



**Environmental Quality Guidelines  
for Alberta Surface Waters**

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## Purpose

This document updates and expands surface water quality and aquatic ecosystem guidelines for Alberta. It is the most recent edition in an ongoing process of development and updates of environmental quality guidelines.

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## Preface

This document updates and expands surface water quality and aquatic ecosystem guidelines for Alberta. It is the most recent edition in an ongoing process of development and updates of environmental quality guidelines. Updated individual guidelines, and any future revised documents, will be posted on the departmental webpage for 'Water Quality Guidelines'. Users should check the website to confirm that they are using the most recent guidelines.

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# 1. Introduction

## 1.1. Purpose of this Document

This document compiles surface water quality and aquatic ecosystem guidelines for Alberta. It updates and replaces the Surface Water Quality Guidelines for use in Alberta (Alberta Environment (AENV) 1999) and Appendix 8 of the Water Quality Based Effluent Limits Procedure Manual (Alberta Environmental Protection (AEP) 1995). It is the latest edition in an ongoing process of development, review, and compilation of environmental quality guidelines. Such guidelines are science-based recommendations that protect water uses and form a cornerstone of aquatic ecosystem management and protection. They are foundational elements in cumulative effects management (CEM). This document includes guidelines for surface water quality (to protect aquatic life, agricultural, and recreational uses), sediment quality, and tissue residue (to protect wildlife consumers and fish from direct toxicity). The surface water quality guidelines herein do not apply to drinking water – there are separate drinking water guidelines available (Health Canada 2012a).

## 1.2. Background and History

The first major step in the development of water quality guidelines for Alberta was the issuance of Surface Water Quality Criteria Province of Alberta by the Alberta Department of Health (ADH) in 1970 (ADH 1970). This was followed by the establishment of the Alberta Surface Water Quality Objectives in 1977 (AENV 1977). These objectives were the main values used to evaluate water quality until 1987, when the Canadian Council of Resource and Environment Ministers (CCREM) released the Canadian Water Quality Guidelines (CCREM 1987). Since then, the Canadian Water Quality Guidelines (CWQG) have been updated and guidelines for new substances have been added. The CWQG were used in Alberta, especially for substances without Alberta objectives, or where guidelines for a specific use were required.

The *Environmental Protection and Enhancement Act (EPEA)*, passed in 1993, provides for the development of guidelines and ambient environmental quality objectives for the province of Alberta. In accordance with this legislation, the department established a protocol for developing water quality guidelines for the protection of freshwater aquatic life (AEP 1996a), which was used to prepare guidelines for selected substances (AEP 1996b; 1997; 1998). The protocol was patterned on United States Environmental Protection Agency (USEPA) methods. Subsequently, the USEPA updated a number of their criteria and procedures (USEPA 1999) and the Canadian Council of Ministers of the Environment (CCME) released a new compilation of environmental quality guidelines (CCME 1999). This prompted further review of guidelines and resulted in the Surface Water Quality Guidelines for use in Alberta (AENV 1999).

Since 1999, the CCME has developed a new protection of aquatic life (PAL) guideline protocol (CCME 2007), developed new PAL guidelines, and updated guidelines for agricultural use. CCME has also issued sediment quality and tissue residue guidelines (CCME 2001; 2002). Environment Canada has developed Federal Environmental Quality Guidelines, based on the updated CCME protocol, for substances assessed as toxic under the *Canada Environmental Protection Act, 1999* and the Chemicals Management Plan. The USEPA has continued to develop PAL guidelines, as have some provinces. The federal-provincial-territorial Committee on Health and the Environment (CHE) has updated the Guidelines for Canadian Recreational Water Quality (Health Canada 2012). The present document updates guidelines for Alberta in view of this more recent information.

### 1.3. Changes from Previous Editions

A number of improvements have been made since 1999. These include incremental refinements to surface water guidelines and their application as well as expansion to include other media important to aquatic ecosystem health. The following changes were incorporated in the 2014 edition:

- Definitions have been updated and aligned with current usage
- Principles are more fully described and aligned with *Water for Life* (Government of Alberta (GOA) 2003)
- More guidance is provided on the use and application of guidelines
- The guidelines themselves have been expanded in scope and updated:
  - The protection of aquatic life (PAL) guidelines have been reviewed and only the most appropriate single source for each substance included (up to three sources were listed in 1999). Updated values and new substances are included. Draft Alberta guidelines for copper and mercury from the 1999 version have been finalized
  - Agricultural and recreational guidelines have been updated
  - Guidelines for sediment quality and tissue residue (for wildlife consumers) are now included

Changes to the 2018 edition include the following:

- Guidelines have been added for fish tissue to protect them from direct toxicity
- Guidelines have been updated for the following substances:
  - Protection of Aquatic Life: Cobalt, Selenium, Silver
  - Recreation: *E. coli*, Enterococci
- Guidelines have been added for the following substances:
  - Protection of Aquatic Life: Carbamazepine, Chlorinated alkanes (CA), Hexabromocyclododecane (HBCD), and Tetrabromobisphenol A

### 1.4. Relationship to Other GOA Guidelines and Policies

Guidelines are science-based recommendations that form a cornerstone of water quality and aquatic ecosystem management. They are not legal instruments, however, guidelines and the site-specific objectives derived from them can be used in developing legally binding effluent limits under the *Environmental Protection and Enhancement Act (EPEA)*. They can also be used in management frameworks as part of Regional Plans developed under the Land-use Framework (GOA 2008a) and the *Alberta Land Stewardship Act*, as well as other management tools. They are an integral component of the GOA Integrated Resource Management system that operates in accordance with the principle of cumulative effects management. The guidelines in this document support the Water Quality Based Effluent Limits Procedures Manual (AEP 1995), the Alberta Tier 1 Soil and Groundwater Remediation Guidelines (Alberta Environment and Parks (AEP 2016a), and the Alberta Tier 2 Soil and Groundwater Remediation Guidelines (AEP 2016b). The recreation and aesthetic guidelines also support those in use by Alberta Health under the *Public Health Act*.

## 2. Definitions and Principles

### 2.1. Definitions

Following are key definitions for the field of aquatic environmental quality guidelines. They are generic since they apply to all aquatic media, including water, sediment, and tissue residue guidelines. Additional relevant definitions are included in the glossary along with abbreviations and acronyms (Section 8). In setting out these definitions this document attempts to:

- Minimize new terms and keep definitions as basic as possible
- Maximize consistency with existing terminology (e.g. CCME)
- Align terminology with legislation and policy guidance where available (e.g. Alberta Environment and Water (AEW) 2012)

#### Guideline

A **Guideline** is a numerical concentration or narrative statement which is **recommended** to protect a specific use of water or other aquatic ecosystem component.

Guidelines are intended to provide consistent, science-based recommendations for the protection of various water uses. Long-term or chronic guidelines are the scientific best-estimates of no-effect thresholds or safe levels for the particular use and substance in question. They do not specifically consider socio-economic factors or site-specific conditions, but can include adaptations where certain ambient chemical or physical conditions modify the toxicity of a substance. As recommendations, guidelines are not directly enforceable, though they do provide the basis for effluent limits and the scientific basis to support other management tools.

#### Site-Specific Guideline (SSG)

A **Site-Specific Guideline** is a numerical concentration or narrative statement which is **recommended** to protect a specific use for specified waters.

Guidelines could be developed for specific sites such as river reaches or lakes where there is evidence that a generic guideline is not appropriate. These would also be science-based recommendations that would not consider socio-economic factors. Guidance for deriving SSGs has been prepared by Alberta (AEP 1996a) and CCME (2003; 2007) and is discussed further in Section 4.10. However, caution should be used when considering the development of SSGs due to the resources and time involved. In many cases, site-specific water quality objectives that give consideration to additional factors, may be more appropriate.

#### Site-Specific Water Quality Objective

A **Site-Specific Water Quality Objective** is a numerical concentration or narrative statement which has been **established** for specified waters and which has an action and/or management commitment.



Consistent with historic and national usage ‘Water Quality Objective’ is the generic term for established values or narratives. They become site-specific when limited in application to specified waters. More specific terms include triggers, targets, and ambient limits (AEW 2012). In contrast to guidelines, site-specific water quality objectives carry some action or management commitment and can be established by means of Water Management Plans, Regional Plans, or other policies and practices.

Establishing water quality objectives involves science-based procedures and also socio-economic considerations (AEP 1996a; AEW 2012; and Section 4.10). Additional guidance on objectives can be found in AEW (2012).

## 2.2. Principles

The intent of the *Water for Life Strategy* (WFL) (GOA 2003; 2008b) is to ensure the wise management of the province’s water resources so that Albertans are assured of:

- Safe and secure drinking water
- Healthy aquatic ecosystems
- Reliable quality water supplies for a sustainable economy

The guidelines in this document support this strategy by identifying levels that may be necessary to meet these goals.

### 2.2.1. Water Uses to Protect

In keeping with the general intent of the *Environmental Protection and Enhancement Act (EPEA)*, the *Water Act*, the Framework for Water Management Planning (including the Strategy for the Protection of the Aquatic Environment that it contains) (AENV 2001), and the *WFL Strategy*, all existing and potential uses of water should be protected. Uses for which guidelines have been developed include:

- Aquatic life
- Agricultural (irrigation and livestock water)
- Recreation and aesthetics
- Raw water for drinking water supply
- Industrial water supply

The first three have numerous guidelines in existence, of which the protection of aquatic life (PAL) guidelines are usually the most stringent, indicating that aquatic life is often the most sensitive use. For some herbicides, irrigation is the most sensitive use because of the toxicity to crops. Guidelines for untreated drinking water **supply** are few, although guidelines or objectives are sometimes developed where warranted. Although mainly relevant to potable water treatment plants, they can also be relevant to local domestic use of surface and ground water. Guidelines for industrial water supply are rarely needed for surface waters, although there may be instances where this is warranted. Although initially supported by the CCME, guidelines for industrial water supplies are no longer considered necessary because water can generally be treated to meet industrial requirements. Additional uses, such as cultural or traditional uses, could be considered in the development of site-specific water quality objectives, but do not have science-based protocols for their derivation.

### **2.2.2. Minimum Level of Protection**

Because all uses of water should be protected, it follows that waters should be managed so that, at a minimum, the water quality guideline (WQG) for the most sensitive use is met. In decisions under *EPEA*, the ability to be protective of the most sensitive use is evaluated. This is especially important for toxic substances, so as to protect aquatic ecosystem health. Exceptions would be where natural water quality does not meet the most sensitive WQG, in which case the natural water quality should be maintained or a site-specific guideline derived.

### **2.2.3. Pollution Prevention**

The guidelines in this document should not be interpreted as permitting, encouraging, or condoning degradation of existing water quality or the aquatic environment, where conditions are better than the guidelines. In other words, guidelines are not ‘pollute-up-to’ numbers. This has been set out in the Alberta Protection of Aquatic Life protocol (AEP 1996a), and is consistent with federal-provincial guidance (CCME 2003; Environment Canada 2004), and transboundary agreements (e.g. Prairie Provinces Water Board (PPWB) 1991).

### 3. Sources and Adoption of Guidelines for Alberta

The PAL guidelines in this document for freshwater, sediment, and tissue have been compiled and assessed from Alberta (AEP 1996b, 1997, 1998), CCME (2017), Environment and Climate Change Canada (ECCC 2017), and USEPA (USEPA 2017) sources, and in some cases from other provinces (Ontario Ministry of Environment and Energy (OMOEE) 1994; Ministère du Développement durable, de l' Environnement, de la Faune et des Parcs (MDDEFP) (Quebec) 2013; B.C. Ministry of Environment 2018). The agricultural guidelines have been compiled primarily from the CCME, while the recreational guidelines are primarily from Health Canada (2012) and the USEPA (2012). Alberta sources were also used for some agricultural and recreational guidelines, but in general, fewer guidelines are available for these uses. The guidelines and their sources are listed in the Summary Tables (Section 9). Only North American guidelines were considered because they are more relevant to Alberta biota and water uses.

New guidelines are continually being developed, as scientific information increases on water quality, water use requirements, contaminant toxicity, and aquatic ecosystem health. The protocols for guideline development also continue to evolve. Guideline development can be a costly and lengthy process and therefore it is efficient to adopt science-based guidelines from other jurisdictions, provided they are sound. Alberta reviews protocols and guidelines from other jurisdictions or contributors as they become available, for the potential to adopt guidelines appropriate for the province. In addition to an acceptable protocol, the level of species protection involved in such guidelines is an important factor. Alberta considers these and other factors, such as the specific conditions and environmental concerns in the province, and uses best scientific judgment when adopting guidelines.

For freshwater aquatic life, guidelines developed using the more recent PAL protocols are preferred (i.e., CCME 2007 Type A; Alberta PAL protocol 1996; USEPA 1985). These protocols generally draw on a larger sample size of toxicity end-points, utilize a statistical approach in guideline derivation, and may or may not include a safety factor. These contrast with older protocols that derive guidelines through application of a safety factor to the most sensitive toxicity endpoint (i.e., CCME 1991). In particular and to promote national consistency, Alberta favours water quality guidelines developed using the CCME 2007 PAL Type A protocol (CCME 2007), in order to ensure guidelines adopted for those substances are at least as protective as the CCME values. Ultimately, the most appropriate guidelines for Alberta are selected with consideration of the protocol, level of protection, amount and suitability of toxicological endpoints used in guideline derivation, inclusion of important Alberta species, and the most appropriate forms of the substance (e.g., total versus dissolved metal forms).

Similarly, guidelines derived using the most recent CCME protocols for agricultural water use (CCME 1993), sediment (CCME 1995), and tissue residue (for wildlife consumer) (CCME 1998) guidelines, are preferred. More detail on guideline sources and adoption can be found in Section 5.

## 4. Use and Application of Guidelines

The science-based guidelines listed in this document are meant to provide guidance for evaluating water quality and aquatic conditions in Alberta, as well as to provide scientific support for water quality management and contaminated site remediation. Examples of some current applications of the guidelines include:

- Providing numeric values against which to evaluate water quality
- Providing the scientific starting point for the derivation of site-specific water quality objectives (targets, triggers and ambient limits; AEW 2012) in management frameworks
- Supporting the Water Quality Based Effluent Limits Procedures Manual (AEP 1995) in setting substance release limits in approvals

Various considerations for use or application of the guidelines are outlined below; however, users should refer to other documents (AEP 1995; 1996a; AEP 2016a; 2016b; AEW 2012) for detailed guidance on their application.

In using environmental quality guidelines, it is important to understand their limitations. Guidelines apply to a single substance and generally do not account for interactions among substances (cumulative toxicity, synergism, antagonism), food web effects (bioaccumulation or biomagnification), or secondary (i.e., indirect) effects. As a result, they do not guarantee the expected level of protection if used as the sole tool in water quality management. As well, they are not available for all substances of concern. If a substance has not been listed in this document it is generally because there are no appropriate guidelines available. Such substances may still be of concern and when warranted, will be dealt with on a case-by-case basis.

### 4.1. Applicable Surface Waters

The protection of aquatic life guidelines in this document are a tool in environmental protection and in keeping with the *Environmental Protection and Enhancement Act*, are meant to apply to all surface waters. The *Act* defines surface waters as “..water in a watercourse..” and includes standing and flowing waters, both natural and man-made. Exceptions may exist, such as lagoons constructed for the purpose of containing raw water supplies or approved wastewaters, particularly where measures are taken to exclude other uses of these waters. The guidelines may have limited applicability to dugouts, depending on the purpose and use of the dugout. They also may have selected applicability to mixing zones (Section 4.7).

Guidelines for the protection of agricultural uses apply to any source used for agricultural purposes, both surface and ground water. Guidelines for recreation apply to any untreated waters that are used for recreation.

### 4.2. Full and Interim Guidelines

Full guidelines are those for which sufficient scientific information was available to meet the minimum requirements of the derivation protocol. This allows for a reliable guideline that provides the specified level of protection. In some instances it may have been necessary to develop a guideline with less scientific information than set out by the protocol. Such guidelines are termed interim or provisional, or in the case of the 2007 CCME protocol, type B2. They generally include safety factors to compensate for the lesser amount of supporting scientific information, in order to provide an appropriate level of protection. Despite such limitations, these

guidelines provide the best available estimate of protective levels and assist in the evaluation and management of water quality. They are upgraded as new information becomes available and priorities warrant.

### **4.3. Coherence of Guidelines for Different Media**

The PAL guidelines in this document cover surface water quality, sediment quality, and tissue residue; therefore, some substances will have guideline values for two or more of these media. These can be useful in accounting for all routes of exposure to a substance. For lipophilic substances (those tending to partition out of water and into fatty tissue), the main exposure to aquatic organisms may be via their food, not water, and so if food tissues are contaminated, there could be impacts on aquatic life even if water concentrations are within the guideline. Similarly, some livestock water guidelines require consideration of the amount of a substance in feed sources in addition to stock watering sources (e.g., fluoride) (Alberta Agriculture and Food (AAF) 2007). Coherent guidelines take the various exposures into account such that the values in each media provide the same level of protection to the water use. In cases where such guidelines are not coherent and the substance in question is of high priority, the values may be adjusted based on the partitioning between media to provide appropriate protection.

### **4.4. Evaluation of Ambient Data**

Guidelines support the evaluation of data on water, sediment, and biota. The guidelines in this document can be used in combination with monitoring data to assess ambient conditions and to identify areas with existing or potential concerns. If monitoring data do not exceed the guidelines, problems are less likely. If the guidelines are exceeded, further investigation may be necessary to determine the source of the substance as well as the magnitude and extent of any exceedance and potential adverse effects. Mitigation and management may be required to address causes and impacts.

### **4.5. Exceedance Due to Natural Conditions**

Under some natural conditions and particularly in certain seasons, water quality variables may exceed guidelines. This situation occurs most often with total metals because of their association with suspended solids in water. A number of other natural exceedances can occur, such as in the naturally saline lakes of the prairie-parkland with their water quality and biota that are much different than freshwater and marine situations. Where it can be demonstrated that the natural water quality does not meet a specific guideline, then the guideline would not be appropriate and other approaches (e.g., site-specific guidelines or objectives) may be used for management purposes. However, this does not mean that degradation of the natural water quality is permitted (see Section 2.2.3).

### **4.6. Averaging Period and Frequency of Exceedance**

Some protection of aquatic life guidelines include averaging periods, which is the length of time over which an average concentration could be determined and compared to the guideline. Similarly, and because aquatic conditions vary in time and space, some guidelines may include an allowable frequency of exceedance (which is implied in an averaging period). Short-term (acute) guidelines have shorter averaging periods and allow fewer, if any, exceedances than long-term (chronic) guidelines. In general, short-term guidelines should be met at all times as they are estimators of severe effects to the aquatic ecosystem and are intended to provide guidance on

severe, but transient situations (e.g., spills) (CCME 2007). The most straightforward approach to long-term guidelines is to meet them all the time, particularly if no short-term guideline is available for the variable. If that is not possible, then an appropriate monitoring frequency and frequency of exceedance could be derived with the intent of minimizing the stress to the aquatic ecosystem and maintaining its ability to recover (resilience). The sources or scientific documents supporting the individual guidelines (Section 5) may provide further information on the appropriate averaging periods and where applicable, are noted in the tables (Section 9). Further information on how these concepts apply to approved effluent limits can be found in AEP (1995).

#### **4.7. Approved Effluents and Mixing Zones**

The surface water quality guidelines to protect aquatic life are important for establishing water quality-based effluent limits (AEP 1995). As effluents rarely mix instantaneously with the receiving streams, limited mixing zones may be established, where necessary, in which water quality guidelines may be exceeded. More details on deriving effluent limits and mixing zones are contained in the Water Quality-Based Effluent Limits Procedures Manual (AEP 1995).

#### **4.8. Analytical Capability and the Use of Guidelines**

Because long-term or chronic guidelines are scientific estimates of no-effect, or safe, levels, they may be below the analytical capability (i.e., detection limit) for some substances. If a guideline value falls below the method detection limit for a variable, it can still be used, for example, in developing effluent limits by means of dilution calculations. Similarly, substances can be measured at the source and modeled to determine its residual concentration.

Analytical capability continues to improve and detection limits are likely to decrease for many variables. Although many analyses may not be routine, specialized analyses may be available. Wherever possible, analyses should be sensitive enough to detect a substance at or below the guideline level or at a minimum, analyses must follow the Laboratory Data Quality Assurance Policy (AENV and ASRD 2001). Those substances that have guidelines that are currently below the detection limits are noted in the appropriate table.

#### **4.9. Exceptions to Application of Guidelines**

As set out in the **Principles** (Section 2.2.2), all uses of water should be protected, and therefore management of surface waters should endeavor to at least meet the most sensitive water or sediment quality guidelines. Possible exceptions to this may be where:

- Natural water/sediment quality does not meet the guideline (Section 4.5)
- A site-specific water quality objective (SSWQO) is established and takes precedence

#### **4.10. Site-Specific Guidelines**

Under limited circumstances where there is evidence that generic toxicity-based WQGs are not appropriate, site-specific protection of aquatic life guidelines could be derived from full guidelines. These situations include:

- 1) Where resident aquatic biota differs notably from that used in guideline derivation

- 2) Where specific water quality at the site may alter the toxicity of the substance
- 3) Where natural conditions exceed the guidelines

Although (1) was described in both AEP (1996a) and CCME (2003), advances in guideline development mean the recalculation procedure is not applicable to guidelines developed using the CCME (2007) Type A protocol. These guidelines rely on a broad distribution of species to statistically determine appropriate guidelines and the protocol also contains provisions for adapting guidelines that may not be fully protective of all resident species. However, for guidelines derived with other protocols, SSGs may be useful for situations where guidelines do not consider an important resident species that is particularly sensitive to a substance.

Deletion of sensitive species that are non-resident as per the recalculation procedure would require intensive surveys to confirm the absence of a resident species and any potential surrogate species.

In the case of (2), many guidelines now include exposure and toxicity-modifying factors, such as pH or hardness, eliminating the need for SSGs in these cases.

In all cases, additional toxicity testing may be required and would be the responsibility of the proponent. Site-specific guidelines can only be developed from full guidelines. Caution should be exercised in the decision to derive acceptable scientifically-rigorous site-specific guidelines due to the significant amount of time and resources required to develop an acceptable guideline. In many cases, the development of a site-specific water quality objective, which also takes into account socio-economics and existing conditions, might be more appropriate. Any efforts to develop site-specific guidelines must be done with extensive consultation with AEP in order:

- To determine the need for developing an SSG
- To ensure that proper procedures are followed
- To develop a guideline that is protective of aquatic life at the site

If these steps are not taken, the SSG may not be accepted for use. Further guidance is available in AEP (1996a) and CCME (2003; 2007).

## 5. Guidelines

### 5.1. Introduction

Guidelines adopted in this document have come from several jurisdictions and were derived with a range of protocols. Relevant information about the guidelines and protocols are provided below to assist in the use of the guidelines in the summary tables (Section 9).

It should be noted that some substances in the tables are slated for virtual elimination under the *Canadian Environmental Protection Act* (CEPA) and have therefore been withdrawn by the CCME as water is not the predominant route of exposure. However, the long-term guidelines are retained here with a strikethrough and footnoted according to the CCME guidance as they may be useful in the unlikely event these contaminants are detected in water.

### 5.2. Surface Water Quality Guidelines for the Protection of Aquatic Life

#### 5.2.1. General Features

Long-term guidelines for the protection of aquatic life (Table 1) are levels of the substance or condition that should result in negligible risk of adverse effects on growth, reproduction, or survival of aquatic biota, for an indefinite period. Short-term guidelines are derived from severe effects data and are meant to provide guidance on severe, but transient situations. Where available and appropriate, both long-term and short-term guidelines are provided (see also Section 4.6). As aquatic species are typically immersed in the aquatic environment for all or part of their life cycle, protection of aquatic life guidelines are often more stringent than for other water uses, including drinking water.

Some substances have toxicity that is influenced by other water quality variables, such as pH, temperature and hardness (exposure and toxicity modifying factors (ETMF)). These are noted in the summary tables and may have supplementary 'look-up' tables and equations provided to aid in calculation of the guideline value under various conditions.

#### 5.2.2. Nutrients

Nutrient enrichment is a very important issue for Alberta's lakes, rivers, and streams. Typical guideline protocols for protection of aquatic life are not valid for deriving guidelines for total nutrients, as not all nutrient forms are directly toxic. Nonetheless, nutrient increases can have considerable detrimental effects, including undesirable growth of algae and aquatic macrophytes that can contribute to recreational and aesthetic impairments, outbreaks of toxic cyanobacteria, shifts in species assemblages, and ultimately, a reduction in dissolved oxygen levels and biodiversity.

Background nutrient concentrations vary widely across the province. Generally, nutrients are very low in lakes and streams with mountainous headwaters, and are enriched with nutrients in other more eastern and northern ecoregions. Other factors, such as land use, soil and vegetation types, hydrological factors, climatic influences, and salinity can also impact nutrient status. Lake trophic condition data and the river water quality index results for nutrients are available on the departmental website. Given the wide range and the numerous factors influencing nutrient concentrations, it is impossible to determine a single value that would be protective or desirable for all Alberta waters. The previously published values of 0.05 mg/L for total phosphorus and 1.0



mg/L for total nitrogen (ADH 1970) have now been withdrawn. In lieu of numeric guideline values, narrative statements have been developed for lakes, rivers, and other water bodies (Table 1.5). Work is ongoing to develop science-based numeric guidelines for major rivers. As with other guidelines, a use-protection approach (AEW 2012), aimed at protecting aquatic life as well as recreational and aesthetic value, will be taken.

### **5.2.3. Metals**

In most cases, guidelines for the total metal are preferred over those for the dissolved fraction. This is to address potential transformation of the metal fractions in receiving waters into more bioavailable forms and to account for all exposure routes. Exceptions are made for iron and aluminum (Table 1), two metals strongly associated with suspended solids, which can be naturally high in Alberta rivers. Applying the guideline to the dissolved form is more appropriate because the particulate fraction is largely natural and of limited bioavailability. New ways of developing and expressing metal guidelines are emerging, particularly the use of the biotic ligand model (BLM). However, the BLM is still in development and often requires extensive supporting data for calculation, limiting its present application across the province.

### **5.2.4. Petroleum Hydrocarbons**

Guidelines for water-soluble petroleum hydrocarbon fractions are listed in Table 1. Although they were not derived using typical protocols, they are important for management of water quality in Alberta. The Canada Wide Standards for Petroleum Hydrocarbons (CCME 2008) recommended water quality benchmarks for sub-fractions based on the number of carbon atoms and structure (aromatic and aliphatic). However, there is difficulty in using these directly for aquatic life guidelines as they were calculated based on fractionation of hydrocarbons in soil and so that sub-fractions could be used for modeling purposes (CCME 2008). Therefore, whole product toxicity thresholds were used for the F1 and F2 fractions. These values showed good agreement with values calculated from the water quality benchmarks adjusted for their maximum solubility in water and toxicity reference values using surrogate hydrocarbons.

### **5.2.5. Toxicity Guidelines**

Table 1 lists PAL guidelines for many toxic substances. As noted earlier, guidelines do not necessarily provide the expected level of protection if utilized as the sole tool in water quality management. There may be interactions between toxic contaminants, and there are many substances for which no guidelines are available. To partly address this limitation, Alberta has set out toxicity guidelines for mixtures (AEP 1995; 1996a). These guidelines can be applied to surface waters that receive substance releases, including mixing zones, and are listed in Table 1.

## **5.3. Water Quality Guidelines for Agriculture**

The majority of water quality guidelines for the Protection of Agricultural Water Uses (Table 2) were developed by the CCME using their 1993 protocol. Several of the guidelines remain as interim values due to limited numbers of crop or livestock studies, and many older guidelines do not have published fact sheets detailing their derivation. Some adaptation of these guidelines is also done by Alberta, as outlined below.

### **5.3.1. Irrigation**

The irrigation guidelines were developed to protect all life stages of sensitive crop species grown in Canada. Most were derived using the CCME (1993) protocol for guidelines for the Protection of Agricultural Water

Uses. When irrigation studies are available, guidelines are derived from the geometric mean of the lowest observed adverse effect level (LOAEL) and no-observed adverse effect level (NOAEL) divided by an uncertainty factor. When these studies are not available, the protocol uses either the acceptable soil concentration (mg/kg) or the acceptable application rate (kg/ha) of a substance based on the most sensitive crop species, to which a safety factor is applied. This value is then divided by the maximum irrigation rate to determine the irrigation guideline. The maximum irrigation rate used in the CCME protocol was either 1000 or 1200 mm/yr, which was based on the maximum application rate in the Okanagan Valley, British Columbia. However, irrigation rates are much lower in Alberta and therefore, where the irrigation rate used in the CCME guideline derivation was known, the guidelines were recalculated using a value of 750 mm/yr for gross irrigation rate. This value was calculated from the 90<sup>th</sup> percentile net irrigation water requirement for alfalfa in Alberta (Bennett et al. 2014) and an irrigation system application efficiency of 70% (AARD 2011). In reality, this is still a very conservative value as typical irrigation rates for Alberta are much lower.

### **5.3.2. Livestock Water**

Livestock water guidelines (Table 2) were mostly adopted from CCME guidelines for the Protection of Agricultural Water Uses, which were designed to protect all Canadian livestock species. The guidelines are based on the tolerable daily intake rates of the contaminant, daily water intake, body weights, the potential for bioaccumulation, and the proportion of contaminant exposure via drinking water. Some guidelines are interim. When adequate information is not available to derive a full livestock guideline, and the human drinking water guideline is lower than the interim guideline, then the human drinking water guideline is used as the livestock water value. However, the protocol of defaulting to the human drinking water guideline is not always appropriate. Some substances have additive effects and therefore must be considered together with the amount consumed in feed to ensure adequate protection of livestock health (AAF 2007). Table 2 provides further information on this.

## **5.4. Surface Water Quality Guidelines for Recreation & Aesthetics**

The guidelines for recreation and aesthetics (Table 3) are mostly adopted from the Guidelines for Canadian Recreational Water Quality (Health Canada 2012) and the Recreational Water Quality Criteria (USEPA 2012). They are designed to minimize the health risks to the average recreational water user, (e.g., swimmers, windsurfers, waterskiers, boaters, and fishers). The purpose of recreational water quality guidelines is to prevent human exposure to chemical or biologic hazards that can cause disease or illness through incidental ingestion, dermal exposure, or inhalation. These guidelines are one component of a multi-barrier risk management approach to protecting human health, which includes activities such as source protection, monitoring, hazard control, communication, and consultation.

The aesthetic objectives are all narrative statements primarily designed to ensure a positive perception of the waters by users. Thus, waters should be free of floating debris and objectionable substances and odours. However, the aesthetic objectives may also have implications for the health and safety of water users (e.g., safety risk associated with turbidity or debris) and, potentially, for aquatic life forms.

## **5.5. Sediment Quality Guidelines**

Sediment quality guidelines for the protection of aquatic life (Table 4) are substance concentrations below which adverse effects on aquatic biota are expected to occur only rarely. Most were adopted from CCME

guidelines derived using the National Status and Trends Program protocol (CCME 1995), which uses co-occurrence data of biological and chemical sediment data to estimate effect levels. This protocol requires defensible relationships between specific sediment (e.g., total organic carbon, particle size distribution) and/or overlying water column (e.g., pH) characteristics in order to derive a full guideline. The CCME recommends a spiked-sediment toxicity test (SSTT) approach also be used to derive full guidelines; however, no such guidelines have yet been derived for freshwater sediments due to insufficient data. However, the SSTT data are used to support the interim guidelines in a weight-of-evidence approach. Therefore, all CCME values in this document remain as Interim Sediment Quality Guidelines (ISQG). In addition, a second value, the probable effects level (PEL) is listed and is the concentration above which adverse biological effects frequently occur.

Additional guidelines were also adopted from Ontario using their Screening Level Concentration (SLC) protocol (OMOEE 1993a). This protocol derives a lowest effect level (LEL), which indicates a level of contamination that can be tolerated by most benthic organisms. They are listed separately as LELs and due caution should be exercised when applying these values due to the relatively limited geographic area and datasets they were derived from. A few guidelines for organic substances were also adopted from Environment Canada. These were calculated from fish tissue guideline levels and the ratio of the substance in fish tissue compared to sediment (i.e., biota-sediment accumulation factor) (Environment Canada 2013).

## **5.6. Tissue Residue Guidelines to Protect Wildlife Consumers of Aquatic Biota**

The tissue residue guidelines (TRGs) in Table 5 (also referred to as Wildlife Dietary Guidelines) are for the protection of terrestrial consumers of aquatic biota, but not for protection of human health<sup>1</sup>. Fish and other aquatic species (not reptiles and amphibians) are usually assumed to be protected by sediment and water quality guidelines as the tissue residue guidelines are typically derived for substances that bioaccumulate through the food chain; however, fish tissue guidelines have been derived from some substances (Section 5.7, Table 6). The tissue residue guidelines are meant to be levels that should result in negligible risk of adverse effects from the substance in question for higher order consumers (CCME 1998). The TRGs are designed mainly for bioaccumulative, persistent, toxic substances, particularly those slated for virtual elimination under the *Canadian Environmental Protection Act*. TRGs are derived from chronic toxicity studies from which a tolerable daily intake (TDI) is calculated that should protect the most sensitive species and life stages. An uncertainty factor of at least 10 is applied in this calculation. The TDI is then used with ingestion rates and body weights, to estimate a final TRG. There are minimum data set requirements, so as to provide sufficient confidence in the guideline, for both full and interim guidelines.

The TRG for polychlorinated biphenyls (PCBs) and polychlorinated dibenzo-*p*-dioxins/dibenzo furans (PCDDs, PCDFs) is expressed in toxic equivalency units (TEQ). These are relative to the most potent congener of the PCB and dioxin/furan groups, which is 2,3,7,8 tetrachloro dibenzo-*p*-dioxin (2,3,7,8 TCDD). Although the TEQ method of assessing the toxicity of congeners and mixtures has limitations, it improves the correlation between concentration and observed adverse effects.

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<sup>1</sup> Canadian guidelines for chemical contaminants in fish and fish products are regulated by Health Canada and the Canadian Food Inspection Agency (CFIA 2011). Provincial fish consumption advisories for Alberta are also available (My Wild Alberta 2012).

Guidance on calculation of toxic equivalents is provided in the CCME fact sheets for these substances (CCME 2014). It notes that PCBs should be evaluated jointly with PCDD/PCDF because of their mutual toxic equivalency factors (TEF).

## **5.7. Fish Tissue Guidelines**

The tissue guidelines presented in Table 6 are designed to protect fish themselves from adverse effects. They provide an additional (and in some cases, preferable) metric of assessing adverse effect in an aquatic ecosystem. However, they are not representative of adverse effect in other species groups (e.g., amphibians, plants etc.) They can be specific to tissue type and their application as a wet weight, dry weight or lipid basis is specified in the comments.

They are based on direct toxicity studies and in most cases, the result of a safety factor applied to the lowest low-effect endpoint due to a lack of data.

## 6. Future Updates and Revisions

The availability of new guidelines will be reviewed regularly. If new guidelines are adopted or developed by Alberta, they will be posted on the website and included in the appropriate table of this document. The document text will only be updated when required. The most recent guidelines and a record of updates will be available from the 'Water Quality Guidelines' website.

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## 8. Glossary

### 8.1 Definitions

**Averaging period:** The time over which concentrations of a substance are averaged in order to compare to the guideline.

**Criteria:** Concentrations or levels associated with a degree of environmental effect upon which scientific judgment may be based (CCME). (Note other agencies may use this term in the sense of guidelines).

**Exposure and Toxicity Modifying Factors:** Environmental factors or physical, chemical or biological interactions that modify the exposure and behaviour of chemical substances and therefore, the toxicity to aquatic plants and animals. Examples include hardness, pH, dissolved organic carbon and temperature.

**Guideline:** A numerical concentration or narrative statement which is recommended to protect a specific use.

**Long-term Guideline:** Guidelines meant to protect against all negative effects during indefinite exposures. Equivalent to chronic guidelines.

**Lowest Effects Level:** For sediment quality guidelines, indicates a level of contamination that can be tolerated by most sediment-dwelling organisms.

**Probable Effects Level:** For sediment quality guidelines, defines the level above which adverse effects are expected to occur frequently.

**Short-term guideline:** Guidelines meant to protect against severe effects and to protect most species against lethality during intermittent and transient events. Equivalent to acute guidelines.

**Site-Specific Guideline:** a numerical concentration or narrative statement which is recommended to protect a specific use for specified waters.

**Site-Specific Water Quality Objective:** A numerical concentration or narrative statement which is established for specified waters, and which has an action and/or management commitment.

**Standard:** Objectives that are recognized in enforceable environmental control laws of a level of government.

**Variable:** A substance in, or condition of, the water. Sometimes referred to as a parameter, it may be physical, chemical, radiological, or biotic.

## 8.2 Abbreviations and Acronyms

<b>AAF:</b>	Alberta Agriculture and Food
<b>AAFRD:</b>	Alberta Agriculture, Food and Rural Development
<b>AARD:</b>	Alberta Agriculture and Rural Development
<b>ADH:</b>	Alberta Department of Health
<b>AEH:</b>	Aquatic Ecosystem Health
<b>AENV:</b>	Alberta Environment
<b>AEP:</b>	Alberta Environmental Protection
<b>AEP:</b>	Alberta Environment and Parks (ESRD became AEP, May 2015)
<b>AEW:</b>	Alberta Environment and Water
<b>BLM:</b>	Biotic Ligand Model
<b>CCME:</b>	Canadian Council of Ministers of the Environment
<b>CCREM:</b>	Canadian Council of Resource and Environment Ministers
<b>CEMS:</b>	Cumulative Effects Management System
<b>CEPA:</b>	<i>Canadian Environmental Protection Act</i>
<b>CHE:</b>	Committee on Health and the Environment (of Health Canada)
<b>CWQG:</b>	Canadian Water Quality Guidelines
<b>DO:</b>	Dissolved oxygen
<b>EPEA:</b>	<i>Environmental Protection and Enhancement Act</i>
<b>ESRD:</b>	(Alberta) Environment and Sustainable Resource Development (consolidated department, May 2012)
<b>ETMF:</b>	Exposure and Toxicity Modifying Factor
<b>FEQG:</b>	Federal Environmental Quality Guideline
<b>GOA:</b>	Government of Alberta
<b>ISQG:</b>	Interim Sediment Quality Guideline
<b>LEL:</b>	Lowest Effects Level
<b>LOAEL:</b>	Lowest Observed Adverse Effect Level
<b>LUF:</b>	Land-use Framework
<b>NOAEL:</b>	No Observed Adverse Effect Level
<b>NTU:</b>	Nephelometric Turbidity Units
<b>OMOEE:</b>	Ontario Ministry of Environment and Energy
<b>PAL:</b>	Protection of Aquatic Life

<b>PCB:</b>	Polychlorinated biphenyl
<b>PCDD:</b>	Polychlorinated dibenzo- <i>p</i> -dioxin
<b>PCDF:</b>	Polychlorinated dibenzofuran
<b>PHC:</b>	Petroleum hydrocarbons
<b>PEL:</b>	Probable effects level
<b>PPWB:</b>	Prairie Provinces Water Board
<b>SLC:</b>	Screening Level Concentration
<b>SAR:</b>	Sodium Adsorption Ratio
<b>SSD:</b>	Species sensitivity distribution
<b>SSG:</b>	Site-specific guideline
<b>SSTT:</b>	Spiked-sediment toxicity test
<b>SSWQO:</b>	Site-specific water quality objective
<b>SWQ:</b>	Surface Water Quality
<b>TDI:</b>	Tolerable daily intake
<b>TEF:</b>	Toxic equivalency factor
<b>TEQ:</b>	Toxic equivalents
<b>TRG:</b>	Tissue residue guideline
<b>TU:</b>	Toxic units
<b>USEPA:</b>	United States Environmental Protection Agency
<b>WFL:</b>	Water for Life
<b>WQG:</b>	Water Quality Guideline
<b>WQO:</b>	Water Quality Objective

## 9. Summary Tables

The following tables summarize guidelines adopted for Alberta. For more information on a particular variable, refer to the source documents as indicated in the tables. Links to the original guideline sources are listed below. To access the related documents referenced in these tables, search one of the following titles at the link below.

### Provincial Governments

1. [Alberta Environment and Parks](#)
  - Surface Water Quality Guidelines and Objectives
2. [Alberta Agriculture and Forestry](#)
  - Salinity and Sodicity Guidelines for Irrigation Water
3. [British Columbia Environmental Protection and Sustainability](#)
  - Approved Water Quality Guidelines & Objectives
4. [Quebec Ministry of Sustainable Development, Parks and the Fight Against Climate Change](#)
  - Critères de Qualité de l'Eau de Surface
5. [Ontario Ministry of Environment and Climate Change](#)
  - Water Management: Policies, Guidelines, Provincial Water Quality Objectives

### Federal Governments

1. [Environment and Climate Change Canada](#)
  - Federal Environmental Quality Guidelines
2. [Health Canada](#)
  - Recreational Water Quality Guidelines
3. [Canadian Council of Ministers of the Environment](#)
  - Canadian Environmental Quality Guidelines Summary Tables
4. [United States Environmental Protection Agency](#)
  - National Recommended Water Quality Criteria
  - Recreational Water Quality Criteria

**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
Acenaphthene	Trace organic (PAH)	µg/L	5.8		CCME 1999	Interim.
Acridine	Trace organic (PAH)	µg/L	4.4		CCME 1999	Interim.
Acrolein	Pesticide	µg/L	3	3	USEPA 2009	Except where and when applied to water as an authorized use. Averaging period is 4 d for long-term and 1 hr for short-term.
Aldicarb	Pesticide	µg/L	1		CCME 1993	Interim. Applies to the concentration of total aldicarb residues (comprising aldicarb, aldicarb sulphoxide (ASO), and aldicarb sulphone (ASO <sub>2</sub> ).
Aldrin	Pesticide	µg/L	0.004		CCME 1987	See footnote A.
Alkalinity (as CaCO <sub>3</sub> )	Ions & general	mg/L	20		USEPA 1986	A minimum value; unless natural conditions are less, in which case the guideline cannot be lower than 25% of the natural level.
Aluminum - dissolved	Metal	µg/L	50 or Equation if pH <6.5	100 or Equation if pH <6.5	BC 2001	For pH<6.5, see Table 1.1. For long-term, use 30-d mean (based on median pH). For short-term, use instantaneous maximum (and instantaneous pH).
Ammonia-N	Ions & general					
- Un-ionized		mg/L	0.016		CCME 2001	As N. For ammonia (i.e, not expressed 'As N'), guideline is 0.019 mg/L.
- Total		mg/L	Equation		CCME 2001	As N. Varies with pH and temperature. See Table 1.2. Total Ammonia-N is also be expressed as NH <sub>3</sub> + NH <sub>4</sub> <sup>+</sup> -N.
Aniline	Trace organic	µg/L	2.2		CCME 1993	
Anthracene	Trace organic (PAH)	µg/L	0.012		CCME 1999	Interim.
Arsenic - total	Metalloid	µg/L	5		CCME 1997	
Atrazine	Pesticide	µg/L	1.8		CCME 1989	
Benz(a)anthracene	Trace organic (PAH)	µg/L	0.018		CCME 1999	Interim.
Benzene	Trace organic	µg/L	40		BC 2007	Interim. Applies to maximum concentration.
Benzo(a)pyrene	Trace organic (PAH)	µg/L	0.015		CCME 1999	Interim.
Boron - total	Metalloid	mg/L	1.5	29	CCME 2009	
Bromacil	Pesticide	µg/L	5		CCME 1997	Interim.
Bromoxynil	Pesticide	µg/L	5		CCME 1993	
Cadmium - total	Metal	µg/L	Equation		CCME 2014	Varies with hardness. See Table 1.3.
Captan	Pesticide	µg/L	1.3		CCME 1991	Interim.
Carbamazepine	Pharmaceutically-active compound	µg/L	10		CCME 2018	
Carbaryl	Pesticide	µg/L	0.2	3.3	CCME 2009	
Carbofuran	Pesticide	µg/L	1.8		CCME 1989	
Carbon tetrachloride (Tetra chloromethane)	Trace organic	µg/L	13.3		CCME 1992	Interim.
Chlordane	Pesticide	µg/L	0.006		CCME 1987	See footnote A.
Chloride	Ions & general	mg/L	120	640	CCME 2011	
Chlorinated alkanes	Trace organic				Env Can 2016	
Short chain (C <sub>10</sub> - 13)		µg/L	2.4			
Medium chain (C <sub>14</sub> - 17)		µg/L	2.4			
Long chain (C <sub>21</sub> 8)		µg/L	2.4			

**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL) (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
Chlorine	Ions & general	µg/L	0.5		CCME 1999	For reactive chlorine species. Applies to the sum of total residual chlorine, combined residual chlorine, total available chlorine, hypochlorous acid, chloramine, combined available chlorine, free residual chlorine, free available chlorine, chlorine-produced oxidants.
<b>Chlorobenzenes</b>	Trace organic					
<b>Mono-</b>		µg/L	1.3		CCME 1997	Interim.
<b>Di-</b>						
<b>1,2-</b>		µg/L	0.7		CCME 1997	Interim.
<b>1,3-</b>		µg/L	150		CCME 1997	Interim.
<b>1,4-</b>		µg/L	26		CCME 1997	Interim.
<b>Tri-</b>						
<b>1,2,3-</b>		µg/L	8		CCME 1997	Interim.
<b>1,2,4-</b>		µg/L	24		CCME 1997	Interim.
<b>Tetra- (1,2,3,4-)</b>		µg/L	1.8		CCME 1997	Interim.
<b>Penta-</b>		µg/L	6		CCME 1997	Interim.
Chloroform (Trichloromethane)	Trace organic	µg/L	1.8		CCME 1992	Interim.
<b>Chlorophenols</b>	Trace organic					
<b>Mono-</b>		µg/L	7		CCME 1987	Includes 2- 3- and 4-chlorophenol.
<b>Di-</b>		µg/L	0.2		CCME 1987	Includes 2,4- 2,5- 2,6- 3,4- and 3,5-dichlorophenol.
<b>Tri-</b>		µg/L	18		CCME 1987	Includes 2,3,4- 2,3,5- 2,3,6- 2,4,5- 2,4,6- trichlorophenol.
<b>Tetra-</b>		µg/L	1		CCME 1987	Includes 2,3,4,5- 2,3,4,6- and 3,4,5,6- tetrachlorophenol.
<b>Pentachlorophenol</b>		µg/L	0.5		CCME 1987	
Chlorothalonil	Pesticide	µg/L	0.18		CCME 1994	Interim.
Chlorpyrifos	Pesticide	µg/L	0.002	0.02	CCME 2008	Except where and when applied to water as an authorized use.
<b>Chromium - total:</b>	Metal					In this context, total refers to analysis of unfiltered samples and not forms.
<b>- Hexavalent (Cr VI)</b>		µg/L	1		CCME 1997	
<b>- Trivalent (Cr III)</b>		µg/L	8.9		CCME 1997	Interim.
<b>Cobalt - total</b>	Metal	µg/L	Equation		Env Can 2017	Federal Environmental Quality Guideline. Varies with hardness. See Table 1.3.
<b>Colour</b>	Ions & general	CU	20% increase		This document	Maximum 20% increase in Colour Units over natural conditions.
<b>Copper - total</b>	Metal	µg/L	7	Equation	AEP 1996b	The long-term guideline only applies to waters of hardness ≥50 mg/L CaCO <sub>3</sub> . The short-term guideline varies with hardness - See Table 1.3.
<b>Cyanazine</b>	Pesticide	µg/L	2		CCME 1990	Interim.
<b>Cyanide - free</b>	Ions & general	µg/L	5.2	22	USEPA 1985	As free CN, but can be applied to total or weak acid dissociable CN as a precautionary or screening approach. Averaging period is 4 d for long-term and 1 hr for short-term.

**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL) (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
D, 2,4- (2,4-D: 2,4-dichlorophenoxy acetic acid)	Pesticide	µg/L	4		CCME 1987	
DB, 2,4- (2,4-DB: 4-(2,4-dichlorophenoxy) butyric acid)	Pesticide	µg/L	25	560	Quebec 1998	Provisional.
DDT (Dichloro diphenyl trichloroethane)	Pesticide	µg/L	0.001		CCME 1987	See footnote A.
Deltamethrin	Pesticide	µg/L	0.0004		CCME 1997	Guideline is below analytical detection limit.
Demeton	Pesticide	µg/L	0.1		USEPA 1985	Averaging period is 4 d.
Diazinon	Pesticide	µg/L	0.17	0.17	USEPA 2005	Averaging period is 4 d for long-term and 1 hr for short-term.
Dicamba	Pesticide	µg/L	10		CCME 1993	
Dichloroethane, 1,2-	Trace organic	µg/L	100		CCME 1991	Interim.
Dichloromethane (Methylene chloride)	Trace organic	µg/L	98.1		CCME 1992	Interim.
Didofop-methyl	Pesticide	µg/L	6.1		CCME 1993	
Didecyl dimethyl ammonium chloride (DDAC)	Pesticide	µg/L	1.5		CCME 1999	Interim.
Dieldrin	Pesticide	µg/L	0.004		CCME 1987	See footnote A.
Diisopropanolamine (DIPA)	Trace organic	mg/L	1.6		CCME 2005; BC 2003	Interim.
Dimethoate	Pesticide	µg/L	6.2		CCME 1993	Interim.
Diethanolamine	Trace organic	µg/L	450		AENV 2010c	Interim.
Di(2-ethylhexyl) phthalate	Trace organic	µg/L	16		CCME 1993	Interim.
Di-n-butyl phthalate	Trace organic	µg/L	19		CCME 1993	Interim.
Dinoseb	Pesticide	µg/L	0.05		CCME 1992	
Endosulfan	Pesticide	µg/L	0.003	0.06	CCME 2010	
Endrin	Pesticide	µg/L	0.0023		CCME 1987	See footnote A.
Ethinylestradiol, 17α- (EE2)	Pharmaceutically-active compound	ng/L	0.5	0.75	BC 2010	Averaging period for long-term is 30-d mean; for short-term is instantaneous maximum.
Ethylbenzene	Trace organic	µg/L	90		CCME 1996	
Fluoranthene	Trace organic (PAH)	µg/L	0.04		CCME 1999	Interim.
Fluorene	Trace organic (PAH)	µg/L	3		CCME 1999	Interim.
Gases (total dissolved)	Ions & general	% saturation	110		USEPA 1986	Should not exceed 110% of the saturation value at existing atmospheric and hydrostatic pressures.



**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL) (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
<b>Glycols:</b>	Organics					
Diethylene glycol		mg/L	150		AENV 2010a	Interim.
Ethylene glycol		mg/L	192		CCME 1997	Interim. May not protect against indirect effects on oxygen demand, nor direct effects of formulated glycols, some of which are more toxic than pure glycols.
1,2 Propylene glycol		mg/L	500		CCME 1997	
Triethylene glycol		mg/L	350		AENV 2010a	Interim.
<b>Glyphosate</b>	Pesticide	µg/L	800	27,000	CCME 2012	Some glyphosate formulations, including Roundup, contain a surfactant that may be considerably more toxic than glyphosate itself. This should be taken into consideration in any spill of this substance directly to surface water and in the evaluation of monitoring data.
<b>Guthion (Azinphos-methyl)</b>	Pesticide	µg/L	0.01		USEPA 1986	Averaging period is 4 d.
<b>Heptachlor (Heptachlor epoxide)</b>	Pesticide	µg/L	<del>0.01</del>		CCME 1987	See footnote A.
<b>Hexabromocyclododecane (HBCD)</b>	Trace organic	µg/L	0.56		Env Can 2016	Federal Environmental Quality Guideline.
<b>Hexachlorobutadiene (HCBD)</b>	Trace organic	µg/L	1.3		CCME 1999	Interim.
<b>Hydrazine</b>	Trace organic	µg/L	2.6		Env Can 2013	Federal Environmental Quality Guideline.
<b>Imidacloprid</b>	Pesticide	µg/L	0.23		CCME 2007	Interim.
<b>3-Iodo-2-propynyl butyl carbamate (IPBC or Iodocarb)</b>	Pesticide	µg/L	1.9		CCME 1999	Interim. Guideline is below analytical detection limit.
<b>Iron - dissolved</b>	Metal	µg/L	300		CCME 1987	
<b>Lead - total</b>	Metal	µg/L	Equation		CCME 1987	Varies with hardness. See Table 1.3.
<b>Lindane (Hexachloro cyclohexane)</b>	Pesticide	µg/L	0.01		CCME 1987	Applies to total concentration of all isomers.
<b>Linuron</b>	Pesticide	µg/L	7		CCME 1995	Interim.
<b>Malathion</b>	Pesticide	µg/L	0.1		USEPA 1986	Averaging period is 4 d.
<b>MCPA (4-chloro-2-methyl phenoxy acetic acid)</b>	Pesticide	µg/L	2.6		CCME 1995	Interim.
<b>Mecoprop (MCPPE)</b>	Pesticide	µg/L	13	10,000	Quebec 2000	Provisional.
<b>Mercury - total:</b>	Metal					In this context, total refers to analysis of unfiltered samples and not forms. Guidelines should be applied to unfiltered samples.
- Total		µg/L	0.005	0.013	AEP 1998	Averaging period is 4 d for long-term and 1 hr for short-term.
- Methyl-		µg/L	0.001	0.002	AEP 1998	Averaging period is 4 d for long-term and 1 hr for short-term.
<b>Methanol</b>	Trace organic	mg/L	1.5		AENV 2010b	

**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL) (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
<b>Methoprene:</b>	Pesticide					
- most waters:		µg/L	0.09		CCME 2007	Interim. Applies to most surface waters. See next line.
- Target organism management value:		µg/L	0.53		CCME 2007	Interim. Applies at times and places where permitted application occurs.
<b>Methoxychlor</b>	Pesticide	µg/L	0.03		USEPA 1986	Averaging period is 4 d.
<b>Methyl tertiary-butyl ether (MTBE)</b>	Trace organic	mg/L	10		CCME 2003	Interim.
<b>Metolachlor</b>	Pesticide	µg/L	7.8		CCME 1991	Interim.
<b>Metribuzin</b>	Pesticide	µg/L	1		CCME 1990	Interim.
<b>Mirex</b>	Pesticide	µg/L	0.001		USEPA 1986	Averaging period is 4 d. Guideline is below analytical detection limit.
<b>Molybdenum - total</b>	Metal	µg/L	73		CCME 1999	Interim.
<b>Monoethanolamine</b>	Trace organic	µg/L	75		AENV 2010c	Interim.
<b>Naphthalene</b>	Trace organic (PAH)	µg/L	1		BC 2007	
<b>Nickel - total</b>	Metal	µg/L	Equation	Equation	USEPA 1995	Varies with hardness. See Table 1.3. Averaging period is 4 d for long-term and 1 hr for short-term.
<b>Nitrate - N</b>	Nutrient; ions & general	mg/L	3.0	124	CCME 2012	As N. For protection from toxicity. Does not consider eutrophication effects.
<b>Nitrite - N</b>	Nutrient; ions & general	mg/L	Varies	Varies	BC 2001	As N. Varies with chloride. See Table 1.4. Averaging period is 30-d for long-term and instantaneous maximum for short-term.
<b>Nitrogen - total (Inorganic + organic)</b>	Nutrient; ions & general		Narrative		This document	See Table 1.5.
<b>Nonylphenol + ethoxylates</b>	Trace organic	µg/L	6.6	28	USEPA 2005	Derived for nonylphenol. To include ethoxylates and octylphenol + ethoxylates in a comparison to guidelines, consult the CCME (2002) nonylphenol fact sheet for toxic equivalents. Averaging period is 4 d for long-term and 1 hr for short-term.
<b>Oil and grease</b>	Ions & general		Narrative	Narrative	This document	Oil and grease attributable to human activities should not be present in amounts that: - cause visible sheens, films, or discoloration; - can be detected by odour; - cause tainting of edible aquatic biota; - form deposits on shores or bottom material that are detectable by sight or odour, or are deleterious to resident biota.
<b>Oxygen - dissolved</b>	Ions & general	mg/L	6.5	5	AEP 1997	Oxygen values are minima.
		mg/L	8.3			See AEP 1997 for guidance when natural conditions do not meet guidelines. Long-term is 7d mean, short-term is instantaneous value.
		mg/L	9.5			For mid-May to end June, to protect mayfly emergence. For areas and times where larval fish develop within gravel beds.
<b>Parathion</b>	Pesticide	µg/L	0.013	0.065	USEPA 1995	Averaging period is 4 d for long-term and 1 hr for short-term. Guideline is below analytical detection limit.

**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL) (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
PCBs - total (Polychlorinated biphenyls)	Trace organic	µg/L	0.001		CCME 1987	See footnote A.
Permethrin	Pesticide	µg/L	0.004		CCME 2006	Interim.
Petroleum Hydrocarbons (PHC)	Trace organic				CCME 2008	Derived as whole product toxicity benchmarks for aquatic life in support of Canada-Wide Standard for Petroleum Hydrocarbons in Soil (CCME 2008).
F1		µg/L		150		Interim. Based on toxicity reference value for gasoline.
F2		µg/L		110		Interim. Based on toxicity reference value for fuel oil #2.
pH	Ions & general	pH units	6.5 - 9.0		USEPA 1996	And not to be altered by more than 0.5 units from background.
Phenanthrene	Trace organic (PAH)	µg/L	0.4		CCME 1999	Interim.
Phenols - mono- and dihydric	Trace organic	µg/L	4		CCME 1999	
Phosphorus	Nutrient		Narrative		This document	See Table 1.5.
Picloram	Pesticide	µg/L	29		CCME 1990	Interim.
Polybrominated Diphenyl Ethers (PBDEs)	Trace organic				Env Can 2013	Federal Environmental Quality Guidelines.
triBDE - total		ng/L	46			
tetraBDE - total		ng/L	24			
pentaBDE - total		ng/L	0.2			
pentaBDE - BDE99		ng/L	4			
pentaBDE - BDE100		ng/L	0.2			
hexaBDE - total		ng/L	120			
heptaBDE - total		ng/L	17			
octaBDE - total		ng/L	17			
Pyrene	Trace organic (PAH)	µg/L	0.025		CCME 1999	Interim.
Quinoline	Trace organic (PAH)	µg/L	3.4		CCME 1999	Interim.
Resin acids	Trace organic					
Dehydroabiatic (DHA)		µg/L	Varies with pH		Ontario 1988	Interim. See Table 1.6.
Total		µg/L	Varies with pH		Ontario 1988	Interim. See Table 1.6. Includes abiatic, isopimaric, neoabiatic, pimaric and sandaracopimaric acids.
Selenium - total	Metalloid				BC 2014	Exceedance of the alert concentration in sensitive environments indicates the need for increased monitoring of water and other ecosystem compartments to support early detection of potential Se bioaccumulation issues and provide earlier opportunities to commence proactive management actions.
Guideline		µg/L	2			
Alert Concentration		µg/L	1			
Silver - total	Metal	µg/L	0.25		CCME 2015	

**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL) (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
Simazine	Pesticide	µg/L	10		CCME 1991	
Solids - total suspended (TSS)	Ions & general	mg/L	Narrative	Narrative	CCME 1999; BC 2001	<u>During clear flows or for clear waters:</u> Maximum increase of 25 mg/L from background for any short-term exposure (e.g. 24-h period). Maximum average increase of 5 mg/L from background levels for longer term exposures (greater than 24 h). <u>During high flow or for turbid waters:</u> Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L. Should not increase more than 10% of background levels when background is ≥250 mg/L.
Styrene	Trace organic	µg/L	72		CCME 1999	Interim.
Sulfolane (Bondelane)	Trace organic	mg/L	50		CCME 2005	Interim.
Sulphate	Ions & general	mg/L	Varies		BC 2013	Varies with Hardness. See Table 1.7. Averaging period is 30 d.
Sulphide - total	Ions & general	µg/L	1.9		USEPA 1986	As S, but can be applied to undissociated H <sub>2</sub> S if concerns arise. Averaging period is 4 d.
Tebuthiuron	Pesticide	µg/L	1.6		CCME 1995	Interim.
Temperature	Ions & general		Narrative	Narrative	CCME 1987	Thermal additions should not alter thermal stratification or turnover dates, exceed maximum weekly average temperatures, nor exceed maximum short-term temperatures.
Tetrabromobisphenol A (TBBPA)	Trace organic	µg/L	3.1		Env Can 2016	Federal Environmental Quality Guideline.
Tetrachloroethylene (PCE; 1,1,2,2-Tetrachloroethene)	Trace organic	µg/L	110		CCME 1993	Interim.
Thallium - total	Metal	µg/L	0.8		CCME 1998	
Toluene	Trace organic	µg/L	0.5		BC 2007	Maximum concentration - should not be exceeded.
Toxaphene	Pesticide	µg/L	0.008		CCME 1987	See footnote A.
Toxicity	Biotic	Toxic units	1 TU <sub>C</sub>	0.3 TU <sub>A</sub>	AEP 1995; 1996a	Units are chronic and acute toxic units.
Triallate	Pesticide	µg/L	0.24		CCME 1992	Interim.
Tributyltin (TBT)	Pesticide	µg/L	0.072	0.46	USEPA 2004	Averaging period is 4 d for long-term and 1 hr for short-term.
Trichlorfon	Pesticide	µg/L	0.009	1.1	CCME 2012	Long-term value is interim. Guideline is below analytical detection limit.
Trichloroethylene (TCE; 1,1,2-Trichloroethene)	Trace organic	µg/L	21		CCME 1993	Interim.
Trifluralin	Pesticide	µg/L	0.2		CCME 1993	
Triphenyltin	Pesticide	µg/L	0.022		CCME 1992	Interim.
Turbidity	Ions & general	NTU	Narrative	Narrative	CCME 1999; BC 2001	<u>For clear waters:</u> Maximum increase of 8 NTU from background for any short-term exposure (e.g. 24-h period). Maximum average increase of 2 NTU from background levels for longer term exposures (greater than 24 h). <u>For high flow or turbid waters:</u> Maximum increase of 8 NTU from background levels at any time when background levels are between 8 and 80 NTU. Should not increase more than 10% of background levels when background is > 80 NTU.

**Table 1. Surface water quality guidelines for the protection of freshwater aquatic life (PAL) (concluded).**

Water Quality Variable (Substance or Condition)	Category	Unit	Long-Term (Chronic)	Short-term (Acute)	Source & Date	Notes and Direction
Uranium - total	Metal	µg/L	15	33	CCME 2011	Refers to toxicity only and not radioactivity.
Xylene	Trace organic	µg/L	30		BC 2007	Applies to sum of all isomers. Maximum concentration should not exceed.
Zinc - total	Metal	µg/L	30		CCME 1987	

Shading indicates:

Units other than ug/L    Interim values

Footnote A:

This guideline (originally published in Canadian Water Quality Guidelines [CCREM 1987 + Appendixes] in 1987 or 1991 [PCBs in marine waters]) is no longer recommended and the value is withdrawn. A water quality guideline is not recommended. Environmental exposure is predominantly via sediment, soil, and/or tissue, therefore, the reader is referred to the respective guidelines for these media.

This substance meets the criteria for Track 1 substances under the national CCME Policy for the Management of Toxic Substances (PMTS) (i.e., persistent, bioaccumulative, primarily the result of human activity, and CEPA-toxic or equivalent), and should be subject to virtual elimination strategies. Guidelines can serve as action levels or interim management objectives towards virtual elimination.

Units	
ng/L	Nanograms per litre = parts per trillion (ppt)
µg/L	Micrograms per litre = parts per billion (ppb)
mg/L	Milligrams per litre = parts per million (ppm)
CU	Colour Units
NTU	Nephelometric Turbidity Units
TU	Toxic units, Acute or Chronic

**Table 1.1. Aluminum guidelines for protection of aquatic life at varying pH.**

pH	Dissolved Aluminum (µg/L)	
	Long-term (Chronic)	Short-term (Acute)
5.0	7	23
5.1	7	24
5.2	8	25
5.3	9	27
5.4	10	29
5.5	11	31
5.6	12	33
5.7	14	36
5.8	15	39
5.9	18	43
6.0	20	47
6.1	24	52
6.2	28	59
6.3	33	66
6.4	40	74
6.5	50	100
7.0	50	100
7.5	50	100
8.0	50	100
8.5	50	100
9.0	50	100

For pH values <6.5, acute equation is  $\{e^{(1.209 - 2.426 (\text{pH}) + 0.286 (\text{pH})^2)}\} \times 1000$

For pH values < 6.5, chronic equation is  $\{e^{(1.6 - 3.327 (\text{pH}) + 0.402 (\text{pH})^2)}\} \times 1000$

Source: BC 2001

**Table 1.2. Ammonia guidelines for protection of aquatic life at varying pH and temperature.**  
Total ammonia-N, as mg/L

Temperature - Celsius	pH																			
	6.0	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	7.0	7.1	7.2	7.3	7.4	7.5	7.6	7.7	7.8	7.9
0	190	151	120	95.1	75.6	60.0	47.7	37.9	30.1	23.9	19.0	15.1	12.0	9.53	7.57	6.02	4.78	3.80	3.02	2.40
1	175	139	110	87.5	69.5	55.2	43.8	34.8	27.7	22.0	17.5	13.9	11.0	8.76	6.96	5.53	4.40	3.50	2.78	2.21
2	161	128	101	80.5	63.9	50.8	40.3	32.0	25.5	20.2	16.1	12.8	10.1	8.06	6.41	5.09	4.05	3.22	2.56	2.04
3	148	117	93.3	74.1	58.9	46.8	37.1	29.5	23.4	18.6	14.8	11.8	9.34	7.42	5.90	4.69	3.73	2.96	2.36	1.88
4	136	108	85.9	68.2	54.2	43.1	34.2	27.2	21.6	17.2	13.6	10.8	8.61	6.84	5.44	4.32	3.44	2.73	2.17	1.73
5	125	100	79.2	62.9	50.0	39.7	31.5	25.1	19.9	15.8	12.6	10.0	7.93	6.30	5.01	3.98	3.17	2.52	2.00	1.60
6	116	91.9	73.0	58.0	46.1	36.6	29.1	23.1	18.4	14.6	11.6	9.21	7.32	5.82	4.62	3.68	2.92	2.32	1.85	1.47
7	107	84.8	67.4	53.5	42.5	33.8	26.8	21.3	16.9	13.5	10.7	8.50	6.75	5.37	4.27	3.39	2.70	2.15	1.71	1.36
8	98.6	78.3	62.2	49.4	39.3	31.2	24.8	19.7	15.6	12.4	9.88	7.85	6.24	4.96	3.94	3.13	2.49	1.98	1.58	1.26
9	91.1	72.4	57.5	45.7	36.3	28.8	22.9	18.2	14.5	11.5	9.12	7.25	5.76	4.58	3.64	2.90	2.30	1.83	1.46	1.16
10	84.2	66.9	53.1	42.2	33.5	26.6	21.2	16.8	13.4	10.6	8.43	6.70	5.33	4.24	3.37	2.68	2.13	1.70	1.35	1.08
11	77.9	61.9	49.1	39.0	31.0	24.6	19.6	15.6	12.4	9.82	7.80	6.20	4.93	3.92	3.12	2.48	1.97	1.57	1.25	1.00
12	72.1	57.2	45.5	36.1	28.7	22.8	18.1	14.4	11.4	9.09	7.22	5.74	4.56	3.63	2.88	2.29	1.83	1.45	1.16	0.923
13	66.7	53.0	42.1	33.4	26.6	21.1	16.8	13.3	10.6	8.41	6.69	5.31	4.22	3.36	2.67	2.13	1.69	1.35	1.07	0.855
14	61.8	49.1	39.0	31.0	24.6	19.6	15.5	12.3	9.81	7.80	6.20	4.92	3.91	3.11	2.48	1.97	1.57	1.25	1.00	0.794
15	57.3	45.5	36.2	28.7	22.8	18.1	14.4	11.4	9.09	7.23	5.74	4.57	3.63	2.89	2.30	1.83	1.45	1.16	0.923	0.737
16	53.1	42.2	33.5	26.6	21.2	16.8	13.4	10.6	8.43	6.70	5.33	4.23	3.37	2.68	2.13	1.70	1.35	1.08	0.857	0.684
17	49.3	39.2	31.1	24.7	19.6	15.6	12.4	9.85	7.83	6.22	4.94	3.93	3.12	2.49	1.98	1.57	1.25	1.00	0.797	0.636
18	45.8	36.4	28.9	22.9	18.2	14.5	11.5	9.14	7.27	5.77	4.59	3.65	2.90	2.31	1.84	1.46	1.16	0.928	0.741	0.592
19	42.5	33.8	26.8	21.3	16.9	13.5	10.7	8.49	6.75	5.36	4.26	3.39	2.70	2.15	1.71	1.36	1.08	0.863	0.689	0.551
20	39.5	31.4	24.9	19.8	15.7	12.5	9.93	7.89	6.27	4.99	3.96	3.15	2.51	1.99	1.59	1.26	1.01	0.803	0.641	0.513
21	36.7	29.2	23.2	18.4	14.6	11.6	9.24	7.34	5.83	4.64	3.69	2.93	2.33	1.86	1.48	1.18	0.938	0.748	0.597	0.478
22	34.2	27.1	21.6	17.1	13.6	10.8	8.59	6.83	5.43	4.31	3.43	2.73	2.17	1.73	1.37	1.10	0.873	0.697	0.557	0.445
23	31.8	25.3	20.1	15.9	12.7	10.1	8.00	6.36	5.05	4.02	3.19	2.54	2.02	1.61	1.28	1.02	0.814	0.650	0.519	0.416
24	29.6	23.5	18.7	14.8	11.8	9.37	7.45	5.92	4.70	3.74	2.97	2.37	1.88	1.50	1.19	0.95	0.759	0.606	0.484	0.388
25	27.6	21.9	17.4	13.8	11.0	8.73	6.94	5.51	4.38	3.48	2.77	2.20	1.75	1.40	1.11	0.887	0.708	0.565	0.452	0.363
26	25.7	20.4	16.2	12.9	10.2	8.14	6.47	5.14	4.09	3.25	2.58	2.06	1.64	1.30	1.04	0.828	0.661	0.528	0.423	0.339
27	24.0	19.0	15.1	12.0	9.55	7.59	6.03	4.79	3.81	3.03	2.41	1.92	1.53	1.22	0.969	0.773	0.617	0.493	0.395	0.317
28	22.4	17.8	14.1	11.2	8.91	7.08	5.63	4.47	3.56	2.83	2.25	1.79	1.42	1.14	0.905	0.722	0.577	0.461	0.370	0.297
29	20.9	16.6	13.2	10.5	8.31	6.61	5.25	4.17	3.32	2.64	2.10	1.67	1.33	1.06	0.845	0.675	0.539	0.432	0.346	0.278
30	19.5	15.5	12.3	9.8	7.76	6.17	4.90	3.90	3.10	2.47	1.96	1.56	1.24	0.991	0.790	0.631	0.505	0.404	0.324	0.261

**Table 1.2. Ammonia guidelines for protection of aquatic life at varying pH and temperature (continued).**

Total ammonia-N, as mg/L

Temperature - Celsius	pH																				
	8.0	8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	9.0	9.1	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10.0
0	1.91	1.52	1.21	0.967	0.771	0.616	0.492	0.394	0.316	0.255	0.205	0.166	0.135	0.111	0.091	0.076	0.063	0.053	0.046	0.040	0.035
1	1.76	1.40	1.12	0.890	0.710	0.567	0.454	0.364	0.292	0.235	0.190	0.154	0.126	0.103	0.085	0.071	0.059	0.050	0.043	0.038	0.033
2	1.62	1.29	1.03	0.820	0.655	0.523	0.419	0.336	0.270	0.218	0.176	0.143	0.117	0.096	0.080	0.066	0.056	0.048	0.041	0.036	0.032
3	1.49	1.19	0.948	0.756	0.604	0.483	0.387	0.311	0.250	0.202	0.163	0.133	0.109	0.090	0.074	0.062	0.053	0.045	0.039	0.034	0.030
4	1.38	1.10	0.875	0.698	0.558	0.446	0.358	0.287	0.231	0.187	0.152	0.124	0.102	0.084	0.070	0.059	0.050	0.043	0.037	0.033	0.029
5	1.27	1.01	0.807	0.645	0.515	0.412	0.331	0.266	0.215	0.174	0.141	0.115	0.095	0.079	0.066	0.055	0.047	0.041	0.036	0.031	0.028
6	1.17	0.935	0.746	0.596	0.476	0.382	0.306	0.247	0.199	0.161	0.131	0.108	0.089	0.074	0.062	0.052	0.045	0.039	0.034	0.030	0.027
7	1.08	0.864	0.689	0.551	0.441	0.353	0.284	0.229	0.185	0.150	0.122	0.100	0.083	0.069	0.058	0.049	0.042	0.037	0.033	0.029	0.026
8	1.00	0.799	0.638	0.510	0.408	0.327	0.263	0.212	0.172	0.140	0.114	0.094	0.078	0.065	0.055	0.047	0.040	0.035	0.031	0.028	0.025
9	0.926	0.739	0.590	0.472	0.378	0.304	0.244	0.197	0.160	0.130	0.107	0.088	0.073	0.061	0.052	0.044	0.039	0.034	0.030	0.027	0.025
10	0.858	0.684	0.547	0.438	0.351	0.282	0.227	0.184	0.149	0.122	0.100	0.083	0.069	0.058	0.049	0.042	0.037	0.032	0.029	0.026	0.024
11	0.794	0.634	0.507	0.406	0.326	0.262	0.211	0.171	0.139	0.114	0.093	0.077	0.065	0.055	0.047	0.040	0.035	0.031	0.028	0.025	0.023
12	0.736	0.588	0.470	0.377	0.302	0.243	0.197	0.159	0.130	0.106	0.088	0.073	0.061	0.052	0.044	0.038	0.034	0.030	0.027	0.025	0.023
13	0.683	0.546	0.437	0.350	0.281	0.227	0.183	0.149	0.121	0.100	0.082	0.069	0.058	0.049	0.042	0.037	0.032	0.029	0.026	0.024	0.022
14	0.634	0.506	0.406	0.325	0.262	0.211	0.171	0.139	0.114	0.093	0.077	0.065	0.055	0.047	0.040	0.035	0.031	0.028	0.025	0.023	0.022
15	0.588	0.471	0.377	0.303	0.244	0.197	0.159	0.130	0.106	0.088	0.073	0.061	0.052	0.044	0.038	0.034	0.030	0.027	0.025	0.023	0.021
16	0.547	0.438	0.351	0.282	0.227	0.184	0.149	0.122	0.100	0.082	0.069	0.058	0.049	0.042	0.037	0.032	0.029	0.026	0.024	0.022	0.021
17	0.508	0.407	0.327	0.263	0.212	0.171	0.139	0.114	0.094	0.078	0.065	0.055	0.047	0.040	0.035	0.031	0.028	0.025	0.023	0.022	0.021
18	0.473	0.379	0.304	0.245	0.198	0.160	0.131	0.107	0.088	0.073	0.061	0.052	0.044	0.039	0.034	0.030	0.027	0.025	0.023	0.021	0.020
19	0.440	0.353	0.284	0.229	0.185	0.150	0.122	0.100	0.083	0.069	0.058	0.049	0.042	0.037	0.033	0.029	0.026	0.024	0.022	0.021	0.020
20	0.410	0.329	0.265	0.213	0.173	0.140	0.115	0.094	0.078	0.065	0.055	0.047	0.041	0.035	0.031	0.028	0.026	0.024	0.022	0.021	0.020
21	0.383	0.307	0.247	0.200	0.162	0.132	0.108	0.089	0.074	0.062	0.052	0.045	0.039	0.034	0.030	0.027	0.025	0.023	0.021	0.020	0.019
22	0.357	0.287	0.231	0.187	0.152	0.124	0.101	0.084	0.070	0.059	0.050	0.043	0.037	0.033	0.029	0.026	0.024	0.022	0.021	0.020	0.019
23	0.333	0.268	0.216	0.175	0.142	0.116	0.095	0.079	0.066	0.056	0.047	0.041	0.036	0.032	0.028	0.026	0.024	0.022	0.021	0.020	0.019
24	0.311	0.251	0.202	0.164	0.133	0.109	0.090	0.075	0.063	0.053	0.045	0.039	0.034	0.030	0.027	0.025	0.023	0.022	0.020	0.019	0.019
25	0.291	0.235	0.189	0.154	0.125	0.103	0.085	0.071	0.059	0.050	0.043	0.038	0.033	0.029	0.027	0.024	0.023	0.021	0.020	0.019	0.018
26	0.272	0.220	0.178	0.144	0.118	0.097	0.080	0.067	0.056	0.048	0.041	0.036	0.032	0.028	0.026	0.024	0.022	0.021	0.020	0.019	0.018
27	0.255	0.206	0.167	0.136	0.111	0.091	0.076	0.063	0.054	0.046	0.040	0.035	0.031	0.028	0.025	0.023	0.022	0.020	0.019	0.019	0.018
28	0.239	0.193	0.157	0.128	0.105	0.086	0.072	0.060	0.051	0.044	0.038	0.033	0.030	0.027	0.025	0.023	0.021	0.020	0.019	0.018	0.018
29	0.224	0.181	0.147	0.120	0.099	0.082	0.068	0.057	0.049	0.042	0.036	0.032	0.029	0.026	0.024	0.022	0.021	0.020	0.019	0.018	0.018
30	0.210	0.170	0.138	0.113	0.093	0.077	0.065	0.054	0.046	0.040	0.035	0.031	0.028	0.025	0.023	0.022	0.021	0.020	0.019	0.018	0.018



**Table 1.2. Ammonia guidelines for protection of aquatic life at varying pH and temperature (concluded).**

Total ammonia-N, as mg/L

Source: CCME 2001

Values falling outside the shaded region should be used with caution.

To calculate un-ionized ammonia fraction ( $f$ ):  $f = 1/[10^{(pK_a - pH)} + 1]$

where  $pK_a = 0.0901821 + 2729.92/T$

$T$  = Temperature in K

$T(\text{in K}) = T(\text{in } ^\circ\text{C}) + 273.15$

Total Ammonia Guideline (as N) =  $(0.019/f) * 0.8224$

To convert to mg/L total ammonia, multiply the corresponding guideline value by 1.216.

**Table 1.3. Metal guidelines for the Protection of Aquatic Life at varying hardness.**

Hardness - mg/L CaCO <sub>3</sub>	Cadmium (µg/L)		Cobalt (µg/L)	Copper (µg/L)		Lead (µg/L)	Nickel (µg/L)	
	Long-term	Short-term	Long-term	Short-term	Long-term	Long-term	Long-term	Short-term
	(Chronic)	(Acute)		(Chronic)				(Acute)
5	0.04	0.11		0.9		1.0	0	1
10	0.04	0.20		1.7		1.0	7	67
15	0.04	0.31		2.5		1.0	10	94
20	0.04	0.41		3.3		1.0	13	120
25	0.05	0.51		4.1		1.0	16	145
30	0.06	0.62		4.9		1.0	19	170
35	0.07	0.72		5.7		1.0	21	190
40	0.07	0.83		6.5		1.0	24	220
45	0.08	0.93		7.3		1.0	27	240
50	0.09	1.0		8.1		1.0	29	260
55	0.10	1.1	0.80	8.9		1.0	31	280
60	0.10	1.2	0.83	9.7		1.0	34	300
65	0.11	1.4	0.85	10		1.8	36	330
70	0.12	1.5	0.88	11		2.0	39	350
75	0.12	1.6	0.91	12		2.2	41	370
80	0.13	1.7	0.93	13		2.4	43	390
85	0.14	1.8	1.0	14		2.6	45	410
90	0.15	1.9	1.0	14		2.8	48	430
95	0.15	2.0	1.0	15		3.0	50	450
100	0.16	2.1	1.0	16		3.2	52	470
105	0.17	2.2	1.0	17		3.4	54	490
110	0.17	2.3	1.1	18		3.6	57	510
115	0.18	2.4	1.1	18		3.8	59	530
120	0.18	2.5	1.1	19		4.0	61	550
125	0.19	2.6	1.1	20		4.2	63	570
130	0.20	2.7	1.1	21		4.4	65	590
135	0.20	2.8	1.2	21		4.7	67	600
140	0.21	3.0	1.2	22		4.9	69	620
145	0.22	3.1	1.2	23		5.1	71	640
150	0.22	3.2	1.2	24		5.3	74	660
155	0.23	3.3	1.2	25		5.6	76	680
160	0.23	3.4	1.2	25		5.8	78	700
165	0.24	3.5	1.3	26		6.0	80	720
170	0.25	3.6	1.3	27		6.3	82	740
175	0.25	3.7	1.3	28		6.5	84	750
180	0.26	3.8	1.3	28		6.7	86	770
185	0.26	3.9	1.3	29		7.0	88	790
190	0.27	4.0	1.3	30		7.0	90	810
195	0.28	4.1	1.3	31		7.0	92	830
200	0.28	4.2	1.4	32		7.0	94	840
205	0.29	4.4	1.4	32		7.0	96	860
210	0.29	4.5	1.4	33		7.0	98	880
215	0.30	4.6	1.4	34		7.0	100	900
220	0.30	4.7	1.4	35		7.0	100	910
225	0.31	4.8	1.4	35		7.0	100	930
230	0.32	4.9	1.4	36		7.0	110	950
235	0.32	5.0	1.5	37		7.0	110	970
240	0.33	5.1	1.5	38		7.0	110	980
245	0.33	5.2	1.5	38		7.0	110	1000
250	0.34	5.3	1.5	39		7.0	110	1020

**Table 1.3. Metal guidelines for the Protection of Aquatic Life at varying hardness (concluded).**

Hardness - mg/L CaCO <sub>3</sub>	Cadmium (µg/L)		Cobalt (µg/L)	Copper (µg/L)	Lead (µg/L)	Nickel (µg/L)	
	Long-term	Short-term	Long-term	Short-term	Long-term	Long-term	Short-term
	(Chronic)	(Acute)	(Chronic)	(Acute)	(Chronic)	(Chronic)	(Acute)
255	0.34	5.4	1.5	40	7.0	120	1040
260	0.35	5.5	1.5	41	7.0	120	1050
265	0.36	5.6	1.5	42	7.0	120	1070
270	0.36	5.8	1.5	42	7.0	120	1090
275	0.37	5.9	1.6	43	7.0	120	1100
280	0.37	6.0	1.6	44	7.0	120	1120
285	0.37	6.1	1.6	45	7.0	130	1140
290	0.37	6.2	1.6	45	7.0	130	1150
295	0.37	6.3	1.6	46	7.0	130	1170
300	0.37	6.4	1.6	47	7.0	130	1190
305	0.37	6.5	1.6	48	7.0	130	1210
310	0.37	6.6	1.6	48	7.0	140	1220
315	0.37	6.7	1.6	49	7.0	140	1240
320	0.37	6.8	1.7	50	7.0	140	1260
325	0.37	7.0	1.7	51	7.0	140	1270
330	0.37	7.1	1.7	51	7.0	140	1290
335	0.37	7.2	1.7	52	7.0	150	1300
340	0.37	7.3	1.7	53	7.0	150	1320
345	0.37	7.4	1.7	54	7.0	150	1340
350	0.37	7.5	1.7	55	7.0	150	1350
355	0.37	7.6	1.7	55	7.0	150	1370
360	0.37	7.7	1.7	56	7.0	150	1390
365	0.37	7.7	1.7	57	7.0	160	1400
370	0.37	7.7	1.8	58	7.0	160	1420
375	0.37	7.7	1.8	58	7.0	160	1440
380	0.37	7.7	1.8	59	7.0	160	1450
385	0.37	7.7	1.8	60	7.0	160	1470
390	0.37	7.7	1.8	61	7.0	160	1480
395	0.37	7.7	1.8	61	7.0	170	1500
400	0.37	7.7		62	7.0	170	1520

**Cadmium:** At hardness  $\geq 17$  mg/L and  $\leq 280$  mg/L, long-term equation is  $10^{(0.83(\log_{10}[\text{hardness}]) - 2.46)}$

**Cadmium:** At hardness  $\geq 5.3$  mg/L and  $\leq 360$  mg/L, short-term equation is  $10^{(1.016(\log_{10}[\text{hardness}]) - 1.71)}$

Source: CCME 2014.

**Cobalt:** At hardness  $\geq 52$  mg/L and  $\leq 396$  mg/L, long-term equation is  $e^{(0.414[\ln(\text{hardness})] - 1.887)}$

Source: Environment and Climate Change Canada 2017

**Copper:** Short-term equation is  $(e^{(0.979123 [\ln(\text{hardness})] - 8.64497)}) \times 1000$

Source: AEP 1996b.

**Lead:** At hardness  $> 60$  mg/L and  $\leq 180$  mg/L, long-term equation is  $e^{(1.273[\ln(\text{hardness})] - 4.705)}$

Source: CCME 1987.

**Nickel:** Long-term equation is  $e^{(0.846 [\ln(\text{hardness})] + 0.0584)}$

**Nickel:** Short-term equation is  $e^{(0.846[\ln(\text{hardness})] + 2.255)}$

Source: US EPA 1995.

**Table 1.4. Nitrite-N guidelines for the protection of aquatic life at varying chloride.**

Chloride (mg/L)	30-d Average Nitrite as N (mg/L)	Maximum Nitrite as N (mg/L)
Less than 2	0.02	0.06
2 to 4	0.04	0.12
4 to 6	0.06	0.18
6 to 8	0.08	0.24
8 to 10	0.10	0.30
Greater than 10	0.20	0.60

Source: BC 2001.

**Table 1.5. Surface water quality guidelines for nutrients.**

Water Body Type	Guideline
Lakes	No increase in nitrogen (total) or phosphorus over existing conditions. Where nitrogen and/or phosphorus have increased due to human activity, develop lake-specific nutrient objectives and management plans where warranted.
Major Rivers (Interim*)	For major rivers, nitrogen (total) and phosphorus concentrations should be maintained so as to prevent detrimental changes to algal and aquatic plant communities, aquatic biodiversity, oxygen levels, and recreational quality. Where priorities warrant, develop site-specific nutrient objectives and management plans.
Other Water Bodies	For surface waters not covered by specific guidelines, nitrogen (total) and phosphorus concentrations should be maintained so as to prevent detrimental changes to algal and aquatic plant communities, aquatic biodiversity, oxygen levels, and recreational quality. Where priorities warrant, develop site-specific nutrient objectives and management plans.

**Table 1.6. Resin acid guidelines for the protection of aquatic life at varying pH.**

Receiving Water pH	Guidelines - µg/L	
	DHA	Total other Resin acids
5	1	1
5.5	2	3
6	2	4
6.5	4	9
7	8	25
7.5	12	45
8	13	52
8.5	14	60
9	14	62

DHA: Dehydroabiatic acid

Other Resin acids include: abietic acid, isopimaric acid, neoabietic acid, pimaric acid and sandaracopimaric acid.

Source: Ontario 1988.

**Table 1.7. Sulphate guidelines for the protection of aquatic life at varying hardness.**

<b>Water Hardness (mg/L)</b>	<b>Sulphate Guideline (mg/L)</b>
Very soft (0 - 30)	128
Soft to moderately soft (31 - 75)	218
Moderately soft/hard to hard (76 - 180)	309
Very hard (181 - 250)	429
>250	Need to determine based on site water

Source: BC 2013

**Table 2. Water quality guidelines for the protection of agricultural water uses.**

Water Quality Variable (Substance or Condition)	Category	Unit	Irrigation	Source & Date	Livestock Water	Source & Date	Notes and Direction
Aldicarb	Pesticide	µg/L	73	Recalculated CCME 1993	11	CCME 1993	Applies to the concentration of total aldicarb residues (comprising aldicarb, aldicarb sulphoxide (ASO), and aldicarb sulphone (ASO <sub>2</sub> ). No longer registered for use in Canada. Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. For legumes, the irrigation guideline is 90 µg/L.
Aluminum - total	Metal	mg/L	5	CCME 1987	5	CCME 1987	See Footnote B. No CCME fact sheet available.
Arsenic	Metal	µg/L	160	Recalculated CCME 1997	25	CCME 1997	Irrigation guideline was re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. For livestock guideline, see Footnote C. Irrigation and livestock guidelines are interim.
Atrazine	Pesticide	µg/L	10	CCME 1989	5	CCME 1989	For livestock guideline, see Footnote C. Irrigation and livestock guidelines are interim.
Beryllium - total	Metal	µg/L	100	CCME 1987	100	CCME 1987	No CCME fact sheet available. Livestock water guideline is interim.
Blue-green algae (Cyanobacteria)	Biological				Avoid heavy growth	CCME 1987	Cyanotoxins may be present even without heavy growth, particularly following blooms. No CCME fact sheet available.
Boron - total	Metal	µg/L	500 to 6000	CCME 1987	5000	CCME 1987	Irrigation guidelines are crop-specific. See Footnote D. No CCME fact sheet available.
Bromacil	Pesticide	µg/L	0.2	CCME 1997	1100	CCME 1997	Irrigation and livestock guidelines are interim. Irrigation guideline for cereals, tame hays and pastures is 0.6 µg/L.
Bromoform (Tribromomethane)	Trace organic	µg/L			100	CCME 1992	See Footnote C. No CCME fact sheet available.
Bromoxynil	Pesticide	µg/L	0.44	Recalculated CCME 1993	11	CCME 1993	Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. The irrigation guideline is 3.3 µg/L for cereals and tame hay and 1.3 µg/L for other crops (excluding legumes). Livestock water value is interim.
Cadmium - total	Metal	µg/L	8.2	Recalculated CCME 1996	80	CCME 1996	Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A.
Calcium	Ions and General	mg/L			1000	CCME 1987	No CCME fact sheet available.
Captan	Pesticide	µg/L			13	CCME 1991	Interim.
Carbaryl	Pesticide	µg/L			1100	CCME 1997	
Carbofuran	Pesticide	µg/L			45	CCME 1987	
Carbon tetrachloride (Tetrachloromethane)	Trace organic	µg/L			5	CCME 1992	Interim. No CCME fact sheet available.
Chlordane	Pesticide	µg/L			7	CCME 1987	CCME no longer recommends this guideline and has withdrawn the value. See Footnote E. No CCME fact sheet available.
Chloride	Ions and General	mg/L	100 to 700	CCME 1987			Chloride guideline is crop-specific. See Footnote F. No CCME fact sheet available.
Chloroform (Trichloromethane)	Trace organic	µg/L			100	CCME 1992	Interim. See Footnote C. No CCME fact sheet available.
Chlorothalonil	Pesticide	µg/L	9.3	Recalculated CCME 1994	170	CCME 1994	Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. Sufficient data were only available to derive a guideline for "other crops", which includes crops other than cereals, tame hays or pastures. Irrigation and livestock water guidelines are interim.
Chlorpyrifos	Pesticide	µg/L			24	CCME 1997	Interim.

**Table 2. Water quality guidelines for the protection of agricultural water uses (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Irrigation	Source & Date	Livestock Water	Source & Date	Notes and Direction
<b>Chromium - total:</b>	Metal	µg/L					
-Hexavalent (Cr VI)			8.0	CCME 1997	50	CCME 1997	Livestock water guideline is interim. See footnote C.
-Trivalent (Cr III)			4.9	CCME 1997	50	CCME 1997	Irrigation and livestock water guidelines are interim. See Footnote C.
<b>Cobalt - total</b>	Metal	µg/L	50	CCME 1987	1000	CCME 1987	See Footnote B. No CCME fact sheet available.
<b>Coliforms, fecal (<i>Escherichia coli</i>)</b>	Biological	#/100 mL	100	CCME 1987			Interim. Derived to address potential risk to human health of consumption of irrigated raw produce. No CCME fact sheet available.
<b>Copper - total</b>	Metal	µg/L	200 to 1000	CCME 1987	500 to 5000	CCME 1987	Irrigation guideline is 200 µg/L for cereals and 1000 µg/L for tolerant crops. Livestock water guideline is 500 µg/L for sheep, 1000 µg/L for cattle and 5000 µg/L for swine and poultry. No CCME fact sheet available.
<b>Cyanazine</b>	Pesticide	µg/L	0.5	CCME 1990	10	CCME 1990	Irrigation and livestock water guidelines are interim. See Footnote C.
<b>DDT (Dichloro diphenyl trichloroethane)</b>	Pesticide	µg/L			<del>30</del>	CCME 1987	See Footnote E. No CCME fact sheet available.
<b>Deltamethrin</b>	Pesticide	µg/L			2.5	CCME 1997	
<b>Dicamba</b>	Pesticide	µg/L	0.008	Recalculated CCME 1993	122	CCME 1993	Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. Irrigation guideline is 0.008 µg/L for other crops, 0.08 µg/L for legumes and 0.8 µg/L for cereals.
<b>Dibromochloromethane</b>	Trace organic	µg/L			100	CCME 1992	See Footnote C. No CCME fact sheet available.
<b>Dichlorobromomethane</b>	Trace organic	µg/L			100	CCME 1992	See Footnote C. No CCME fact sheet available.
<b>Dichloroethane (1,2)</b>	Trace organic	µg/L			5	CCME 1991	Interim. See Footnote C. No CCME fact sheet available.
<b>Dichloromethane (Methylene chloride)</b>	Trace organic	µg/L			50	CCME 1992	Interim. See Footnote C. No CCME fact sheet available.
<b>Diclofop-methyl</b>	Pesticide	µg/L	0.24	Recalculated CCME 1993	9	CCME 1993	Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. Irrigation guideline is 0.24 µg/L for cereals and tame hay and 7.5 µg/L for other crops. Livestock water guideline is interim. See Footnote C.
<b>Diisopropanolamine (DIPA)</b>	Trace organic	µg/L	3200	Recalculated CCME 2005			Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. Interim.
<b>Dimethoate</b>	Pesticide	µg/L			3	CCME 1993	Interim.
<b>Dinoseb</b>	Pesticide	µg/L	21	Recalculated CCME 1992	150	CCME 1992	Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. Irrigation guideline is 21 µg/L for other crops, 61 µg/L for cereals and tame hay, and 120 µg/L for legumes.
<b>Endrin</b>	Pesticide	µg/L			<del>0.2</del>	CCME 1987	The guideline is withdrawn. See Footnote E. No CCME fact sheet available.
<b>Ethylbenzene</b>	Trace organic	µg/L			2.4	CCME 1996	No CCME fact sheet available.
<b>Fluoride</b>	Ions and General	mg/L	1	CCME 1987	1 to 2	CCME 1987	See Footnote B. Livestock guideline: 1 mg/L if feed contains fluoride. No CCME fact sheet available.
<b>Glyphosate</b>	Pesticide	µg/L			280	CCME 1989	No CCME fact sheet available.
<b>Heptachlor (Heptachlor epoxide)</b>	Pesticide	µg/L			<del>3</del>	CCME 1987	The guideline is withdrawn. See Footnote E. No CCME fact sheet available.
<b>Hexachlorobenzene</b>	Trace organic	µg/L			0.52	CCME 1997	Interim.
<b>Iron - total</b>	Metal	mg/L	5	CCME 1987			No CCME fact sheet available.

**Table 2. Water quality guidelines for the protection of agricultural water uses (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Irrigation	Source & Date	Livestock Water	Source & Date	Notes and Direction
Lead - total	Metal	µg/L	200	CCME 1987	100	CCME 1987	No CCME fact sheet available.
Lindane (Hexachlorocyclohexane)	Pesticide	µg/L			4	CCME 1987	The concentration refers to the gamma isomer only. Guidelines for livestock can serve as action levels or interim management objectives towards virtual elimination. See Footnote C. No CCME fact sheet available.
Linuron	Pesticide	µg/L	0.11	Recalculated CCME 1995			Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. Irrigation guideline is 0.11 µg/L for other crops and 5.3 µg/L for cereals, tame hays and pasture. Interim.
Lithium - total	Metal	mg/L	2.5	CCME 1987			No CCME fact sheet available.
Manganese - total	Metal	µg/L	200	CCME 1987			See Footnote B. No CCME fact sheet available.
MCPA (4-chloro-2-methyl phenoxy acetic acid)	Pesticide	µg/L	0.04	Recalculated CCME 1995	25	CCME 1995	Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A. Irrigation guideline is 0.040 µg/L for other crops and 0.26 µg/L for cereals, tame hays and pasture. Livestock water guideline is interim.
Mercury - total	Metal	µg/L			3	CCME 1987	No CCME fact sheet available.
Metolachlor	Pesticide	µg/L	28	CCME 1991	50	CCME 1991	Both irrigation and livestock water guidelines are interim. See Footnote C.
Metribuzin	Pesticide	µg/L	0.5	CCME 1990	80	CCME 1990	Irrigation guideline is interim. See Footnote C.
Molybdenum - total	Metal	µg/L	10	CCME 1987	500	CCME 1987	No CCME fact sheet available.
Nickel - total	Metal	µg/L	200	CCME 1987	1000	CCME 1987	See Footnote B. No CCME fact sheet available.
Nitrate + Nitrite-N	Nutrient	mg/L			100	CCME 1987	No CCME fact sheet available.
Nitrite-N	Nutrient	mg/L			10	CCME 1987	No CCME fact sheet available.
Phenols (mono- & dihydric)	Trace organic	µg/L			2	CCME 1987	No CCME fact sheet available.
Phenoxy herbicides	Pesticide	µg/L			100	CCME 1987	No CCME fact sheet available. Applies to sum of all phenoxy herbicides, including 2,4-D, dichlorprop, 2,4-DB, mecoprop, MCPA, MCPB, quinclorac.
Picloram	Pesticide	µg/L			190	CCME 1990	See Footnote C. No CCME fact sheet available.
Selenium - total	Metal	µg/L	20 or 50	CCME 1987	50	CCME 1987	Irrigation guideline is 20 µg/L for continuous use and 50 µg/L for intermittent use. No CCME fact sheet available.
Simazine	Pesticide	µg/L	0.5	CCME 1991	10	CCME 1991	Both irrigation and livestock water guidelines are interim.
Sodium Adsorption Ratio (SAR)	Ions and General		5	AAFRD 2002			Safe level. Higher levels of SAR may be safe for irrigation, see Table 2.1 and consult an irrigation specialist.
Sulfolane	Trace organic	µg/L	800	Recalculated CCME 2005			Interim. Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A.
Sulphate	Ions and General	mg/L			1000	CCME 1987	No CCME fact sheet available. Guideline may not be protective in all cases (see AAF 2007).
Tebuthiuron	Pesticide	µg/L	0.43	Recalculated CCME 1995	130	CCME 1995	Both irrigation and livestock water guidelines are interim. Irrigation guidelines were re-calculated based on a maximum irrigation rate of 750 mm per year. See Footnote A.
Toluene	Trace organic	µg/L			24	CCME 1996	No CCME fact sheet available.
Total Dissolved Solids (TDS)	Ions and General	mg/L	500 to 3500	CCME 1987	3000	CCME 1987	Irrigation guideline is crop-specific. See Footnote G. No CCME fact sheet available.



**Table 2. Water quality guidelines for the protection of agricultural water uses (continued).**

Water Quality Variable (Substance or Condition)	Category	Unit	Irrigation	Source & Date	Livestock Water	Source & Date	Notes and Direction
Toxaphene	Pesticide	µg/L			5	CCME 1987	See Footnote E. No CCME fact sheet available.
Triallate	Pesticide	µg/L			230	CCME 1992	Interim. See Footnote C. No CCME fact sheet available.
Tributyltin	Trace organic	µg/L			250	CCME 1992	Interim. No CCME fact sheet available.
Trichloroethylene (1,1,2-Trichloroethene)	Trace organic	µg/L			50	CCME 1991	Interim. See Footnote C.
Tricyclohexyltin	Trace organic	µg/L			250	CCME 1992	Interim.
Trifluralin	Pesticide	µg/L			45	CCME 1999	Interim.
Triphenyltin	Trace organic	µg/L			820	CCME 1992	Interim.
Uranium - total	Metal	µg/L	10	CCME 1987	200	CCME 1987	Irrigation guideline is interim. No CCME fact sheet available.
Vanadium - total	Metal	µg/L	100	CCME 1987	100	CCME 1987	No CCME fact sheet available.
Zinc - total	Metal	mg/L	1 or 5	CCME 1987	50	CCME 1987	Irrigation guideline is 1 mg/L when soil pH is <6.5 and 5 mg/L when soil pH is > 6.5. No CCME fact sheet available.

**Shading indicates:**

Units other than µg/L

Interim values

Value recalculated using revised irrigation rate

**Footnotes:**

- A. As per CCME (1993) protocol, irrigation guidelines were recalculated based on the existing allowable contaminant mass or acceptable application rate and a safety factor, but using a revised maximum irrigation rate of 750 mm per year derived from net irrigation water requirement for alfalfa (Bennett et al. in press) and irrigation efficiency (AARD 2011). Irrigation rates used by the CCME were 1000 mm per year (Aldicarb, Bromoxynil, Dicamba, Diclofop-methyl, Dinoseb) or 1200 mm per year (Arsenic, Cadmium, Chlorothalonil, Diisopropanolamine, Linuron, MCPA, Sulfolane, Tebuthiuron).
- B. Irrigation guidelines were derived for all soils, but higher concentrations may be safe for neutral or alkaline soils. However, the substance should not be allowed to accumulate in soils.
- C. Insufficient data were available to derive a full livestock water guideline. As per the CCME (1993) protocol, the Canadian drinking water quality guideline was adopted. Although the drinking water guideline may have subsequently been revised, not all livestock water guidelines have been updated.
- D. The irrigation guideline for boron is crop-specific:
- 500 µg/L: blackberries;
  - 500 to 1000 µg/L: peaches, cherries, plums, grapes, cowpeas, onions, garlic, sweet potatoes, wheat, barley, sunflowers, mung beans, sesame, lupins, strawberries, Jerusalem artichokes, kidney beans, and lima beans;
  - 1000 to 2000 µg/L: red peppers, peas, carrots, radishes, potatoes, and cucumbers;
  - 2000 to 4000 µg/L: lettuce, cabbage, celery, turnips, Kentucky bluegrass, oats, corn, artichokes, tobacco, mustard, clover, squash, and muskmelons;
  - 4000 to 6000 µg/L: sorghum, tomatoes, alfalfa, purple vetch, parsley, red beets, and sugar beets;
  - 6000 µg/L: asparagus.
- E. This guideline (originally published in Canadian Water Quality Guidelines (CCREM 1987 + Appendixes)) is no longer recommended and the value is withdrawn. A water quality guideline is not recommended. Environmental exposure is predominantly via sediment, soil, and/or tissue, therefore, the user is referred to the respective guidelines for these media. This substance meets the criteria for Track 1 substances under the national CCME Policy for the Management of Toxic Substances (PMTS) (i.e., persistent, bioaccumulative, primarily the result of human activity, and CEPA-toxic or equivalent), and should be subject to virtual elimination strategies. Guidelines can serve as action levels or interim management objectives towards virtual elimination.

**Table 2. Water quality guidelines for the protection of agricultural water uses (concluded).**

F. The irrigation guideline for chloride is crop-specific:

Foliar damage:	100 to 178 mg/L:	almonds, apricots, plums;
	178 to 355 mg/L:	grapes, peppers, potatoes and tomatoes;
	355 to 710 mg/L:	alfalfa, barley, corn and cucumbers;
	>710 mg/L:	cauliflower, cotton, safflower, sesame, sorghum, sugar beets and sunflowers.
Rootstocks:	180 to 600 mg/L:	stone fruit;
	710 to 960 mg/L:	grapes;
Cultivars:	110 to 180 mg/L:	strawberries;
	230 to 460 mg/L:	grapes;
	250 mg/L:	boysenberries, blackberries and raspberries.

G. The irrigation guideline for total dissolved solids (TDS) is crop specific:

500 mg/L:	strawberries, raspberries, beans, and carrots;
500 to 800 mg/L:	boysenberries, currants, blackberries, gooseberries, plums, grapes, apricots, peaches, pears, cherries, apples, onions, parsnips, radishes, peas, pumpkins, lettuce, peppers, muskmelons, sweet potatoes, sweet corn, potatoes, celery, cabbage, kohlrabi, cauliflower, cowpeas, broadbeans, flax, sunflower, and corn;
800 to 1500 mg/L:	spinach, cantaloupe, cucumbers, tomatoes, squash, Brussels sprouts, broccoli, turnips, smooth brome, alfalfa, big trefoil, beardless wild rye, vetch, timothy, and crested wheat grass;
1500 to 2500 mg/L:	beets, zucchini, canola, sorghum, oat hay, wheat hay, mountain brome, tall fescue, sweet clover, reed canary grass, birdsfoot trefoil and perennial ryegrass;
2500 to 3500 mg/L:	asparagus, soybeans, safflower, oats, rye, wheat, sugar beets, barley, barley hay and tall wheat grass.

**Table 2.1. Irrigation water quality guidelines for sodium adsorption ratio (SAR) and electrical conductivity (EC).**

SAR	EC (dS/m)	Irrigation Suitability
≤ 5	≤ 1.0	Safe
> 5 to < 10	> 1.0 to < 2.0	Possibly Safe
≥ 10	≥ 2.0	Hazardous

Saline-sodic irrigation water in the possibly safe range may negatively affect structural stability of the soil and an irrigation specialist should be consulted.

Source: AAFRD 2002.

**Table 3. Surface water quality guidelines for recreation and aesthetics**

Water Quality Variable (Substance or Condition)	Category	Unit	Numeric Guideline	Source & Date	Notes and Direction
<b>Recreation</b>					
<i>E. coli</i>	Microbiological	cfu/100 mL	≤ 100	USEPA 2012	Geometric Mean (30-d interval). A minimum of weekly samples is recommended.
			≤ 320		Statistical threshold value - no more than 10% of samples should exceed over a 30-d interval. A minimum of weekly samples is recommended.
Enterococci (culturable)	Microbiological	cfu/100 mL	≤ 30	USEPA 2012	Geometric Mean (30-d interval). A minimum of weekly samples is recommended.
			≤ 110		Statistical threshold value - no more than 10% of samples should exceed over a 30-d interval. A minimum of weekly samples is recommended.
<i>Enterococcus</i> spp. (qPCR)	Microbiological	cce/100 mL	≤ 300	USEPA 2012	Geometric Mean (30-d interval). A minimum of weekly samples is recommended.
			≤ 1280		Statistical threshold value - no more than 10% of samples should exceed over a 30-d interval. A minimum of weekly samples is recommended.
Pathogenic Microorganisms	Microbiological			Health Canada 2012	Testing only needed when there is epidemiological or other evidence to suggest that this is necessary.
Cyanobacteria and Cyanotoxins	Microbiological			Health Canada 2012	
Total Cyanobacteria		cells/mL	100 000		
Total Microcystins		µg/L	20		Expressed as microcystin-LR
pH	Ions & general		5.0 to 9.0	Health Canada 2012	For waters used in primary contact recreation.
Chemical Hazards				Health Canada 2012	Risks associated with specific chemical hazards will be dependent on the particular circumstances and should be assessed on a case-by-case basis.
Other Biological Hazards (e.g., Schistosomes causing Swimmer's itch, aquatic vascular plants and algae)				Health Canada 2012	Recreational activities should not be pursued in waters where the responsible authority deems the presence of these organisms poses a risk to the health and safety of the users.
<b>Aesthetics</b>					
Clarity	Ions & general	Narrative		Health Canada 2012	Clarity should be sufficient for user to estimate depths and see subsurface hazards.
Colour	Ions & general	Narrative		Health Canada 2012	Colour should not be so intense as to impede the visibility in areas used for swimming.
Litter	Ions & general	Narrative		Health Canada 2012	Areas should be free from floating debris as well as materials that will settle to form objectionable deposits.
Odour	Ions & general	Narrative		This document	Free from materials that produce odour in such a degree as to be objectionable or impair use.
Oil and Grease	Ions & general	Narrative		Health Canada 2012	Should not be present in concentrations that can be detected as a visible film, sheen discoloration or odour, or that can form deposits on shorelines or bottom sediments that are detectable by sight or odour.
Turbidity	Ions & general	Narrative		Health Canada 2012	Turbidity should not exceed 50 NTU to satisfy most recreational users.

Units cfu = colony forming units cce = calibrator cell equivalent
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**Table 4. Sediment quality guidelines for the protection of aquatic life.**

Sediment Quality Variable (Substance)	Category	Unit (dry weight)	Interim Sediment Quality Guideline (ISQG)	Probable Effects Level (PEL)	Lowest Effects Level (LEL)	Source & Date	Notes and Direction
Acenaphthene	Trace organic (PAH)	µg/kg	6.71	88.9		CCME 1998	Provisional. Adopted Marine ISQG.
Acenaphthylene	Trace organic (PAH)	µg/kg	5.87	128		CCME 1998	Provisional. Adopted Marine ISQG.
Aldrin	Pesticide	µg/kg			2	Ontario 1993	
Anthracene			46.9	245		CCME 1998	Provisional. Adopted Marine ISQG.
Arsenic	Metal	µg/kg	5900	17 000		CCME 1998	
Benz(a)anthracene	Trace organic (PAH)	µg/kg	31.7	385		CCME 1998	
Benzo(a)pyrene	Trace organic (PAH)	µg/kg	31.9	782		CCME 1998	
Chlordane	Pesticide	µg/kg	4.5	8.87		CCME 1998	
Chlorinated Alkanes	Trace organic					Env Can 2016	Federal Environmental Quality Guideline. Normalized to 1% TOC.
Short chain (C <sub>10-13</sub> )		mg/kg	1.8				
Medium chain (C <sub>14-17</sub> )		mg/kg	5.4				
Long chain (C <sub>≥18</sub> )		mg/kg	100				
Chromium (total)	Metal	µg/kg	37 300	90 000		CCME 1998	
Chrysene	Trace organic (PAH)	µg/kg	57.1	862		CCME 1998	
Copper	Metal	µg/kg	35 700	197 000		CCME 1998	
Dichloro diphenyl dichloroethane (DDD)	Pesticide	µg/kg	3.54	8.51		CCME 1998	
Dichloro diphenyl ethylene (DDE)	Pesticide	µg/kg	1.42	6.75		CCME 1998	
Dichloro diphenyl trichloroethane (DDT)	Pesticide	µg/kg	1.19	4.77		CCME 1998	Provisional. Adopted Marine ISQG and PEL.
Dieldrin	Pesticide	µg/kg	2.85	6.67		CCME 1998	
Endrin	Pesticide	µg/kg	2.67	62.4		CCME 1998	

**Table 4. Sediment quality guidelines for the protection of aquatic life (continued).**

Sediment Quality Variable (Substance)	Category	Unit (dry weight)	Interim Sediment Quality Guideline (ISQG)	Probable Effects Level (PEL)	Lowest Effects Level (LEL)	Source & Date	Notes and Direction
Fluoranthene	Trace organic (PAH)	µg/kg	111	2355		CCME 1998	
Fluorene	Trace organic (PAH)	µg/kg	21.2	144		CCME 1998	Provisional. Adopted Marine ISQG.
Heptachlor epoxide	Pesticide	µg/kg	0.6	2.74		CCME 1998	
Hexabromocyclododecane (HBCD)	Trace Organic	mg/kg	1.6			Env Can 2016	Federal Environmental Quality Guideline. Normalized to 1% TOC.
Hexachlorocyclohexane - Total (formerly Benzene Hexachloride)	Pesticide	µg/kg			3	Ontario 1993	
Hexachlorocyclohexane - α (formerly known as Benzene Hexachloride - α)	Pesticide	µg/kg			6	Ontario 1993	
Hexachlorocyclohexane - β (formerly Benzene Hexachloride - β)	Pesticide	µg/kg			5	Ontario 1993	
Lead	Metal	mg/kg	35	91.3		CCME 1998	
Lindane (Hexachlorocyclohexane - γ)	Pesticide	µg/kg	0.94	1.38		CCME 1998	
Manganese	Metal	mg/kg			460	Ontario 1993	
Mercury	Metal	µg/kg	170	486		CCME 1997	
Methylnaphthalene (2-)	Trace Organic (PAH)	µg/kg	20.2	201		CCME 1998	Provisional. Adopted Marine ISQG.
Mirex	Pesticide	µg/kg			7	Ontario 1993	
Nickel	Metal	mg/kg			16	Ontario 1993	

**Table 4. Sediment quality guidelines for the protection of aquatic life (continued).**

Sediment Quality Variable (Substance)	Category	Unit (dry weight)	Interim Sediment Quality Guideline (ISQG)	Probable Effects Level (PEL)	Lowest Effects Level (LEL)	Source & Date	Notes and Direction
Nonylphenol and its ethoxylates	Organic nonylphenol and its ethoxylates	mg/kg	1.4			CCME 2002	Provisional. Toxic equivalency factors used for congeners (see CCME 2002). Normalized to 1% TOC; If TOC is in the range 0.2 – 12 %, multiply the guideline by percent TOC to derive a site-specific value.
Phenanthrene	Trace Organic (PAH)	µg/kg	41.9	515		CCME 1998	
Polycyclic Aromatic Hydrocarbons (Total)	Trace Organic (PAH)	µg/kg			4000	Ontario 1993	
Pyrene	Trace Organic (PAH)	µg/kg	53	875		CCME 1998	
Polychlorinated Biphenyls (PCBs) - total	Trace Organic	µg/kg	34.1	277		CCME 2002	
Polybrominated Diphenyl Ethers	Trace Organic					Env Can 2013	Federal Environmental Quality Guideline.
triBDE		µg/kg	44				
tetraBDE		µg/kg	39				
pentaBDE		µg/kg	0.4				
pentaBDE (BDE-99)		µg/kg	0.4				
penta BDE (BDE-100)		µg/kg	0.4				
hexaBDE		µg/kg	440				
octaBDE		µg/kg	5600				
decaBDE		µg/kg	19				
Polychlorinated dibenzo- <i>p</i> -dioxins/dibenzo furans (PCDD/Fs)	Trace Organic (Dioxins, Furans)	ng/kg	0.85	21.5		CCME 2001	Toxic equivalency factors for fish used for congeners (see CCME 2001). Toxicity calculation should also consider coplanar PCBs as they have a similar mode of toxicity.
Selenium	Metal	µg/kg	2000			BC 1992; 2014	
Tetrabromobisphenol A (TBBPA)	Trace organic	mg/kg	0.6			Env Can 2016	Federal Environmental Quality Guideline. Normalized to 1% TOC.

**Table 4. Sediment quality guidelines for the protection of aquatic life (concluded).**

Sediment Quality Variable (Substance)	Category	Unit (dry weight)	Interim Sediment Quality Guideline (ISQG)	Probable Effects Level (PEL)	Lowest Effects Level (LEL)	Source & Date	Notes and Direction
Toxaphene	Organic pesticides Organochlorine compounds	µg/kg	0.1			CCME 2002	Provisional. Guideline should be multiplied by % TOC.
Zinc	Metal	mg/kg	123	315		CCME 1998	

Units other than µg/kg are shaded.

**Table 5. Tissue residue guidelines for the protection of wildlife consumers of aquatic biota.**

Variable (Substance)	Unit (diet, as wet weight)	Tissue Residue Guideline	Source & Date	Notes and Direction
<b>Chlorinated Alkanes</b>			Env Can 2016	Federal Environmental Quality Guideline. Mammalian toxicity only.
<b>Short Chain (C<sub>10-13</sub>)</b>	mg/kg	18		
<b>Medium Chain (C<sub>14-17</sub>)</b>	mg/kg	0.54		
<b>Long chain liquid (C<sub>&gt;20</sub>)</b>	mg/kg	18		Due to lack of data, no guidelines were derived for Long chain CAs with C <sub>18-20</sub> .
<b>Long chain solid (C<sub>&gt;20</sub>)</b>	mg/kg	770		
<b>DDT (total) - Dichloro diphenyl trichloroethane</b>	µg/kg	14	CCME 1997	Total DDT = <i>o,p'</i> + <i>p,p'</i> DDT; <i>o,p'</i> + <i>p,p'</i> DDE; <i>o,p'</i> + <i>p,p'</i> DDD.
<b>Mercury, - methyl</b>	µg/kg	33	CCME 2001	
<b>Hexabromocyclododecane (HBCD)</b>	mg/kg	40	Env Can 2016	Federal Environmental Quality Guideline. Mammalian toxicity only.
<b>Polybrominated diphenyl ethers (PBDEs)</b>			Env Can 2013	Federal Environmental Quality Guideline. Applies to mammalian wildlife unless otherwise noted.
tetraBDE	ng/g	44		
pentaBDE (total)	ng/g			
- Mammalian:	ng/g	3		
- Avian:	ng/g	13		
pentaBDE (BDE-99)	ng/g			
hexaBDE	ng/g	4		
heptaBDE	ng/g	64		
octaBDE	ng/g	63		
nonaBDE	ng/g	78		
decaBDE	ng/g	9		
<b>Polychlorinated biphenyls (PCBs)</b>			CCME 1998	Consult the CCME Fact Sheets for toxic equivalency factors (TEQ). See footnote A.
- Mammalian:	ng TEQ/kg	0.79		
- Avian:	ng TEQ/kg	2.4		
<b>Polychlorinated dibenzo-<i>p</i>-dioxins/dibenzo furans (PCDDs, PCDFs)</b>			CCME 2001	Consult the CCME Fact Sheets for toxic equivalency factors (TEQ). See footnote A.
- Mammalian:	ng TEQ/kg	0.71		
- Avian:	ng TEQ/kg	4.75		Interim.
<b>Tetrabromobisphenol A (TBBPA)</b>	mg/kg	20	Env Can 2016	Federal Environmental Quality Guideline. Mammalian toxicity only.
<b>Toxaphene</b>	µg/kg	6.3	CCME 1997	

**Footnote A:** Where both PCBs and PCDD/DFs contribute significantly to the [TEQ] in tissue, the lower TRG for each class of animals should be used, i.e. the avian PCB and the mammalian PCDD/DF values.

Units:  
 µg/kg = parts per billion (ppb)  
 ng/kg = parts per trillion (ppt)  
 TEQ = Toxic equivalency units



**Table 6. Fish tissue guidelines for protection of aquatic life.**

Variable (Substance)	Unit	Fish Tissue Guideline	Source & Date	Notes and Direction
<b>Chlorinated Alkanes</b>			Env Can 2016	Federal Environmental Quality Guideline.
<b>Short Chain (C<sub>10-13</sub>)</b>	µg/g lipid	2.7		
<b>Medium Chain (C<sub>14-17</sub>)</b>	µg/g lipid	0.76		
<b>Polybrominated diphenyl ethers (PBDEs)</b>			Env Can 2013	Federal Environmental Quality Guideline.
<b>triBDE</b>	ng/g (ww)	120		
<b>tetraBDE</b>	ng/g (ww)	88		
<b>pentaBDE (total)</b>	ng/g (ww)	1		
<b>pentaBDE (BDE-99)</b>	ng/g (ww)	1		
<b>pentaBDE (BDE-100)</b>	ng/g (ww)	1		
<b>hexaBDE</b>	ng/g (ww)	420		
<b>Selenium</b>			BC 2014	
<b>Egg/Ovary</b>	µg/g (dw)	11		
<b>Muscle/Muscle plug</b>	µg/g (dw)	4		Interim

Units:

µg/g = parts per million (ppm)

ng/g = parts per billion (ppb)

dw = dry weight basis

ww = wet weight basis

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