



Chlorinated ethanes include 1,2-dichloroethane ($\text{CH}_2\text{ClCH}_2\text{Cl}$), 1,1,1-trichloroethane, and 1,1,2,2-tetrachloroethane. The CAS registry number for 1,2-dichloroethane is 107-06-02. Total production of 1,2-dichloroethane in Canada in 1988 was 763 000 t, of which 32 000 t were exported (CIS 1988a). 1,2-Dichloroethane is predominantly used for vinyl chloride production (98%), as an antiknock additive in leaded fuel, and in the production of adhesives, coatings, solvent extractants, and cleaning solutions (ZENON 1982).

1,1,1-Trichloroethane (CH_3CCl_3) has a CAS registry number of 71-55-6. Total domestic production in 1988 was 10 000 t and an additional 6000 t were imported (CIS 1988b). In Canada, 85–90% is used in metal cleaning, particularly the armatures of electric motors, generators, and switchgear and electronic equipment. It is also used in adhesives, as a propellant modifier in aerosols, in several textile finishing operations, as a constituent in various office supplies, as dry lubricants, and as a laboratory solvent (Environment Canada 1988).

1,1,2,2-Tetrachloroethane ($\text{CHCl}_2\text{CHCl}_2$) has a CAS registry number of 79-34-5. It is primarily used as a feedstock to produce other chlorinated compounds (Archer 1979). 1,1,2,2-Tetrachloroethane is not manufactured in Canada (CIS 1988c).

The chlorinated ethanes may enter the environment during production, storage, disposal, and secondary processing. 1,2-Dichloroethane may be released to the environment, during the production phase, via the atmosphere, wastewater releases, and land disposal (Environment Canada 1988). Indirect environmental releases of 1,2-dichloroethane can also occur through dispersive uses such as lead scavenging, paints, coating, grain fumigation, and cleaning (USEPA 1985). 1,1,1-Trichloroethane may be released to land, water, and air during its manufacture and consumption in degreasing operations. The remaining uses (e.g., aerosol vapour depressants, adhesives, paints, film cleaners, and leather tanning) result almost entirely in atmospheric releases (USEPA 1982). The largest threat of release of 1,1,2,2-tetrachloroethane is to groundwater from existing landfills (Pakdel et al. 1989).

Data on the concentration of 1,2-dichloroethane in Canadian surface waters is limited. Levels of 1,2-dichloroethane have been detected in groundwater samples of a landfill site at concentrations up to $7200 \text{ mg}\cdot\text{L}^{-1}$ (Pakdel et al. 1989). Industrial discharges have also been found to contain high levels of 1,2-dichloroethane (up to $6000 \text{ mg}\cdot\text{L}^{-1}$). 1,1,1-Trichloroethane is a contaminant frequently found in Canadian waters, particularly near industrialized areas. Concentrations range from below the detection limit of $0.0005 \text{ mg}\cdot\text{L}^{-1}$ to $18 \text{ mg}\cdot\text{L}^{-1}$ (Kaiser et al. 1983; Lum and Kaiser 1986; S. Lesage 1989, National Water Research Institute, Burlington, Ontario, pers. com.). In Ontario, 1,1,2,2-tetrachloroethane has been detected in the Great Lakes at concentrations up to $4.0 \text{ mg}\cdot\text{L}^{-1}$ (COARGLWQ 1986).

The chlorinated ethanes have a low potential for bioconcentration, with bioconcentration factors in bluegill (*Lepomis macrochirus*) of 2, 9, and 8 for 1,2-dichloroethane, 1,1,1-trichloroethane, and 1,1,2,2-tetrachloroethane, respectively (Barrows et al. 1980).

Volatilization appears to be the major process of removal for 1,2-dichloroethane, based upon the limited information available on fate processes (Dilling et al. 1975). The atmospheric half-life was reported to be 234 h (Radding et al. 1977). The USEPA (1975) and Howard and Evenson (1976) estimated that 1,2-dichloroethane has

Table 1. Water quality guidelines for chlorinated ethanes for the protection of aquatic life (Environment Canada 1991a).

Aquatic life	Guideline value ($\mu\text{g}\cdot\text{L}^{-1}$)
Freshwater	
1,2-dichloroethane	100*
1,1,1-trichloroethane	NRG [†]
1,1,2,2-tetrachloroethane	NRG [†]
Marine	
1,2-dichloroethane	NRG [†]
1,1,1-trichloroethane	NRG [†]
1,1,2,2-tetrachloroethane	NRG [†]

* Interim guideline.

[†] No recommended guideline.

an atmospheric lifetime of 3–4 and 1.7 months, respectively. Despite its relatively short residence time in the atmosphere, Pearson and McConnell (1975) suggested that 1,2-dichloroethane has the potential for long-range transport, which accounts for its presence in upland waters.

No studies were found on photolysis, oxidation, or hydrolysis. Studies conducted on analogous compounds (e.g., dichloromethane, trichloroethane, dibromoethane), however, indicate that these processes are unlikely to be important in the removal of 1,2-dichloroethane (Dilling et al. 1975; Radding et al. 1977). The biodegradation half-life was found to be 48 h in freshwater and 4–5 times greater in saline conditions (Portier and Meyers 1984). Partitioning of 1,2-dichloroethane to sediments and biota is not an important fate process (Gossett et al. 1983).

Volatilization is likely the major process for the removal of 1,1,1-trichloroethane from aquatic ecosystems with half-lives of 11 d in winter and 24 d in spring (Dilling et al. 1975; Wakeham et al. 1983). Photolysis, oxidation, and elimination reactions are not important fate processes (Dilling et al. 1975; USEPA 1979; Vogel and McCarty 1987). The hydrolysis half-life ranges from 0.5 to 0.75 years (Dilling et al. 1975; Pearson and McConnell 1975; Haag et al. 1986). In Canadian groundwater, however, residues have been found more than 10 years after disposal (Lesage et al. 1990).

1,1,1-Trichloroethane is long-lived in the atmosphere, with a photooxidative half-life of more than 6 years in the troposphere. Consequently, 12–25% of 1,1,1-trichloroethane in the troposphere will reach the stratosphere (McConnell and Schiff 1978; USEPA 1982). Chlorine atoms released during the photolysis of 1,1,1-trichloroethane in the stratosphere can attack and deplete ozone. Its presence in upland waters is believed to be due to long-range transport (Pearson and McConnell 1975).

There are few data on the environmental fate and behaviour of 1,1,2,2-tetrachloroethane. The hydrolysis half-life in subsurface sediment was reported to be 24 d (Haag et al. 1986). The tropospheric lifetime is estimated to be longer than 1160 d (Singh et al. 1982). The principal removal process in this estimate was photooxidation; however, competing processes have not yet been investigated.

Water Quality Guideline Derivation

Sufficient data required to develop an interim Canadian water quality guideline for the protection of freshwater life were available only for 1,2-dichloroethane. This was developed based on the CCME protocol (CCME 1991b).

Freshwater Life

The 96-h LC₅₀ values for the most sensitive fish species ranged from 116 mg·L⁻¹ for the fathead minnow (*Pimephales promelas*) (Walbridge et al. 1983) to 225 mg·L⁻¹ for rainbow trout (*Oncorhynchus mykiss*) (Mayer and Eilersieck 1986). Other reported LC₅₀ values ranged from 106 mg·L⁻¹ for guppies (*Poecilla reticulata*) after a 7-d exposure (Konemann 1981) to 550 mg·L⁻¹ for *L. macrochirus* after a 4-d exposure (Dawson et al. 1975/77).

The only acceptable invertebrate toxicity studies found were for *Daphnia magna*, with 48-h LC₅₀ values ranging from 220 to 320 mg·L⁻¹ (LeBlanc 1980; Richter et al. 1983). EC₅₀ values (immobilization) were as low as

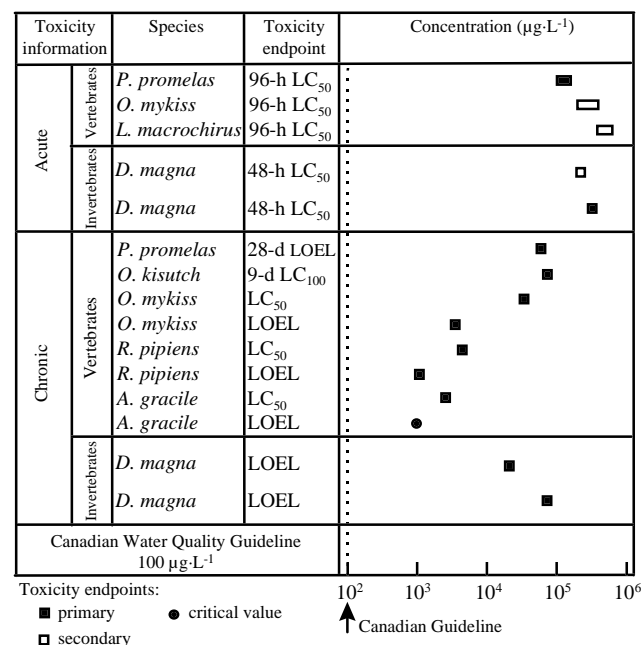


Figure 1. Select freshwater toxicity data for 1,2-dichloroethane.

160 mg·L⁻¹ for unfed *D. magna* during a 48-h exposure (Richter et al. 1983).

Acceptable chronic toxicity studies were found for three fish and two amphibian species. A LOEL of 59.0 mg·L⁻¹ (62% reduction in weight gain) and a NOEL of 29.0 mg·L⁻¹ were reported for *P. promelas* (Benoit et al. 1982). The EC₅₀ for hatchability and the LC₅₀ for 4-d posthatch survival of *O. mykiss* fertilized eggs and larvae were reported as 34.0 mg·L⁻¹ (Black et al. 1982). Black et al. (1982) studied the effects of 1,2-dichloroethane on hatchability and 4-d posthatch survival of two amphibians—the northwestern salamander (*Ambystoma gracile*) and the leopard frog (*Rana pipiens*). For *A. gracile*, the hatchability EC₅₀ was 6.53 mg·L⁻¹, the 4-d posthatch LC₅₀ was 2.54 mg·L⁻¹, and the 4-d posthatch LOEL (23% reduction in survival) was 0.99 mg·L⁻¹. The corresponding values for *R. pipiens* were 4.52, 4.40, and 1.07 mg·L⁻¹ (24% reduction in posthatch survival), respectively. Coho salmon (*O. kisutch*) experienced 100% alevin mortality 9 d after hatching after exposure for 21 d to 73 mg·L⁻¹ (Reid et al. 1982). In this study, 46% of eggs did not hatch after exposure to 124 mg·L⁻¹ for 21 d.

Only one acceptable invertebrate chronic toxicity study was found. Richter et al. (1983) determined NOEL and LOEL values for reproductive success of 10.6 and 20.7 mg·L⁻¹, respectively, for *D. magna*. The influence of 1,2-dichloroethane on growth was less severe, with NOEL and LOEL values of 41.6 and 71.7 mg·L⁻¹, respectively.

The interim water quality guideline for 1,2-dichloroethane for the protection of freshwater life is 100 µg·L⁻¹. It was derived by multiplying the LOEL of 0.99 mg·L⁻¹ (990 µg·L⁻¹) for the most sensitive organism to 1,2-dichloroethane, *A. gracile* (Black et al. 1982), by a safety factor of 0.1 (CCME 1991a).

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