEQ, 2015	
AE <sub>i</sub> Details				
Relative Source Contribution for Water (RSC <sub>w</sub> )		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC <sub>s</sub> )		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC <sub>A</sub> )		1.0	MDEQ, 2015	
Others				

**(D) Rule 57 Water Quality Values and GSI Criteria**

<b>Current GSI value (µg/L)</b>	18
<b>Updated GSI value (µg/L)</b>	18
<b>Rule 57 Drinking Water Value (µg/L)</b>	25

	<b>Rule 57 Value (µg/L)</b>	<b>Verification Date</b>
<b>Human Non-cancer Values- Drinking water source (HNV-drink)</b>	2,100	4/1997
<b>Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)</b>	8,900	4/1997
<b>Wildlife Value (WV)</b>	NA	NA
<b>Human Cancer Values for Drinking Water Source (HCV-drink)</b>	25	9/2004
<b>Human Cancer values for non-drinking water source (HCV-Non-drink)</b>	110	9/2004
<b>Final Chronic Value (FCV)</b>	18	9/2003
<b>Aquatic maximum value (AMV)</b>	160	9/2003
<b>Final Acute Value (FAV)</b>	320	9/2003

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 [website](#)
2. MDEQ Rule 57 [table](#)



**(E) Target Detection Limits (TDL)**

	<b>Value</b>	<b>Source</b>
<b>Target Detection Limit – Soil (<math>\mu\text{g}/\text{kg}</math>)</b>	50	MDEQ, 2015
<b>Target Detection Limit – Water (<math>\mu\text{g}/\text{L}</math>)</b>	1	MDEQ, 2015
<b>Target Detection Limit – Air (ppbv)</b>	1.90E+01	MDEQ, 2015
<b>Target Detection Limit – Soil Gas (ppbv)</b>	6.40E+02	MDEQ, 2015

**CHEMICAL UPDATE WORKSHEET ABBREVIATIONS:**

CAS # - Chemical Abstract Service Number.

**Section (A) Chemical-Physical Properties****Reference Source(s):**

CRC	Chemical Rubber Company Handbook of Chemistry and Physics, 95th edition, 2014-2015
EMSOFT	USEPA Exposure Model for Soil-Organic Fate and Transport (EMSOFT) (EPA, 2002)
EPA2001	USEPA (2001) Fact Sheet, Correcting the Henry's Law Constant for Soil Temperature. Office of Solid Waste and Emergency Response, Washington, D.C.
EPA4	USEPA (2004) User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February 22, 2004.
EPI	USEPA's Estimation Programs Interface SUITE 4.1, Copyright 2000-2012
HSDB	Hazardous Substances Data Bank
MDEQ	Michigan Department of Environmental Quality
NPG	National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards
PC	National Center for Biotechnology Information's PubChem database
PP	Syracuse Research Corporation's PhysProp database
SCDM	USEPA's Superfund Chemical Data Matrix
SSG	USEPA's Soil Screening Guidance: Technical Background Document, Second Edition, 1996
USEPA/EPA	United States environmental protection agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

W9 USEPA's User Guide for Water9 Software, Version 2.0.0, 2001

**Basis/Comments:**

EST	estimated
EXP	experimental
EXT	extrapolated
NA	not available or not applicable
NR	not relevant

**Section (B) Toxicity Values/Benchmarks****Sources/References:**

ATSDR	Agency for Toxic Substances and Disease Registry
CALEPA	California Environmental Protection Agency
CAL DTSC	California Department of Toxic Substances Control
CAL OEHHHA	CAEPA Office of Environmental Health Hazard Assessment
CCD	MDEQ Chemical Criteria Database
ECHA	European Chemicals Agency (REACH)
OECD HPV	Organization for Economic Cooperation and Development HPV Database
HEAST	USEPA's Health Effects Assessment Summary Tables
IRIS	USEPA's Integrated Risk Information System
MADEP	Massachusetts Department of Environmental Protection
MDEQ/DEQ	Michigan Department of Environmental Quality
DEQ-CCD/AQD	MDEQ Air Quality Division
DEQ-CCD/RRD	MDEQ Remediation and Redevelopment Division
DEQ-CCD/WRD	MDEQ Water Resources Division
MNDOH	Minnesota Department of Health

NJDEP	New Jersey Department of Environmental Protection
NYDEC	New York State Department of Environmental Conservation
OPP/OPPT	USEPA's Office of Pesticide Programs
PPRTV	USEPA's Provisional Peer Reviewed Toxicity Values
RIVM	The Netherlands National Institute of Public Health and the Environment
TCEQ	Texas Commission on Environmental Quality
USEPA	United States Environmental Protection Agency
USEPA OSWER	USEPA Office of Solid Waste and Emergency Response
USEPA MCL	USEPA Maximum Contaminant Level
WHO	World Health Organization
WHO IPCS	International Programme on Chemical Safety (IPCS/INCHEM)
WHO IARC	International Agency for Research on Cancers
NA	Not Available.
NR	Not Relevant.

**Toxicity terms:**

BMC	Benchmark concentration
BMCL	Lower bound confidence limit on the BMC
BMD	benchmark dose
BMDL	Lower bound confidence limit on the BMD
CSF	Cancer slope Factor
CNS	Central nervous system
IURF or IUR	Inhalation unit risk factor
LOAEL	Lowest observed adverse effect level
LOEL	Lowest observed effect level
MRL	Minimal risk level (ATSDR)
NOAEL	No observed adverse effect level
NOEL	No observed effect level

RfC	Reference concentration
RfD	Reference dose
p-RfD	Provisional RfD
aRfD	Acute RfD
UF	Uncertainty factor
WOE	Weight of evidence

**Section (C) Chemical-specific Absorption Factors**

MDEQ	Michigan Department of Environmental Quality
USEPA RAGS-E	United States Environmental Protection Agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

**Section (D) Rule 57 Water Quality Values and GSI Criteria**

GSI	Groundwater-surface water interface
NA	A value is not available or not applicable.
ID	Insufficient data to derive value
NLS	No literature search has been conducted