

**Minnesota Department of Health**

**Adopted Permanent Rules Relating to Health Risk Limits For Groundwater**

**4717.7810 HEALTH RISK LIMITS; PURPOSE AND SCOPE.**

Subpart 1. **Purpose.** The purpose of parts 4717.7810 to 4717.7900 is to establish health risk limits (HRLs) for substances found to degrade Minnesota groundwater.

Subp. 2. **Scope.**

A. As provided by Minnesota Statutes, sections 103H.005, subdivision 3, and 103H.201, subdivision 1, HRLs are derived as human health-based groundwater standards based on cancer or noncancer effects from consumption and federal maximum contaminant levels incorporated by reference as required by Laws 2007, chapter 147, article 17, section 2.

B. Health risk limits are for use by public agencies and private entities in Minnesota in determining whether groundwater, impacted by human activity, is subject to regulatory or advisory actions based on human health concerns. HRLs specify a minimum level of quality for water used for human consumption, such as ingestion of water, and do not imply that allowing degradation of water supplies to HRL levels is acceptable.

**4717.7820 DEFINITIONS.**

Subpart 1. **Scope.** For the purposes of parts 4717.7810 to 4717.7900, the terms in this part have the meanings given them.

Subp. 2. **AF<sub>lifetime</sub> or lifetime adjustment factor.** "AF<sub>lifetime</sub>" or "lifetime adjustment factor" is a numerical multiplier used to modify the adult-based cancer slope factor for lifetime exposure based on chemical-specific data.

Subp. 3. **ADAFs or age-dependent adjustment factors.** "ADAFs" or "age-dependent adjustment factors" are the default modifiers to the cancer slope factor that account for the increased susceptibility to cancer from early life exposures to linear

carcinogens in the absence of chemical-specific data. For the default derivation of cancer HRLs, the following ADAFs and corresponding age groups are utilized:

ADAF<sub><2</sub>=10, for birth until two years of age; ADAF<sub>2 to <16</sub>=3, for two up to 16 years of age; and ADAF<sub>16+</sub>=1, for 16 years of age and older.

Subp. 4. **Additional lifetime cancer risk.** "Additional lifetime cancer risk" means the probability that daily exposure to a carcinogen over a lifetime may induce cancer. The Department of Health uses an additional cancer risk of  $1 \times 10^{-5}$  (1 in 100,000) to derive cancer HRLs.

Subp. 5. **Carcinogen.** "Carcinogen" means a chemical:

A. classified as a human carcinogen or a probable human carcinogen according to the "EPA Classification System for Categorizing Weight of Evidence for Carcinogenicity from Human and Animal Studies," the Risk Assessment Guidelines of 1986, United States Environmental Protection Agency, Office of Health and Environmental Assessment (August 1987), which is incorporated by reference;

B. classified as "carcinogenic to humans" or "likely to be carcinogenic to humans" according to the Final Guidelines for Carcinogenic Risk Assessment, United States Environmental Protection Agency, Office of Research and Development (March 2005), which are incorporated by reference. The guidelines are not subject to frequent change. The final guidelines are available at: <http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=116283> or through the public library using the Minitex interlibrary loan system; or

C. classified as a substance known to be a human carcinogen or reasonably anticipated to be a human carcinogen in the Report on Carcinogens, United States Department of Health and Human Services, Public Health Service, National Toxicology Program. This report is incorporated by reference and is subject to frequent change. The report is available at: <http://ntp.niehs.nih.gov/go/roc>.

3.1 Subp. 6. **Chemical.** "Chemical" includes a single chemical or a defined mixture of  
3.2 two or more chemicals.

3.3 Subp. 7. **Chemical abstracts service registry number or CAS number.** The  
3.4 "chemical abstracts service registry number" or "CAS number" means the number  
3.5 assigned to a chemical by the Chemical Abstracts Service, a division of the American  
3.6 Chemical Society, 2540 Olentangy River Road, Box 3012, Columbus, OH 43210-0012.  
3.7 CAS numbers function as unique identifiers for chemicals in part ~~4717.4860~~ 4717.7860.  
3.8 The Chemical Abstracts Service maintains a database of all CAS numbers at  
3.9 <http://www.cas.org>.

3.10 Subp. 8. **Developmental health endpoint or developmental.** "Developmental  
3.11 health endpoint" or "developmental" means an adverse effect on the developing organism  
3.12 that may result from parental exposure prior to conception, maternal exposure during  
3.13 prenatal development, or direct exposure postnatally until the time of sexual maturation.  
3.14 Developmental toxicity may be detected at any point in the lifespan of the organism. The  
3.15 major manifestations of developmental toxicity include:

- 3.16 A. death of the developing organism;
- 3.17 B. structural abnormality;
- 3.18 C. altered growth; and
- 3.19 D. functional deficiency.

3.20 Subp. 9. **Duration.** "Duration" means the length of the exposure period under  
3.21 consideration.

3.22 A. For the default derivation of noncancer health risk limits, the following  
3.23 durations are utilized:

- 3.24 (1) acute - a period of 24 hours or less;
- 3.25 (2) short-term - a period of more than 24 hours, up to 30 days;

4.1 (3) subchronic - a period of more than 30 days, up to approximately ten  
4.2 percent of the life span in humans; or

4.3 (4) chronic - a period of more than approximately ten percent of the life  
4.4 span in humans.

4.5 B. For the default derivation of cancer health risk limits, the durations  
4.6 corresponding to the three age groups associated with the age-dependent adjustments  
4.7 (ADAFs) specified in subpart 3, are utilized:

4.8 (1) two-year duration for the birth to two-year age group;

4.9 (2) 14-year duration for the two- to 16-year age group; and

4.10 (3) 54-year duration for the 16 and older age group.

4.11 C. For the chemical-specific derivation of a noncancer or cancer health risk  
4.12 limit, the duration is based on chemical-specific information regarding the relevant  
4.13 length of exposure.

4.14 Subp. 10. **Endocrine or (E).** "Endocrine" or "(E)" means a change in circulating  
4.15 hormone levels or interactions with hormone receptors, regardless of the organ or organ  
4.16 system affected. Endpoints with or without the (E) designation are deemed equivalent,  
4.17 for example, thyroid (E)=thyroid, and shall be included in the same health risk index  
4.18 equation in part 4717.7880.

4.19 Subp. 11. **Health risk index.** "Health risk index" is a sum of the quotients calculated  
4.20 by identifying all chemicals that share a common health endpoint and dividing the  
4.21 measured or statistically derived concentration of each chemical by its HRL. The multiple  
4.22 chemical health risk index is compared to the multiple chemical health risk limit, defined  
4.23 in subpart 19 as one, to identify exceedances. Equations to calculate multiple chemical  
4.24 health risk indices are found in parts 4717.7880 and 4717.7890.

5.1 Subp. 12. **Health risk index endpoint or health endpoint.** "Health risk index  
5.2 endpoint" or "health endpoint" means the general description of toxic effects used to group  
5.3 chemicals for the purpose of calculating a health risk index. Health risk index endpoints  
5.4 or health endpoints for each chemical are listed in part 4717.7860.

5.5 Subp. 13. **Health risk limit or HRL.** "Health risk limit" or "HRL" has the meaning  
5.6 given in Minnesota Statutes, section 103H.005, subdivision 3. An HRL is expressed  
5.7 as  $\mu\text{g/L}$ .

5.8 Subp. 14. **Intake rate or IR.** "Intake rate" or "IR" means the rate of ingestion of  
5.9 water, or the amount of water, on a per body weight basis, ingested per day, expressed as  
5.10 liters per kilogram body weight per day or L/kg-day. The time-weighted average of the  
5.11 95th percentile intake rate for the derivation of cancer and noncancer HRLs is calculated  
5.12 for the relevant duration specified in subpart 9.

5.13 Subp. 15. **Maximum contaminant level or MCL.** "Maximum contaminant level" or  
5.14 "MCL" means the maximum permissible level of a contaminant in water that is delivered  
5.15 to any user of a public water system under the Federal Drinking Water Program according  
5.16 to Code of Federal Regulations, title 40, section 141.2.

5.17 Subp. 16. **Maximum contaminant level-based health risk limit or MCL-based**  
5.18 **HRL.** "Maximum contaminant level-based health risk limit" or "MCL-based HRL" means  
5.19 an MCL that is adopted as an HRL as authorized by Laws 2007, chapter 147, article  
5.20 17, section 2.

5.21 Subp. 17.  **$\mu\text{g/L}$ .** " $\mu\text{g/L}$ " means micrograms of chemical per liter of water.

5.22 Subp. 18. **mg/kg-day.** "mg/kg-day" means milligrams of chemical per kilogram  
5.23 of body weight per day.

5.24 Subp. 19. **Multiple chemical health risk limit or multiple chemical HRL.**  
5.25 The "multiple chemical health risk limit" or "multiple chemical HRL" is equal to one.

6.1 Equations to determine whether the multiple chemical health risk limit has been exceeded  
6.2 are in parts 4717.7880 and 4717.7890.

6.3 Subp. 20. **Nonlinear carcinogen.** "Nonlinear carcinogen" means a chemical agent  
6.4 for which, particularly at low doses, the associated cancer risk does not rise in direct  
6.5 proportion to the extent of exposure, and for which a threshold level of exposure exists  
6.6 below which there is no cancer risk. The HRL for a nonlinear carcinogen is based on a  
6.7 reference dose that is lower than the threshold for cancer risk.

6.8 Subp. 21. **Reference dose or RfD.** "Reference dose" or "RfD" means an estimate of a  
6.9 dose for a given duration to the human population, including susceptible subgroups such as  
6.10 infants, that is likely to be without an appreciable risk of adverse effects during a lifetime.  
6.11 It is derived from a suitable exposure dose level at which there are few or no statistically or  
6.12 biologically significant increases in the frequency or severity of an adverse effect between  
6.13 an exposed the dosed population and its associated control group. The RfD includes  
6.14 one or more divisors, applied to the suitable dose level, accounting for: (i) uncertainty  
6.15 in extrapolating from mammalian laboratory animal data to humans; (ii) variation in  
6.16 toxicological sensitivity among individuals in the human population; (iii) uncertainty in  
6.17 extrapolating from effects observed in a short-term study to effects of long-term exposure;  
6.18 (iv) uncertainty in using a study in which health effects were found at all doses tested; and  
6.19 (v) uncertainty associated with deficiencies in the available data. An HRL is not derived if  
6.20 the product of the divisors exceeds 3,000. The RfD is expressed as mg/kg-day.

6.21 Subp. 22. **Relative source contribution or RSC.** "Relative source contribution" or  
6.22 "RSC" means the fraction of total exposure to a substance or chemical that is allocated to  
6.23 drinking water. The default RSC is 0.2 for highly volatile chemicals. For other chemicals,  
6.24 the default RSC is 0.5 for acute and short-term HRLs and 0.2 for subchronic or chronic  
6.25 HRLs.

7.1 Subp. 23. **Slope factor or SF.** "Slope factor" or "SF" means an upper-bound estimate  
7.2 of risk per increment of dose that can be used to estimate cancer risk probabilities for  
7.3 different exposure levels. A cancer slope factor is expressed as cancer incidence per  
7.4 mg/kg-day. Minnesota Statutes, section 103H.201, subdivision 1, paragraph (d), requires  
7.5 the Department of Health, when deriving cancer HRLs, to use cancer slope factors  
7.6 published by the United States Environmental Protection Agency.

7.7 Subp. 24. **Toxic effects.** "Toxic effects" means an observable or measurable adverse  
7.8 biological event, or the organ, tissue, or system in which the effect is manifested. The  
7.9 designation of endpoints does not exclude other possible observable and measurable  
7.10 biological events. For the purpose of grouping chemicals and creating a health risk index  
7.11 when multiple chemicals are present, toxic effects may be ascribed to more general health  
7.12 risk index endpoints or health endpoints. Health endpoints are listed in part 4717.7860.

7.13 Subp. 25. **Volatility.** "Volatility" means having a tendency to evaporate. Using  
7.14 Henry's Law constants, chemicals are characterized as nonvolatile or low, moderate, or  
7.15 high volatility as follows:

7.16 A. nonvolatile - Henry's Law constant  $<3 \times 10^{-7}$  atm-m<sup>3</sup>/mol

7.17 B. low - Henry's Law constant  $>3 \times 10^{-7}$  to  $1 \times 10^{-5}$  atm-m<sup>3</sup>/mol

7.18 C. moderate - Henry's Law constant  $>1 \times 10^{-5}$  to  $1 \times 10^{-3}$  atm-m<sup>3</sup>/mol

7.19 D. high - Henry's Law constant  $>1 \times 10^{-3}$  atm-m<sup>3</sup>/mol

7.20 **4717.7830 FOR TOXIC EFFECTS OTHER THAN CANCER.**

7.21 Subpart 1. **Scope.** This part establishes the method for determining a health risk  
7.22 limit for a toxic effect other than cancer.

7.23 Subp. 2. **Equation for toxic effects other than cancer or MCL-based HRLs.** The  
7.24 equation for deriving a health risk limit for a toxic effect other than cancer or a maximum  
7.25 contaminant level-based health risk limit is:

$$\text{nHRL}_{\text{duration}} = \frac{\text{RfD}_{\text{duration}} \times \text{RSC} \times 1,000}{\text{IR}_{\text{duration}}}$$

Where:

A.  $\text{nHRL}_{\text{duration}}$  is the noncancer health risk limit for a given duration as defined in part 4717.7820, subparts 9, item A, and 13, expressed as  $\mu\text{g/L}$ . The HRLs derived for each chemical are listed in part 4717.7860.

B.  $\text{RfD}_{\text{duration}}$  is the reference dose for a given duration as defined in part 4717.7820, subparts 9, item A, and 21, expressed as  $\text{mg/kg-day}$ . The RfDs utilized for each chemical are listed in part 4717.7860.

C. RSC is the relative source contribution factor as defined in part 4717.7820, subpart 22. The RSCs utilized for each chemical are listed in part 4717.7860.

D. 1,000 is a factor used to convert milligrams (mg) to micrograms ( $\mu\text{g}$ ). There are 1,000 micrograms per milligram.

E.  $\text{IR}_{\text{duration}}$  is the intake rate for a given duration as defined in part 4717.7820, subparts 9, item A, and 14. The IRs utilized for each chemical are listed in part 4717.7860.

#### 4717.7840 FOR CANCER.

Subpart 1. **Scope.** This part establishes the methods for determining a health risk limit for cancer.

Subp. 2. **Equation for cancer for chemicals other than chemicals for which a lifetime adjustment factor has been derived or nonlinear carcinogens.** The equation for deriving the health risk limit for cancer for chemicals other than chemicals identified in subpart 3, or nonlinear carcinogens is:



$$(1 \times 10^{-5}) \times 1,000$$

cHRL =

$$[(SF \times ADAF_{<2} \times IR_{<2} \times D_{<2}) + (SF \times ADAF_{2 \text{ to } <16} \times IR_{2 \text{ to } <16} \times D_{2 \text{ to } <16}) + (SF \times ADAF_{16+} \times IR_{16+} \times D_{16+})] / 70 \text{ years}$$

Where:

A. cHRL is the cancer health risk limit expressed as  $\mu\text{g/L}$ .

B.  $(1 \times 10^{-5})$  is the additional cancer risk level.

C. Units 1,000 are as described in part 4717.7830, subpart 2.

D. SF or slope factor is expressed in units of cancer incidence per mg/kg-day.

The SFs utilized for each chemical are listed in part 4717.7860.

E. ADAF is the age-dependent adjustment factor as defined in part 4717.7820, subpart 3. The ADAFs utilized for each chemical are listed in part 4717.7860.

F.  $IR_{\text{duration}}$  is the intake rate for a given duration as defined in part 4717.7820, subpart 14. The IRs utilized for each chemical are listed in part 4717.7860.

G. D is the duration corresponding to the three age groups birth up to two years of age (two-year duration), two up to 16 years of age (14-year duration), and 16 up to 70 years of age (54-year duration) as defined in part 4717.7820, subpart 9, item B.

H. 70 years is the standard lifetime duration utilized by the United States Environmental Protection Agency in the characterization of lifetime cancer risk.

Subp. 3. **Equation for cancer for chemicals for which a lifetime adjustment factor has been derived.** The Department of Health may depart from the default equation presented in subpart 2 when an adjustment factor is based on chemical-specific information. The equation for deriving the health risk limit for cancer for these chemicals is:

$$cHRL = \frac{(1 \times 10^{-5}) \times 1,000}{[SF \times AF_{lifetime} \times IR_{lifetime}]}$$

Where:

A. Units or values for cHRL,  $(1 \times 10^{-5})$ , 1,000, and SF are as described in part 4717.7840, subpart 2.

B.  $AF_{lifetime}$  is the lifetime adjustment factor utilized to adjust the adult exposure-based SF for lifetime exposure based on chemical-specific data. The  $AF_{lifetime}$  utilized is described in part 4717.7860.

C.  $IR_{lifetime}$  is the 95th percentile water intake rate representative of a lifetime period.

#### 4717.7850 USE OF MAXIMUM CONTAMINANT LEVELS.

Subpart 1. **Scope.** This part establishes the methods for determining a health risk limit based on a maximum contaminant level.

Subp. 2. **Water level standards.** As authorized by Laws 2007, chapter 147, article 17, section 2, the maximum contaminant levels for the following chemicals are adopted by reference as health risk limits:

- A. Atrazine;
- B. Dichloromethane;
- C. Di(2-ethylhexyl) phthalate;
- D. Nitrate (as N);
- E. Pentachlorophenol;
- F. Simazine;
- G. 1,1,2,2-Tetrachloroethylene;

11.2 H. 1,1,2-Trichloroethylene; and

11.3 I. 2(2,4,5-Trichlorophenoxy)propionic acid.

11.4 **4717.7860 HEALTH RISK LIMITS TABLE.**

11.5 Subpart 1. **Generally.** This table lists the health risk limits derived from methods  
11.6 specified in parts 4717.7830, 4717.7840, and 4717.7850. For each chemical, this table  
11.7 specifies: the chemical name; the CAS number; the year the HRL was established; the  
11.8 volatility classification; any noncancer HRL; any cancer HRL; the RfD and RSC used in  
11.9 the derivation of any noncancer HRL; the slope factor and any ADAF or AF<sub>lifetime</sub> used in  
11.10 the derivation of any cancer HRL; the intake rate used in the derivation of any noncancer  
11.11 or cancer HRL; and the health endpoints.

11.12 Subp. 2. **Explanation of table in this part.**

11.13 A. "-" symbol means not relevant.

11.14 B. "NA" means not applicable.

11.15 C. "ND" means not derived due to absence or paucity of toxicity information.

11.16 D. "None" means not applicable for inclusion in the health risk index.

11.17 E. The following explanations in subitems (1) to (3) apply where noted:

11.18 (1) The acute HRL value is less than the calculated HRL. To be protective  
11.19 of acute exposures, the HRL is set equal to the acute HRL value.

11.20 (2) The short-term HRL value is less than the calculated HRL. To be  
11.21 protective of short-term exposures, the HRL is set equal to the short-term HRL value.

11.22 (3) The subchronic HRL value is less than the calculated HRL. To be  
11.23 protective of subchronic exposures, the HRL is set equal to the subchronic HRL value.

11.24 Subp. 3. **Acetochlor.**

12.1 CAS number: 34256-82-1

12.2 Year Established: 2008

12.3 Volatility: Nonvolatile

12.4		Acute	Short-term	Subchronic	Chronic	Cancer
12.5	HRL (µg/L)	40	40	40 (2)	9	NA
12.6	RfD	0.021	0.021	(2)	0.002	—
12.7	(mg/kg-day)					
12.8	RSC	0.5	0.5	(2)	0.2	—
12.9	SF (per	—	—	—	—	—
12.10	mg/kg-day)					
12.11	ADAF or	—	—	—	—	—
12.12	AF <sub>lifetime</sub>					
12.13	Intake Rate	0.289	0.289	(2)	0.043	—
12.14	(L/kg-day)					
12.15	Endpoints	developmental	developmental	developmental	hepatic (liver)	—
12.16					system, male	
12.17					reproductive	
12.18					system,	
12.19					nervous system,	
12.20					renal (kidney)	
12.21					system,	
12.22					respiratory	
12.23					system	

12.24 Subp. 4. **Alachlor.**

12.25 CAS number: 15972-60-8

12.26 Year Established: 2008

12.27 Volatility: Nonvolatile

12.28		Acute	Short-term	Subchronic	Chronic	Cancer
12.29	HRL (µg/L)	ND	200	30	5	NA
12.30	RfD	—	0.1	0.01	0.001	—
12.31	(mg/kg-day)					
13.1	RSC	—	0.5	0.2	0.2	—

13.2	13.3	<b>SF (per mg/kg-day)</b>	—	—	—	—	—
13.4	13.5	<b>ADAF or AF<sub>lifetime</sub></b>	—	—	—	—	—
13.6	13.7	<b>Intake Rate (L/kg-day)</b>	—	0.289	0.077	0.043	—
13.8	13.9	<b>Endpoints</b>	—	renal (kidney) system	hepatic (liver) system, hematological (blood) system	hepatic (liver) system, hematological (blood) system	—

13.12 Subp. 5. ~~Alachlor-ESA.~~

13.13 CAS number: ~~142363-53-9~~

13.14 Year Established: ~~2008~~

13.15 Volatility: ~~Nonvolatile~~

13.16		<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
13.17	<b>HRL (µg/L)</b>	ND	ND	100	20	NA
13.18	<b>RfD</b>	—	—	0.053	0.0053	—
13.19	<b>(mg/kg-day)</b>					
13.20	<b>RSC</b>	—	—	0.2	0.2	—
13.21	<b>SF (per</b>	—	—	—	—	—
13.22	<b>mg/kg-day)</b>					
13.23	<b>ADAF or</b>	—	—	—	—	—
13.24	<b>AF<sub>lifetime</sub></b>					
13.25	<b>Intake Rate</b>	—	—	0.077	0.043	—
13.26	<b>(L/kg-day)</b>					
13.27	<b>Endpoints</b>	—	—	hematological	hematological	—
13.28				(blood)-system	(blood)-system	

13.29 Subp. 6 5. **Atrazine.**

14.1 CAS number: 1912-24-9

14.2 Year Established: 2008

14.3 Volatility: Nonvolatile  
 14.4 MCL-based HRL: 3 µg/L

14.5 Subp. 7 6. **Benzene.**

14.6 CAS number: 71-43-2  
 14.7 Year Established: 2008  
 14.8 Volatility: High

14.9		<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
14.10	<b>HRL (µg/L)</b>	10	10	3	3 (3)	2
14.11	<b>RfD</b>	0.015	0.014	0.0013	(3)	—
14.12	<b>(mg/kg-day)</b>					
14.13	<b>RSC</b>	0.2	0.2	0.2	(3)	—
14.14	<b>SF (per</b>	—	—	—	—	0.055
14.15	<b>mg/kg-day)</b>					
14.16	<b>ADAF</b>	—	—	—	—	10 (ADAF <sub>&lt;2</sub> )
14.17						3 (ADAF <sub>2 to &lt;16</sub> )
14.18						1 (ADAF <sub>16+</sub> )
14.19	<b>Intake Rate</b>	0.289	0.289	0.077	(3)	0.137 (< <sub>2</sub> )
14.20	<b>(L/kg-day)</b>					0.047 (< <sub>2 to &lt;16</sub> )
14.21						0.039 (< <sub>16+</sub> )
14.22	<b>Endpoints</b>	develop-	hemato-	hemato-	hemato-	cancer
14.23		mental	logical	logical	logical	
14.24			(blood)	(blood)	(blood)	
14.25			system,	system,	system,	
14.26			immune	immune	immune	
14.27			system	system	system	

14.28 Subp. 8 7. **Chloroform.**

15.1 CAS number: 67-66-3  
 15.2 Year Established: 2008  
 15.3 Volatility: High

	<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
<b>HRL (µg/L)</b>	ND	30	30 (2)	30 (2)	NA
<b>RfD (mg/kg-day)</b>	—	0.05	(2)	(2)	—
<b>RSC</b>	—	0.2	(2)	(2)	—
<b>SF (per mg/kg-day)</b>	—	—	—	—	—
<b>ADAF or AF<sub>lifetime</sub></b>	—	—	—	—	—
<b>Intake Rate (L/kg-day)</b>	—	0.289	(2)	(2)	—
<b>Endpoints</b>	—	developmental, hepatic (liver) system, immune system	developmental, hepatic (liver) system, immune system, male reproductive system	developmental, hepatic (liver) system, immune system, male reproductive system	—

**Subp. 98. Cyanazine.**

CAS number: 21725-46-2

Year Established: 2008

Volatility: Nonvolatile

	<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
<b>HRL (µg/L)</b>	2	2	2	1	NA
<b>RfD (mg/kg-day)</b>	0.001	0.001	0.00063	0.00026	—
<b>RSC</b>	0.5	0.5	0.2	0.2	—
<b>SF (per mg/kg-day)</b>	—	—	—	—	—
<b>ADAF or AF<sub>lifetime</sub></b>	—	—	—	—	—

16.3	<b>Intake Rate</b>	0.289	0.289	0.077	0.043	—
16.4	<b>(L/kg-day)</b>					
16.5	<b>Endpoints</b>	developmental	developmental	hepatic (liver)	None	—
16.6				system, renal		
16.7				(kidney)		
16.8				system		

16.9 Subp. ~~10~~ 9. **cis 1,2-Dichloroethylene.**

16.10 CAS number: 156-59-2

16.11 Year Established: 2008

16.12 Volatility: High

16.13		<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
16.14	<b>HRL (µg/L)</b>	ND	70	70 (2)	50	NA
16.15	<b>RfD</b>	—	0.097	(2)	0.011	—
16.16	<b>(mg/kg-day)</b>					
16.17	<b>RSC</b>	—	0.2	(2)	0.2	—
16.18	<b>SF (per</b>	—	—	—	—	—
16.19	<b>mg/kg-day)</b>					
16.20	<b>ADAF or</b>	—	—	—	—	—
16.21	<b>AF<sub>lifetime</sub></b>					
16.22	<b>Intake Rate</b>	—	0.289	(2)	0.043	—
16.23	<b>(L/kg-day)</b>					
16.24	<b>Endpoints</b>	—	hematological	hematological	hematological	—
16.25			(blood) system	(blood) system	(blood) system	

16.26 Subp. ~~11~~ 10. **Dichloromethane.**

16.27 CAS number: 75-09-2

16.28 Year Established: 2008

16.29 Volatility: High

16.30 MCL-based HRL: 5 µg/L

17.1 Subp. ~~12~~ 11. **Dieldrin.**



17.2 CAS number: 60-57-1

17.3 Year Established: 2008

17.4 Volatility: Nonvolatile

17.5		Acute	Short-term	Subchronic	Chronic	Cancer
17.6	HRL (µg/L)	0.2	0.2	0.2 (2)	0.2	0.006
17.7	RfD	0.0001	0.0001	(2)	0.00005	—
17.8	(mg/kg-day)					
17.9	RSC	0.5	0.5	(2)	0.2	—
17.10	SF (per	—	—	—	—	16
17.11	mg/kg-day)					
17.12	AF <sub>lifetime</sub>	—	—	—	—	2.5
17.13	Intake Rate	0.289	0.289	(2)	0.043	0.043
17.14	(L/kg-day)					
17.15	Endpoints	developmental	developmental,	developmental,	hepatic	cancer
17.16			immune system,	immune system,	(liver)	
17.17			nervous system	nervous system	system,	
17.18					nervous	
17.19					system	

17.20 Subp. ~~13~~ 12. **Di-(2-ethylhexyl) phthalate.**

17.21 CAS number: 117-81-7

17.22 Year Established: 2008

17.23 Volatility: Moderate

17.24 MCL-based HRL: 6 µg/L

17.25 Subp. ~~14~~ 13. **Nitrate (as N).**

17.26 CAS number: 14797-55-8

17.27 Year Established: 2008

17.28 Volatility: Nonvolatile

17.29 MCL-based HRL: 10,000 µg/L

18.1 Subp. ~~15~~ 14. **Pentachlorophenol.**

18.2 CAS number: 87-86-5  
 18.3 Year Established: 2008  
 18.4 Volatility: Nonvolatile  
 18.5 MCL-based HRL: 1 µg/L

18.6 Subp. ~~16~~ 15. **Perfluorooctane sulfonate (PFOS) and salts.**

18.7 CAS number: 1763-23-1; 29081-56-9; 2795-39-3; 70225-14-8; and  
 18.8 29457-72-5  
 18.9 Year Established: 2008  
 18.10 Volatility: Nonvolatile

18.11		<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
18.12	<b>HRL (µg/L)</b>	ND	ND	ND	0.3	NA
18.13	<b>RfD</b>	—	—	—	0.00008	—
18.14	<b>(mg/kg-day)</b>					
18.15	<b>RSC</b>	—	—	—	0.2	—
18.16	<b>SF (per</b>	—	—	—	—	—
18.17	<b>mg/kg-day)</b>					
18.18	<b>ADAF or</b>	—	—	—	—	—
18.19	<b>AF<sub>lifetime</sub></b>					
18.20	<b>Intake Rate</b>	—	—	—	0.049	—
18.21	<b>(L/kg-day)</b>					
18.22	<b>Endpoints</b>	—	—	—	developmental, hepatic (liver) system, thyroid (E)	—
18.23						
18.24						
18.25						

18.26 Subp. ~~17~~ 16. **Perfluorooctanoic acid (PFOA) and salts.**

18.27 CAS number: 335-67-1; 3825-26-1; 2395-00-8; 335-93-3; and 335-95-5  
 18.28 Year Established: 2008  
 18.29 Volatility: Nonvolatile

19.1		<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
19.2	<b>HRL (µg/L)</b>	ND	ND	ND	0.3	NA

19.3	<b>RfD</b>	—	—	—	0.000077	—
19.4	<b>(mg/kg-day)</b>					
19.5	<b>RSC</b>	—	—	—	0.2	—
19.6	<b>SF (per</b>	—	—	—	—	—
19.7	<b>mg/kg-day)</b>					
19.8	<b>ADAF or</b>	—	—	—	—	—
19.9	<b>AF</b> lifetime					
19.10	<b>Intake Rate</b>	—	—	—	0.053	—
19.11	<b>(L/kg-day)</b>					
19.12	<b>Endpoints</b>	—	—	—	developmental,	—
19.13					hepatic (liver)	
19.14					system, immune	
19.15					system	

19.16 Subp. ~~18~~ 17. **Simazine.**

19.17 CAS number: 122-34-9

19.18 Year Established: 2008

19.19 Volatility: Nonvolatile

19.20 MCL-based HRL: 4 µg/L

19.21 Subp. ~~19~~ 18. **1,1,2,2-Tetrachloroethylene.**

19.22 CAS number: 127-18-4

19.23 Year Established: 2008

19.24 Volatility: High

19.25 MCL-based HRL: 5 µg/L

19.26 Subp. ~~20~~ 19. **1,1,1-Trichloroethane.**

19.27 CAS number: 71-55-6

19.28 Year Established: 2008

19.29 Volatility: High

20.1		<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
20.2	<b>HRL (µg/L)</b>	ND	ND	20,000	9,000	NA

20.3	<b>RfD</b>	—	—	7	2	—
20.4	<b>(mg/kg-day)</b>					
20.5	<b>RSC</b>	—	—	0.2	0.2	—
20.6	<b>SF (per</b>	—	—	—	—	—
20.7	<b>mg/kg-day)</b>					
20.8	<b>ADAF or</b>	—	—	—	—	—
20.9	<b>AF</b> lifetime					
20.10	<b>Intake Rate</b>	—	—	0.077	0.043	—
20.11	<b>(L/kg-day)</b>					
20.12	<b>Endpoints</b>	—	—	hepatic	hepatic (liver)	—
20.13				(liver)	system, male	
20.14				system, male	reproductive	
20.15				reproductive	system	
20.16				system		

20.17 Subp. ~~21~~ 20. **1,1,2-Trichloroethylene (TCE).**

20.18 CAS number: 79-01-6

20.19 Year Established: 2008

20.20 Volatility: High

20.21 MCL-based HRL: 5 µg/L

20.22 Subp. ~~22~~ 21. **2(2,4,5-Trichlorophenoxy)propionic acid (2,4,5-TP or Silvex).**

20.23 CAS number: 93-72-1

20.24 Year Established: 2008

20.25 Volatility: Nonvolatile

20.26 MCL-based HRL: 50 µg/L

20.27 Subp. ~~23~~ 22. **1,3,5-Trimethylbenzene.**

21.1 CAS number: 108-67-8

21.2 Year Established: 2008

21.3 Volatility: High

	<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
<b>HRL (µg/L)</b>	ND	100	100 (2)	100 (2)	NA
<b>RfD (mg/kg-day)</b>	ND	0.14	(2)	(2)	—
<b>RSC</b>	—	0.2	(2)	(2)	—
<b>SF (per mg/kg-day)</b>	—	—	—	—	—
<b>ADAF or AF<sub>lifetime</sub></b>	—	—	—	—	—
<b>Intake Rate (L/kg-day)</b>	—	0.289	(2)	(2)	—
<b>Endpoints</b>	—	hepatic (liver) system	hepatic (liver) system; renal (kidney) system	hepatic (liver) system; renal (kidney) system	—

Subp. ~~24~~ 23. **Vinyl Chloride.**

CAS number: 75-01-4

Year Established: 2008

Volatility: High

	<b>Acute</b>	<b>Short-term</b>	<b>Subchronic</b>	<b>Chronic</b>	<b>Cancer</b>
<b>HRL (µg/L)</b>	ND	ND	80	10	0.2
<b>RfD (mg/kg-day)</b>	—	—	0.03	0.003	—
<b>RSC</b>	—	—	0.2	0.2	—
<b>SF (per mg/kg-day)</b>	—	—	—	—	1.4
<b>ADAF or AF<sub>lifetime</sub></b>	—	—	—	—	1

22.3	<b>Intake Rate</b>	—	—	0.077	0.043	0.043
22.4	<b>(L/kg-day)</b>					
22.5	<b>Endpoints</b>	—	—	hepatic (liver)	hepatic	cancer
22.6				system	(liver)	
22.7					system	

22.8        Subp. 24. **Transition.** The health risk limits established for the specific chemicals  
 22.9        in this part supersede the health risk limits for those chemicals in part 4717.7500. For  
 22.10       chemicals not included in this part, the health risk limits established in part 4717.7500  
 22.11       remain in place.

22.12       **4717.7870 EVALUATING CONCURRENT EXPOSURES TO MULTIPLE**  
 22.13       **CHEMICALS.**

22.14       Risk from multiple chemicals detected in groundwater must be evaluated as specified  
 22.15       in part 4717.7880 for effects other than cancer and in part 4717.7890 for cancer. If a  
 22.16       chemical causes both cancer and effects other than cancer, the risk contributed by that  
 22.17       chemical must be included in both evaluations. When the multiple chemical health risk  
 22.18       index is greater than one, the multiple chemical health risk limit has been exceeded.

22.19       **4717.7880 MULTIPLE CHEMICAL HEALTH RISK LIMITS: NONCANCER.**

22.20       Subpart 1. **Scope.** To evaluate the risk of effects other than cancer from multiple  
 22.21       chemicals detected in groundwater, a health risk index for each health endpoint must be  
 22.22       calculated for each duration period using the procedure specified in this part.

22.23       Subp. 2. **Grouping of chemicals.** Chemicals must be grouped according to health  
 22.24       endpoints, other than cancer, specified in part 4717.7860, and according to duration except  
 22.25       that:

22.26            A. chemicals for which no health endpoint is specified will not be grouped; and

23.1            B. a chemical will be included in the group for each health endpoint listed for  
 23.2       that chemical.

23.3 Subp. 3. **Equation.** Using the following equation, a noncancer health risk index  
 23.4 must be determined for each group of two or more chemicals that have a common health  
 23.5 endpoint and common duration period.

23.6 Noncancer health risk index<sub>duration</sub> =  $C_1/nHRL_{1duration} + C_2/nHRL_{2duration} + \dots + C_N/nHRL_{Nduration}$

23.7 Where:

23.8 A.  $C_N$  represents the concentration expressed as µg/L of the first through Nth  
 23.9 chemical. In the case of a chemical that has been detected but cannot be quantified,  $C_N$  is  
 23.10 determined by standard statistical procedures.

23.11 B.  $nHRL_{Nduration}$  represents the duration specific acute, short-term, subchronic,  
 23.12 or chronic noncancer health risk limit expressed as µg/L for the first through Nth chemical,  
 23.13 as specified in part ~~4717.7850~~ 4717.7860.

23.14 **4717.7890 MULTIPLE CHEMICAL HEALTH RISK LIMITS: CANCER.**

23.15 Subpart 1. **Scope.** To evaluate the risk of cancer from multiple chemicals detected in  
 23.16 groundwater, a cancer health risk index must be calculated using the procedure specified  
 23.17 in this part.

23.18 Subp. 2. **Equation.** To evaluate the risk of cancer from multiple chemicals detected  
 23.19 in groundwater, a cancer index must be calculated using the following equation:

23.20 Cancer health risk index =  $C_1/cHRL_1 + C_2/cHRL_2 + \dots + C_N/cHRL_N$

23.21 Where:

23.22 A.  $C_N$  represents the concentration expressed as µg/L of the first through Nth  
 23.23 chemical. In the case of a chemical that is detected but cannot be quantified,  $C_N$  is  
 23.24 determined by acceptable statistical procedures.

24.1 B.  $cHRL_N$  represents the cancer health risk limit for the first through Nth  
 24.2 chemical, as specified in part ~~4717.7850~~ 4717.7860.

24.3 **4717.7900 CHEMICAL BREAKDOWN PRODUCTS.**

24.4       When testing indicates that chemical breakdown products (degradates) are present in  
24.5 groundwater, it is necessary to consider those breakdown products in a risk assessment.  
24.6       When no health risk limit or other health-based water value exists for a chemical  
24.7 breakdown product, due to absence or paucity of toxicity information on the chemical  
24.8 breakdown product, the health risk limit specified for the parent chemical in part  
24.9 4717.7860 is the health risk limit for the chemical breakdown product. When a parent and  
24.10 one or more of its breakdown products are present, or when multiple breakdown products  
24.11 are present even in the absence of the parent, it is necessary to conduct a risk assessment  
24.12 for multiple chemicals, according to the procedures in parts 4717.7880 and 4717.7890.

24.13 **REPEALER.** Minnesota Rules, parts ~~4717.4200~~; 4717.7100; 4717.7150, subparts 1, 2,  
24.14 3, 4, 6, 7, 8, 9, 10, and 11; 4717.7200; 4717.7300; 4717.7400; 4717.7600; 4717.7650;  
24.15 4717.7700; 4717.7750; and 4717.7800, are repealed.