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CANADIAN GROUNDWATER QUALITY GUIDELINES FOR THE PROTECTION OF ENVIRONMENTAL AND HUMAN HEALTH

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DOCUMENT OVERVIEW

This document is divided into three sections: (1) a summary of the protocol used to derive these guidelines, (2) separate guideline tables for one hundred and one organic compounds and (3) appendices containing the substance-specific chemical property information that was used to derive the guidelines. Detailed guiding principles and guideline development processes are available in the Canadian Council of Ministers of the Environment (CCME) protocols (CCME 2006; 2015).

1.0 SUMMARY OF THE GROUNDWATER QUALITY GUIDELINE PROTOCOL

CCME has established a framework for assessing and remediating contaminated sites in Canada and has developed scientific tools to provide guidance and promote consistency across the country. The Canadian groundwater quality guidelines can be added to the existing suite of Canadian Environmental Quality Guidelines. These groundwater quality guidelines may be used at contaminated sites in conjunction with the Canadian soil quality guidelines and Canadian soil vapour quality guidelines.

The groundwater quality guidelines are intended to protect both environmental and human health. Procedures for deriving groundwater quality guidelines are documented in *A Protocol for the Derivation of Groundwater Quality Guidelines for Use at Contaminated Sites* (CCME 2015), referred to herein as the groundwater protocol. The groundwater protocol is based on *A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines* (CCME 2006) referred to herein as the soil protocol. The groundwater protocol represents a separate and abbreviated version of the soil protocol, presenting key policy and technical elements needed to derive groundwater-specific guidelines.

Groundwater guidelines are developed to maintain specific uses of groundwater (e.g., irrigation or drinking water) and to protect receptors in environments that may directly or indirectly come into contact with contaminated groundwater due to contaminant migration (e.g., surface water bodies or vapour intrusion into basements). The groundwater quality guidelines are not intended to protect organisms living in aquifers, but rather to protect the uses of groundwater or downgradient receptors.

Groundwater quality guidelines are primarily derived by using existing benchmarks (e.g., Canadian water quality guideline) and back-calculating a groundwater concentration, using fate and transport models, that will not result in an exceedance of the benchmark once the contaminant reaches the environment of concern (e.g., surface water body). In cases where exposure to groundwater is through untreated well water, the benchmark (e.g., Guidelines for Canadian Drinking Water Quality) is adopted directly as the groundwater quality guideline.

Table 1: Key receptors and exposure pathways addressed by the groundwater quality guidelines

Exposure pathway	Receptor(s)
saturated zone transport to surface water	aquatic life
rising water table into shallow soils	terrestrial plants and invertebrates
migration of vapours into indoor air	human
use of well water	human, livestock, crops

The final generic groundwater quality guideline is based on the lowest value generated by the environmental and human health approaches. Generic guidelines can be altered to account for site-specific conditions. For more information on setting site-specific objectives, see section 1.1 of the soil protocol, suggestions presented in the groundwater protocol and Guidance Manual for Developing Site-Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada (CCME 1996).

1.1 Chemicals of Concern

Chemicals will exhibit different fate and transport characteristics in the environment by virtue of different physical and chemical properties. Chemicals considered for groundwater quality guideline derivation include soluble organic chemicals, which may be dissociating or non-dissociating, volatile or non-volatile. The groundwater protocol does not derive guidelines for inorganic substances (e.g., metals).

The evaluation of chemical aqueous solubility is based on a review of the available published water quality guidelines in Canada. Any chemical for which a published water quality guideline is available in Canada can be considered sufficiently soluble to warrant consideration for guideline derivation. Guidelines published by CCME are preferred; however, if no Canadian water quality guideline exists, then guidelines from other jurisdictions (e.g., Canadian or international) offering a similar level of protection may be used. When CCME develops human health guidelines, it consults Health Canada for appropriate human health benchmarks.

Consistent with the CCME protocol for the development of soil vapour quality guidelines, the indoor vapour inhalation pathway is always considered for any chemical which vapour concentrations can exceed risk-based concentration limits after accounting for a *de minimus* value of attenuation (CCME 2014). This definition accounts for the fact that some chemicals with low vapour pressures and Henry's law constants are nevertheless capable of posing a potential risk because of their high toxicity, while some highly volatile compounds are not capable of posing a risk via inhalation because of their insufficient toxicity.

1.2 Environmental Fate and Behaviour in Groundwater

Four primary processes control the fate and behaviour of a chemical in groundwater, including: (1) ability to form a dissolved phase into groundwater; (2) adsorption to soil and sediment affecting chemical mobility; (3) volatilization into the gas phase, coupled with diffusive and advective transport; and (4) biodegradation and chemical persistence.

Among the soluble organic chemicals considered for guideline development, there are approximately five to eight orders of magnitude of difference in terms of aqueous solubility. If the chemical concentration present in groundwater is higher than aqueous solubility, the formation of a separate non-aqueous phase liquid (NAPL) is possible. In situations where the site groundwater concentration of a chemical is approximately 50% of the pure phase solubility threshold, NAPL may be present hydraulically upgradient of the sampling location and further investigation may be justified.

The tendency to partition between water and air (represented by Henry's law constant) is approximated as the ratio of a chemical's abundance in the gas phase (i.e., vapour pressure) to that in the aqueous phase (solubility) at equilibrium. Henry's law constants provide an indicator of a chemical's tendency to volatilize from water to air. Chemicals with a relatively higher Henry's law constant are usually more volatile, such as n-hexane and BTEX (benzene, toluene, ethylbenzene, and xylenes) compared to PAHs (polycyclic aromatic hydrocarbons) or CHCs (chlorohydrocarbons). As stated by Environment Canada (2005), temperature significantly influences the partitioning of a chemical between the air and water phases. As the Henry's law constant increases with increasing temperature, the loss of dissolved phase chemicals in groundwater to the soil (in vapour phase) through volatilization also increases.

Chemicals with a high organic carbon partition coefficient (K_{oc}) tend to sorb strongly to soil particles and therefore are less mobile in the environment relative to those with a lower K_{oc}. The reported ranges of K_{oc} for soluble organic chemicals of concern display differences of a few orders of magnitude. PAHs with greater than two rings are an example of high-K_{oc}, low-mobility compounds and trihalomethanes (THMs) and BTEX are relatively high-mobility and low-K_{oc} compounds.

Certain contaminants may potentially degrade into chemicals which are more toxic or mobile than the parent compound. The rate and extent of degradation of the parent compound may be affected by a number of site-specific factors, such as electron acceptor availability and redox conditions. With the exception of parent products (for example, tetrachloroethylene and trichloroethylene) associated with the anaerobic degradation pathway resulting in vinyl chloride formation, no formal Tier 1 method for adjusting groundwater quality guidelines to reflect degradation into more toxic compounds is specified. However, where data support doing so, accounting for degradation to more toxic compounds should be considered on a chemical-specific basis in generic guideline development.

1.3 Guideline Derivation

The development of groundwater quality guidelines is based on both scientific and management considerations, and takes into consideration risks to both the environment and human receptors. Where appropriate, separate guidelines are developed for coarse- and fine-textured soils. Detailed guideline development processes are discussed in the groundwater protocol.

1.3.1 Groundwater Quality Guidelines for Human Health

Groundwater quality guidelines for the protection of human health are developed to ensure that contaminants present at the guideline concentration will result in no appreciable human health risk. For the purpose of guideline development, CCME assumes a chronic exposure scenario (i.e., lifetime exposure to a remediated site). Human health groundwater quality guidelines are derived for the protection of potable groundwater and indirect exposure via indoor vapour inhalation. Human health guidelines for non-threshold (carcinogenic) chemicals require the development of groundwater quality guidelines that employ a critical risk-based dose based on lifetime incremental risks from groundwater ingestion and indoor vapour inhalation. Canadian jurisdictions generally employ a 10^{-5} or 10^{-6} incremental lifetime cancer risk as a *de minimus* risk level. For convenience, CCME provides guidelines for the protection of human health at both the 10^{-5} and 10^{-6} incremental risk levels.

The volatilization of a chemical in groundwater and its subsequent migration through soil and into indoor air is always evaluated for volatile chemicals. For the calculation of groundwater quality guidelines for the protection of indoor air quality ($GWQG_{IAQ}$) the presence of a minimum of one metre of clean soil between the top of the capillary fringe and base of the building foundation is assumed. Groundwater quality guidelines protective of indoor air inhalation are derived based on chemical-specific toxicological reference values (TRVs). For threshold substances a tolerable concentration (TC) is used to evaluate chemical toxicity to humans; for non-threshold substances, such as carcinogens, a risk-specific concentration (RSC) is used. If a TC or RSC is not available, they can be extrapolated from a tolerable daily intake (TDI) or a risk-specific dose (RSD), respectively, if the mode of toxicity supports extrapolation of an inhalation TRV from an oral TRV (CCME 2006; 2015). Human health TRVs developed or endorsed by Health Canada (Health Canada 2010a; 2010b) are considered suitable for guideline derivation purposes. Indoor air quality guidelines are calculated separately for two land use scenarios: an agricultural/residential guideline reflecting an individual residing at the site full-time, and a commercial/industrial scenario reflecting a typical occupational exposure scenario. If toxicity is evaluated using a TC or RSC, receptor characteristics are unnecessary. If TC or RSC is extrapolated from a TDI or RSD, characteristics for a toddler are used for all land uses.

Groundwater quality guidelines for the protection of potable water ($GWQG_{PW}$) are based directly on the Guidelines for Canadian Drinking Water Quality (Health Canada 2017). While these guidelines primarily address the ingestion of water, recent guidelines published by Health Canada have also included consideration of dermal and inhalation contact with water while bathing and showering. Since the values developed by Health Canada are applied directly, there is no need to consider additional receptor characteristics. As noted, the 10^{-5} to 10^{-6} incremental cancer risk range corresponds to the range considered essentially negligible in the derivation of the maximum allowable concentrations (MACs) for carcinogenic chemicals in drinking water. The use of groundwater as a source of domestic water is not considered to be dependent on land use. When Canadian drinking water guidelines are not available, source guidance values for groundwater can be developed (CCME 2006).

1.3.2 Groundwater Quality Guidelines for Environmental Health

Ecological receptors may not commonly come into direct contact with contaminated groundwater. Groundwater quality guideline derivation is not oriented toward the protection of receptors

residing in groundwater (e.g., stygobitic organisms), but rather receptors in other media which may be exposed to groundwater contamination.

The groundwater quality guideline for groundwater contact by soil-dependant organisms ($GWQG_{GC}$) is intended to protect terrestrial plants and soil invertebrates immersed temporarily in contaminated groundwater, and is derived based on the conservative assumption that roots of phreatophyte species may be permanently immersed in, and drawing from, contaminated groundwater. The $GWQG_{GC}$ is calculated assuming partitioning of the soil quality guideline for soil contact ($SoQG_{SC}$) (CCME 1999) for agricultural land using equations described in the groundwater protocol. The groundwater protocol provides site-specific options for when phreatophytes are not present.

The protection of the aquatic life exposure pathway addresses contaminants moving laterally in groundwater and being discharged into a downgradient surface water body. As the distance to the nearest downgradient surface water body increases, the likelihood of adverse impacts on the aquatic life at the receiving water body decreases due to the attenuation of the chemical. Groundwater quality guidelines for the protection of aquatic life ($GWQG_{FL}$ for freshwater life and $GWQG_{ML}$ for marine life) are developed to be sufficiently low as to maintain the water quality of a surface water body (freshwater or marine) located 10 m away from the contaminated groundwater. The calculation is intended to result in a groundwater concentration at 10 m from the surface water body that, upon discharge to the receiving water body, meets the Canadian Water Quality Guidelines for the Protection of Aquatic Life (CCME 1999). There is no adjustment for receiving water body dilution (i.e., the dilution factor is 1).

In addition, water wells and dugouts are potential exposure pathways to groundwater used for livestock watering or crop irrigation. A water well or dugout can potentially be installed or constructed at any location, including within, or immediately adjacent to, a groundwater contaminant source. As a result, the groundwater quality guidelines for the protection of livestock watering ($GWQG_{LW}$) and irrigation water ($GWQG_{IR}$) are adopted directly from the Canadian Water Quality Guidelines for the Protection of Agricultural Water Uses (Livestock Water and Irrigation Water, respectively) (CCME 1999).

Chemicals in groundwater tend to be more mobile than those in soil, and therefore the potential for contaminants to move from a less sensitive to a more sensitive land use is greater for groundwater than for soil. Accordingly, groundwater quality guidelines for environmental health are not developed to be land use-specific, but rather to reflect a level of ecological protection appropriate to the most sensitive land use or to support any ecological groundwater use which can reasonably be anticipated.

1.3.3 Non-Toxicity Considerations, Management Limits

The development of groundwater quality management considerations is required to reflect any additional concern associated with the substance of concern beyond toxicity to human and ecological receptors. As discussed in the groundwater protocol, the solubility limit should be taken into account and groundwater concentrations should not exceed 50% of the substance aqueous solubility limit (represented as the management limit, $GWQG_{M}$). Additional concerns may

include aesthetic concerns (e.g., odours), explosive hazards, free-phase liquid formation, or damage to utilities and infrastructure.

1.4 Use of Canadian Groundwater Quality Guidelines

The Canadian groundwater quality guidelines represent "clean down to" levels at contaminated sites and should not be interpreted as "pollute up to" levels for less contaminated sites. They are not intended to be used either to manage pristine sites or to evaluate the quality of wastes or other substances being discharged to groundwater. The guidelines are also not intended for application at the point of exposure (e.g., water distribution systems or surface water).

Groundwater quality guidelines are developed using a specific set of assumptions and models. In some cases, the assumptions used to derive these guidelines may not be protective for particularly sensitive sites. A list of site conditions that may invalidate the assumptions used to develop groundwater quality guidelines are described in the groundwater protocol. Below are some specific deviations (from the soil protocol) associated with the development of groundwater quality guidelines:

- Groundwater quality guidelines are not developed separately for the four land uses defined in the soil protocol. Separate vapour inhalation guidelines are calculated based on agricultural/residential and commercial/industrial exposure scenarios; however, jurisdictions may allow for the exclusion of certain exposure pathways based on land use, potentially subject to offset distances to more sensitive land uses.
- Groundwater quality guidelines for the protection of plants and soil organisms are calculated based on a single level of protection, equivalent to the soil quality guideline for soil contact for agricultural land use.
- Certain input parameters for the fate and transport models have been updated to reflect recent improvements in the science and research reflected in the 2008 update of the Canada-wide Standard for Petroleum Hydrocarbons in Soil (CCME 2008) and in recent scientific literature.

1.5 Final Groundwater Quality Guidelines

The lowest of the guidelines established for human health and environmental health becomes the final groundwater quality guideline ($GWQG_F$) for a given substance. Professional judgement is used at the time of guideline development on whether to adjust the $GWQG_F$ based on a management limit. The $GWQG_F$ is also checked against practical quantitation limits (PQL) and background concentrations when available. Where the $GWQG_F$ is less than typical Canadian background concentrations, CCME recommends that the accepted background concentration replace the $GWQG_F$ generated using the groundwater protocol. If a $GWQG_F$ is lower than the available quantitation limit, a footnote is added, but the $GWQG_F$ should not be adjusted based on the PQL. Jurisdictions may incorporate the PQL in the implementation of the guideline.

Note that the guidelines for the protection of potable water ($GWQG_{PW}$) and aquatic life ($GWQG_{FL}$ for freshwater life and $GWQG_{ML}$ for marine life) are considered required exposure

pathways. If one or both of these guidelines cannot be established, the $GWQG_F$ is considered to be a provisional guideline.

2.0 CANADIAN GROUNDWATER QUALITY GUIDELINES

Canadian groundwater quality guidelines for 101 chemicals of concern are presented in the following tables. Each table presents the Canadian groundwater quality guidelines for an individual substance, or carcinogenic PAH mixture, two receptor scenarios for indoor air and two soil textures. In addition, human health guidelines for non-threshold (carcinogenic) chemicals are presented at both the 10^{-5} and 10^{-6} incremental risk levels.

The final groundwater quality guideline ($GWQG_F$) is presented in the top row of each table. Final guidelines are also referred to as Tier 1 or "generic" guidelines. The goal of the final groundwater quality guideline is to protect both ecological and human health, and is selected based on the lowest of available environmental and human health pathway-specific guidelines. The final guideline may be adjusted based on non-toxicity considerations—for example, a management limit based on solubility intended as an alert to the potential presence of upstream sources of free phase product.

A final guideline may be labelled as provisional to reflect uncertainty in the guideline development process when there is a data gap, e.g., a required pathway is missing, or when the final guideline is based on an ecological or human health pathway-specific guideline that did not fully meet guideline derivation data requirements as outlined in the groundwater protocol.

At a site, all ecological and human health water uses (represented as pathway-specific guidelines in the table) are considered applicable at Tier 1.

It may be possible to exclude or modify certain water uses at Tier 2. Due to the mobility of both groundwater and soil vapours, particular care should be applied when excluding exposure pathways based on land use. Consult the jurisdiction for specific requirements for offset distances from more sensitive land uses.

The groundwater protocol provides an introduction to potential Tier 2 adjustments. More detailed Tier 2 guidance can be found in *Guidance Manual for Developing Site-Specific Soil Quality Remediation Objectives for Contaminated Sites in Canada* (CCME 1996).

An initial suite of Canadian groundwater quality guidelines are developed for substances that have existing Canadian soil quality guidelines, Canadian water quality guidelines or Guidelines for Canadian Drinking Water Quality.

CCME has not developed scientific criteria documents for the groundwater quality guidelines. Background information for many substances in this document may be found in the scientific criteria documents for various Canadian soil or water quality guidelines. This section and Appendices B through E contain all of the input parameters needed to derive the groundwater quality guidelines. Readers may consult the equations in the groundwater protocol to understand how these physical and chemical parameters contribute to the guideline calculation, and/or

replicate the individual guideline values presented here. Additionally, the footnote section of individual guideline tables may contain information on specific features or decisions related to the contaminant. By documenting the most essential elements of guideline derivation, CCME has been able to produce a large quantity of groundwater quality guidelines.

Additional information that is needed for guideline derivation but not found in Appendices B to E is summarized below:

- The lower of the maximum acceptable concentration (MAC) or aesthetic objective (AO) in the Guidelines for Canadian Drinking Water Quality was selected for the groundwater quality guidelines for the protection of potable water ($GWQG_{PW}$). The potable water values in Appendix D attributed to Health Canada are the MAC, unless indicated otherwise.
- Certain input parameters and methods unique to petroleum hydrocarbon fractions F1 and F2 can be found in the *Canada-wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale Supporting Technical Document* (CCME 2008) and Table C-10 of the *Alberta Tier 1 Soil and Groundwater Remediation Guidelines* (AEP 2019).
- Some substance-specific chemical information used to derive the groundwater quality guidelines for the protection of indoor air quality ($GWQG_{IAQ}$) is summarized here:
    - Adjustment factor (Adj.F) (unitless) = 10 for benzene, toluene, ethylbenzene, xylenes, F1, F2, naphthalene and n-hexane. For all other substances, Adj.F = 1.
    - Allocation Factor (AF) (unitless) = 0.2 for all substances.
    - Background groundwater concentration (BGC) (mg/L) = 0 for all substances.

The groundwater guideline tables are presented alphabetically, with some substances placed in groupings: chlorinated benzenes (12 chemicals), chlorinated ethanes (three chemicals), chlorinated ethenes (two chemicals), chlorinated phenols (five chemicals), halogenated methanes (six chemicals), organotins (two chemicals), petroleum hydrocarbon fraction F1 and F2, phthalate esters (two chemicals) and polycyclic aromatic hydrocarbons (nine chemicals plus carcinogenic PAHs).

Groundwater Quality Guidelines for Acridine (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0044**	**0.31**	**0.0044**	**0.31**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0044	0.31	0.0044	0.31
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	19	19	19	19

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Aldicarb (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00015 ML**	**0.00015 ML**	**0.00015 ML**	**0.00015 ML**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water§	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.001	0.001	0.001	0.001
Protection of marine life	0.00015	0.00015	0.00015	0.00015
Protection of livestock watering	0.011	0.011	0.011	0.011
Protection of irrigation water	0.055	0.055	0.055	0.055
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	3000	3000	3000	3000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

ML: Final guideline is based on the protection of marine life pathway. If no marine water bodies are present, users may wish to conduct a Tier 2 evaluation.

§ The Guideline for Canadian Drinking Water Quality for aldicarb has been withdrawn. If the substance is detected in groundwater which is used (or may be used) as a source of drinking water, Health Canada should be contacted for guidance.

Degradation note

Potential degradation products include aldicarb sulfoxide and aldicarb sulfone. Consideration of these additional degradation products is potentially necessary when evaluating site groundwater quality impacted by aldicarb.

Groundwater Quality Guidelines for Aldrin + Dieldrin (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000004 ‡**	**0.000032**	**0.000004 ‡**	**0.000032**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water §	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000004	0.000032	0.000004	0.000032
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.13	0.13	0.13	0.13

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

‡: Laboratories may not be able to reliably measure a concentration of this magnitude.

§: The Guideline for Canadian Drinking Water Quality for aldrin + dieldrin has been withdrawn. If the substance is detected in groundwater which is used (or may be used) as a source of drinking water, Health Canada should be contacted for guidance.

Degradation note

Aldrin is rapidly metabolized to dieldrin in the environment.

Groundwater Quality Guidelines for Aniline (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0022**	**0.0022**	**0.0022**	**0.0022**
Human health guidelines				
Protection of indoor air quality (basement) #	52	370	--	--
Protection of indoor air quality (slab on grade) #	65	390	540	4000
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0022	0.0022	0.0022	0.0022
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	18000	18000	18000	18000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

#: Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for Atrazine (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0018**	**0.0018**	**0.0018**	**0.0018**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.005	0.005	0.005	0.005
Environmental health guidelines				
Protection of freshwater life	0.0018	0.0018	0.0018	0.0018
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.005	0.005	0.005	0.005
Protection of irrigation water	0.01	0.01	0.01	0.01
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	17	17	17	17

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential degradation products include possibly more toxic deethylatrazine, deisopropylatrazine and deethyldeisopropylatrazine. Consideration of these additional degradation products is potentially necessary when evaluating site groundwater quality impacted by atrazine, although it may not be possible to quantify these compounds separately from atrazine.

Groundwater Quality Guidelines for Benzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk	**0.005**	**0.005**	**0.005**	**0.005**
Guideline – 10^{-6} incremental risk	**0.005**	**0.005**	**0.005**	**0.005**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ◊	0.073 ♦	0.55 ♦	--	--
Protection of indoor air quality (slab on grade) ◊	0.091 ♦	0.58 ♦	0.41	3.1
Protection of potable water	0.005	0.005	0.005	0.005
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ◊	0.014	0.1	--	--
Protection of indoor air quality (slab on grade) ◊	0.017	0.11	0.041	0.31
Protection of potable water	0.005	0.005	0.005	0.005
Environmental health guidelines				
Protection of freshwater life	0.69	33	0.69	33
Protection of marine life	0.2	9.8	0.2	9.8
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	62	110	62	110
Management considerations				
Water solubility (50%)	900	900	900	900

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

♦ Presented value is based on the non-carcinogenic risk.

Groundwater Quality Guidelines for Bromacil (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0002**	**0.0002**	**0.0002**	**0.0002**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.005	0.005	0.005	0.005
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	1.1	1.1	1.1	1.1
Protection of irrigation water	0.0002	0.0002	0.0002	0.0002
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	410	410	410	410

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Bromoxynil (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00033**	**0.00033**	**0.00033**	**0.00033**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.005	0.005	0.005	0.005
Environmental health guidelines				
Protection of freshwater life	0.005	0.005	0.005	0.005
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.011	0.011	0.011	0.011
Protection of irrigation water	0.00033	0.00033	0.00033	0.00033
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	65	65	65	65

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Monochlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.0013**	**0.0013**	**0.0013**	**0.0013**
Human health guidelines				
Protection of indoor air quality (basement)	0.019	0.13	--	--
Protection of indoor air quality (slab on grade)	0.024	0.14	0.2	1.4
Protection of potable water	0.03	0.03	0.03	0.03
Environmental health guidelines				
Protection of freshwater life	0.0013	0.0013	0.0013	0.0013
Protection of marine life	0.025	0.025	0.025	0.025
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	250	250	250	250

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

Groundwater Quality Guidelines for 1,2-Dichlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.0007**	**0.0007**	**0.0007**	**0.0007**
Human health guidelines				
Protection of indoor air quality (basement)	3.2	21	--	--
Protection of indoor air quality (slab on grade)	4.2	23	33	NRG
Protection of potable water	0.003	0.003	0.003	0.003
Environmental health guidelines				
Protection of freshwater life	0.0007	0.0007	0.0007	0.0007
Protection of marine life	0.042	0.042	0.042	0.042
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	78	78	78	78

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Degradation note

Potential degradation products include D1 = monochlorobenzene and benzene under anaerobic conditions. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,2-dichlorobenzene. (Note: *D* stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,3-Dichlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.15**	**0.15**	**0.15**	**0.15**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.15	0.15	0.15	0.15
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	63	63	63	63

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential degradation products include D1 = monochlorobenzene and benzene under anaerobic conditions. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,3-dichlorobenzene. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,4-Dichlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.001**	**0.001**	**0.001**	**0.001**
Guideline – 10^{-6} incremental risk (provisional*)	**0.0007**	**0.001**	**0.001**	**0.001**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ◊	0.007	0.046	--	--
Protection of indoor air quality (slab on grade) ◊	0.0093	0.05	0.02	0.14
Protection of potable water	0.001	0.001	0.001	0.001
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ◊	0.0007	0.0046	--	--
Protection of indoor air quality (slab on grade) ◊	0.00093	0.005	0.002	0.014
Protection of potable water	0.001	0.001	0.001	0.001
Environmental health guidelines				
Protection of freshwater life	0.026	0.026	0.026	0.026
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	41	41	41	41

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for 1,2,3-Trichlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.008**	**0.008**	**0.008**	**0.008**
Human health guidelines				
Protection of indoor air quality (basement) #	0.021	0.13	--	--
Protection of indoor air quality (slab on grade) #	0.03	0.14	0.22	1.4
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.008	0.008	0.008	0.008
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	9	9	9	9

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Degradation note

Potential degradation products include D1 = 1,2-dichlorobenzene and 1,4-dichlorobenzene and 1,3-dichlorobenzene, D2 = monochlorobenzene and benzene under anaerobic conditions. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,2,3-trichlorobenzene. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,2,4-Trichlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0054** [ML]	**0.0054** [ML]	**0.0054** [ML]	**0.0054** [ML]
Human health guidelines				
Protection of indoor air quality (basement)	0.045	0.26	--	--
Protection of indoor air quality (slab on grade)	0.063	0.3	0.46	2.8
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.024	0.024	0.024	0.024
Protection of marine life	0.0054	0.0054	0.0054	0.0054
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	25	25	25	25

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis

ML: Final guideline is based on the protection of marine life pathway. If no marine water bodies are present, users may wish to conduct a Tier 2 evaluation.

Degradation note

Potential degradation products include D1 = 1,4-dichlorobenzene and D2 = monochlorobenzene under anaerobic conditions. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,2,4-trichlorobenzene. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,3,5-Trichlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.016**	**0.097**	**0.17**	**1**
Human health guidelines				
Protection of indoor air quality (basement)	0.016	0.097	--	--
Protection of indoor air quality (slab on grade)	0.023	0.11	0.17	1
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	15	15	15	15

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for 1,2,3,4-Tetrachlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0018**	**0.0018**	**0.0018**	**0.0018**
Human health guidelines				
Protection of indoor air quality (basement) #	0.096	0.52	--	--
Protection of indoor air quality (slab on grade) #	0.14	0.6	0.99	5.5 ES
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0018	0.0018	0.0018	0.0018
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	3	3	3	3

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Degradation note

Potential degradation products include D1 = 1,2,3-trichlorobenzene, D2 = 1,2-dichlorobenzene, 1,4-dichlorobenzene, 1,3-dichlorobenzene, D3 = monochlorobenzene and benzene under anaerobic conditions. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,2,3,4- tetrachlorobenzene. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,2,3,5-Tetrachlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0056**	**0.03**	**0.057**	**0.32**
Human health guidelines				
Protection of indoor air quality (basement) #	0.0056	0.03	--	--
Protection of indoor air quality (slab on grade) #	0.0081	0.034	0.057	0.32
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	2.6	2.6	2.6	2.6

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for 1,2,4,5-Tetrachlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0053**	**0.029**	**0.055**	**0.3**
Human health guidelines				
Protection of indoor air quality (basement) #	0.0053	0.029	--	--
Protection of indoor air quality (slab on grade) #	0.0077	0.034	0.055	0.31 ES
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.3	0.3	0.3	0.3

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for Pentachlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.006**	**0.0068**	**0.006**	**0.0068**
Human health guidelines				
Protection of indoor air quality (basement) #	0.039	0.21	--	--
Protection of indoor air quality (slab on grade) #	0.056	0.24	0.4	NRG
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.006	0.0068	0.006	0.0068
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.42	0.42	0.42	0.42

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Degradation note

Potential degradation products include D1 = 1,2,3,5-tetrachlorobenzene, D3 = 1,3,5-TCB and D4 = 1,3-dichlorobenzene. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by PCB. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for Hexachlorobenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00052**	**0.00052**	**0.00052**	**0.00052**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.00052	0.00052	0.00052	0.00052
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.0031	0.0031	0.0031	0.0031

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential degradation products include D1 = pentachlorobenzene, D2 = 1,2,3,5-tetrachlorobenzene, D3 = 1,3,5-TCB and D4 = 1,3-dichlorobenzene. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by HCB. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,2-Dichloroethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.005**	**0.005**	**0.005**	**0.005**
Guideline – 10^{-6} incremental risk (provisional*)	**0.005**	**0.005**	**0.005**	**0.005**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ♯	0.12	0.87	--	--
Protection of indoor air quality (slab on grade) ♯	0.15	0.93	0.34	2.6
Protection of potable water	0.005	0.005	0.005	0.005
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ♯	0.012	0.087	--	--
Protection of indoor air quality (slab on grade) ♯	0.015	0.093	0.034	0.26
Protection of potable water	0.005	0.005	0.005	0.005
Environmental health guidelines				
Protection of freshwater life	0.1	0.1	0.1	0.1
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.005	0.005	0.005	0.005
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	4300	4300	4300	4300

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

#: Risk-specific concentration (RsC) extrapolated from risk-specific dose (RsD).

Degradation note

The possible degradation product is D1 = chloroethane. Consideration of this additional degradation product is necessary when evaluating site groundwater quality impacted by 1,2-dichloroethane. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,1,1-Trichloroethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**1.3**	**8.8**	**13**	**95**
Human health guidelines				
Protection of indoor air quality (basement)	1.3	8.8	--	--
Protection of indoor air quality (slab on grade)	1.7	9.6	13	95
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	650	650	650	650

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

D1 = 1,1-dichloroethene, D2 = chloroethane produced under anaerobic conditions. Alternatively, abiotic degradation may result in D1 = 1,1-dichloroethene and subsequent D2 = vinyl chloride under anaerobic conditions. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,1,1-trichloroethane. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,1,2,2-Tetrachloroethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.18**	**1.1**	**0.51**	**3.3**
Guideline – 10^{-6} incremental risk (provisional*)	**0.018**	**0.11**	**0.051**	**0.33**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ◊	0.18	1.1	--	--
Protection of indoor air quality (slab on grade) ◊	0.24	1.2	0.51	3.3
Protection of potable water	NA	NA	NA	NA
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ◊	0.018	0.11	--	--
Protection of indoor air quality (slab on grade) ◊	0.024	0.12	0.051	0.33
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	1400	1400	1400	1400

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

D1 = 1,1,2-trichloroethane, D2 = 1,2-dichloroethane, D3 = chloroethane. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,1,2,2-tetrachloroethane. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,1,2-Trichloroethene (TCE) (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.00037** ‡	**0.0027**	**0.0039**	**0.005**
Guideline – 10^{-6} incremental risk (provisional*)	**0.00037** ‡	**0.0027**	**0.0022**	**0.005**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ◊	0.00037 ♦	0.0027 ♦	--	--
Protection of indoor air quality (slab on grade) ◊	0.00047 ♦	0.0029 ♦	0.0039 ♦	0.029 ♦
Protection of potable water	0.005	0.005	0.005	0.005
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ◊	0.00037 ♦	0.0027 ♦	--	--
Protection of indoor air quality (slab on grade) ◊	0.00047 ♦	0.0029 ♦	0.0022	0.016
Protection of potable water	0.005	0.005	0.005	0.005
Environmental health guidelines				
Protection of freshwater life	0.028	0.25	0.028	0.25
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.05	0.05	0.05	0.05
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	5.6	5	5.6	5
Management considerations				
Water solubility (50%)	640	640	640	640

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

♦ Presented value is based on the non-carcinogenic risk.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

Degradation note

D1 = dichloroethylene, D2 = vinyl chloride. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,1,2-trichloroethene (TCE). The concentrations of D1 and the parent compound should not exceed 10 times the vinyl chloride risk based guideline. See OMOE (2011) for more details. (Note: D stands for the order of degradation products.)

Groundwater Quality Guidelines for 1,1,2,2-Tetrachloroethene (PCE) (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.0079**	**0.01**	**0.01**	**0.01**
Guideline – 10^{-6} incremental risk (provisional*)	**0.00079**	**0.0062**	**0.0023**	**0.01**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ◊	0.0079 #	0.06 ♦	--	--
Protection of indoor air quality (slab on grade) ◊	0.0097 #	0.065 #	0.023 ♦	0.18 #
Protection of potable water	0.01	0.01	0.01	0.01
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ◊	0.00079 #	0.0062 #	--	--
Protection of indoor air quality (slab on grade) ◊	0.00097 #	0.0065 #	0.0023 ♦	0.018 #
Protection of potable water	0.01	0.01	0.01	0.01
Environmental health guidelines				
Protection of freshwater life	0.11	0.11	0.11	0.11
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	100	100	100	100

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

♦ Presented value is based on the non-carcinogenic risk.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

D1 = 1,1-trichloroethene, D2 = cis-1,2-dichloroethene and/or trans 1,2-dichloroethene and/or 1,1-dichloroethene, D3 = vinyl chloride produced under anaerobic conditions. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by 1,1,2,2-tetrachloroethene. The concentrations of D1 and D2 and the parent compound should not exceed 10 times the vinyl chloride risk based guideline. (Note: D stands for the order of degradation products.)

PCE guideline is capped at 10 times the corresponding guideline value derived for vinyl chloride. For rationale, see section 7.13 of OMOE (2011).

Groundwater Quality Guidelines for 2-Chlorophenol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.007**	**0.007**	**0.007**	**0.007**
Human health guidelines				
Protection of indoor air quality (basement)	6.5	45	--	--
Protection of indoor air quality (slab on grade)	8.4	48	68	480
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.007	0.007	0.007	0.007
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	5700	5700	5700	5700

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for 2,4-Dichlorophenol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0002**	**0.0002**	**0.0002**	**0.0002**
Human health guidelines				
Protection of indoor air quality (basement) #	420	2600 ES	--	--
Protection of indoor air quality (slab on grade) #	570	2800 ES	4400 ES	NRG
Protection of potable water	0.0003	0.0003	0.0003	0.0003
Environmental health guidelines				
Protection of freshwater life	0.0002	0.0002	0.0002	0.0002
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	2300	2300	2300	2300

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for 2,4,6-Trichlorophenol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.002**	**0.002**	**0.002**	**0.002**
Guideline – 10^{-6} incremental risk (provisional*)	**0.002**	**0.002**	**0.002**	**0.002**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ♯	50	250	--	--
Protection of indoor air quality (slab on grade) ♯	72	270	140	740[ES]
Protection of potable water	0.002	0.002	0.002	0.002
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ♯	5	25	--	--
Protection of indoor air quality (slab on grade) ♯	7.2	27	14	74
Protection of potable water	0.002	0.002	0.002	0.002
Environmental health guidelines				
Protection of freshwater life	0.018	0.018	0.018	0.018
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	400	400	400	400

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

♯: Risk-specific concentration (RsC) extrapolated from risk-specific dose (RsD).

Groundwater Quality Guidelines for 2,3,4,6-Tetrachlorophenol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.001**	**0.001**	**0.001**	**0.001**
Human health guidelines				
Protection of indoor air quality (basement) #	NRG	NRG	--	--
Protection of indoor air quality (slab on grade) #	NRG	NRG	NRG	NRG
Protection of potable water	0.001	0.001	0.001	0.001
Environmental health guidelines				
Protection of freshwater life §	0.001	0.001	0.001	0.001
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	12	12	12	12

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

§ Guideline values are applicable to fine and coarse textured sites at all groundwater pHs. For sites with fine-textured soils and groundwater pH < 5.6, site-specific remediation objectives using pH-specific K_{oc} values may result in slightly higher values than the generic guideline.

Groundwater Quality Guidelines for Pentachlorophenol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0005**	**0.0005**	**0.0005**	**0.0005**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.03	0.03	0.03	0.03
Environmental health guidelines				
Protection of freshwater life §	0.0005	0.0005	0.0005	0.0005
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NRG	NRG	NRG	NRG
Management considerations				
Water solubility (50%)	7	7	7	7

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

§ Guideline values are applicable to fine and coarse textured sites at all groundwater pHs. For sites with fine-textured soils and groundwater pH < 5.8, site-specific remediation objectives using pH-specific K_{oc} values may result in slightly higher values than the generic guideline.

Groundwater Quality Guidelines for Captan (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0013**	**0.0013**	**0.0013**	**0.0013**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0013	0.0013	0.0013	0.0013
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.013	0.013	0.013	0.013
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	2.6	2.6	2.6	2.6

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Carbaryl (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.0002**	**0.0002**	**0.0002**	**0.0002**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.09	0.09	0.09	0.09
Environmental health guidelines				
Protection of freshwater life	0.0002	0.0002	0.0002	0.0002
Protection of marine life	0.00029	0.00029	0.00029	0.00029
Protection of livestock watering	1.1	1.1	1.1	1.1
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	55	55	55	55

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

Degradation note

Potentially degraded to 1-naphthol and methylamine under anaerobic conditions. Consideration of these additional degradation products is potentially necessary when evaluating site groundwater quality impacted by carbaryl.

Groundwater Quality Guidelines for Carbofuran (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0018**	**0.0018**	**0.0018**	**0.0018**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.09	0.09	0.09	0.09
Environmental health guidelines				
Protection of freshwater life	0.0018	0.0018	0.0018	0.0018
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.045	0.045	0.045	0.045
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	160	160	160	160

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potentially degraded to 3-hydroxy and 3-keto carbofuran. Consideration of these additional degradation products is potentially necessary when evaluating site groundwater quality impacted by carbofuran.

Groundwater Quality Guidelines for Chlorothalonil (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00018**	**0.00018**	**0.00018**	**0.00018**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.00018	0.00018	0.00018	0.00018
Protection of marine life	0.00036	0.00036	0.00036	0.00036
Protection of livestock watering	0.17	0.17	0.17	0.17
Protection of irrigation water	0.0058	0.0058	0.0058	0.0058
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.41	0.41	0.41	0.41

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Chlorpyrifos (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.000002 ‡**	**0.0000053**	**0.000002 ‡**	**0.0000053**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.09	0.09	0.09	0.09
Environmental health guidelines				
Protection of freshwater life	0.000002	0.0000053	0.000002	0.0000053
Protection of marine life	0.000002	0.0000053	0.000002	0.0000053
Protection of livestock watering	0.024	0.024	0.024	0.024
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.56	0.56	0.56	0.56

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

Groundwater Quality Guidelines for Cyanazine (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0005**	**0.0005**	**0.0005**	**0.0005**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water §	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.002	0.002	0.002	0.002
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.01	0.01	0.01	0.01
Protection of irrigation water	0.0005	0.0005	0.0005	0.0005
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	85	85	85	85

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§ The Guideline for Canadian Drinking Water Quality for cyanazine has been withdrawn. If the substance is detected in groundwater which is used (or may be used) as a source of drinking water, Health Canada should be contacted for guidance.

Groundwater Quality Guidelines for Deltamethrin (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0000023**	**0.001**	**0.0000023**	**0.001**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0000023	NRG	0.0000023	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.0025 ES	0.0025 ES	0.0025 ES	0.0025 ES
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.001	0.001	0.001	0.001

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Groundwater Quality Guidelines for Dicamba (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000006**	**0.000006**	**0.000006**	**0.000006**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.12	0.12	0.12	0.12
Environmental health guidelines				
Protection of freshwater life	0.01	0.01	0.01	0.01
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.12	0.12	0.12	0.12
Protection of irrigation water	0.000006	0.000006	0.000006	0.000006
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	4200	4200	4200	4200

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for DDT (total §) (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0028**	**0.0028**	**0.0028**	**0.0028**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NRG	NRG	NRG	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.03 ES	0.03 ES	0.03 ES	0.03 ES
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	0.003 ES	0.003 ES	0.003 ES	0.003 ES
Management considerations				
Water solubility (50%)	0.0028	0.0028	0.0028	0.0028

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

§ Total DDT = sum of the concentrations of *p,p'*-DDT, *o,p'*-DDT, *p,p'*-DDE, *o,p'*-DDE, *p,p'*-DDD and *o,p'*-DDD.

Degradation note

DDT isomers are degraded or metabolized to DDE and DDD in the environment.

Groundwater Quality Guidelines for Diclofop-methyl (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00018**	**0.00018**	**0.00018**	**0.00018**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.009	0.009	0.009	0.009
Environmental health guidelines				
Protection of freshwater life	0.0061	0.0062	0.0061	0.0062
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.009	0.009	0.009	0.009
Protection of irrigation water	0.00018	0.00018	0.00018	0.00018
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.4	0.4	0.4	0.4

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Didecyl dimethyl ammonium chloride (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**350**	**350**	**350**	**350**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NRG	NRG	NRG	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	350	350	350	350

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Diisopropanolamine (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**1.6**	**1.6**	**1.6**	**1.6**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water §	4	4	4	4
Environmental health guidelines				
Protection of freshwater life	1.6	1.6	1.6	1.6
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	2	2	2	2
Groundwater contact by soil-dependent organisms	160	160	160	160
Management considerations				
Water solubility (50%)	440000	440000	440000	440000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§ This guideline is considered provisional because there was no Guideline for Canadian Drinking Water Quality. As a substitute, a Source Guidance Value for Groundwater was developed during the derivation of the Canadian Soil Quality Guideline for diisopropanolamine. The values are presented for users to consider applying at their own discretion.

Groundwater Quality Guidelines for Dimethoate (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.003**	**0.003**	**0.003**	**0.003**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.02	0.02	0.02	0.02
Environmental health guidelines				
Protection of freshwater life	0.0062	0.0062	0.0062	0.0062
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.003	0.003	0.003	0.003
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	12000	12000	12000	12000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Dinoseb (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00005**	**0.000062**	**0.00005**	**0.000062**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water §	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.00005	0.000062	0.00005	0.000062
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.15	0.15	0.15	0.15
Protection of irrigation water	0.016	0.016	0.016	0.016
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	26	26	26	26

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§: The Guideline for Canadian Drinking Water Quality for dinoseb has been withdrawn. If the substance is detected in groundwater which is used (or may be used) as a source of drinking water, Health Canada should be contacted for guidance.

Groundwater Quality Guidelines for Endosulfan (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000002 ML**	**0.0000045 ML**	**0.000002 ML**	**0.0000045 ML**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000003	0.0000068	0.000003	0.0000068
Protection of marine life	0.000002	0.0000045	0.000002	0.0000045
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.16	0.16	0.16	0.16

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

ML: Final guideline is based on the protection of marine life pathway. If no marine water bodies are present, users may wish to conduct a Tier 2 evaluation.

Degradation note

Potential degradation products include endosulfan sulfate. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by endosulfan.

Groundwater Quality Guidelines for Ethylbenzene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.0016 ‡**	**0.0016 ‡**	**0.0016 ‡**	**0.0016 ‡**
Human health guidelines				
Protection of indoor air quality (basement)	7	50	--	--
Protection of indoor air quality (slab on grade)	9	54	74	NRG
Protection of potable water	0.0016	0.0016	0.0016	0.0016
Environmental health guidelines				
Protection of freshwater life	42	NRG	42	NRG
Protection of marine life	12	NRG	12	NRG
Protection of livestock watering	0.0024	0.0024	0.0024	0.0024
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	20	42	20	42
Management considerations				
Water solubility (50%)	85	85	85	85

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

Groundwater Quality Guidelines for Ethylene glycol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**190**	**190**	**190**	**190**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	190	190	190	190
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	16000	9200	16000	9200
Management considerations				
Water solubility (50%)	500000	500000	500000	500000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Glyphosate (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.28**	**0.28**	**0.28**	**0.28**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.28	0.28	0.28	0.28
Environmental health guidelines				
Protection of freshwater life	0.8	0.81	0.8	0.81
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.28	0.28	0.28	0.28
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	5800	5800	5800	5800

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final Guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential degradation product includes aminomethylphosphonic acid. Consideration of this additional degradation product is potentially necessary when evaluating site groundwater quality impacted by glyphosate.

Groundwater Quality Guidelines for Dichloromethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.05**	**0.05**	**0.05**	**0.05**
Guideline – 10^{-6} incremental risk (provisional*)	**0.05**	**0.05**	**0.05**	**0.05**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) #◊	0.12 ♦	0.94 ♦	--	--
Protection of indoor air quality (slab on grade) #◊	0.15 ♦	0.99 ♦	1.3 ♦	10 ♦
Protection of potable water	0.05	0.05	0.05	0.05
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) #◊	0.12 ♦	0.94 ♦	--	--
Protection of indoor air quality (slab on grade) #◊	0.15 ♦	0.99 ♦	0.88	6.8
Protection of potable water	0.05	0.05	0.05	0.05
Environmental health guidelines				
Protection of freshwater life	0.098	0.098	0.098	0.098
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.05	0.05	0.05	0.05
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	6500	6500	6500	6500

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

♦ Presented value is based on the non-carcinogenic risk.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for Trichloromethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.0018**	**0.0018**	**0.0018**	**0.0018**
Guideline – 10^{-6} incremental risk (provisional*)	**0.0018**	**0.0018**	**0.0018**	**0.0018**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ◊	0.022 ♦	0.16 ♦	--	--
Protection of indoor air quality (slab on grade) ◊	0.028 ♦	0.17 ♦	0.089	0.65
Protection of potable water §	0.1	0.1	0.1	0.1
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ◊	0.0031	0.022	--	--
Protection of indoor air quality (slab on grade) ◊	0.0039	0.024	0.0089	0.065
Protection of potable water §	0.1	0.1	0.1	0.1
Environmental health guidelines				
Protection of freshwater life	0.0018	0.0018	0.0018	0.0018
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.1	0.1	0.1	0.1
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	4000	4000	4000	4000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

♦ Presented value is based on the non-carcinogenic risk.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§ This value is for trihalomethanes (THMs) and refers to the total of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform); the total sum of bromodichloromethane, dibromochloromethane, tribromomethane and trichloromethane concentrations should not exceed 0.1 mg/L.

Groundwater Quality Guidelines for Tetrachloromethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00013 ‡**	**0.00087**	**0.0014**	**0.002**
Human health guidelines				
Protection of indoor air quality (basement) #	0.00013	0.00087	--	--
Protection of indoor air quality (slab on grade) #	0.00017	0.00095	0.0014	0.0094
Protection of potable water	0.002	0.002	0.002	0.002
Environmental health guidelines				
Protection of freshwater life	0.013	0.013	0.013	0.013
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.005	0.005	0.005	0.005
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	400	400	400	400

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for Bromodichloromethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.01**	**0.067**	**0.029**	**0.1**
Guideline – 10^{-6} incremental risk (provisional*)	**0.001**	**0.0067**	**0.0029**	**0.02**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement) ◊	0.01	0.067	--	--
Protection of indoor air quality (slab on grade) ◊	0.013	0.073	0.029	0.2
Protection of potable water §	0.1	0.1	0.1	0.1
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement) ◊	0.001	0.0067	--	--
Protection of indoor air quality (slab on grade) ◊	0.0013	0.0073	0.0029	0.02
Protection of potable water §	0.1	0.1	0.1	0.1
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.1	0.1	0.1	0.1
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	1500	1500	1500	1500

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

◊ Value represents the lowest of either carcinogenic or non-carcinogenic guidelines.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§ This value is for trihalomethanes (THMs) and refers to the total of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform); the total sum of bromodichloromethane, dibromochloromethane, tribromomethane and trichloromethane concentrations should not exceed 0.1 mg/L.

Groundwater Quality Guidelines for Dibromochloromethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.1**	**0.1**	**0.1**	**0.1**
Human health guidelines				
Protection of indoor air quality (basement)	0.33	1.9	--	--
Protection of indoor air quality (slab on grade)	0.46	2.1	3.4	20
Protection of potable water §	0.1	0.1	0.1	0.1
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.1	0.1	0.1	0.1
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	1400	1400	1400	1400

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§ This value is for trihalomethanes (THMs) and refers to the total of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform); the total sum of bromodichloromethane, dibromochloromethane, tribromomethane and trichloromethane concentrations should not exceed 0.1 mg/L.

Groundwater Quality Guidelines for Tribromomethane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.1**	**0.1**	**0.1**	**0.1**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water §	0.1	0.1	0.1	0.1
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.1	0.1	0.1	0.1
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	1600	1600	1600	1600

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§ This value is for trihalomethanes (THMs) and refers to the total of bromodichloromethane, dibromochloromethane, tribromomethane (bromoform) and trichloromethane (chloroform); the total sum of bromodichloromethane, dibromochloromethane, tribromomethane and trichloromethane concentrations should not exceed 0.1 mg/L.

Groundwater Quality Guidelines for n-Hexane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.024**	**0.14**	**0.13**	**0.14**
Human health guidelines				
Protection of indoor air quality (basement)	0.024	0.2	--	--
Protection of indoor air quality (slab on grade)	0.027	0.21	0.26	2
Protection of potable water §	0.23	0.23	0.23	0.23
Environmental health guidelines				
Protection of freshwater life	0.13	0.14	0.13	0.14
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	4.8	4.8	4.8	4.8

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

§ This guideline is considered provisional because there was no Guideline for Canadian Drinking Water Quality. As a substitute, a Source Guidance Value for Groundwater was developed during the derivation of the Canadian Soil Quality Guideline for n-hexane. The values are presented for users to consider applying at their own discretion.

Groundwater Quality Guidelines for 3-Iodo-2-propynyl butyl carbamate (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0019**	**0.0019**	**0.0019**	**0.0019**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0019	0.0019	0.0019	0.0019
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	220	220	220	220

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential aerobic degradation product is propargyl butyl carbamate (PBC). Consideration of this additional degradation product is potentially necessary when evaluating site groundwater quality impacted by IPBC.

Groundwater Quality Guidelines for Heptachlor + heptachlor epoxide (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000014**	**0.003**	**0.000014**	**0.003**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000014	NRG	0.000014	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.003	0.003	0.003	0.003
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.09	0.09	0.09	0.09

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Hexachlorobutadiene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0013**	**0.0013**	**0.0013**	**0.0013**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0013	0.0013	0.0013	0.0013
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	1.6	1.6	1.6	1.6

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Hexachlorocyclohexane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00001**	**0.00001**	**0.00001**	**0.00001**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.00001	0.00001	0.00001	0.00001
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.004	0.004	0.004	0.004
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	3.7	3.7	3.7	3.7

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential degradation products include 1,2,3,5-tetrachlorbenzene and alpha HCH. Consideration of these additional degradation products is necessary when evaluating site groundwater quality impacted by gamma-HCH.

Groundwater Quality Guidelines for Imidacloprid (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00023**	**0.00023**	**0.00023**	**0.00023**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.00023	0.00023	0.00023	0.00023
Protection of marine life	0.00065	0.00065	0.00065	0.00065
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	260	260	260	260

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Linuron (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000071**	**0.000071**	**0.000071**	**0.000071**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.007	0.007	0.007	0.007
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	0.000071	0.000071	0.000071	0.000071
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	38	38	38	38

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Methanol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**19**	**19**	**19**	**19**
Human health guidelines				
Protection of indoor air quality (basement)	20000	160000	--	--
Protection of indoor air quality (slab on grade)	23000	170000	210000	NRG
Protection of potable water §	19	19	19	19
Environmental health guidelines				
Protection of freshwater life	32	630	32	630
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	17000	9900	17000	9900
Management considerations				
Water solubility (50%)	500000	500000	500000	500000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis. In addition, take note that the provisional guideline for the protection of potable water forms the basis of the final guidelines. See footnote § for more details.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

§ This guideline is considered provisional because there was no Guideline for Canadian Drinking Water Quality. As a substitute, a Source Guidance Value for Groundwater was developed during the derivation of the Canadian Soil Quality Guideline for methanol. The values are presented for users to consider applying at their own discretion.

Groundwater Quality Guidelines for Methoprene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00009**	**0.00019**	**0.00009**	**0.00019**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.00009	0.00019	0.00009	0.00019
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.7	0.7	0.7	0.7

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Methyl tertiary-butyl ether (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.015**	**0.015**	**0.015**	**0.015**
Human health guidelines				
Protection of indoor air quality (basement)	0.31	2.2	--	--
Protection of indoor air quality (slab on grade)	0.4	2.4	3.3	24
Protection of potable water	0.015	0.015	0.015	0.015
Environmental health guidelines				
Protection of freshwater life	10	10	10	10
Protection of marine life	5	5	5	5
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	26000	26000	26000	26000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

Groundwater Quality Guidelines for Methylchlorophenoxyacetic acid (2-methyl-4-chlorophenoxyacetic acid) (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.000025**	**0.000025**	**0.000025**	**0.000025**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.1	0.1	0.1	0.1
Environmental health guidelines				
Protection of freshwater life	0.0026	0.0026	0.0026	0.0026
Protection of marine life	0.0042	0.0042	0.0042	0.0042
Protection of livestock watering	0.025	0.025	0.025	0.025
Protection of irrigation water	0.000025	0.000025	0.000025	0.000025
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	320	320	320	320

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

Groundwater Quality Guidelines for Methylmercury (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000004**	**0.0000047**	**0.000004**	**0.0000047**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000004	0.0000047	0.000004	0.0000047
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	16000	16000	16000	16000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for 2-Methylnaphthalene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.15**	**0.95**	**1.5**	**10**
Human health guidelines				
Protection of indoor air quality (basement) #	0.15	0.95	--	--
Protection of indoor air quality (slab on grade) #	0.2	1	1.5	10
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	12	12	12	12

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for Metolachlor (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0078**	**0.0078**	**0.0078**	**0.0078**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.05	0.05	0.05	0.05
Environmental health guidelines				
Protection of freshwater life	0.0078	0.0078	0.0078	0.0078
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.05	0.05	0.05	0.05
Protection of irrigation water	0.028	0.028	0.028	0.028
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	270	270	270	270

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential degradation products include sulfonic and oxanilic acids of metolachlor. Consideration of these additional degradation products is potentially necessary when evaluating site groundwater quality impacted by metolachlor.

Groundwater Quality Guidelines for Metribuzin (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0005**	**0.0005**	**0.0005**	**0.0005**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.08	0.08	0.08	0.08
Environmental health guidelines				
Protection of freshwater life	0.001	0.001	0.001	0.001
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.08	0.08	0.08	0.08
Protection of irrigation water	0.0005	0.0005	0.0005	0.0005
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	530	530	530	530

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Nonylphenol and its ethoxylates (mg TEQ/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline § (provisional*)	**0.0081**	**0.0081**	**0.0081**	**0.0081**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.092	NRG	0.092	NRG
Protection of marine life	0.065	NRG	0.065	NRG
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	0.0081	0.0081	0.0081	0.0081
Management considerations				
Water solubility (50%)	2.7	2.7	2.7	2.7

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

§ Expressed on a toxic equivalency (TEQ) basis using toxic equivalency factors (TEFs). See water or soil guideline factsheets, or NP+E supporting document (EC 2002) for details.

Groundwater Quality Guidelines for Tributyltin (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000001** ML	**0.000014** ML	**0.000001** ML	**0.000014** ML
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000008	0.00011	0.000008	0.00011
Protection of marine life	0.000001	0.000014	0.000001	0.000014
Protection of livestock watering	0.25	0.25	0.25	0.25
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	8.5	8.5	8.5	8.5

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

ML: Final guideline is based on the protection of marine life pathway. If no marine water bodies are present, users may wish to conduct a Tier 2 evaluation.

Groundwater Quality Guidelines for Triphenyltin (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.069**	**0.069**	**0.069**	**0.069**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NRG	NRG	NRG	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.82[ES]	0.82[ES]	0.82[ES]	0.82[ES]
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.069	0.069	0.069	0.069

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Groundwater Quality Guidelines for Permethrin (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000014** [ML]	**0.003**	**0.000014** [ML]	**0.003**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000055	NRG	0.000055	NRG
Protection of marine life	0.000014	NRG	0.000014	NRG
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.003	0.003	0.003	0.003

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

ML: Final guideline is based on the protection of marine life pathway. If no marine water bodies are present, users may wish to conduct a Tier 2 evaluation.

Groundwater Quality Guidelines for Petroleum hydrocarbon fraction F1 (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.2** ‡	**1.2**	**1.9**	**1.9**
Human health guidelines				
Protection of indoor air quality (basement)	0.2	1.2	--	--
Protection of indoor air quality (slab on grade)	0.27	1.4	2.1	13
Protection of potable water	2.4 ES	2.2 ES	2.4 ES	2.2 ES
Environmental health guidelines				
Protection of aquatic life	9.8 ES	NRG	9.8 ES	NRG
Protection of livestock watering	53 ES	53 ES	53 ES	53 ES
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	7 ES	6.5 ES	7 ES	6.5 ES
Management considerations				
Water solubility (50%)	1.9	1.9	1.9	1.9

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Petroleum hydrocarbon fraction F2 (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.18** ‡	**0.18** ‡	**0.18** ‡	**0.18** ‡
Human health guidelines				
Protection of indoor air quality (basement)	0.4 ES	2.4 ES	--	--
Protection of indoor air quality (slab on grade)	0.5 ES	2.7 ES	4 ES	26 ES
Protection of potable water	1.1 ES	1.1 ES	1.1 ES	1.1 ES
Environmental health guidelines				
Protection of aquatic life	1.3 ES	NRG	1.3 ES	NRG
Protection of livestock watering	49 ES	49 ES	49 ES	49 ES
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	1.8 ES	1.8 ES	1.8 ES	1.8 ES
Management considerations				
Water solubility (50%)	0.18	0.18	0.18	0.18

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Phenol (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.002**	**0.002**	**0.002**	**0.002**
Human health guidelines				
Protection of indoor air quality (basement) #	2100	15000	--	--
Protection of indoor air quality (slab on grade) #	2700	15000	23000	NRG
Protection of potable water §	0.56	0.56	0.56	0.56
Environmental health guidelines				
Protection of freshwater life	0.004	0.004	0.004	0.004
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.002	0.002	0.002	0.002
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	150	110	150	110
Management considerations				
Water solubility (50%)	41000	41000	41000	41000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

§ This guideline is considered provisional because there was no Guideline for Canadian Drinking Water Quality. As a substitute, a Source Guidance Value for Groundwater was developed during the derivation of the Canadian Soil Quality Guideline for phenol. The values are presented for users to consider applying at their own discretion.

Groundwater Quality Guidelines for Phenoxy herbicides (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.004**	**0.004**	**0.004**	**0.004**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.1	0.1	0.1	0.1
Environmental health guidelines				
Protection of freshwater life	0.004	0.004	0.004	0.004
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.1	0.1	0.1	0.1
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	340	340	340	340

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

The potential degradation product consists of 2,4-dichlorophenol. Consideration of this additional degradation product is potentially necessary when evaluating site groundwater quality impacted by 2,4-D.

Groundwater Quality Guidelines for Di-*n*-butyl phthalate (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.019**	**0.019**	**0.019**	**0.019**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.019	0.019	0.019	0.019
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	5.6	5.6	5.6	5.6

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Di(2-ethylhexyl) phthalate (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.14**	**0.14**	**0.14**	**0.14**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NRG	NRG	NRG	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.14	0.14	0.14	0.14

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Acenaphthene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0058**	**0.006**	**0.0058**	**0.006**
Human health guidelines				
Protection of indoor air quality (basement)	NRG	NRG	--	--
Protection of indoor air quality (slab on grade)	NRG	NRG	NRG	NRG
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0058	0.006	0.0058	0.006
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	2	2	2	2

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Anthracene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000012**	**0.0034**	**0.000012**	**0.0034**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000012	0.0034	0.000012	0.0034
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	0.025 ES	0.025 ES	0.025 ES	0.025 ES
Management considerations				
Water solubility (50%)	0.023	0.023	0.023	0.023

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Groundwater Quality Guidelines for Benz(a)anthracene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0047**	**0.0047**	**0.0047**	**0.0047**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	NRG	NRG	NRG	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.0047	0.0047	0.0047	0.0047

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Benzo(a)pyrene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00004**	**0.00004**	**0.00004**	**0.00004**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.00004	0.00004	0.00004	0.00004
Environmental health guidelines				
Protection of freshwater life	NRG	NRG	NRG	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NRG	NRG	NRG	NRG
Management considerations				
Water solubility (50%)	0.0008	0.0008	0.0008	0.0008

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Carcinogenic PAHs (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**00004 B[a]P TPE***	**0.00004 B[a]P TPE***	**0.00004 B[a]P TPE***	**0.00004 B[a]P TPE***
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.00004 B[a]P TPE*	0.00004 B[a]P TPE*	0.00004 B[a]P TPE*	0.00004 B[a]P TPE*
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NC	NC	NC	NC
Protection of irrigation water	NC	NC	NC	NC
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	NC	NC	NC	NC

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

*B[a]P TPE = Benzo[a]pyrene Total Potency Equivalents (TPE), which is the sum of estimated cancer potency relative to B[a]P for all potentially carcinogenic unsubstituted polycyclic aromatic hydrocarbons (PAHs). The B[a]P TPE for a groundwater sample is calculated by multiplying the concentration of each PAH in the sample by its B[a]P Potency Equivalence Factor (PEF), given below, and summing the products. See CCME (2010b) for more guidance.

B[a]P Potency Equivalence Factors:

Benz[a]anthracene	0.1
Benzo[a]pyrene	1
Benzo[b+j+k]fluoranthene	0.1
Benzo[g,h,i]perylene	0.01
Chrysene	0.01
Dibenz[a,h]anthracene	1
Indeno[1,2,3-c,d]pyrene	0.1

Groundwater Quality Guidelines for Fluoranthene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000057**	**0.13**	**0.000057**	**0.13**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000057	NRG	0.000057	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	0.24 ES	0.24 ES	0.24 ES	0.24 ES
Management considerations				
Water solubility (50%)	0.13	0.13	0.13	0.13

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Groundwater Quality Guidelines for Fluorene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.003**	**0.0042**	**0.003**	**0.0042**
Human health guidelines				
Protection of indoor air quality (basement) #	NRG	NRG	--	--
Protection of indoor air quality (slab on grade) #	NRG	NRG	NRG	NRG
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.003	0.0042	0.003	0.0042
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.95	0.95	0.95	0.95

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

#: Tolerable concentration (TC) extrapolated from tolerable daily intake (TDI).

Groundwater Quality Guidelines for Naphthalene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0011**	**0.0011**	**0.0011**	**0.0011**
Human health guidelines				
Protection of indoor air quality (basement)	0.12	0.78	--	--
Protection of indoor air quality (slab on grade)	0.15	0.85	1.2	8.4
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0011	0.0011	0.0011	0.0011
Protection of marine life	0.0014	0.0014	0.0014	0.0014
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	0.17	0.16	0.17	0.16
Management considerations				
Water solubility (50%)	16	16	16	16

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.
* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Phenanthrene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0004**	**0.00087**	**0.0004**	**0.00087**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0004	0.00087	0.0004	0.00087
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.58	0.58	0.58	0.58

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Pyrene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000093**	**0.068**	**0.000093**	**0.068**
Human health guidelines				
Protection of indoor air quality (basement)	NRG	NRG	--	--
Protection of indoor air quality (slab on grade)	NRG	NRG	NRG	NRG
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000093	NRG	0.000093	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.068	0.068	0.068	0.068

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Picloram (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.029**	**0.029**	**0.029**	**0.029**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.19	0.19	0.19	0.19
Environmental health guidelines				
Protection of freshwater life	0.029	0.029	0.029	0.029
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.19	0.19	0.19	0.19
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	220	220	220	220

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Quinoline (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0034**	**0.0034**	**0.0034**	**0.0034**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0034	0.0034	0.0034	0.0034
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	3100	3100	3100	3100

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Simazine (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0005**	**0.0005**	**0.0005**	**0.0005**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.01	0.01	0.01	0.01
Environmental health guidelines				
Protection of freshwater life	0.01	0.01	0.01	0.01
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.01	0.01	0.01	0.01
Protection of irrigation water	0.0005	0.0005	0.0005	0.0005
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	3.1	3.1	3.1	3.1

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Degradation note

Potential degradation product includes monodeethylsimazine. Consideration of this additional degradation product is potentially necessary when evaluating site groundwater quality impacted by simazine.

Groundwater Quality Guidelines for Styrene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.072**	**0.072**	**0.072**	**0.072**
Human health guidelines				
Protection of indoor air quality (basement)	0.2	1.4	--	--
Protection of indoor air quality (slab on grade)	0.26	1.5	2.1	15
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.072	0.072	0.072	0.072
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	160	160	160	160

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Sulfolane (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.09 ‡**	**0.09 ‡**	**0.09 ‡**	**0.09 ‡**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water §	0.09	0.09	0.09	0.09
Environmental health guidelines				
Protection of freshwater life	50	50	50	50
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	0.5	0.5	0.5	0.5
Groundwater contact by soil-dependent organisms	2800	1700	2800	1700
Management considerations				
Water solubility (50%)	630000	630000	630000	630000

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis. In addition, take note that the provisional guideline for the protection of potable water forms the basis of the final guidelines. See footnote § for more details.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

§ This guideline is considered provisional because there was no guideline for Canadian drinking water quality. As a substitute, a source guidance value for groundwater was developed during the derivation of the Canadian Soil Quality Guideline for sulfolane. The values are presented for users to consider applying at their own discretion.

Groundwater Quality Guidelines for Tebuthiuron (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00027**	**0.00027**	**0.00027**	**0.00027**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.0016	0.0016	0.0016	0.0016
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.13	0.13	0.13	0.13
Protection of irrigation water	0.00027	0.00027	0.00027	0.00027
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	1300	1300	1300	1300

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Toluene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline	**0.024**	**0.024**	**0.024**	**0.024**
Human health guidelines				
Protection of indoor air quality (basement)	30	230	--	--
Protection of indoor air quality (slab on grade)	38	240	320 ES	NRG
Protection of potable water	0.024	0.024	0.024	0.024
Environmental health guidelines				
Protection of freshwater life	0.083	NRG	0.083	NRG
Protection of marine life	8.9	NRG	8.9	NRG
Protection of livestock watering	0.024	0.024	0.024	0.024
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	59	83	59	83
Management considerations				
Water solubility (50%)	260	260	260	260

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

ES: Exceedance of 1/2 aqueous solubility; a separate phase may be potentially present.

Groundwater Quality Guidelines for Toxaphene (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.000041 ‡**	**0.005**	**0.000041 ‡**	**0.005**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.000041	NRG	0.000041	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.005	0.005	0.005	0.005
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.37	0.37	0.37	0.37

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

Groundwater Quality Guidelines for Triallate (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.00024**	**0.00024**	**0.00024**	**0.00024**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	NA	NA	NA	NA
Environmental health guidelines				
Protection of freshwater life	0.00024	0.00024	0.00024	0.00024
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.23	0.23	0.23	0.23
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	2	2	2	2

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Trifluralin (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.0002**	**0.014**	**0.0002**	**0.014**
Human health guidelines				
Protection of indoor air quality (basement)	NC	NC	--	--
Protection of indoor air quality (slab on grade)	NC	NC	NC	NC
Protection of potable water	0.045	0.045	0.045	0.045
Environmental health guidelines				
Protection of freshwater life	0.0002	0.014	0.0002	0.014
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	0.045	0.045	0.045	0.045
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	0.092	0.092	0.092	0.092

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

Groundwater Quality Guidelines for Xylenes (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline (provisional*)	**0.02**	**0.02**	**0.02**	**0.02**
Human health guidelines				
Protection of indoor air quality (basement)	1.6	12	--	--
Protection of indoor air quality (slab on grade)	2.1	13	17	NRG
Protection of potable water	0.02	0.02	0.02	0.02
Environmental health guidelines				
Protection of freshwater life	18	NRG	18	NRG
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	31	21	31	21
Management considerations				
Water solubility (50%)	53	53	53	53

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

NRG = no recommended guideline. Calculated guideline > substance solubility or > 1,000,000 mg/L.

Groundwater Quality Guidelines for Vinyl chloride (mg/L)

	Land use and soil texture			
	Agricultural/Residential		Commercial/Industrial	
	Coarse	Fine	Coarse	Fine
Guideline – 10^{-5} incremental risk (provisional*)	**0.00079**	**0.002**	**0.002**	**0.002**
Guideline – 10^{-6} incremental risk (provisional*)	**0.000079** ‡	**0.00062**	**0.00023** ‡	**0.0018**
Human health guidelines – 10^{-5} incremental risk				
Protection of indoor air quality (basement)	0.00079	0.0062	--	--
Protection of indoor air quality (slab on grade)	0.00097	0.0065	0.0023	0.018
Protection of potable water	0.002	0.002	0.002	0.002
Human health guidelines – 10^{-6} incremental risk				
Protection of indoor air quality (basement)	0.000079	0.00062	--	--
Protection of indoor air quality (slab on grade)	0.000097	0.00065	0.00023	0.0018
Protection of potable water	0.002	0.002	0.002	0.002
Environmental health guidelines				
Protection of freshwater life	NC	NC	NC	NC
Protection of marine life	NC	NC	NC	NC
Protection of livestock watering	NA	NA	NA	NA
Protection of irrigation water	NA	NA	NA	NA
Groundwater contact by soil-dependent organisms	NC	NC	NC	NC
Management considerations				
Water solubility (50%)	4400	4400	4400	4400

Notes: NC = not calculated (due to insufficient data); NA = not available (no CCME or Health Canada benchmarks are available); -- = the pathway is not considered for the selected land use.

* Provisional guideline. Protection of potable water and protection of aquatic life (freshwater and marine) are considered to be required exposure pathways; if any of these guidelines are missing, the final guideline is considered to be provisional. Missing pathways should be addressed on a site-specific basis.

‡ Laboratories may not be able to reliably measure a concentration of this magnitude.

3.0 REFERENCES

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APPENDICES

CCME uses Domenico (1987) to model the movement of contaminants in groundwater to surface water bodies. At the time of publication (2015), the groundwater protocol used the time-dependent version of the model, with sufficiently long values of time since contaminant release to ensure that the calculated groundwater quality guideline for the protection of aquatic life, freshwater ($GWQG_{FL}$) and marine ($GWQL_{ML}$), represents a steady state condition. CCME has revised guideline development from steady state conditions to a fixed time ("t") of 500 years since release. The $GWQG_{FL}$ and $GWQL_{ML}$ presented in the tables of the Canadian Groundwater Quality Guidelines were calculated using a value of t = 500 years in equation A-3 of the groundwater protocol.

The rationale for this policy change is discussed below. Readers are encouraged to review the groundwater protocol description of the Domenico model (Part B section 4.3) and the time-dependent versus steady state considerations of the model (Part B section 4.3.1 and Appendix B page 49, Time at Which Groundwater Model is Evaluated).

Some contaminants adsorb strongly to surfaces of solids, resulting in very limited mobility and extremely long travel times in groundwater. Some highly retarded contaminants may take tens of thousands of years, in coarse textured soil, to hundreds of thousands of years, in fine textured soil, to travel the 10-m default CCME separation distance between contaminant source and surface water receptor. The time needed to reach steady state would take longer; steady state represents a worst case scenario where contaminants in a groundwater plume reaching the receptor have reached maximum, and stable, concentrations.

The policy change to a time-dependent model is a recognition that driving site clean-up based on potential risks posed by contaminated groundwater to receptors which are only expected to occur in the far future is not necessary for two main reasons. First, technological advances will likely provide more effective contaminant management, reducing the potential of an exceedance more than 500 years from now. Second, more attenuation will likely occur than estimated from the generic model and assumptions, primarily due to an underestimation of diffusion and biodegradation over long time scales.

Section 4.3.2 of the groundwater protocol states that "generic groundwater quality guidelines [for the protection of aquatic life] are intended to protect water quality at all future times." With the policy change to a time-dependent model, this is no longer true. Generic groundwater quality guidelines can only assure the protection of surface water receptors over a defined time period, i.e., 500 years since contaminant release.

Appendix B. Physical and Chemical Parameters

Chemicals	Henry's law constant[a,b,c]				Enthalpy of vaporization[d,e] at the normal boiling point ($\Delta H_{v,b}$) and at the average soil temperature ($\Delta H_{v,TS}$) of 15°C		
	H 25°C atm-m³/mol	Reference	H' 25°C unitless	H' 15°C unitless	$\Delta H_{v,b}$ cal/mol	Reference	$\Delta H_{v,TS}$ cal/mol
1,1,1-Trichloroethane	1.72E-02	ORNL 2015	7.03E-01	4.51E-01	7.44E+03	HC 2009	8.17E+03
1,1,2,2-Tetrachloroethene (PCE)	2.63E-02	HC 1996	1.07E+00	6.20E-01	8.88E+03	HC 2009	1.02E+04
1,1,2,2-Tetrachloroethane	3.67E-04	ORNL 2015	1.50E-02	7.89E-03	9.89E+03	HC 2009	1.15E+04
1,1,2-Trichloroethene (TCE)	8.78E-03	CCME 2007b	3.59E-01	2.21E-01	7.86E+03	HC 2009	8.88E+03
1,2,3,4-Tetrachlorobenzene	7.61E-04	ORNL 2015	3.11E-02	1.46E-02	1.06E+04	calculated using equations in DTSC 2001	1.35E+04
1,2,3,5-Tetrachlorobenzene	1.58E-03	ORNL 2015	6.46E-02	3.08E-02	1.04E+04	calculated using equations in DTSC 2001	1.32E+04
1,2,3-Trichlorobenzene	1.25E-03	ORNL 2015	5.11E-02	2.51E-02	1.02E+04	calculated using equations in DTSC 2001	1.27E+04
1,2,4,5-Tetrachlorobenzene	1.00E-03	ORNL 2015	4.09E-02	1.59E-02	1.32E+04	calculated using equations in DTSC 2001	1.68E+04
1,2,4-Trichlorobenzene	1.42E-03	ORNL 2015	5.81E-02	2.78E-02	1.05E+04	HC 2009	1.32E+04
1,2-Dichlorobenzene	1.92E-03	ORNL 2015	7.85E-02	4.11E-02	9.70E+03	HC 2009	1.16E+04
1,2-Dichloroethane	1.18E-03	ORNL 2015	4.82E-02	2.96E-02	8.03E+03	HC 2009	8.89E+03
1,3,5-Trichlorobenzene	1.89E-03	ORNL 2015	7.73E-02	3.96E-02	9.61E+03	calculated using equations in DTSC 2001	1.20E+04
1,3-Dichlorobenzene	2.64E-03	ORNL 2015		5.82E-02	9.23E+03	HC 2009	1.11E+04
1,4-Dichlorobenzene	2.41E-03	ORNL 2015	9.85E-02	5.29E-02	9.27E+03	HC 2009	1.12E+04
2-Methylnaphthalene	5.19E-04	ORNL 2015	2.12E-02	8.57E-03	1.25E+04	HC 2009	1.60E+04
3-Iodo-2-propynyl butyl carbamate	8.93E-09	ORNL 2015		-			-
Acenaphthene	1.55E-04	CCME 2010b	6.34E-03	2.56E-03	1.22E+04	HC 2009	1.61E+04
Acridine	3.96E-07	ORNL 2015		-			-
Aldicarb	1.44E-09	ORNL 2015		-			-
Aniline	2.02E-06	ORNL 2015	8.26E-05	3.68E-05	1.18E+04	HC 2009	1.44E+04
Anthracene	3.54E-05	CCME 2010b	1.45E-03	4.46E-04	1.57E+04	calculated using equations in DTSC 2001	2.07E+04
Atrazine	2.36E-09	ORNL 2015		-			-
Benzene	5.51E-03	EC 2005b	2.25E-01	1.42E-01	7.72E+03	HC 2009	8.48E+03
Benz(a)anthracene	3.35E-06	CCME 2010b	1.37E-04	3.68E-05	1.60E+04	OMOE 2011	2.30E+04
Benzo(a)pyrene	1.13E-06	CCME 2010b	4.62E-05	6.63E-06	1.90E+04	DTSC 2001	3.37E+04
Bromacil	1.29E-10	ORNL 2015		-			-
Bromodichloromethane	2.12E-03	ORNL 2015	8.67E-02	5.42E-02	7.80E+03	HC 2009	8.62E+03
Bromoxynil	1.32E-10	ORNL 2015		-			-
Captan	7.00E-09	ORNL 2015		-			-
Carbaryl	3.28E-09	ORNL 2015		-			-
Carbofuran	3.08E-09	ORNL 2015		-			-
Chlorothalonil	2.00E-06	ORNL 2015		-			-
Chlorpyrifos	2.94E-06	ORNL 2015		-			-
Cyanazine	2.57E-12	ORNL 2015		-			-

Appendix B. Physical and Chemical Parameters

Chemicals	Henry's law constant[a,b,c]				Enthalpy of vaporization[d,e] at the normal boiling point ($\Delta H_{v,b}$) and at the average soil temperature ($\Delta H_{v,TS}$) of 15°C		
	H 25°C atm-m³/mol	Reference	H' 25°C unitless	H' 15°C unitless	$\Delta H_{v,b}$ cal/mol	Reference	$\Delta H_{v,TS}$ cal/mol
Deltamethrin	4.99E-06	ORNL 2015		-			-
Di(2-ethylhexyl) phthalate	2.69E-07	ORNL 2015		-	2.54E+04	HC 2009	-
Dibromochloromethane	7.83E-04	ORNL 2015	3.20E-02	2.26E-02	5.90E+03	HC 2009	6.51E+03
Dicamba	2.18E-09	ORNL 2015		-	1.86E+04	HC 2009	-
DDT (total)	8.32E-06	ORNL 2015		5.54E-05	2.20E+04	DTSC 2001	3.15E+04
Dichloromethane	3.25E-03	ORNL 2015	1.33E-01	9.05E-02	6.88E+03	HC 2009	7.16E+03
2,4-Dichlorophenol	4.28E-06	ORNL 2015	1.75E-04	7.74E-05	1.16E+04	calculated using equations in DTSC 2001	1.45E+04
Diclofop-methyl	1.97E-06	ORNL 2015		-			-
Didecyl dimethyl ammonium chloride	6.85E-10	ORNL 2015		-			-
Dieldrin	4.09E-4	OMOE 2011		4.07E-03	1.70E+04	OMOE 2011	2.47E+04
Diisopropanolamine	1.72E-07	CCME 2006c		2.04E-06	1.71E+04	calculated using equations in DTSC 2001	2.17E+04
Dimethoate	2.43E-10	ORNL 2015		-			-
Di-*n*-butyl phthalate	1.81E-06	ORNL 2015	7.40E-05	-	2.23E+04	HC 2009	-
Dinoseb	4.55E-07	ORNL 2015		-			-
Endosulfan	6.51E-05	ORNL 2015		1.17E-03	1.40E+04	HC 2009	1.46E+04
Ethylbenzene	8.76E-03	EC 2005a	3.58E-01	1.95E-01	9.25E+03	HC 2009	1.10E+04
Ethylene glycol	6.00E-08	EC 1999c		1.04E-06	1.23E+04	calculated using equations in DTSC 2001	1.52E+04
F1-fraction				-			-
F1-Aliphatics C>8-C10	1.90E+00	CCME 2008	7.77E+01	8.04E+01			-
F1-Aliphatics C>6-C8	1.20E+00	CCME 2008	4.90E+01	5.07E+01			-
F1-Aromatics C>8-C10	1.20E-02	CCME 2008	4.90E-01	5.07E-01			-
F2-fraction				-			-
F2-Aliphatics C>10-C12	2.90E+00	CCME 2008	1.19E+02	1.23E+02			-
F2-Aliphatics C>12-C16	1.25E+01	CCME 2008	5.11E+02	5.29E+02			-
F2-Aromatics C>10-C12	3.40E-03	CCME 2008	1.39E-01	1.44E-01			-
F2-Aromatics C>12-C16	1.30E-03	CCME 2008	5.31E-02	5.50E-02			-
Fluoranthene	1.44E-05	CCME 2010b	5.89E-04	1.91E-04	1.38E+04	OMOE 2011	1.98E+04
Fluorene	7.96E-05	CCME 2010b	3.25E-03	1.31E-03	1.27E+04	HC 2009	1.61E+04
Glyphosate	2.10E-12	ORNL 2015		-			-
Heptachlor + heptachlor epoxide	2.94E-04	ORNL 2015		3.14E-03	1.75E+04	HC 2009	2.35E+04
Hexachlorobenzene	1.70E-03	ORNL 2015		-	1.44E+04	DTSC 2001	2.00E+04
Hexachlorobutadiene	1.03E-02	ORNL 2015		2.07E-01	1.02E+04	HC 2009	1.27E+04
Hexachlorocyclohexane	5.14E-06	ORNL 2015		6.36E-05	1.50E+04	OMOE 2011	2.10E+04
Imidacloprid	9.89E-13	CCME 2007a		-			-
Linuron	6.26E-09	ORNL 2015		-			-

Appendix B. Physical and Chemical Parameters

Chemicals	Henry's law constant[a,b,c]				Enthalpy of vaporization[d,e] at the normal boiling point ($\Delta H_{v,b}$) and at the average soil temperature ($\Delta H_{v,TS}$) of 15°C		
	H 25°C atm-m³/mol	Reference	H' 25°C unitless	H' 15°C unitless	$\Delta H_{v,b}$ cal/mol	Reference	$\Delta H_{v,TS}$ cal/mol
Methanol	4.60E-06	CCME 2017	1.88E-04	1.13E-04	8.37E+03	calculated using equations in DTSC 2001	9.23E+03
Methoprene	6.89E-06	ORNL 2016		-			-
Methyl tertiary-butyl ether	5.87E-04	ORNL 2015	2.40E-02	1.63E-02	6.68E+03	HC 2009	7.23E+03
Methylchlorophenoxyacetic acid (2-Methyl-4-chloro phenoxy acetic acid)	1.33E-09	ORNL 2015		-			-
Methylmercury	7.22E-03	OMOE 2011	2.95E-01	-			-
Metolachlor	9.00E-09	ORNL 2015		-			-
Metribuzin	1.17E-10	ORNL 2015		-			-
Monochlorobenzene	3.11E-03	ORNL 2015	1.27E-01	7.42E-02	8.41E+03	HC 2009	9.75E+03
2-chlorophenol	1.12E-05	ORNL 2015	4.58E-04	2.21E-04	1.07E+04	HC 2009	1.30E+04
Naphthalene	4.83E-04	CCME 2010b	1.97E-02	9.62E-03	1.04E+04	HC 2009	1.29E+04
n-Hexane	1.78E+00	CCME 2011	7.28E+01	3.14E+01	1.44E+04	HC 2009	1.49E+04
Nonylphenol	1.09E-04	EC 2002		1.50E-03	1.47E+04	calculated using equations in DTSC 2001	1.91E+04
Pentachlorobenzene	7.02E-04	ORNL 2015	2.87E-02	1.09E-02	1.33E+04	calculated using equations in DTSC 2001	1.72E+04
Pentachlorophenol	2.45E-08	ORNL 2015		2.74E-07	1.61E+04	DTSC 2001	2.27E+04
Permethrin	1.87E-06	ORNL 2015		-			-
Phenanthrene	2.33E-05	CCME 2010b		-			-
Phenol	3.97E-07	EC 1999b	1.62E-05	7.33E-06	1.16E+04	HC 2009	1.42E+04
Phenoxy herbicides	3.55E-08	ORNL 2015		-			-
Picloram	5.33E-14	ORNL 2015		-			-
Propylene glycol	1.29E-08	ORNL 2015		-			-
Pyrene	1.10E-05	CCME 2010b	4.50E-04	1.51E-04	1.44E+04	HC 2009	1.93E+04
Quinoline	1.67E-06	ORNL 2015		-			-
Simazine	9.42E-10	ORNL 2015		-			-
Styrene	3.01E-03	Gustafson et al. 1997	1.23E-01	6.40E-02	9.87E+03	HC 2009	1.17E+04
Sulfolane	8.90E-10	CCME 2006a		1.56E-08	1.16E+04	calculated using equations in DTSC 2001	1.50E+04
Tebuthiuron	1.20E-10	ORNL 2015		-			-
Tetrachloromethane	2.77E-02	ORNL 2015	1.13E+00	7.25E-01	7.45E+03	HC 2009	8.17E+03
2,3,4,6-Tetrachlorophenol	8.83E-06	ORNL 2015	3.61E-04	6.61E-05	2.46E+04	calculated using equations in DTSC 2001	2.96E+04
Toluene	6.70E-03	EC 2005a	2.74E-01	1.60E-01	8.51E+03	HC 2009	9.76E+03
Toxaphene	6.00E-06	ORNL 2015		-			-
Triallate	1.20E-05	ORNL 2015		-			-
Tribromomethane	5.36E-04	ORNL 2015		1.20E-02	9.48E+03	HC 2009	1.08E+04
Tributyltin	8.59E-03	ORNL 2015		-			-
Trichloromethane	3.67E-03	ORNL 2015	1.50E-01	9.69E-02	7.50E+03	HC 2009	8.05E+03
2,4,6-Trichlorophenol	2.59E-06	ORNL 2015	1.06E-04	4.34E-05	1.20E+04	DTSC 2001	1.58E+04

Appendix B. Physical and Chemical Parameters

Chemicals	Henry's law constant[a,b,c] H 25°C atm-m^3/mol	Reference	H' 25°C unitless	H' 15°C unitless	Enthalpy of vaporization[d,e] at the normal boiling point ($\Delta H_{v,b}$) and at the average soil temperature ($\Delta H_{v,TS}$) of 15°C $\Delta H_{v,b}$ cal/mol	Reference	$\Delta H_{v,TS}$ cal/mol
Trifluralin	1.03E-04	ORNL 2015		-	2.09E+06	HC 2009	-
Triphenyltin	7.85E-05	ORNL 2015		-			-
Xylenes	6.17E-03	EC 2005a	2.52E-01	1.35E-01	9.47E+03	HC 2009	1.13E+04
Vinyl chloride	2.79E-02	ORNL 2015	1.14E+00	8.83E-01	5.25E+03	OMOE 2011	4.95E+03

[a] Henry's law constant (H) at 25°C (atm-m^3/mol) obtained from literature. Used in equation 1 of DTSC 2001, from the State of California's Department of Toxic Substances Control, to calculate dimensionless (unitless) Henry's law constant at 15°C.

[b] Henry's law constant (H') at 15°C (unitless) calculated using equation 1 of DTSC 2001.

[c] Henry's law constant (H) (atm-m^3/mol) for petroleum hydrocarbon subfractions reflect a range of temperatures from 10°C to 25°C (CCME 2008).

[d] Enthalpy of vaporization at the normal boiling point ($\Delta H_{v,b}$) (cal/mol) obtained from literature, or estimated from equations 9 and 10 in DTSC (2001). Used in equation 2 of DTSC 2001 to calculate enthalpy of vaporization at a subsurface temperature of 15°C ($\Delta H_{v,TS}$) (cal/mol).

[e] Enthalpy of vaporization at a subsurface temperature of 15°C ($\Delta H_{v,TS}$) (cal/mol) estimated from equation 2 of DTSC 2001. Used in equation 1 of DTSC 2001 to calculate dimensionless (unitless) Henry's law constant at 15°C.

Chemicals	Vapour pressure[f] 25°C atm	Reference	Normal boiling point[g] °K	Reference	Critical temperature[h] °K	Reference
1,1,1-Trichloroethane	1.63E-01	ORNL 2015	3.47E+02	ORNL 2015	5.45E+02	HC 2009
1,1,2,2-Tetrachloroethene (PCE)	2.43E-02	ORNL 2015	3.94E+02	HC 1996	6.20E+02	HC 2009
1,1,2,2-Tetrachloroethane	6.08E-02	ORNL 2015	4.20E+02	ORNL 2015	6.61E+02	HC 2009
1,1,2-Trichloroethene (TCE)	9.08E-02	ORNL 2015	3.60E+02	CCME 2007b	5.44E+02	HC 2009
1,2,3,4-Tetrachlorobenzene	5.13E-05	ORNL 2015	5.27E+02	ORNL 2015	7.91E+02	calculated using equations in DTSC 2001
1,2,3,5-Tetrachlorobenzene	1.07E-04	ORNL 2015	5.11E+02	ORNL 2015	7.67E+02	calculated using equations in DTSC 2001
1,2,3-Trichlorobenzene	2.76E-04	ORNL 2015	4.92E+02	ORNL 2015	7.37E+02	calculated using equations in DTSC 2001
1,2,4,5-Tetrachlorobenzene	7.11E-06	ORNL 2015	5.18E+02	ORNL 2015	7.76E+02	calculated using equations in DTSC 2001
1,2,4-Trichlorobenzene	6.05E-04	ORNL 2015	4.87E+02	ORNL 2015	7.25E+02	HC 2009
1,2-Dichlorobenzene	1.79E-03	ORNL 2015	4.53E+02	ORNL 2015	7.05E+02	HC 2009
1,2-Dichloroethane	1.04E-01	ORNL 2015	3.57E+02	ORNL 2015	5.61E+02	HC 2009
1,3,5-Trichlorobenzene	6.03E-04	ORNL 2015	4.81E+02	ORNL 2015	7.22E+02	calculated using equations in DTSC 2001
1,3-Dichlorobenzene	2.83E-03	ORNL 2015	4.46E+02	ORNL 2015	6.84E+02	HC 2009
1,4-Dichlorobenzene	2.29E-03	ORNL 2015	4.47E+02	ORNL 2015	6.85E+02	HC 2009
2-Methylnaphthalene	7.24E-05	ORNL 2015	5.14E+02	ORNL 2015	7.61E+02	HC 2009
3-Iodo-2-propynyl butyl carbamate	6.08E-07	ORNL 2015	5.74E+02	ORNL 2015		
Acenaphthene	2.83E-06	ORNL 2015	5.51E+02	Gustafson et al. 1997	8.03E+02	HC 2009
Aldicarb	4.57E-08	ORNL 2015	5.24E+02	ORNL 2015		

Appendix B. Physical and Chemical Parameters

Chemicals	Vapour pressure[f] 25°C atm	Reference	Normal boiling point[g] °K	Reference	Critical temperature[h] °K	Reference
Aniline	8.78E-04	ORNL 2015	4.57E+02	ORNL 2015	6.99E+02	HC 2009
Anthracene	8.59E-09	ORNL 2015	6.13E+02	Gustafson et al. 1997	9.20E+02	calculated using equations in DTSC 2001
Atrazine	3.80E-10	ORNL 2015	5.86E+02	ORNL 2015		
Benzene	1.25E-01	ORNL 2015	3.53E+02	EC 2005b	5.62E+02	HC 2009
Benz(a)anthracene	2.76E-10	ORNL 2015	7.08E+02	Gustafson et al. 1997	1.00E+03	OMOE 2011
Benzo(a)pyrene	7.22E-12	ORNL 2015	7.68E+02	Gustafson et al. 1997	9.69E+02	DTSC 2001
Bromacil	4.04E-10	ORNL 2015	6.94E+02	ORNL 2015		
Bromodichloromethane	6.58E-02	ORNL 2015	3.63E+02	ORNL 2015	5.86E+02	HC 2009
Bromoxynil	6.21E-11	ORNL 2015	6.02E+02	ORNL 2015		
Captan	1.18E-10	ORNL 2015	7.11E+02	ORNL 2015		
Carbaryl	1.79E-09	ORNL 2015	5.88E+02	ORNL 2015		
Carbofuran	6.38E-09	ORNL 2015	5.84E+02	ORNL 2015		
Chlorothalonil	7.50E-10	ORNL 2015	6.23E+02	ORNL 2015		
Chlorpyrifos	2.67E-08	ORNL 2015	6.50E+02	ORNL 2015		
Cyanazine	1.82E-10	ORNL 2015	6.42E+02	ORNL 2015		
Deltamethrin	1.97E-11	ORNL 2015	7.64E+02	ORNL 2015		
Di(2-ethylhexyl) phthalate	1.87E-10	ORNL 2015	6.57E+02	ORNL 2015		
Dibromochloromethane	2.05E-02	ORNL 2015	3.93E+02	ORNL 2015	6.78E+02	HC 2009
Dicamba	1.64E-08	ORNL 2015	6.02E+02	ORNL 2015		
DDT (total)	2.11E-10	ORNL 2015	5.33E+02	ORNL 2015	7.21E+02	ORNL 2015
Dichloromethane	5.72E-01	ORNL 2015	3.13E+02	ORNL 2015	5.10E+02	HC 2009
2,4-Dichlorophenol	1.18E-04	ORNL 2015	4.83E+02	ORNL 2015	7.25E+02	calculated using equations in DTSC 2001
Diclofop-methyl	4.61E-09	ORNL 2015	4.49E+02	ORNL 2015		
Didecyl dimethyl ammonium chloride	3.07E-14	ORNL 2015	8.08E+02	ORNL 2015		
Dieldrin	3.00E-06	OMOE 2011	6.13E+02	OMOE 2011	8.42E+02	OMOE 2011
Diisopropanolamine	1.64E-07	ORNL 2016	5.23E+02	ORNL 2016	7.85E+02	calculated using equations in DTSC 2001
Dimethoate	2.47E-08	ORNL 2015	3.90E+02	ORNL 2015		
Di-*n*-butyl phthalate	2.64E-08	ORNL 2015	6.13E+02	ORNL 2015		
Dinoseb	9.79E-08	ORNL 2015	6.05E+02	ORNL 2015		
Endosulfan	7.89E-10	ORNL 2015	3.79E+02	ORNL 2015	9.43E+02	HC 2009
Ethylbenzene	1.26E-02	ORNL 2015	4.09E+02	EC 2005a	6.17E+02	HC 2009
Ethylene glycol	1.21E-04	ORNL 2015	4.70E+02	ORNL 2015	7.05E+02	calculated using equations in DTSC 2001
F1-fraction						
F1-Aliphatics C>8-C10	6.30E-03	CCME 2008				
F1-Aliphatics C>6-C8	6.30E-02	CCME 2008				
F1-Aromatics C>8-C10	6.30E-03	CCME 2008				
F2-fraction						
F2-Aliphatics C>10-C12	6.30E-04	CCME 2008				
F2-Aliphatics C>12-C16	4.80E-05	CCME 2008				
F2-Aromatics C>10-C12	6.30E-04	CCME 2008				

Appendix B. Physical and Chemical Parameters

Chemicals	Vapour pressure[f] 25°C atm	Reference	Normal boiling point[g] °K	Reference	Critical temperature[h] °K	Reference
F2-Aromatics C>12-C16	4.80E-05	CCME 2008				
Fluoranthene	1.21E-08	ORNL 2015	6.48E+02	Gustafson et al. 1997	9.05E+02	OMOE 2011
Fluorene	7.89E-07	ORNL 2015	5.68E+02	Gustafson et al. 1997	8.70E+02	HC 2009
Glyphosate	1.29E-10	ORNL 2015	6.90E+02	ORNL 2015		
Heptachlor + heptachlor epoxide	5.26E-07	ORNL 2015	5.83E+02	ORNL 2015	8.46E+02	HC 2009
Hexachlorobenzene	2.37E-08	ORNL 2015	5.83E+02	DTSC 2001	8.25E+02	DTSC 2001
Hexachlorobutadiene	2.89E-04	ORNL 2015	4.88E+02	ORNL 2015	7.38E+02	HC 2009
Hexachlorocyclohexane	5.53E-08	ORNL 2015	5.96E+02	ORNL 2015	8.39E+02	OMOE 2011
Imidacloprid	8.88E-15	CCME 2007a				
Linuron	1.88E-09	ORNL 2015	6.39E+02	ORNL 2015		
Methanol	1.68E-01	CCME 2017	3.38E+02	CCME 2017	5.07E+02	calculated using equations in DTSC 2001
Methoprene	3.11E-08	ORNL 2016	6.12E+02	ORNL 2016		
Methyl tertiary-butyl ether	3.29E-01	ORNL 2015	3.28E+02	ORNL 2015	4.97E+02	HC 2009
Methylchlorophenoxyacetic acid (2-Methyl-4-chloro phenoxy acetic acid)	7.76E-09	ORNL 2015	5.60E+02	ORNL 2015		
Methylmercury	1.01E-01	OMOE 2011	3.65E+02	HC 2009		
Metolachlor	4.13E-08	ORNL 2015	5.55E+02	ORNL 2015		
Metribuzin	5.72E-10	ORNL 2015	6.40E+02	ORNL 2015		
Monochlorobenzene	1.58E-02	ORNL 2015	4.05E+02	ORNL 2015	6.32E+02	HC 2009
2-chlorophenol	3.33E-03	ORNL 2015	4.48E+02	ORNL 2015	6.75E+02	HC 2009
Naphthalene	1.12E-04	ORNL 2015	4.91E+02	Gustafson et al. 1997	7.48E+02	HC 2009
n-Hexane	1.99E-01	ORNL 2015	3.42E+02	ORNL 2015	8.25E+02	HC 2009
Nonylphenol	1.24E-07	ORNL 2016	5.68E+02	ORNL 2016	8.52E+02	calculated using equations in DTSC 2001
Pentachlorobenzene	1.33E-06	ORNL 2015	5.50E+02	ORNL 2015	8.25E+02	calculated using equations in DTSC 2001
Pentachlorophenol	1.45E-07	ORNL 2015	5.83E+02	ORNL 2015	8.13E+02	DTSC 2001
Permethrin	2.87E-11	ORNL 2015	4.73E+02	ORNL 2015		
Phenanthrene	1.59E-07	ORNL 2015	6.12E+02	Gustafson et al. 1997		
Phenol	4.61E-04	ORNL 2015	4.55E+02	EC 1999b	6.94E+02	HC 2009
Phenoxy herbicides	1.09E-07	ORNL 2015	4.33E+02	ORNL 2015		
Picloram	9.49E-14	ORNL 2015	6.46E+02	ORNL 2015		
Propylene glycol	1.70E-04	ORNL 2015	4.61E+02	ORNL 2015		
Pyrene	5.92E-09	ORNL 2015	6.33E+02	Gustafson et al. 1997	9.36E+02	HC 2009
Quinoline	7.89E-05	ORNL 2015	5.10E+02	ORNL 2015		
Simazine	2.91E-11	ORNL 2015	5.80E+02	ORNL 2015		
Styrene	8.42E-03	ORNL 2015	4.18E+02	Gustafson et al. 1997	6.36E+02	HC 2009
Sulfolane	5.38E-06	ORNL 2015	5.58E+02	ORNL 2015	8.37E+02	calculated using equations in DTSC 2001
Tebuthiuron	2.63E-09	ORNL 2015	6.67E+02	ORNL 2015		
Tetrachloromethane	1.51E-01	ORNL 2015	3.50E+02	ORNL 2015	5.57E+02	HC 2009
2,3,4,6-Tetrachlorophenol	8.76E-07	ORNL 2015	4.23E+02	ORNL 2015	6.35E+02	calculated using equations in DTSC 2001
Toluene	3.74E-02	ORNL 2015	3.84E+02	EC 2005a	5.92E+02	HC 2009

Appendix B. Physical and Chemical Parameters

Chemicals	Vapour pressure[f] 25°C atm	Reference	Normal boiling point[g] °K	Reference	Critical temperature[h] °K	Reference
Toxaphene	1.87E-09	ORNL 2015	6.56E+02	ORNL 2015		
Triallate	1.58E-07	ORNL 2015	3.90E+02	ORNL 2015		
Tribromomethane	7.11E-03	ORNL 2015	4.22E+02	ORNL 2015	6.96E+02	HC 2009
Tributyltin	4.79E-04	ORNL 2015	4.66E+02	ORNL 2015		
Trichloromethane	2.59E-01	ORNL 2015	3.34E+02	ORNL 2015	5.36E+02	HC 2009
2,4,6-Trichlorophenol	1.05E-05	ORNL 2015	5.19E+02	ORNL 2015	7.49E+02	DTSC 2001
Trifluralin	6.03E-08	ORNL 2015	4.13E+02	ORNL 2015		
Triphenyltin	1.03E-07	ORNL 2015	6.32E+02	ORNL 2015		
Xylenes	1.05E-02	ORNL 2015	4.12E+02	ORNL 2015	6.21E+02	HC 2009
Vinyl chloride	3.92E+00	ORNL 2015	2.60E+02	ORNL 2015	4.32E+02	OMOE 2011

[f] Vapour pressure at 25°C (atm) obtained from literature. Used in equation 10 of DTSC 2001 to calculate the Antoine B coefficient, which is used to calculate enthalpy of vaporization at the normal boiling point ($\Delta H_{v,b}$) (cal/mol) if $\Delta H_{v,b}$ is not available from the literature.

[g] Normal boiling point (°K) obtained from literature. Used in equation 2 of DTSC 2001 to calculate enthalpy of vaporization at subsurface temperature of 15°C ($\Delta H_{v,TS}$) (cal/mol). Can also be used to estimate enthalpy of vaporization at the normal boiling point ($\Delta H_{v,b}$) (cal/mol) and critical temperature, if they are not available from literature sources.

[h] Critical temperature (°K) obtained from literature, or estimated from equation 8 of DTSC 2001. Used in equation 2 of DTSC 2001 to calculate enthalpy of vaporization at subsurface temperature of 15°C ($\Delta H_{v,TS}$) (cal/mol).

Appendix B. Physical and Chemical Parameters

Chemicals	Molecular weight		Organic carbon partition coefficient		Diffusivity in air		Diffusivity in water		Solubility	
	g/mol	Reference	K_{oc} cm^3/g	Reference	D_a cm^2/s	Reference	D^w cm^2/s	Reference	mg/L	Reference
1,1,1-Trichloroethane	1.33E+02	HC 2009	4.39E+01	ORNL 2015	6.48E-02	ORNL 2015	9.60E-06	ORNL 2015	1.29E+03	ORNL 2015
1,1,2,2-Tetrachloroethene (PCE)	1.66E+02	HC 1996	3.11E+02	HC 1996	5.05E-02	ORNL 2015	9.46E-06	ORNL 2015	2.06E+02	ORNL 2015
1,1,2,2-Tetrachloroethane	1.68E+02	HC 2009	9.49E+01	ORNL 2015	4.89E-02	ORNL 2015	9.29E-06	ORNL 2015	2.83E+03	ORNL 2015
1,1,2-Trichloroethene (TCE)	1.31E+02	CCME 2007b	8.60E+01	CCME 2007b	7.87E-02	CCME 2007b	1.02E-05	ORNL 2015	1.28E+03	ORNL 2015
1,2,3,4-Tetrachlorobenzene	2.16E+02	HC 2009	2.27E+03	ORNL 2015	3.07E-02	ORNL 2015	8.30E-06	ORNL 2015	5.92E+00	ORNL 2015
1,2,3,5-Tetrachlorobenzene	2.16E+02	HC 2009	2.22E+03	ORNL 2015	2.96E-02	ORNL 2015	7.92E-06	ORNL 2015	5.10E+00	ORNL 2015
1,2,3-Trichlorobenzene	1.81E+02	HC 2009	1.38E+03	ORNL 2015	3.95E-02	ORNL 2015	8.38E-06	ORNL 2015	1.80E+01	ORNL 2015
1,2,4,5-Tetrachlorobenzene	2.16E+02	HC 2009	2.22E+03	ORNL 2015	3.19E-02	ORNL 2015	8.75E-06	ORNL 2015	5.95E-01	ORNL 2015
1,2,4-Trichlorobenzene	1.81E+02	HC 2009	1.36E+03	ORNL 2015	3.96E-02	ORNL 2015	8.40E-06	ORNL 2015	4.90E+01	ORNL 2015
1,2-Dichlorobenzene	1.47E+02	HC 2009	3.83E+02	ORNL 2015	5.62E-02	ORNL 2015	8.92E-06	ORNL 2015	1.56E+02	ORNL 2015
1,2-Dichloroethane	9.90E+01	HC 2009	3.96E+01	ORNL 2015	8.57E-02	ORNL 2015	1.10E-05	ORNL 2015	8.60E+03	ORNL 2015
1,3,5-Trichlorobenzene	1.81E+02	HC 2009	1.33E+03	ORNL 2015	3.95E-02	ORNL 2015	8.37E-06	ORNL 2015	3.00E+01	ORNL 2015
1,3-Dichlorobenzene	1.47E+02	HC 2009	3.75E+02	ORNL 2015	5.58E-02	ORNL 2015	8.85E-06	ORNL 2015	1.25E+02	ORNL 2015
1,4-Dichlorobenzene	1.47E+02	HC 2009	3.75E+02	ORNL 2015	5.50E-02	ORNL 2015	8.68E-06	ORNL 2015	8.13E+01	ORNL 2015
2-Methylnaphthalene	1.42E+02	HC 2009	2.48E+03	ORNL 2015	5.24E-02	ORNL 2015	7.78E-06	ORNL 2015	2.46E+01	ORNL 2015
3-Iodo-2-propynyl butyl carbamate	2.81E+02	ORNL 2015	2.85E+02	ORNL 2015	4.43E-02	ORNL 2015	5.17E-06	ORNL 2015	4.37E+02	ORNL 2015
Acenaphthene	1.54E+02	Gustafson et al. 1997	2.82E+03	CCME 2010b	4.21E-02	Gustafson et al. 1997	7.69E-06	Gustafson et al. 1997	3.90E+00	CCME 2010b
Acridine	1.79E+02	ORNL 2015	1.64E+04	ORNL 2015	3.44E-02	ORNL 2015	6.77E-06	ORNL 2015	3.84E+01	ORNL 2015
Aldicarb	1.90E+02	HC 2009	2.46E+01	ORNL 2015	3.19E-02	ORNL 2015	7.25E-06	ORNL 2015	6.03E+03	ORNL 2015
Aniline	9.31E+01	HC 2009	7.02E+01	ORNL 2015	8.30E-02	ORNL 2015	1.01E-05	ORNL 2015	3.60E+04	ORNL 2015
Anthracene	1.78E+02	Gustafson et al. 1997	2.00E+04	CCME 2010b	3.24E-02	Gustafson et al. 1997	7.74E-06	Gustafson et al. 1997	4.50E-02	Gustafson et al. 1997
Atrazine	2.16E+02	HC 2009	2.25E+02	ORNL 2015	2.65E-02	ORNL 2015	6.84E-06	ORNL 2015	3.47E+01	ORNL 2015
Benzene	7.81E+01	EC 2005b	8.12E+01	EC 2005b	8.80E-02	EC 2005b	9.80E-06	Gustafson et al. 1997	1.79E+03	ORNL 2015
Benz(a)anthracene	2.28E+02	CCME 2010b	2.00E+05	CCME 2010b	5.10E-02	Gustafson et al. 1997	9.00E-06	Gustafson et al. 1997	9.40E-03	CCME 2010b
Benzo(a)pyrene	2.52E+02	CCME 2010b	2.19E+06	CCME 2010b	4.30E-02	Gustafson et al. 1997	9.00E-06	Gustafson et al. 1997	1.60E-03	CCME 2010b

Appendix B. Physical and Chemical Parameters

Chemicals	Molecular weight		Organic carbon partition coefficient		Diffusivity in air		Diffusivity in water		Solubility	
	g/mol	Reference	K_{oc} cm^3/g	Reference	D_a cm^2/s	Reference	D^w cm^2/s	Reference	mg/L	Reference
Bromacil	2.61E+02	ORNL 2015	6.66E+01	ORNL 2015	2.67E-02	ORNL 2015	7.00E-06	ORNL 2015	8.15E+02	ORNL 2015
Bromodichloromethane	1.64E+02	HC 2009	3.18E+01	ORNL 2015	5.63E-02	ORNL 2015	1.07E-05	ORNL 2015	3.03E+03	ORNL 2015
Bromoxynil	2.77E+02	HC 2009	3.30E+02	ORNL 2015	4.47E-02	ORNL 2015	5.23E-06	ORNL 2015	1.30E+02	ORNL 2015
Captan	3.01E+02	ORNL 2015	2.52E+02	ORNL 2015	2.62E-02	ORNL 2015	6.90E-06	ORNL 2015	5.10E+00	ORNL 2015
Carbaryl	2.01E+02	ORNL 2015	3.55E+02	ORNL 2015	2.74E-02	ORNL 2015	7.12E-06	ORNL 2015	1.10E+02	ORNL 2015
Carbofuran	2.21E+02	HC 2009	9.53E+01	ORNL 2015	2.56E-02	ORNL 2015	6.57E-06	ORNL 2015	3.20E+02	ORNL 2015
Chlorothalonil	2.66E+02	ORNL 2015	1.04E+03	ORNL 2015	2.76E-02	ORNL 2015	7.32E-06	ORNL 2015	8.10E-01	ORNL 2015
Chlorpyrifos	3.51E+02	HC 2009	7.28E+03	ORNL 2015	3.82E-02	ORNL 2015	4.46E-06	ORNL 2015	1.12E+00	ORNL 2015
Cyanazine	2.41E+02	HC 2009	1.34E+02	ORNL 2015	4.91E-02	ORNL 2015	5.74E-06	ORNL 2015	1.70E+02	ORNL 2015
Deltamethrin	5.05E+02	ORNL 2015	7.98E+04	ORNL 2015	3.00E-02	ORNL 2015	3.50E-06	ORNL 2015	2.00E-03	ORNL 2015
Di(2-ethylhexyl) phthalate	3.91E+02	HC 2009	1.20E+05	ORNL 2015	1.73E-02	ORNL 2015	4.18E-06	ORNL 2015	2.71E-01	ORNL 2015
Dibromochloromethane	2.08E+02	HC 2009	3.18E+01	ORNL 2015	3.66E-02	ORNL 2015	1.06E-05	ORNL 2015	2.70E+03	ORNL 2015
Dicamba	2.21E+02	HC 2009	2.90E+01	ORNL 2015	2.92E-02	ORNL 2015	7.80E-06	ORNL 2015	8.31E+03	ORNL 2015
DDT (total)	3.55E+02	EC 1999a	7.94E+05	EC 1999a	3.79E-02	ORNL 2015	4.43E-06	ORNL 2015	5.50E-03	ORNL 2015
Dichloromethane	8.49E+01	HC 2009	2.17E+01	ORNL 2015	9.99E-02	ORNL 2015	1.25E-05	ORNL 2015	1.30E+04	ORNL 2015
2,4-Dichlorophenol	1.63E+02	HC 2009	4.92E+02	ORNL 2015	4.86E-02	ORNL 2015	8.68E-06	ORNL 2015	4.50E+03	ORNL 2015
Diclofop-methyl	3.41E+02	HC 2009	2.59E+03	ORNL 2015	3.89E-02	ORNL 2015	4.55E-06	ORNL 2015	8.00E-01	ORNL 2015
Didecyl dimethyl ammonium chloride	3.62E+02	ORNL 2015	4.85E+05	ORNL 2015	3.74E-02	ORNL 2015	4.37E-06	ORNL 2015	7.00E+02	EC 1998
Dieldrin	3.81E+02	OMOE 2011	1.06E+04	OMOE 2011	1.25E-02	OMOE 2011	4.74E-06	OMOE 2011	2.5E-01	OMOE 2011
Diisopropanolamine	1.33E+02	CCME 2006c	2.2[i]	CCME 2006c	7.29E-02	ORNL 2016	8.51E-06	ORNL 2016	8.70E+05	CCME 2006c
Dimethoate	2.29E+02	HC 2009	1.28E+01	ORNL 2015	2.61E-02	ORNL 2015	6.74E-06	ORNL 2015	2.33E+04	ORNL 2015
Di-*n*-butyl phthalate	2.78E+02	HC 2009	1.16E+03	ORNL 2015	2.14E-02	ORNL 2015	5.33E-06	ORNL 2015	1.12E+01	ORNL 2015
Dinoseb	2.40E+02	HC 2009	4.29E+03	ORNL 2015	2.53E-02	ORNL 2015	6.52E-06	ORNL 2015	5.20E+01	ORNL 2015
Endosulfan	4.07E+02	CCME 2010a	6.76E+03	ORNL 2015	2.25E-02	ORNL 2015	5.76E-06	ORNL 2015	3.25E-01	ORNL 2015
Ethylbenzene	1.06E+02	HC 2009	5.37E+02	EC 2005a	7.50E-02	EC 2005a	7.80E-06	Gustafson et al. 1997	1.69E+02	ORNL 2015
Ethylene glycol	6.21E+01	EC 1999c	1.79E-02	EC 1999c	1.17E-01	ORNL 2015	1.36E-05	ORNL 2015	1.00E+06	ORNL 2015
F1-fraction										

Appendix B. Physical and Chemical Parameters

Chemicals	Molecular weight		Organic carbon partition coefficient		Diffusivity in air		Diffusivity in water		Solubility	
	g/mol	Reference	K_{oc} cm^3/g	Reference	D_a cm^2/s	Reference	D^w cm^2/s	Reference	mg/L	Reference
F1-Aliphatics C>8-C10	1.30E+02	CCME 2008	3.16E+04	CCME 2008	5.00E-02	CCME 2008	6.00E-06	OMOE 2011	4.30E-01	CCME 2008
F1-Aliphatics C>6-C8	1.00E+02	CCME 2008	3.98E+03	CCME 2008	5.00E-02	CCME 2008	6.00E-06	OMOE 2011	5.40E+00	CCME 2008
F1-Aromatics C>8-C10	1.20E+02	CCME 2008	1.58E+03	CCME 2008	5.00E-02	CCME 2008	6.00E-06	OMOE 2011	6.50E+01	CCME 2008
F2-fraction										
F2-Aliphatics C>10-C12	1.60E+02	CCME 2008	2.51E+05	CCME 2008	5.00E-02	CCME 2008	6.00E-06	OMOE 2011	3.40E-02	CCME 2008
F2-Aliphatics C>12-C16	2.00E+02	CCME 2008	5.01E+06	CCME 2008	5.00E-02	CCME 2008	6.00E-06	OMOE 2011	7.60E-04	CCME 2008
F2-Aromatics C>10-C12	1.30E+02	CCME 2008	2.51E+03	CCME 2008	5.00E-02	CCME 2008	6.00E-06	OMOE 2011	2.50E+01	CCME 2008
F2-Aromatics C>12-C16	1.50E+02	CCME 2008	5.01E+03	CCME 2008	5.00E-02	CCME 2008	6.00E-06	OMOE 2011	5.80E+00	CCME 2008
Fluoranthene	2.02E+02	CCME 2010b	4.17E+04	CCME 2010b	3.02E-02	Gustafson et al. 1997	6.35E-06	Gustafson et al. 1997	2.60E-01	CCME 2010b
Fluorene	1.66E+02	CCME 2010b	4.90E+03	CCME 2010b	3.60E-02	Gustafson et al. 1997	7.88E-06	Gustafson et al. 1997	1.90E+00	CCME 2010b
Glyphosate	1.69E+02	ORNL 2015	2.10E+03	ORNL 2015	6.21E-02	ORNL 2015	7.26E-06	ORNL 2015	1.16E+04	CCME 2012
Heptachlor + heptachlor epoxide	3.73E+02	HC 2009	4.13E+04	ORNL 2015	2.23E-02	ORNL 2015	5.70E-06	ORNL 2015	1.80E-01	ORNL 2015
Hexachlorobenzene	8.62E+01	HC 2009	6.20E+03	ORNL 2015	2.90E-02	ORNL 2015	7.85E-06	ORNL 2015	6.20E-03	ORNL 2015
Hexachlorobutadiene	2.61E+02	HC 2009	8.45E+02	ORNL 2015	2.67E-02	ORNL 2015	7.03E-06	ORNL 2015	3.20E+00	ORNL 2015
Hexachlorocyclohexane	2.91E+02	HC 2009	2.81E+03	ORNL 2015	4.33E-02	ORNL 2015	5.06E-06	ORNL 2015	7.30E+00	ORNL 2015
Imidacloprid	2.56E+02	CCME 2007a	2.10E+02	CCME 2007a					5.10E+02	CCME 2007a
Indeno(1,2,3-c,d)pyrene	2.76E+02	CCME 2010b	1.58E+06	CCME 2010b	2.30E-02	Gustafson et al. 1997	4.41E-06	Gustafson et al. 1997	2.20E-05	CCME 2010b
Linuron	2.49E+02	ORNL 2015	3.40E+02	ORNL 2015	4.80E-02	ORNL 2015	5.61E-06	ORNL 2015	7.50E+01	ORNL 2015
Methanol	3.20E+01	CCME 2017	2.70E-01	CCME 2017	1.50E-01	CCME 2017	1.65E-05	ORNL 2018	1.00E+06	ORNL 2018
Methoprene	3.10E+02	ORNL 2016	6.46E+03	ORNL 2016	4.14E-02	ORNL 2016	4.84E-06	ORNL 2016	1.40E+00	ORNL 2016
Methyl tertiary-butyl ether	8.81E+01	HC 2009	1.16E+01	ORNL 2015	7.53E-02	ORNL 2015	8.59E-06	ORNL 2015	5.10E+04	ORNL 2015

Appendix B. Physical and Chemical Parameters

Chemicals	Molecular weight		Organic carbon partition coefficient		Diffusivity in air		Diffusivity in water		Solubility	
	g/mol	Reference	K_{oc} cm^3/g	Reference	D_a cm^2/s	Reference	D^w cm^2/s	Reference	mg/L	Reference
Methylchlorophenoxyacetic acid (2-Methyl-4-chloro phenoxy acetic acid)	2.01E+02	ORNL 2015	2.96E+01	ORNL 2015	3.06E-02	ORNL 2015	8.24E-06	ORNL 2015	6.30E+02	ORNL 2015
Methylmercury	2.16E+02	OMOE 2011	4.00E+03	OMOE 2011					3.13E+04	OMOE 2011
Metolachlor	2.84E+02	HC 2009	4.89E+02	ORNL 2015	2.19E-02	ORNL 2015	5.48E-06	ORNL 2015	5.30E+02	ORNL 2015
Metribuzin	2.14E+02	HC 2009	5.31E+01	ORNL 2015	2.73E-02	ORNL 2015	7.13E-06	ORNL 2015	1.05E+03	ORNL 2015
Monochlorobenzene	1.13E+02	HC 2009	2.34E+02	ORNL 2015	7.21E-02	ORNL 2015	9.48E-06	ORNL 2015	4.98E+02	ORNL 2015
2-chlorophenol	129E+02	HC 2009	3.07E+02	ORNL 2015	6.61E-02	ORNL 2015	9.48E-06	ORNL 2015	1.13E+04	ORNL 2015
Naphthalene	1.28E+02	CCME 2010b	7.08E+02	CCME 2010b	5.90E-02	Gustafson et al. 1997	7.50E-06	Gustafson et al. 1997	3.17E+01	CCME 2010b
n-Hexane	8.62E+01	CCME 2011	3.41E+03	CCME 2011	2.00E-01	CCME 2011	7.77E-06	CCME 2011	9.50E+00	CCME 2011
Nonylphenol	2.20E+02	EC 2002	1.41E+05	EC 2002	5.21E-02	ORNL 2016	6.09E-06	ORNL 2016	5.43E+00	EC 2002
Pentachlorobenzene	2.50E+02	HC 2009	3.71E+03	ORNL 2015	2.94E-02	ORNL 2015	7.95E-06	ORNL 2015	8.31E-01	ORNL 2015
Pentachlorophenol	2.66E+02	HC 2009	2176 @ pH 5.8	USEPA 1996	2.95E-02	ORNL 2015	8.01E-06	ORNL 2015	1.40E+01	ORNL 2015
Permethrin	3.91E+02	CCME 2006b	1.00E+05	CCME 2006b	1.94E-02	ORNL 2015	4.78E-06	ORNL 2015	6.00E-03	CCME 2006b
Phenanthrene	1.78E+02	ORNL 2015	6.61E+03	CCME 2010b	3.30E-02	Gustafson et al. 1997	7.47E-06	Gustafson et al. 1997	1.15E+00	CCME 2010b
Phenol	9.41E+01	EC 1999b	1.18E+01	EC 1999b	8.34E-02	ORNL 2015	1.03E-05	ORNL 2015	8.28E+04	ORNL 2015
Phenoxy herbicides	2.21E+02	ORNL 2015	2.96E+01	ORNL 2015	2.79E-02	ORNL 2015	7.34E-06	ORNL 2015	6.77E+02	ORNL 2015
Picloram	2.41E+02	HC 2009	3.88E+01	ORNL 2015	4.90E-02	ORNL 2015	5.73E-06	ORNL 2015	4.30E+02	ORNL 2015
Propylene glycol	7.61E+01	CCME 2007c	5.75E+00	CCME 2007c	9.81E-02	ORNL 2015	1.15E-05	ORNL 2015	1.00E+06	ORNL 2015
Pyrene	2.02E+02	CCME 2010b	6.92E+04	CCME 2010b	2.70E-02	Gustafson et al. 1997	7.24E-06	Gustafson et al. 1997	1.35E-01	ORNL 2015
Quinoline	1.29E+02	ORNL 2015	1.54E+03	ORNL 2015	6.18E-02	ORNL 2015	8.69E-06	ORNL 2015	6.11E+03	ORNL 2015
Simazine	2.02E+02	HC 2009	1.47E+02	ORNL 2015	2.81E-02	ORNL 2015	7.37E-06	ORNL 2015	6.20E+00	ORNL 2015
Styrene	1.04E+02	HC 2009	4.46E+02	ORNL 2015	7.10E-02	Gustafson et al. 1997	8.00E-06	Gustafson et al. 1997	3.10E+02	ORNL 2015
Sulfolane	1.20E+02	CCME 2006a	1.17E+00	CCME 2006a	7.16E-02	ORNL 2015	9.91E-06	ORNL 2015	1.27E+06	CCME 2006a
Tebuthiuron	2.28E+02	ORNL 2015	4.24E+01	ORNL 2015	5.09E-02	ORNL 2015	5.94E-06	ORNL 2015	2.50E+03	ORNL 2015

Appendix B. Physical and Chemical Parameters

Chemicals	Molecular weight		Organic carbon partition coefficient		Diffusivity in air		Diffusivity in water		Solubility	
	g/mol	Reference	K_{oc} cm^3/g	Reference	D_a cm^2/s	Reference	D^w cm^2/s	Reference	mg/L	Reference
Tetrachloromethane	1.54E+02	HC 2009	4.39E+01	ORNL 2015	5.71E-02	ORNL 2015	9.78E-06	ORNL 2015	7.93E+02	ORNL 2015
2,3,4,6-Tetrachlorophenol	2.32E+02	HC 2009	2129 @ pH 5.6	USEPA 1996	5.03E-02	ORNL 2015	5.88E-06	ORNL 2015	2.30E+01	ORNL 2015
Toluene	9.21E+01	EC 2005a	2.34E+02	EC 2005a	8.70E-02	EC 2005a	8.60E-06	Gustafson et al. 1997	5.26E+02	ORNL 2015
Toxaphene	4.14E+02	HC 2009	7.72E+04	ORNL 2015	3.42E-02	ORNL 2015	4.00E-06	ORNL 2015	7.40E-01	ORNL 2015
Triallate	3.05E+02	ORNL 2015	1.01E+03	ORNL 2015	2.25E-02	ORNL 2015	5.67E-06	ORNL 2015	4.00E+00	ORNL 2015
Tribromomethane	2.53E+02	HC 2009	3.18E+01	ORNL 2015	3.57E-02	ORNL 2015	1.04E-05	ORNL 2015	3.10E+03	ORNL 2015
Tributyltin	3.26E+02	ORNL 2015	1.21E+04	ORNL 2015	4.02E-02	ORNL 2015	4.69E-06	ORNL 2015	1.70E+01	ORNL 2015
Trichloromethane	1.19E+02	HC 2009	3.18E+01	ORNL 2015	7.69E-02	ORNL 2015	1.09E-05	ORNL 2015	7.95E+03	ORNL 2015
2,4,6-Trichlorophenol	1.97E+02	HC 2009	1.78E+03	ORNL 2015	3.14E-02	ORNL 2015	8.09E-06	ORNL 2015	8.00E+02	ORNL 2015
Trifluralin	3.35E+02	HC 2009	1.64E+04	ORNL 2015	2.21E-02	ORNL 2015	5.57E-06	ORNL 2015	1.84E-01	ORNL 2015
Triphenyltin	3.51E+02	ORNL 2015	3.36E+05	ORNL 2015	3.82E-02	ORNL 2015	4.46E-06	ORNL 2015	1.37E-01	ORNL 2015
Xylenes	1.06E+02	EC 2005a	5.86E+02	EC 2005a	7.80E-02	EC 2005a	8.46E-06	ORNL 2015	1.06E+02	ORNL 2015
Vinyl chloride	6.25E+01	HC 2009	2.17E+01	ORNL 2015	1.07E-01	ORNL 2015	1.20E-05	ORNL 2015	8.80E+03	ORNL 2015

[i] Value presented is K_d (cm^3/g), and not K_{oc}, because DIPA preferentially sorbs to clays instead of organic carbon (CCME 2006c).

Appendix C. Human Health Toxicological Reference Values

Chemicals	Background indoor air concentration		Tolerable daily intake		Tolerable concentration	
	C_a mg/m^3	Reference	TDI mg/kg bw/day	Reference	TC mg/m^3	Reference
1,1,1-Trichloroethane	1.6E-03	SLE 2013	2.00E+00	IRIS as reported in HC 2010b	4.0E+00	IRIS as reported in HC 2010b
1,1,2,2-Tetrachloroethene (PCE)	3.6E-03	SLE 2013	1.40E-02	HC 2010a	4.0E-02	USEPA 2012
1,1,2,2-Tetrachloroethane	2.4E-05	SLE 2013	6.00E-02	IRIS as reported in HC 2010b	1.2E-01	IRIS as reported in HC 2010b
1,1,2-Trichloroethene (TCE)	1.4E-03	CCME 2007b	1.46E-03	HC 2010a	2.0E-03	USEPA 2011
1,2,3,4-Tetrachlorobenzene	0.0	SLE 2013	3.40E-03	HC 2010a		
1,2,3,5-Tetrachlorobenzene	0.0	SLE 2013	4.10E-04	HC 2010a		
1,2,3-Trichlorobenzene	0.0	SLE 2013	1.50E-03	HC 2010a		
1,2,4,5-Tetrachlorobenzene	0.0	SLE 2013	2.10E-04	HC 2010a		
1,2,4-Trichlorobenzene	1.1E-04	SLE 2013	1.60E-03	HC 2010a	7.0E-03	HC 2010a
1,2-Dichlorobenzene	5.1E-05	SLE 2013	4.30E-01	HC 2010a	8.6E-01	HC 2010b
1,2-Dichloroethane						
1,3,5-Trichlorobenzene	0.0	SLE 2013	1.50E-03	HC 2010a	3.6E-03	HC 2010a
1,3-Dichlorobenzene						
1,4-Dichlorobenzene	1.0E-03	SLE 2013	1.10E-01	HC 2010a	9.5E-02	HC 2010a
2-Methylnaphthalene			4.00E-03	HC 2010a		
3-Iodo-2-propynyl butyl carbamate						
Acenaphthene			6.00E-02	IRIS as reported in HC 2010b	1.2E-01	IRIS as reported in HC 2010b
Acridine						
Aldicarb						
Aldrin						
Aniline			7.20E-03	HC 2010a		
Anthracene			3.00E-01	IRIS as reported in HC 2010b	6.0E-01	IRIS as reported in HC 2010b
Atrazine						
Benzene			4.00E-03	IRIS/Health Canada as reported in HC 2010b	8.0E-03	IRIS/Health Canada as reported in HC 2010b
Benz(a)anthracene						
Benzo(a)pyrene						
Bromacil						
Bromodichloromethane	6.2E-04	SLE 2013	2.00E-02	IRIS as reported in HC 2010b	8.9E-02	IRIS as reported in HC 2010b
Bromoxynil						
Captan						
Carbaryl		-				
Carbofuran						

Appendix C. Human Health Toxicological Reference Values

Chemicals	Background indoor air concentration		Tolerable daily intake		Tolerable concentration	
	C_a mg/m³	Reference	TDI mg/kg bw/day	Reference	TC mg/m³	Reference
Chlorothalonil						
Chlorpyrifos						
Cyanazine						
Deltamethrin						
Di(2-ethylhexyl) phthalate						
Dibromochloromethane	3.6E-04	SLE 2013	2.00E-02	IRIS as reported in HC 2010b	4.0E-02	IRIS as reported in HC 2010b
Dicamba						
DDT (total)						
Dichloromethane	1.1E-02	SLE 2013	5.00E-02	HC 2010a		
2,4-Dichlorophenol			1.00E-01	HC 2010a		
Diclofop-methyl						
Didecyl dimethyl ammonium chloride						
Dieldrin						
Diisopropanolamine						
Dimethoate						
Di-*n*-butyl phthalate	0.0	SLE 2013	6.30E-02	HC 2010a		
Dinoseb						
Endosulfan						
Ethylbenzene	7.5E-03	EC 2005a	1.00E-01	HC 2010a	1.0E+00	HC 2010a
Ethylene glycol						
F1-fraction						
F1-Aliphatics C>8-C10	3.9E-02	CCME 2008	1.00E-01	CCME 2008	1.0E+00	CCME 2008
F1-Aliphatics C>6-C8	9.1E-02	CCME 2008	5.00E+00	CCME 2008	1.8E+01	CCME 2008
F1-Aromatics C>8-C10	3.7E-02	CCME 2008	4.00E-02	CCME 2008	2.0E-01	CCME 2008
F2-fraction						
F2-Aliphatics C>10-C12	0.0	CCME 2008	1.00E-01	CCME 2008	1.0E+00	CCME 2008
F2-Aliphatics C>12-C16	0.0	CCME 2008	1.00E-01	CCME 2008	1.0E+00	CCME 2008
F2-Aromatics C>10-C12	0.0	CCME 2008	4.00E-02	CCME 2008	2.0E-01	CCME 2008
F2-Aromatics C>12-C16	0.0	CCME 2008	4.00E-02	CCME 2008	2.0E-01	CCME 2008
Fluoranthene			4.00E-02	IRIS as reported in HC 2010b	8.0E-02	IRIS as reported in HC 2010b
Fluorene			4.00E-02	IRIS as reported in HC 2010b		
Glyphosate						
Heptachlor + heptachlor epoxide						
Hexachlorobenzene						
Hexachlorobutadiene						
Hexachlorocyclohexane						

Appendix C. Human Health Toxicological Reference Values

Chemicals	Background indoor air concentration		Tolerable daily intake		Tolerable concentration	
	C_a mg/m³	Reference	TDI mg/kg bw/day	Reference	TC mg/m³	Reference
Imidacloprid						
Indeno(1,2,3-c,d)pyrene						
Linuron						
Methanol	4.00E-02	CCME 2017	2.00E+00	CCME 2017	2.00E+01	CCME 2017
Methoprene						
Methyl tertiary-butyl ether	1.6E-05	SLE 2013	1.00E-02	HC 2010a	3.7E-02	HC 2010a
Methylchlorophenoxyacetic acid (2-Methyl-4-chloro phenoxy acetic acid)						
Methylmercury			2.00E-04	HC 2010a		
Metolachlor						
Metribuzin						
Monochlorobenzene	4.2E-05	SLE 2013			1.0E-02	HC 2010a
2-chlorophenol	0.0	SLE 2013	5.00E-03	IRIS as reported in HC 2010b	9.9E-03	IRIS as reported in HC 2010b
Naphthalene	2.3E-03	SLE 2013	2.00E-02	HC 2010a	3.0E-03	HC 2010b
n-Hexane	2.0E-03	CCME 2011	1.00E-01	HC 2010a	7.0E-01	HC 2010a
Nonylphenol and its ethoxylates						
Pentachlorobenzene			1.00E-03	HC 2010a		
Pentachlorophenol						
Permethrin						
Phenanthrene						
Phenol			6.00E-02	HC 2010a		
Phenoxy herbicides						
Picloram						
Propylene glycol						
Pyrene			3.00E-02	HC 2010a	6.0E-02	HC 2010b
Quinoline						
Simazine						
Styrene	1.4E-03	SLE 2013	1.20E-01	HC 2010a	9.2E-02	HC 2010a
Sulfolane		-				
Tebuthiuron						
Tetrachloromethane	7.9E-04	SLE 2013	7.10E-04	HC 2010a		
2,3,4,6-Tetrachlorophenol	0.0	SLE 2013	1.00E-02	HC 2010a		
Toluene	4.4E-02	EC 2005a	2.20E-01	HC 2010a	3.8E+00	HC 2010a
Toxaphene						
Triallate						
Tribromomethane						
Tributyltin						

Appendix C. Human Health Toxicological Reference Values

Chemicals	Background indoor air concentration		Tolerable daily intake		Tolerable concentration	
	C_a **mg/m³**	Reference	**TDI** **mg/kg bw/day**	Reference	**TC** **mg/m³**	Reference
Trichloromethane	4.1E-03	SLE 2013	1.00E-02	IRIS/RAIS as reported in HC 2010b	2.0E-02	IRIS/RAIS as reported in HC 2010b
2,4,6-Trichlorophenol	0.0	SLE 2013				
Trifluralin						
Triphenyltin						
Xylenes	1.8E-02	EC 2005a	1.50E+00	HC 2010a	1.8E-01	HC 2010a
Vinyl chloride	2.3E-05	SLE 2013				

Appendix C. Human Health Toxicological Reference Values

Chemicals	Inhalation unit risk		Risk-specific concentration	Oral slope factor	
	IUR $(mg/m^3)^{-1}$	Reference	RsC mg/m^3	SF $(mg/kg\ bw\text{-}day)^{-1}$	Reference
1,1,1-Trichloroethane			-		
1,1,2,2-Tetrachloroethene (PCE)	2.60E-04	USEPA 2012	3.85E-02	2.10E-03	USEPA 2012
1,1,2,2-Tetrachloroethane	5.80E-03	IRIS as reported in HC 2010b	1.72E-03		
1,1,2-Trichloroethene (TCE)	4.10E-03	USEPA 2011	2.44E-03	4.60E-02	USEPA 2011
1,2,3,4-Tetrachlorobenzene			-		
1,2,3,5-Tetrachlorobenzene			-		
1,2,3-Trichlorobenzene			-		
1,2,4,5-Tetrachlorobenzene			-		
1,2,4-Trichlorobenzene			-		
1,2-Dichlorobenzene			-		
1,2-Dichloroethane			5.28E-03	8.06E-03	HC 2010a
1,3,5-Trichlorobenzene			-		
1,3-Dichlorobenzene			-		
1,4-Dichlorobenzene	2.10E-02	HC 2010b	4.76E-04		
2-Methylnaphthalene			-		
3-Iodo-2-propynyl butyl carbamate			-		
Acenaphthene			-		
Acridine			-		
Aldicarb			-		
Aldrin			-		
Aniline			-		
Anthracene			-		
Atrazine			-		
Benzene	3.30E-03	HC 2010a	3.03E-03	8.34E-02	HC 2010a
Benz(a)anthracene	8.80E-02	RAIS as reported in HC 2010b	1.14E-04	3.10E-01	RAIS as reported in HC 2010b
Benzo(a)pyrene	3.10E-02	HC 2010a	3.23E-04	2.30E+00	HC 2010a
Bromacil			-		
Bromodichloromethane	1.40E-02	IRIS as reported in HC 2010b	7.14E-04	6.20E-02	IRIS as reported in HC 2010b
Bromoxynil			-		
Captan			-		
Carbaryl			-		
Carbofuran			-		
Chlorothalonil			-		
Chlorpyrifos			-		
Cyanazine			-		

Appendix C. Human Health Toxicological Reference Values

Chemicals	Inhalation unit risk		Risk-specific concentration	Oral slope factor	
	IUR $(mg/m^3)^{-1}$	Reference	RsC mg/m^3	SF $(mg/kg\ bw\text{-}day)^{-1}$	Reference
Deltamethrin			-		
Di(2-ethylhexyl) phthalate			-		
Dibromochloromethane			-		
Dicamba			-		
DDT (total)			-		
Dichloromethane	2.30E-05	HC 2010a	4.35E-01	7.90E-05	HC 2010a
2,4-Dichlorophenol			-		
Diclofop-methyl			-		
Didecyl dimethyl ammonium chloride			-		
Dieldrin					
Diisopropanolamine			-		
Dimethoate			-		
Di-*n*-butyl phthalate			-		
Dinoseb			-		
Endosulfan			-		
Ethylbenzene			-		
Ethylene glycol			-		
F1-fraction			-		
F1-Aliphatics C>8-C10			-		
F1-Aliphatics C>6-C8			-		
F1-Aromatics C>8-C10			-		
F2-fraction			-		
F2-Aliphatics C>10-C12			-		
F2-Aliphatics C>12-C16			-		
F2-Aromatics C>10-C12			-		
F2-Aromatics C>12-C16			-		
Fluoranthene			-		
Fluorene			-		
Glyphosate			-		
Heptachlor + heptachlor epoxide			-		
Hexachlorobenzene			-		
Hexachlorobutadiene			-		
Hexachlorocyclohexane			-		
Imidacloprid			-		
Indeno(1,2,3-c,d)pyrene	8.80E-03	RAIS as reported in HC 2010b	1.14E-03	3.10E-01	RAIS as reported in HC 2010b
Linuron			-		
Methanol			-		

Appendix C. Human Health Toxicological Reference Values

Chemicals	Inhalation unit risk		Risk-specific concentration	Oral slope factor	
	IUR $(mg/m^3)^{-1}$	Reference	RsC mg/m^3	SF $(mg/kg\ bw\text{-}day)^{-1}$	Reference
Methoprene			-		
Methyl tertiary-butyl ether			-		
Methylchlorophenoxyacetic acid (2-Methyl-4-chloro phenoxy acetic acid)			-		
Methylmercury			-		
Metolachlor			-		
Metribuzin			-		
Monochlorobenzene			-		
2-chlorophenol			-		
Naphthalene			-		
n-Hexane			-		
Nonylphenol and its ethoxylates			-		
Pentachlorobenzene			-		
Pentachlorophenol			-		
Permethrin			-		
Phenanthrene			-		
Phenol			-		
Phenoxy herbicides			-		
Picloram			-		
Propylene glycol			-		
Pyrene			-		
Quinoline			-		
Simazine			-		
Styrene			-		
Sulfolane			-		
Tebuthiuron			-		
Tetrachloromethane			-		
2,3,4,6-Tetrachlorophenol			-		
Toluene			-		
Toxaphene			-		
Triallate			-		
Tribromomethane			-		
Tributyltin			-		
Trichloromethane	2.30E-03	IRIS/RAIS as reported in HC 2010b	4.35E-03		
2,4,6-Trichlorophenol			2.13E-03	2.00E-02	HC 2010a
Trifluralin			-		
Triphenyltin			-		

Appendix C. Human Health Toxicological Reference Values

Chemicals	Inhalation unit risk		Risk-specific concentration	Oral slope factor	
	IUR $(mg/m^3)^{-1}$	Reference	RsC mg/m^3	SF $(mg/kg\ bw\text{-}day)^{-1}$	Reference
Xylenes			-		
Vinyl chloride	8.80E-03	HC 2010b	1.14E-03	2.60E-01	HC 2010a

Appendix D. Water Quality Benchmarks

Chemicals	Fresh water		Marine		Livestock watering		Irrigation		Potable water	
	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference
1,1,1-Trichloroethane	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,1,2,2-Tetrachloroethene (PCE)	1.1E-01	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	1.0E-02	HC 2017
1,1,2,2-Tetrachloroethane	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,1,2-Trichloroethene (TCE)	2.1E-02	CCME 1999	Insufficient data	CCME 1999	5.0E-02	CCME 1999	Insufficient data	CCME 1999	5.0E-03	HC 2017
1,2,3,4-Tetrachlorobenzene	1.8E-03	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,2,3,5-Tetrachlorobenzene	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,2,3-Trichlorobenzene	8.0E-03	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,2,4,5-Tetrachlorobenzene	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,2,4-Trichlorobenzene	2.4E-02	CCME 1999	5.4E-03	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,2-Dichlorobenzene	7.0E-04	CCME 1999	4.2E-02	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	3.0E-03[a]	HC 2017
1,2-Dichloroethane	1.0E-01	CCME 1999	Insufficient data	CCME 1999	5.0E-03	CCME 1999	Insufficient data	CCME 1999	5.0E-03	HC 2017
1,3,5-Trichlorobenzene	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,3-Dichlorobenzene	1.5E-01	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
1,4-Dichlorobenzene	2.6E-02	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	1.0E-03[a]	HC 2017
2-Methylnaphthalene										
3-Iodo-2-propynyl butyl carbamate	1.9E-03	CCME 1999								
Acenaphthene	5.8E-03	CCME 1999	Insufficient data	CCME 1999						
Acridine	4.4E-03	CCME 1999	Insufficient data	CCME 1999						
Aldicarb	1.0E-03	CCME 1999	1.5E-04	CCME 1999	1.1E-02	CCME 1999	5.49E-02	CCME 1999		
Aldrin+Dieldrin	4.0E-06	CCME 1999								
Aniline	2.2E-03	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		

Appendix D. Water Quality Benchmarks

Chemicals	Fresh water		Marine		Livestock watering		Irrigation		Potable water	
	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference
Anthracene	1.2E-05	CCME 1999	Insufficient data	CCME 1999						
Atrazine	1.8E-03	CCME 1999			5.0E-03	CCME 1999	1.00E-02	CCME 1999	5.0E-03	HC 2017
Benzene	3.7E-01	CCME 1999	1.1E-01	CCME 1999					5.0E-03	HC 2017
Benz(a)anthracene	1.8E-05	CCME 1999	Insufficient data	CCME 1999						
Benzo(a)pyrene	1.5E-05	CCME 1999	Insufficient data	CCME 1999					4.0E-05	HC 2017
Bromacil	5.0E-03	CCME 1999	Insufficient data	CCME 1999	1.1E+00	CCME 1999	2.00E-04	CCME 1999		
Bromodichloromethane	Insufficient data	CCME 1999	Insufficient data	CCME 1999	1.0E-01	CCME 1999	Insufficient data	CCME 1999	1.0E-01[b]	HC 2017
Bromoxynil	5.0E-03	CCME 1999	Insufficient data	CCME 1999	1.1E-02	CCME 1999	3.30E-04	CCME 1999	5.0E-03	HC 2017
Captan	1.3E-03	CCME 1999		CCME 1999	1.3E-02	CCME 1999	Insufficient data	CCME 1999		
Carbaryl	2.0E-04	CCME 1999	2.9E-04	CCME 1999	1.1E+00	CCME 1999	Insufficient data	CCME 1999	9.0E-02	HC 2017
Carbofuran	1.8E-03	CCME 1999		CCME 1999	4.5E-02	CCME 1999	Insufficient data	CCME 1999	9.0E-02	HC 2017
Chlorothalonil	1.8E-04	CCME 1999	3.6E-04	CCME 1999	1.7E-01	CCME 1999	5.80E-03	CCME 1999		
Chlorpyrifos	2.0E-06	CCME 1999	2.0E-06	CCME 1999	2.4E-02	CCME 1999	Insufficient data	CCME 1999	9.0E-02	HC 2017
Cyanazine	2.0E-03	CCME 1999		CCME 1999	1.0E-02	CCME 1999	5.00E-04	CCME 1999		
Deltamethrin	4.0E-07	CCME 1999	Insufficient data	CCME 1999	2.5E-03	CCME 1999	Insufficient data	CCME 1999		
Di(2-ethylhexyl) phthalate	1.6E-02	CCME 1999	Insufficient data	CCME 1999		CCME 1999		CCME 1999		
Dibromochloromethane	Insufficient data	CCME 1999	Insufficient data	CCME 1999	1.0E-01	CCME 1999	Insufficient data	CCME 1999	1.0E-01[b]	HC 2017
Dicamba	1.0E-02	CCME 1999			1.2E-01	CCME 1999	6.00E-06	CCME 1999	1.2E-01	HC 2017
DDT (total)	1.0E-06	CCME 1999			3.0E-02	CCME 1999				
Dichloromethane	9.8E-02	CCME 1999	Insufficient data	CCME 1999	5.0E-02	CCME 1999	Insufficient data	CCME 1999	5.0E-02	HC 2017

Appendix D. Water Quality Benchmarks

Chemicals	Fresh water		Marine		Livestock watering		Irrigation		Potable water	
	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference
2,4-Dichlorophenol	2.0E-04	CCME 1999							3.0E-04[a]	HC 2017
Diclofop-methyl	6.1E-03	CCME 1999			9.0E-03	CCME 1999	1.80E-04	CCME 1999	9.0E-03	HC 2017
Didecyl dimethyl ammonium chloride	1.5E-03	CCME 1999	Insufficient data	CCME 1999						
Diisopropanolamine	1.6E+00	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	2.00E+00	CCME 1999	4.0E+00	CCME 2006c
Dimethoate	6.2E-03	CCME 1999	Insufficient data	CCME 1999	3.0E-03	CCME 1999	Insufficient data	CCME 1999	2.0E-02	HC 2017
Di-*n*-butyl phthalate	1.9E-02	CCME 1999	Insufficient data	CCME 1999						
Dinoseb	5.0E-05	CCME 1999		CCME 1999	1.5E-01	CCME 1999	1.60E-02	CCME 1999		
Endosulfan	3.0E-06	CCME 1999	2.0E-06	CCME 1999						
Ethylbenzene	9.0E-02	CCME 1999	2.5E-02	CCME 1999	2.4E-03	CCME 1999	Insufficient data	CCME 1999	1.6E-03[a]	HC 2017
Ethylene glycol	1.9E+02	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
F1-fraction					5.3E+01	CCME 2008				
F1-Aliphatics C>8-C10	7.6E-03	CCME 2008			5.3E+01	CCME 2008			2.47E+00	CCME 2008
F1-Aliphatics C>6-C8	4.7E-02	CCME 2008			5.3E+01	CCME 2008			1.37E+02	CCME 2008
F1-Aromatics C>8-C10	1.4E-01	CCME 2008			5.3E+01	CCME 2008			8.42E-01	CCME 2008
F2-fraction					4.9E+01	CCME 2008				
F2-Aliphatics C>10-C12	1.2E-03	CCME 2008			4.9E+01	CCME 2008			2.75E+00	CCME 2008
F2-Aliphatics C>12-C16	7.4E-05	CCME 2008			4.9E+01	CCME 2008			2.75E+00	CCME 2008
F2-Aromatics C>10-C12	9.6E-02	CCME 2008			4.9E+01	CCME 2008			1.10E+00	CCME 2008
F2-Aromatics C>12-C16	5.5E-02	CCME 2008			4.9E+01	CCME 2008			1.10E+00	CCME 2008
Fluoranthene	4.0E-05	CCME 1999	Insufficient data	CCME 1999						

Appendix D. Water Quality Benchmarks

Chemicals	Fresh water		Marine		Livestock watering		Irrigation		Potable water	
	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference
Fluorene	3.0E-03	CCME 1999	Insufficient data	CCME 1999						
Glyphosate	8.0E-01	CCME 1999		CCME 1999	2.8E-01	CCME 1999			2.8E-01	HC 2017
Heptachlor + heptachlor epoxide	1.0E-05	CCME 1999		CCME 1999	3.0E-03	CCME 1999				
Hexachlorobenzene	Insufficient data	CCME 1999	Insufficient data	CCME 1999	5.2E-04	CCME 1999	Insufficient data	CCME 1999		
Hexachlorobutadiene	1.3E-03	CCME 1999		CCME 1999						
Hexachlorocyclohexane	1.0E-05	CCME 1999		CCME 1999	4.0E-03	CCME 1999		CCME 1999		
Imidacloprid	2.3E-04	CCME 1999	6.5E-04	CCME 1999						
Linuron	7.0E-03	CCME 1999		CCME 1999	Insufficient data	CCME 1999	7.10E-05	CCME 1999		
Methanol	2.30E+01	CCME 2017							1.90E+01	CCME 2017
Methoprene	9.0E-05	CCME 1999	Insufficient data	CCME 1999						
Methyl tertiary-butyl ether	1.0E+01	CCME 1999	5.0E+00	CCME 1999		CCME 1999		CCME 1999	1.5E-02[a]	HC 2017
Methylchlorophenoxyacetic acid (2-Methyl-4-chloro phenoxy acetic acid)	2.6E-03	CCME 1999	4.2E-03	CCME 1999	2.5E-02	CCME 1999	2.50E-05	CCME 1999	1.0E-01	HC 2017
Methylmercury	4.0E-06	CCME 1999								
Metolachlor	7.8E-03	CCME 1999			5.0E-02	CCME 1999	2.80E-02	CCME 1999	5.0E-02	HC 2017
Metribuzin	1.0E-03	CCME 1999			8.0E-02	CCME 1999	5.00E-04	CCME 1999	8.0E-02	HC 2017
Monochlorobenzene	1.3E-03	CCME 1999	2.5E-02	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	3.0E-02[a]	HC 2017
2-chlorophenol	7.0E-03	CCME 1999								
Naphthalene	1.1E-03	CCME 1999	1.4E-03	CCME 1999						
n-Hexane	1.3E-01	CCME 2011							2.3E-01	CCME 2011
Nonylphenol and its ethoxylates	1.0E-03	CCME 1999	7.0E-04	CCME 1999						

Appendix D. Water Quality Benchmarks

Chemicals	Fresh water		Marine		Livestock watering		Irrigation		Potable water	
	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference
Pentachlorobenzene	6.0E-03	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
Pentachlorophenol	5.0E-04	CCME 1999		CCME 1999					3.0E-02[a]	HC 2017
Permethrin	4.0E-06	CCME 1999	1.0E-06	CCME 1999						
Phenanthrene	4.0E-04	CCME 1999	Insufficient data	CCME 1999						
Phenol	4.0E-03	CCME 1999			2.0E-03	CCME 1999			5.6E-01	HC 1995
Phenoxy herbicides	4.0E-03	CCME 1999		CCME 1999	1.0E-01	CCME 1999			1.0E-01	HC 2017
Picloram	2.9E-02	CCME 1999		CCME 1999	1.9E-01	CCME 1999	Insufficient data	CCME 1999	1.9E-01	HC 2017
Propylene glycol	5.0E+02	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999		
Pyrene	2.5E-05	CCME 1999	Insufficient data	CCME 1999						
Quinoline	3.4E-03	CCME 1999	Insufficient data	CCME 1999						
Simazine	1.0E-02	CCME 1999		CCME 1999	1.0E-02	CCME 1999	5.00E-04	CCME 1999	1.0E-02	HC 2017
Styrene	7.2E-02	CCME 1999		CCME 1999						
Sulfolane	5.0E+01	CCME 1999	Insufficient data	CCME 1999	Insufficient data	CCME 1999	5.00E-01	CCME 1999	9.0E-02	CCME 2006a
Tebuthiuron	1.6E-03	CCME 1999	Insufficient data	CCME 1999	1.3E-01	CCME 1999	2.70E-04	CCME 1999		
Tetrachloromethane	1.3E-02	CCME 1999	Insufficient data	CCME 1999	5.0E-03	CCME 1999	Insufficient data	CCME 1999	2.0E-03	HC 2017
2,3,4,6-Tetrachlorophenol	1.0E-03	CCME 1999		CCME 1999					1.0E-03[a]	HC 2017
Toluene	2.0E-03	CCME 1999	2.2E-01	CCME 1999	2.4E-02	CCME 1999	Insufficient data	CCME 1999	2.4E-02[a]	HC 2017
Toxaphene	8.0E-06	CCME 1999		CCME 1999	5.0E-03	CCME 1999				
Triallate	2.4E-04	CCME 1999		CCME 1999	2.3E-01	CCME 1999	Insufficient data	CCME 1999		
Tribromomethane	Insufficient data	CCME 1999	Insufficient data	CCME 1999	1.0E-01	CCME 1999	Insufficient data	CCME 1999	1.0E-01[b]	HC 2017

Appendix D. Water Quality Benchmarks

Chemicals	Fresh water		Marine		Livestock watering		Irrigation		Potable water	
	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference	mg/L	Reference
Tributyltin	8.0E-06	CCME 1999	1.0E-06	CCME 1999	2.5E-01	CCME 1999	Insufficient data	CCME 1999		
Trichloromethane	1.8E-03	CCME 1999	Insufficient data	CCME 1999	1.0E-01	CCME 1999	Insufficient data	CCME 1999	1.0E-01[b]	HC 2017
2,4,6-Trichlorophenol	1.8E-02	CCME 1999		CCME 1999					2.0E-03[a]	HC 2017
Trifluralin	2.0E-04	CCME 1999		CCME 1999	4.5E-02	CCME 1999	Insufficient data	CCME 1999	4.5E-02	HC 2017
Triphenyltin	2.2E-05	CCME 1999		CCME 1999	8.2E-01	CCME 1999	Insufficient data	CCME 1999		
Xylenes	1.8E-01	EC 2005a							2.0E-02[a]	HC 2017
Vinyl chloride									2.0E-03	HC 2017

[a] Value is the aesthetic objective (AO). Consult HC 2017 for more information.

[b] Value is for trihalomethanes (THMs) and refers to the total of bromodichloromethane (BDCM), dibromochloromethane (DBCM), tribromomethane (bromoform) and trichloromethane (chloroform); the total sum of bromodichloromethane, dibromochloromethane, tribromomethane and trichloromethane concentrations should not exceed 0.1 mg/L.

Appendix E. Half-Life and Soil Quality Guidelines

Chemicals	Half-life in saturated zone		Soil quality guidelines for soil contact		
	$t_{1/2}$ yr	Reference	Agricultural (coarse texture) mg/kg	Agricultural (fine texture) mg/kg	Reference
1,1,1-Trichloroethane					
1,1,2,2-Tetrachloroethene (PCE)					
1,1,2,2-Tetrachloroethane					
1,1,2-Trichloroethene (TCE)	2.19	CCME 2007b	3	3	CCME 1999
1,2,3,4-Tetrachlorobenzene					
1,2,3,5-Tetrachlorobenzene					
1,2,3-Trichlorobenzene					
1,2,4,5-Tetrachlorobenzene					
1,2,4-Trichlorobenzene					
1,2-Dichlorobenzene					
1,2-Dichloroethane					
1,3,5-Trichlorobenzene					
1,3-Dichlorobenzene					
1,4-Dichlorobenzene					
2-Methylnaphthalene					
3-Iodo-2-propynyl butyl carbamate					
Acenaphthene					
Acridine					
Aldicarb					
Aldrin					
Aniline					
Anthracene			2.5	2.5	CCME 1999
Atrazine					
Benzene	1	EC 2005b	31	60	CCME 1999
Benz(a)anthracene					
Benzo(a)pyrene			20	20	CCME 1999
Bromacil					
Bromodichloromethane					
Bromoxynil					
Captan					
Carbaryl					
Carbofuran					
Chlorothalonil					
Chlorpyrifos					
Cyanazine					
Deltamethrin					
Di(2-ethylhexyl) phthalate					
Dibromochloromethane					
Dicamba					
DDT (total)			12	12	CCME 1999

Appendix E. Half-Life and Soil Quality Guidelines

Chemicals	Half-life in saturated zone		Soil quality guidelines for soil contact		
	$t_{1/2}$ yr	Reference	Agricultural (coarse texture) mg/kg	Agricultural (fine texture) mg/kg	Reference
Dichloromethane					
2,4-Dichlorophenol					
Diclofop-methyl					
Didecyl dimethyl ammonium chloride					
Dieldrin					
Diisopropanolamine			360	360	CCME 1999
Dimethoate					
Di-*n*-butyl phthalate					
Dinoseb					
Endosulfan					
Ethylbenzene	0.312	EC 2005a	55	120	CCME 1999
Ethylene glycol			1100	1100	CCME 1999
F1-fraction			210	210	CCME 2008
F1-Aliphatics C>8-C10	1.95	CCME 2008	210	210	CCME 2008
F1-Aliphatics C>6-C8	1.95	CCME 2008	210	210	CCME 2008
F1-Aromatics C>8-C10	1.95	CCME 2008	210	210	CCME 2008
F2-fraction			150	150	CCME 2008
F2-Aliphatics C>10-C12	4.79	CCME 2008	150	150	CCME 2008
F2-Aliphatics C>12-C16	4.79	CCME 2008	150	150	CCME 2008
F2-Aromatics C>10-C12	4.79	CCME 2008	150	150	CCME 2008
F2-Aromatics C>12-C16	4.79	CCME 2008	150	150	CCME 2008
Fluoranthene			50	50	CCME 1999
Fluorene					
Glyphosate					
Heptachlor + heptachlor epoxide					
Hexachlorobenzene					
Hexachlorobutadiene					
Hexachlorocyclohexane					
Imidacloprid					
Indeno(1,2,3-c,d)pyrene					
Linuron					
Methanol	0.67	CCME 2017	1200	1200	CCME 2017
Methoprene					
Methyl tertiary-butyl ether					
Methylchlorophenoxyacetic acid (2-Methyl-4-chloro phenoxy acetic acid)					
Methylmercury					
Metolachlor					
Metribuzin					
Monochlorobenzene					

Appendix E. Half-Life and Soil Quality Guidelines

Chemicals	Half-life in saturated zone		Soil quality guidelines for soil contact		
	$t_{1/2}$ yr	Reference	Agricultural (coarse texture) mg/kg	Agricultural (fine texture) mg/kg	Reference
2-chlorophenol					
Naphthalene			0.6	0.6	CCME 1999
n-Hexane					
Nonylphenol and its ethoxylates			5.7	5.7	CCME 1999
Pentachlorobenzene					
Pentachlorophenol			11	11	CCME 1999
Permethrin					
Phenanthrene					
Phenol			20	20	CCME 1999
Phenoxy herbicides					
Picloram					
Propylene glycol	0.0274	CCME 2007c			
Pyrene					
Quinoline					
Simazine					
Styrene					
Sulfolane			210	210	CCME 1999
Tebuthiuron					
Tetrachloromethane					
2,3,4,6-Tetrachlorophenol					
Toluene	0.288	EC 2005a	75	110	CCME 1999
Toxaphene					
Triallate					
Tribromomethane					
Tributyltin					
Trichloromethane					
2,4,6-Trichlorophenol					
Trifluralin					
Triphenyltin					
Xylenes	0.5	EC 2005a	95	65	CCME 1999
Vinyl chloride					

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