Recommended Groundwater Standards – Volatile Organic Compounds

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Today's presentation

Groundwater standard process

Recommended groundwater standards for:

- 1,1-Dichloroethane
- 1,4-Dioxane
- 1,2,3-Trichloropropane
- Tetrachloroethylene (PCE)
- Trichloroethylene (TCE)

Two-thirds of Wisconsin residents use groundwater.

Wisconsin's groundwater standards have 2 parts.

Enforcement Standard

Preventive Action Limit

The enforcement standard is established from available health information.

Enforcement standards can be based on:

Federal number

State drinking water standard

EPA value

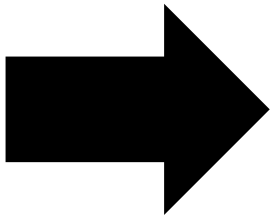
Technical information

Cancer risk

When an enforcement standard is based on:

Federal number

State drinking water standard



Use the concentration as the standard

When an enforcement standard is based on:

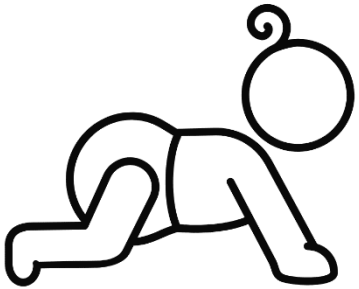
- EPA value
- Technical information
- Cancer risk

→ Calculate the appropriate standard

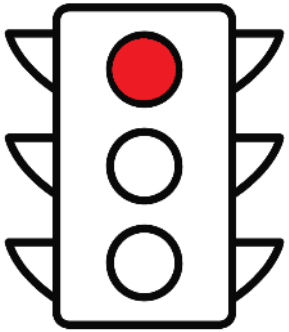
Enforcement standards based on

EPA value

Technical information



Set to protect a young child



Enforcement Standard

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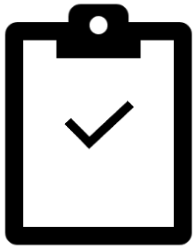


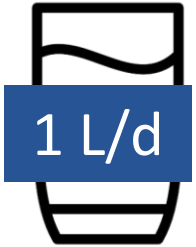
Acceptable daily intake

×

Body weight

×

Relative source contribution

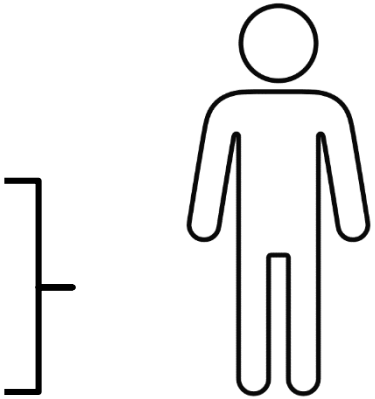


Water consumption

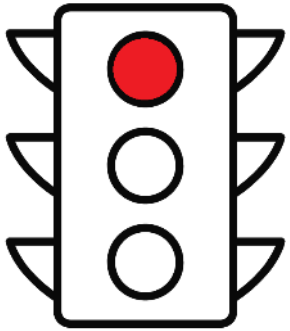
Specified in Statute

Enforcement standards based on

Cancer risk

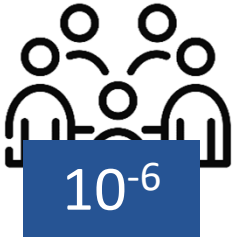


Set to protect from a lifetime of exposure



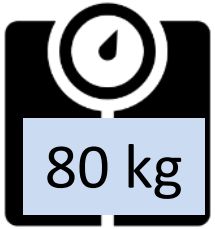
Enforcement Standard

=

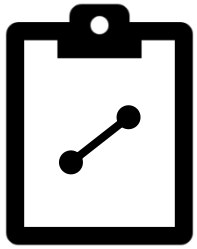


Risk level

×

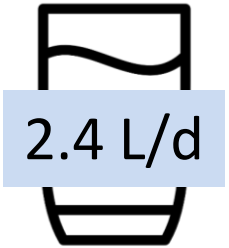


Body weight



Cancer slope factor

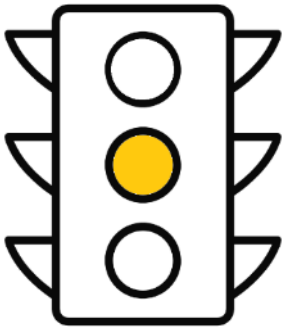
×



Water consumption

Specified in Statute | Recommended by EPA

The preventive action limit is set at a percentage of the enforcement standard.

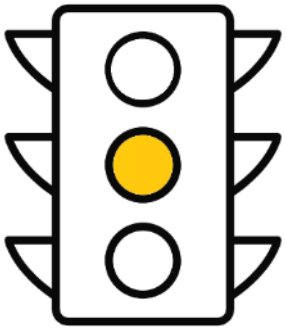


Preventive action limit

= 10%

of the enforcement standard

Substances that cause carcinogenic, mutagenic, teratogenic, or interactive effects



Preventive action limit

= 20%

of the enforcement standard

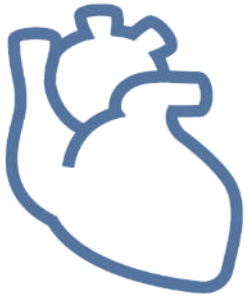
All other substances

1,1-Dichloroethane

1,1-dichloroethane can impact the

Central nervous system

Liver



Heartbeat

Bone development

Wisconsin currently has groundwater standards for **1,1-dichloroethane**.

The current enforcement standard for **1,1-dichloroethane** of **850 µg/L** is based on:

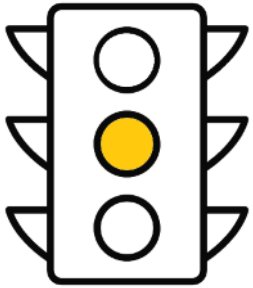
Technical information

Liver damage in cats

6 month inhalation study

Established in 1988

The current preventive action limit for **1,1-dichloroethane** is set at:



= 10% of the enforcement standard

Potential carcinogenic effects

Available scientific information for **1,1-dichloroethane**:

Federal number

State drinking water standard

EPA value

Technical information

Cancer risk

Available scientific information for **1,1-dichloroethane**:

Technical information

EPA Provisional Peer-Reviewed Toxicity Value (2006)

0.2 mg/kg-d

Central nervous system and neurological effects in male rats

90 day oral study

Available scientific information for **1,1-dichloroethane:**

Cancer risk

CalEPA Cancer Slope Factor (1992)

$0.0057\ (mg/kg\text{-}d)^{-1}$

Mammary gland tumors at the highest dose in females rats

2 year oral study

CalEPA = California Environmental Protection Agency

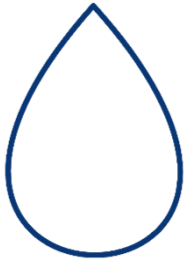
DHS recommends **no change** to the enforcement standard and preventive action limit for **1,1-dichloroethane**.

1,2,3-Trichloropropane

1,2,3-trichloropropane can cause

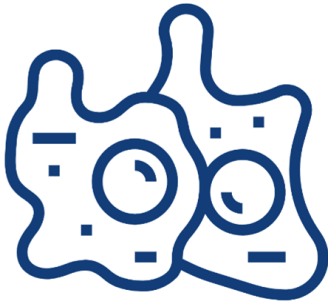
Liver damage

Stomach irritation



Blood disorders

Kidney damage



Tumors

Wisconsin currently has groundwater standards for **1,2,3-trichloropropane.**

The current enforcement standard for **1,2,3-trichloropropane** is **60 µg/L** based on:

EPA value

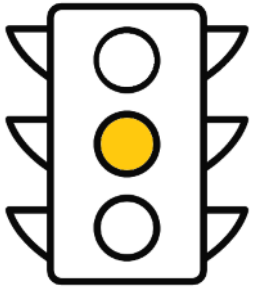
Oral reference dose

Effects on liver, kidney, growth, and blood in rats

60-120 day oral study

Established in 1997

The current preventive action limit for **1,2,3-trichloropropane** is set at:



= 20% of the enforcement standard

Not shown to have carcinogenic, mutagenic, teratogenic or interactive effects at the time

Available scientific information for **1,2,3-trichloropropane:**

Federal number

State drinking water standard

EPA value

Technical information

Cancer risk

Available scientific information for **1,2,3-trichloropropane**:

EPA value

Oral reference dose (2009)

0.004 mg/kg-d

Liver effects in males rats

2 year oral exposure

Available scientific information for **1,2,3-trichloropropane**:

Cancer risk

EPA cancer slope factor (2009)

30 $(mg/kg\text{-}d)^{-1}$

Tumors in the liver, digestive system, uterus, and Harderian gland

2 year oral study

DHS recommends that the **enforcement standard** for **1,2,3-trichloropropane** be based on **cancer risk**.

Carcinogens cause cancer through one of two ways.

Genotoxic chemicals

Directly alter DNA

Default approach

No safe level of exposure

Use cancer slope factor

Genotoxic chemicals

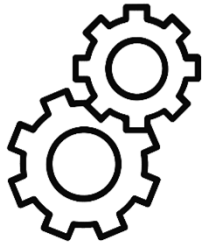
Directly alter DNA

Default approach

No safe level of exposure

Use cancer slope factor

Non-genotoxic chemicals

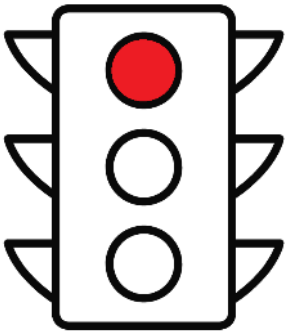


Do not directly cause gene damage

Safe level of exposure

Use acceptable daily intake

1,2,3-Trichloropropane is considered a **genotoxic** because it can cause mutagenic effects.



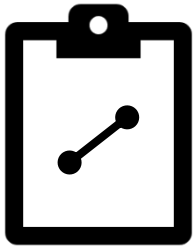
Enforcement Standard

=

10^{-6}

×

Age adjusted*



30 $(mg/kg\text{-}d)^{-1}$

×

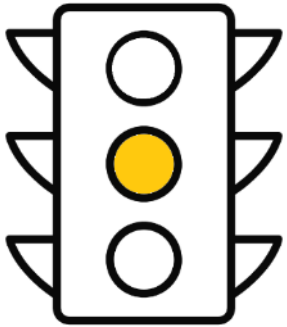
Age adjusted*

*Accounts for differences in relative risk at various ages – see support document

DHS recommends an **enforcement standard** of **0.3 ng/L** for **1,2,3-trichloropropane**.

DHS recommends that the **preventive action limit** for **1,2,3-trichloropropane** be set at **10%.**

DHS recommends that the preventive action limit for **1,2,3-trichloropropane** be set at:



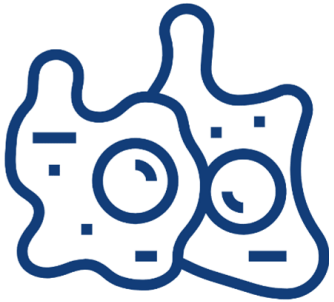
= 0.03 ng/L

10% due to carcinogenic and mutagenic effects

1,4-Dioxane

1,4-Dioxane can cause

Liver damage



Tumors

Kidney damage

Wisconsin currently has groundwater standards for **1,4-dioxane.**

The current enforcement standard for **1,4-dioxane** is **3 µg/L** based on:

Cancer risk

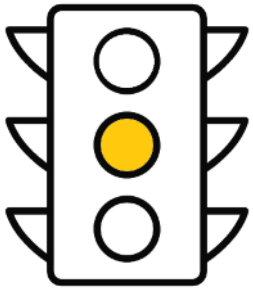
Cancer slope factor from 1988

Nasal tumors in male rats

2 year drinking water study

Established in 2010

The current preventive action limit for **1,4-dioxane** is set at:



= 10% of the enforcement standard

Carcinogenic effects

Available scientific information for **1,4-dioxane**:


Federal number

State drinking water standard


EPA value


Technical information


Cancer risk

Available scientific information for **1,4-dioxane:**

Federal number

Drinking Water Concentrations at Specified Cancer Risk Levels (2010)

Based on updated cancer slope factor

Drinking water concentrations at specified cancer risk levels for **1,4-dioxane**:

Cancer Risk Level	Water Concentration
1 in 10,000	35 µg/L
1 in 100,000	3.5 µg/L
1 in 1,000,000	0.35 µg/L

Available scientific information for **1,4-dioxane:**

Cancer risk

EPA cancer slope factor (2010)

0.1 $(mg/kg\text{-}d)^{-1}$

Tumors in female mice

2 year drinking water study

Available scientific information for **1,4-dioxane**:

EPA value

Oral reference dose (2010)

0.03 mg/kg-d

Liver and kidney damage in rats

2 year drinking water study

Available scientific information for **1,4-dioxane**:

Technical information

ATSDR Chronic Oral Minimum Risk Level (2012)

0.1 mg/kg-d

Same study as EPA but did not include database uncertainty factor

ATSDR = Agency for Toxic Substances and Disease Registry

Available scientific information for **1,4-dioxane**:

Technical information

Two critical studies

Dourson et al., 2014 examined mode of action from 1978 cancer study.

Gi et al. 2018 evaluated effect of exposure on mutagenicity in rats.

ATSDR = Agency for Toxic Substances and Disease Registry

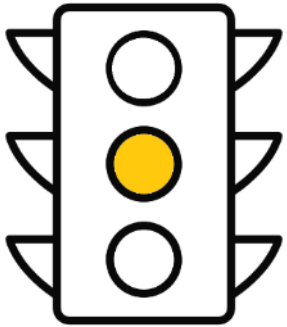
DHS recommends that the **enforcement standard** for **1,4-dioxane** be based on EPA's **cancer risk concentration**.

1,4-dioxane is treated as **genotoxic** because its mode of action is unclear.

DHS recommends an **enforcement standard** of **0.35 µg/L** for **1,4-dioxane**.

DHS recommends to that the **preventive action limit** for **1,4-dioxane** be set at **10%**.

DHS recommends that the preventive action limit for **1,4-dioxane** be set at:



= 0.035 µg/L

10% due to carcinogenic, mutagenic, and teratogenic effects

Tetrachloroethylene (PCE)

PCE can cause

Liver damage

Altered brain chemistry

Kidney damage

Impaired reproduction/ development

Wisconsin currently has groundwater standards for **PCE**.

The current enforcement standard for **PCE** is **5 µg/L** based on:

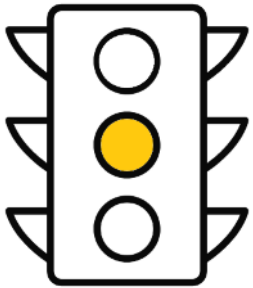
Federal number

MCL from 1991

Based on cancer risk and feasibility of treatment

Established in 1992

The current preventive action limit for **PCE** is set at:



= 10% of the enforcement standard

Carcinogenic and mutagenic effects

Available scientific information for **PCE**:

Federal number

State drinking water standard

EPA value

Technical information

Cancer risk

Available scientific information for **PCE:**

Federal number

Drinking Water Concentrations at Specified Cancer Risk Levels (2012)

Based on updated cancer slope factor

Drinking water concentrations at specified cancer risk levels for **PCE**:

Cancer Risk Level	Water Concentration
1 in 10,000	2,000 µg/L
1 in 100,000	200 µg/L
1 in 1,000,000	20 µg/L

Available scientific information for **PCE:**

Cancer risk

EPA cancer slope factor (2012)

0.0021 $(mg/kg\text{-}d)^{-1}$

Non-Hodgkin's lymphoma, liver cancer

Convert from inhalation to oral risk from studies among people

Available scientific information for **PCE**:

EPA value

Oral reference dose (2012)

0.006 mg/kg-d

Neurological effects

Based on inhalation studies in workers

Available scientific information for **PCE**:

Technical information

ATSDR Chronic Oral Minimum Risk Level (2014)

0.006 mg/kg-d

Same as EPA

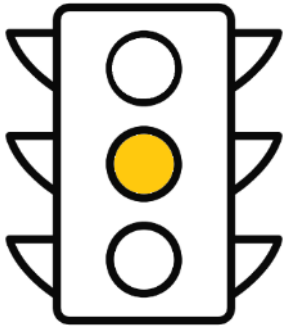
ATSDR = Agency for Toxic Substances and Disease Registry

DHS recommends that the **enforcement standard** for **PCE** be based on EPA's **cancer risk concentration**.

DHS recommends an **enforcement standard** of **20 µg/L** for **PCE.**

DHS recommends to that the **preventive action limit** for **PCE** be set at **10%**.

DHS recommends that the preventive action limit for **PCE** be set at:



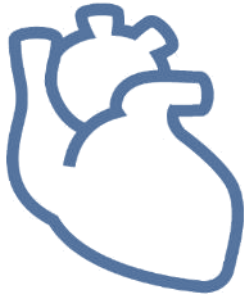
= 2 µg/L

10% due to carcinogenic, mutagenic, and interactive effects

Trichloroethylene (TCE)

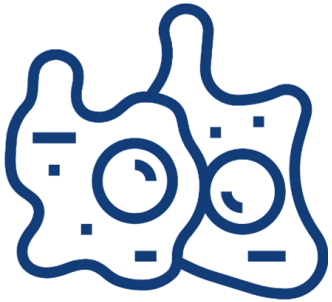
TCE can cause

Liver damage



Altered heartbeat

Kidney damage



Cancer

Wisconsin currently has groundwater standards for **TCE**.

The current enforcement standard for **TCE** is **5 µg/L** based on:

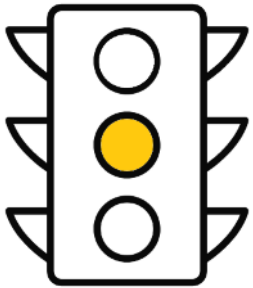
Federal number

MCL from 1989

Based on cancer risk and feasibility of treatment

Established in 1990

The current preventive action limit for **TCE** is set at:



= 10% of the enforcement standard

Carcinogenic and mutagenic effects

Available scientific information for **TCE**:


Federal number


State drinking water standard


EPA value


Technical information


Cancer risk

Available scientific information for **TCE:**

Federal number

Drinking Water Concentrations at Specified Cancer Risk Levels (2011)

Based on updated cancer slope factor

Drinking water concentrations at specified cancer risk levels for **TCE**:

Cancer Risk Level	Water Concentration
1 in 10,000	50 µg/L
1 in 100,000	5 µg/L
1 in 1,000,000	0.5 µg/L

Available scientific information for **TCE:**

Cancer risk

EPA cancer slope factor (2011)

0.0464 $(mg/kg\text{-}d)^{-1}$

Kidney cancer, non-Hodgkin's lymphoma, liver cancer

Convert from inhalation to oral risk from studies among people

Available scientific information for **TCE**:

EPA value

Oral reference dose (2011)

0.0005 mg/kg-d

Effects on the thymus, immune system, and heart

Based on 3 drinking water studies in rodents

Available scientific information for **TCE**:

Technical information

ATSDR Chronic Oral Minimum Risk Level (2014)

0.005 mg/kg-d

Same as EPA

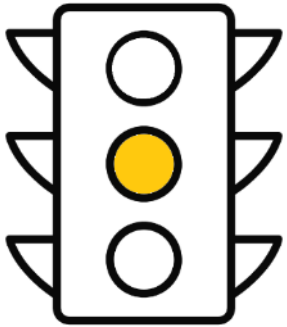
ATSDR = Agency for Toxic Substances and Disease Registry

DHS recommends that the **enforcement standard** for **TCE** be based on EPA's **cancer risk concentration**.

DHS recommends an **enforcement standard** of **0.5 µg/L** for **TCE.**

DHS recommends to that the **preventive action limit** for **TCE** be set at **10%**.

DHS recommends that the preventive action limit for **TCE** be set at:



= 0.05 µg/L

10% due to carcinogenic, mutagenic, and teratogenic effects

In summary, DHS recommends

1,1-Dichloroethane	No change
1,2,3-Trichloropropane	Lower standard
1,4-Dioxane	Lower standard
Tetrachloroethylene (PCE)	Higher standard
Trichloroethylene (TCE)	Lower standard

Additional information can be found on DHS' webpage: dhs.wisconsin.gov\water\gws.htm

The full scientific support document for all of the Cycle 10 compounds is available here: dhs.wisconsin.gov\publications\p02434v.pdf.

Thanks!

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