

## MEMORANDUM

**To:** LeRoy Feusner, Solid and Hazardous Waste Division Administrator

**From:** Robert Doctor, Solid Waste Permitting and Corrective Action Program Manager

**Date:** May 3, 2007

**RE:** Groundwater Protection Standards for Municipal Solid Waste disposal facilities

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Due to the differences in regulatory language between Type I and Type II municipal solid waste (MSW) disposal facilities, this memo explains in general terms the basis for development of the attached groundwater protection standards. Language in Chapter 2 Section 6 provides the administrator some flexibility in developing groundwater protections standards that provide a consistent approach to addressing groundwater contamination detected at Type I or Type II MSW landfills.

Regulatory language in Chapter 2 Section 6 of the Solid Waste Rules and Regulations differs for Type I and Type II municipal solid waste (MSW) landfills differs in several areas, including:

- Detection and assessment groundwater monitoring requirements;
- The need to develop groundwater protection standards;
- Nature and extent investigation requirements; and
- The path to follow to reach corrective action.

Detection groundwater monitoring requirements for Type I and Type II landfills are described in Chapter 2 Section 6 (b)(i)(D) and Chapter 2 Section 6 (b)(ii)(D)(II). Detection monitoring is performed during the life cycle of a facility to detect whether a release to groundwater has occurred. Per Chapter 2 Section 6 (b)(i)(D)(III), under detection monitoring, a release is defined as a statistically significant difference in water quality between background and any downgradient well, which can not be attributed to a source other than a release from the solid waste disposal facility. Such a detection triggers the need for assessment monitoring, described in Chapter 2 Section 6 (b)(i)(E).

Assessment monitoring involves, among other things, sampling for an increased set of constituents. These data are used to evaluate whether there may be other constituents present in groundwater at statistically significant concentrations above background. If a facility enters into assessment monitoring, the owner/operator needs to request that the administrator establish groundwater protection standards.

When the Department establishes groundwater protection standards, Chapter 2 Section 6 (b)(i)(E)(VIII) specifies that groundwater protection standards shall be:

- (1.) For constituents where a maximum contaminant level (MCL) has been promulgated, the MCL for that constituent;
- 2.) For constituents for which MCL's have not been promulgated, the background concentration established from wells in accordance with paragraph (b) (i) (B) (I); or
- 3.) For constituents for which the background level is higher than the MCL or health-based levels identified under paragraph (b) (i) (E) (IX) of this section, the background concentration.

Chapter 2 Section 6 (b)(i)(E)(IX) continues on:

The administrator may establish an alternative groundwater protection standard for constituents for which MCL's have not been established. These groundwater protection standards shall be health-based levels meeting the requirements of Chapter 8 of the Water Quality Rules and Regulations.

The attached groundwater protection standards have been updated consistent with the discussion above. Note that groundwater protection standards for individual sites may differ slightly from those in the attached document due to site specific circumstances. Therefore, the attached standards should only be used as general guidance. Landfill owners/operators need to consult with the Department to receive site specific standards.

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**Groundwater Protection Standards**

**Solid Waste Chapter 2 Appendix B Volatiles and Inorganics, and Baseline Constituents**

**Volatiles (64)**

<b>Common name<sup>1</sup></b>	<b>CAS RN<sup>2</sup></b>	<b>Chemical abstracts service index name<sup>3</sup></b>	<b>GPS<sup>4</sup> (ug/L<sup>5</sup>)</b>
Acetone	67-64-1	2-Propanone	32,800 <sub>A-3</sub> (DWEL <sup>6</sup> )
Acetonitrile; Methyl cyanide	75-05-8	Acetonitrile	620 <sub>A-9</sub> (DWEL <sup>6</sup> )
Acrolein	107-02-8	2-Propenal	18 <sub>A-3</sub> (DWEL <sup>6</sup> )
Acrylonitrile	107-13-1	2-Propenenitrile	0.16 <sub>B-3</sub> (DWEL <sup>6</sup> )
Allyl chloride	107-05-1	1-Propene, 3-chloro-	11 <sub>A-9</sub> (DWEL <sup>6</sup> )
Benzene	71-43-2	Benzene	5 (MCL <sup>8</sup> )
Bromochloromethane; Chlorobromomethane	74-97-5	Methane, bromochloro-	Background <sup>7</sup>
Bromodichloromethane	75-27-4	Methane, bromodichloro-	80 (MCL <sup>8</sup> for total THM <sup>9</sup> )
Bromoform; Tribromomethane	75-25-2	Methane, tribromo-	80 (MCL <sup>8</sup> for total THM <sup>9</sup> )
Carbon disulfide	75-15-0	Carbon disulfide	3,650 <sub>A-3</sub> (DWEL <sup>6</sup> )
Carbon tetrachloride	56-23-5	Methane, tetrachloro-	5 (MCL <sup>8</sup> )
Chlorobenzene	108-90-7	Benzene, chloro-	730 <sub>A-3</sub> (DWEL <sup>6</sup> )
Chloroethane; Ethyl chloride	75-00-3	Ethane, chloro-	29.3 <sub>B-3</sub> (DWEL <sup>6</sup> )
Chloroform; Trichloromethane	67-66-3	Methane, trichloro-	80 (MCL <sup>8</sup> for total THM <sup>9</sup> )
Chloroprene	126-99-8	1,3-Butadiene, 2-chloro-	Background <sup>7</sup>
Dibromochloromethane; Chlorodibromomethane	124-48-1	Methane, dibromochloro-	80 (MCL <sup>8</sup> for total THM <sup>9</sup> )
1,2-Dibromo-3-chloropropane; DBCP	96-12-8	Propane, 1,2-dibromo-3-chloro-	0.2 (MCL <sup>8</sup> )
1,2-Dibromoethane; Ethylene dibromide; EDB	106-93-4	Ethane, 1,2-dibromo-	0.05 (MCL <sup>8</sup> )
o-Dichlorobenzene	95-50-1	Benzene, 1,2-dichloro-	600 (MCL <sup>8</sup> )
m-Dichlorobenzene; 1,3-Dichlorobenzene	541-73-1	Benzene, 1,3-dichloro-	600 (MCL <sup>8</sup> )

Common name <sup>1</sup>	CAS RN <sup>2</sup>	Chemical abstracts service index name <sup>3</sup>	GPS <sup>4</sup> (ug/L <sup>5</sup> )
p-Dichlorobenzene; 1,4-Dichlorobenzene	106-46-7	Benzene, 1,4-dichloro-	75 (MCL <sup>8</sup> )
trans-1,4-Dichloro-2-butene	110-57-6	2-Butene, 1,4-dichloro-, (E)-	0.009 <sub>B-9</sub> (DWEL <sup>6</sup> )
Dichlorodifluoromethane	75-71-8	Methane, dichlorodifluoro-	7,300 <sub>A-3</sub> (DWEL <sup>6</sup> )
1,1-Dichloroethane; Ethylidene chloride	75-34-3	Ethane, 1,1-dichloro-	3650 <sub>A-9</sub> (DWEL <sup>6</sup> )
1,2-Dichloroethane; Ethylene dichloride	107-06-2	Ethane, 1,2-dichloro-	5 (MCL <sup>8</sup> )
1,1-Dichloroethylene; 1,1-Dichloroethene; Vinylidene chloride	75-35-4	Ethene, 1,1-dichloro-	7 (MCL <sup>8</sup> )
cis-1,2-Dichloroethylene; cis-1,2-Dichloroethene	156-59-2	Ethene, 1,2-dichloro-, (Z)-	70 (MCL <sup>8</sup> )
trans-1,2-Dichloroethylene trans-1,2-Dichloroethene	156-60-5	Ethene, 1,2-dichloro-, (E)-	100 (MCL <sup>8</sup> )
1,2-Dichloropropane; Propylene dichloride	78-87-5	Propane, 1,2-dichloro-	5 (MCL <sup>8</sup> )
1,3-Dichloropropane; Trimethylene dichloride	142-28-9	Propane, 1,3-dichloro-	730 <sub>A-3</sub> (DWEL <sup>6</sup> )
2,2-Dichloropropane; Isopropylidene chloride	594-20-7	Propane, 2,2-dichloro-	Background <sup>7</sup>
1,1-Dichloropropene;	563-58-6	1-Propene, 1,1-dichloro-	Background <sup>7</sup>
cis-1,3-Dichloropropene	10061-01-5	1-Propene, 1,3-dichloro-, (Z)-	0.85 (DWEL <sup>8</sup> )
trans-1,3-Dichloropropene	10061-02-6	1-Propene, 1,3-dichloro-, (E)-	0.85 (DWEL <sup>6</sup> )
Ethylbenzene	100-41-4	Benzene, ethyl-	700 (MCL <sup>8</sup> )
Ethyl methacrylate	97-63-2	2-Propenoic acid, 2-methyl-, ethyl ester	3,280 <sub>A-9</sub> (DWEL <sup>6</sup> )
2-Hexanone; Methyl butyl ketone	591-78-6	2-Hexanone	Background <sup>7</sup>
Isobutyl alcohol	78-83-1	1-Propanol, 2-methyl-	10,900 <sub>A-3</sub> (DWEL <sup>6</sup> )
Methacrylonitrile	126-98-7	2-Propenenitrile, 2-methyl-	3.65 <sub>A-9</sub> (DWEL <sup>6</sup> )
Methyl bromide; Bromomethane	74-83-9	Methane, bromo-	51 <sub>A-9</sub> (DWEL <sup>6</sup> )
Methyl chloride; Chloromethane	74-87-3	Methane, chloro-	Background <sup>7</sup>
Methylene bromide; Dibromomethane	74-95-3	Methane, dibromo-	365 <sub>A-3</sub> (DWEL <sup>6</sup> )

Common name <sup>1</sup>	CAS RN <sup>2</sup>	Chemical abstracts service index name <sup>3</sup>	GPS <sup>4</sup> (ug/L <sup>5</sup> )
Methylene chloride; Dichloromethane	75-09-2	Methane, dichloro-	5 (MCL <sup>8</sup> )
Methyl ethyl ketone; MEK; 2-Butanone	78-93-3	2-Butanone	21,900 <sub>A-3</sub> (DWEL <sup>6</sup> )
Methyl iodide; Iodomethane	74-88-4	Methane, iodo-	Background <sup>7</sup>
Methyl methacrylate	80-62-6	2-Propenoic acid, 2-methyl-, methyl ester	51,000 <sub>A-3</sub> (DWEL <sup>6</sup> )
4-Methyl-2-pentanone; Methyl isobutyl ketone	108-10-1	2-Pentanone, 4-methyl-	2920 <sub>A-9</sub> (DWEL <sup>6</sup> )
Naphthalene	91-20-3	Naphthalene	730 <sub>A-9</sub> (DWEL <sup>6</sup> )
Propionitrile; Ethyl cyanide	107-12-0	Propanenitrile	Background <sup>7</sup>
Styrene	100-42-5	Benzene, ethenyl-	100 (MCL <sup>8</sup> )
1,1,1,2-Tetrachloroethane	630-20-6	Ethane, 1,1,1,2-tetrachloro-	3.3 <sub>B-3</sub> (DWEL <sup>6</sup> )
1,1,2,2-Tetrachloroethane	79-34-5	Ethane, 1,1,2,2-tetrachloro-	0.42 <sub>B-3</sub> (DWEL <sup>6</sup> )
Tetrachloroethylene; Tetrachloroethene; Perchloroethylene	127-18-4	Ethene, tetrachloro-	5 (MCL <sup>8</sup> )
Toluene	108-88-3	Benzene, methyl-	1,000 (MCL <sup>8</sup> )
1,2,4-Trichlorobenzene	120-82-1	Benzene, 1,2,4-trichloro-	70 (MCL <sup>8</sup> )
1,1,1-Trichloroethane; Methylchloroform	71-55-6	Ethane, 1,1,1-trichloro-	200 (MCL <sup>8</sup> )
1,1,2-Trichloroethane	79-00-5	Ethane, 1,1,2-trichloro-	5 (MCL <sup>8</sup> )
Trichloroethylene; Trichloroethene	79-01-6	Ethene, trichloro-	5 (MCL <sup>8</sup> )
Trichlorofluoromethane; CFC-11	75-69-4	Methane, trichlorofluoro-	10,900 <sub>A-3</sub> (DWEL <sup>6</sup> )
1,2,3-Trichloropropane	96-18-4	Propane, 1,2,3-trichloro-	0.042 <sub>B-3</sub> (DWEL <sup>6</sup> )
Vinyl acetate	108-05-4	Acetic acid, ethenyl ester	36,500 <sub>A-3</sub> (DWEL <sup>6</sup> )
Vinyl chloride; Chloroethene	75-01-4	Ethene, chloro-	2 (MCL <sup>8</sup> )
Xylene (total - Includes o, m, p and unspecified isomers)	Not applicable	Benzene, dimethyl-	10,000 (MCL <sup>8</sup> )

**Inorganics (19)**

<b>Constituent name</b>	<b>Class I (mg/l) <sup>10</sup></b>	<b>Class II (mg/l) <sup>10</sup></b>	<b>Class III (mg/l) <sup>10</sup></b>	<b>Special (A) Fish/Aquatic Life (mg/l)</b>
Antimony	0.006 (MCL <sup>8</sup> ) <sup>12</sup>	0.006 (MCL <sup>8</sup> ) <sup>12</sup>	0.006 (MCL <sup>8</sup> ) <sup>12</sup>	Background
Arsenic	0.01 (MCL <sup>8</sup> ) <sup>11, 12</sup>	0.01 (MCL <sup>8</sup> ) <sup>11, 12</sup>	0.01 (MCL <sup>8</sup> ) <sup>11, 12</sup>	0.05 <sup>12</sup>
Barium	2 (MCL <sup>8</sup> ) <sup>12</sup>	2 (MCL <sup>8</sup> ) <sup>12</sup>	2 (MCL <sup>8</sup> ) <sup>12</sup>	5.0 <sup>12</sup>
Beryllium	0.004 (MCL <sup>8</sup> ) <sup>12</sup>	0.004 (MCL <sup>8</sup> ) <sup>11, 12</sup>	0.004 (MCL <sup>8</sup> ) <sup>12</sup>	0.011-1.3 <sup>13</sup>
Cadmium	0.005 (MCL <sup>8</sup> ) <sup>12</sup>	0.005 (MCL <sup>8</sup> ) <sup>11, 12</sup>	0.005(MCL <sup>8</sup> ) <sup>11, 12</sup>	0.0004-0.015 <sup>13</sup>
Chromium	0.1 (MCL <sup>8</sup> ) <sup>12</sup>	0.1 (MCL <sup>8</sup> ) <sup>12</sup>	0.05 <sup>12</sup>	0.05 <sup>12</sup>
Cobalt	Background <sup>12</sup>	0.05 <sup>12</sup>	1.0 <sup>12</sup>	Background
Copper	1.0 <sup>12</sup>	0.2 <sup>12</sup>	0.5 <sup>12</sup>	0.01-0.04 <sup>13</sup>
Cyanide	0.2 (MCL <sup>8</sup> ) <sup>12</sup>	0.2 (MCL <sup>8</sup> ) <sup>12</sup>	0.2 (MCL <sup>8</sup> ) <sup>12</sup>	0.005
Lead	0.015 <sup>12</sup>	5.0 <sup>12</sup>	0.1 <sup>12</sup>	0.004-0.15 <sup>13</sup>
Mercury	0.002 (MCL <sup>8</sup> ) <sup>12</sup>	0.002 (MCL <sup>8</sup> ) <sup>12</sup>	0.00005 <sup>12</sup>	0.00005
Nickel	Background	0.2 <sup>12</sup>	Background	0.05-0.4 <sup>13</sup>
Selenium	0.05 (MCL <sup>8</sup> ) <sup>12</sup>	0.02 <sup>12</sup>	0.05 (MCL <sup>8</sup> ) <sup>12</sup>	0.05 <sup>12</sup>
Silver	0.1 <sup>12</sup>	Background	Background	0.0001-0.00025 <sup>13</sup>
Sulfide	Background	Background	Background	Background
Thallium	0.002 (MCL <sup>8</sup> ) <sup>12</sup>	0.002 (MCL <sup>8</sup> ) <sup>12</sup>	0.002 (MCL <sup>8</sup> ) <sup>12</sup>	Background
Tin	19 (DWEL <sup>6</sup> ) <sup>12</sup>	19 (DWEL <sup>6</sup> ) <sup>12</sup>	19 (DWEL <sup>6</sup> ) <sup>12</sup>	Background
Vanadium	0.2 (DWEL <sup>6</sup> ) <sup>12</sup>	0.1 <sup>12</sup>	0.1 <sup>12</sup>	Background
Zinc	5.0 <sup>12</sup>	2.0 <sup>12</sup>	25.0 <sup>12</sup>	0.05-0.6 <sup>13</sup>

**Baseline Monitoring Constituents**

Constituent	Groundwater Protection Standard (mg/l <sup>10</sup> unless otherwise noted)			
	Class I	Class II	Class III	Special (A) Fish/Aquatic Life
pH	6.5-8.5 <sup>12</sup>	4.5-9.0 <sup>12</sup>	6.5-8.5 <sup>12</sup>	6.5-9.0 <sup>12</sup>
Total Dissolved Solids	500 <sup>12</sup>	2000 <sup>12</sup>	5000 <sup>12</sup>	2000.0 <sup>12</sup>
Chemical Oxygen Demand	Background	Background	Background	Background
Ammonia as N	0.5 <sup>12</sup>	Background	Background	0.02 <sup>15</sup>
Nitrate as N	10 (MCL <sup>8</sup> ) <sup>12</sup>	10 (MCL <sup>8</sup> ) <sup>12</sup>	10(MCL <sup>8</sup> ) <sup>12</sup>	10(MCL <sup>8</sup> ) <sup>12</sup>
Bicarbonate	Background	Background	Background	Background
Carbonate	Background	Background	Background	Background
Chloride	250 <sup>12</sup>	100 <sup>12</sup>	2000 <sup>12</sup>	Background
Fluoride	4.0 <sup>12</sup>	Background	Background	Background
Calcium	Background	Background	Background	Background
Potassium	Background	Background	Background	Background
Magnesium	Background	Background	Background	Background
Sodium	Background	Background	Background	Background
Sulfate	250 <sup>12</sup>	200 <sup>12</sup>	3000 <sup>12</sup>	Background
Iron	0.3 <sup>12</sup>	5.0 <sup>12</sup>	Background	0.5 <sup>12</sup>
Manganese	0.05 <sup>12</sup>	0.2 <sup>12</sup>	Background	1.0 <sup>12</sup>

**Footnotes**

<sup>1</sup> Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

<sup>2</sup> Chemical Abstracts Service registry number. Where "Total" is entered, all species in the groundwater that contain this element are included.

<sup>3</sup> CAS index names are those used in the 9th Collective Index.

<sup>4</sup> GPS - Groundwater protection standard

<sup>5</sup> ug/l – microgram per liter

<sup>6</sup> DWEL- Drinking Water Equivalent Level, Wyoming Department of Environmental Quality, Water Quality Division, Chapter 17; 12/01/05

<sup>7</sup> Background – the background value is the groundwater protection standard.

<sup>8</sup> MCL - Maximum contaminant level; EPA Drinking Water Standards and Health Advisories, 2006.

<sup>9</sup> THM - Trihalomethanes

<sup>10</sup> mg/L - milligrams per liter

<sup>11</sup> The MCL is lower than the class of use concentration; therefore the MCL was used as the GPS

<sup>12</sup> If background is higher than the MCL or groundwater class of use value (Wyoming Department of Environmental Quality, Water Quality Division, Chapter 8, 4/26/05) for naturally occurring constituents, the background value is the GPS.

<sup>13</sup> Dependent on hardness: The toxicity of metals in natural waters varies with the hardness of the water; generally, the limiting concentration is higher in hard water than in soft water.

<sup>14</sup> Fish and aquatic life

<sup>15</sup> Unionized ammonia: When ammonia dissolves in water, some of the ammonia reacts with water to form ammonium ions. A chemical equilibrium is established which contains unionized ammonia ( $\text{NH}_3$ ), ionized ammonia ( $\text{NH}_4^+$ ) and hydroxide ions ( $\text{OH}^-$ ). The toxicity of aqueous solutions of ammonia is attributed to  $\text{NH}_3$ ; therefore, the standard is for unionized ammonia. (Note: 0.02 mg/L  $\text{NH}_3$  is equivalent to 0.016  $\text{NH}_3$  as N.).

A Using oral reference dose (3 denotes EPA Region III RBC Table 10/31/06; 9 denotes EPA Region 9 PRG Table 10/04)

B Using oral cancer potency slope factor (3 denotes EPA Region III RBC Table 10/31/06; 9 denotes EPA Region 9 PRG Table 10/04)