



Ministry of
Environment and
Climate Change Strategy

PROTOCOL 10 ***FOR CONTAMINATED SITES***

Hardness Dependent Site-Specific Freshwater Standards for Zinc

Version 2.0

Prepared pursuant to Section 64 of the
Environmental Management Act

Approved:

Cameron Lewis
Director of Waste Management

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Date

1.0 Definitions

The following words, acronyms, and expressions used in this document are defined in [Procedure 8, “Definitions and Acronyms for Contaminated Sites”](#):

aquatic life	protocol
aquatic life water use (AW)	Regulation
contaminated sites legal instrument	site-specific numerical standard (SSS)
ministry	

2.0 Introduction

This protocol provides a procedure whereby site-specific water standards (SSSw) to protect freshwater aquatic life can be developed for zinc. A table of pre-calculated, pre-approved aquatic life site-specific water standards is presented for water hardness up to 500 mg/L as CaCO₃.

3.0 Overview

Schedule 3.2 of the Contaminated Sites Regulation (the Regulation) provides hardness dependent water standards for a number of substances. For zinc, freshwater aquatic life standards are truncated for water hardness values of 400 mg/L CaCO₃. However, the Canadian Council of Ministers of the Environment (CCME) and ministry water quality guidelines upon which the water standards are based also provide formulas by which guidelines, and by extension SSSw, can be calculated should water hardness exceed 400 mg/L CaCO₃.

The intent of these site-specific standards is to allow limited modification of the scheduled numerical water standards of the Regulation based on information compiled for a particular site. For zinc, ministry approved SSSw may be used instead of corresponding Schedule 3.2 water standards, for the site for which they were developed to determine if:

- a site is a contaminated site; or
- a contaminated site has been satisfactorily remediated.

Site-specific standards developed for use under the regulation represent objective, quantitative standards. The ministry will not approve SSSw developed on the basis of qualitative or subjective rationale.

4.0 Methodology

Either of the following two methods may be used to derive freshwater aquatic life site-specific water standards for zinc.

4.1 Calculation (Hardness \geq 500 mg/L as CaCO₃)

1. In accordance with [Protocol 21, "Water Use Determinations"](#), determine if Schedule 3.2 aquatic life water standards are applicable at the site.
2. In accordance with good industry practice and in consideration of [Technical Guidance 10, "Guidance for a Stage 1 Preliminary Site Investigation"](#) and [Technical Guidance 11, "Guidance for a Stage 2 Preliminary Site Investigation"](#), and requirements provided in the ministry [field sampling](#) and [laboratory manual](#), determine the natural background site-specific hardness of water (surface and/or groundwater) present on site.
3. Determine if CSR Schedule 3.2 aquatic life water standards for zinc are exceeded at the site.
4. If measured water hardness at the site exceeds 500 mg/L as CaCO₃, use the following equation to calculate freshwater aquatic life site-specific water standards (SSSw) for the site-specific water hardness values obtained on site:

$$\text{SSSw}_{\text{fw aq. life}} (\text{ug/L}) = 10 \times [7.5 + \{(0.75)(\text{hardness} - 90)\}] \quad (\text{adapted from [1]}).$$

4.2 Look up table (Hardness \geq 400 to < 500 mg/L)

1. In accordance with [Protocol 21](#), determine if Schedule 3.2 aquatic life water standards are applicable at the site.
2. In accordance with good industry practice and in consideration of [Technical Guidance 10](#) and [11](#), and requirements provided in the ministry [field sampling](#) and [laboratory manual](#), determine the natural background site-specific hardness of water (surface and/or groundwater) present on site.
3. Determine if Schedule 3.2 aquatic life water standards for zinc are exceeded at the site.

4. If measured water hardness at the site exceeds the corresponding water hardness upper bound identified for freshwater aquatic life (400 mg/L as CaCO₃) Schedule 3.2 standards but does not exceed 500 mg/L as CaCO₃, select from Table 1 corresponding pre-calculated extended range freshwater aquatic life site-specific water standards (SSSw) for the site-specific water hardness values obtained on site.

5.0 Ministry approval and data reporting requirements

5.1 Calculation method

If freshwater aquatic life zinc SSSw were calculated for site-specific water hardness values at the site, submit the site-specific water hardness investigative and characterization data (including analytical results) and the SSSw calculations to the ministry for review and approval prior to use as SSSw.

Naturally attributable ambient water hardness values ≥ 500 mg/L as CaCO₃ would be considered extremely unusual within the Province and may be indicative of anthropogenic pollution (e.g. waste disposal leachate, acid rock drainage, etc.). Sufficient supporting evidence needs to be submitted to show that the observed hardness can be attributed to natural rather than anthropogenic circumstances.

5.2 Look up table method

If extended range pre-calculated aquatic life SSSw were selected from Table 1 for the site-specific water hardness values obtained at the site, the SSSw may be used directly for contaminated site regulatory purposes without additional ministry approval. Upon submission of an application for a contaminated sites legal instrument, the site-specific water hardness investigative and characterization data (including analytical results) are a required component of any preliminary or detailed site investigation prepared for the site.

6.0 References

1. **British Columbia. Ministry of Environment, Lands and Parks. 1999.** [*Ambient Water Quality Guidelines for Zinc*](#). Water Management Branch, Environment and Resource Management Department. Victoria, British Columbia.

For more information, please direct inquiries to site@gov.bc.ca.

Revision history

Approved Date	Effective Date	Document Version	Notes
	December, 2002	1.0	
	November 1, 2017	2.0	Updated for CSR Stage 10 amendment

Table 1. Pre-calculated extended range aquatic life site-specific water standards (SSSw) for zinc for site-specific water hardness to 500 mg/L as CaCO₃.¹

COLUMN I	COLUMN II	COLUMN III	COLUMN IV	COLUMN V
Substance	Aquatic Life ² (AW)	Irrigation ² (IW)	Livestock ² (LW)	Drinking Water ² (DW)
INORGANIC SUBSTANCES				
Zinc	75 @ H < 90 ^{5,21} 150 @ H = 90 - < 100 ^{5,21} 900 @ H = 100 - < 200 ^{5,21} 1 650 @ H = 200 - < 300 ^{5,21} 2 400 @ H = 300 - < 400 ^{5,21} 3 150 @ H = 400 - < 500^{5,21} 100 ⁶	1 000 @ pH < 6.0 ⁷⁰ 2 000 @ pH 6.0 - < 7.0 ⁷⁰ 5 000 @ pH ≥ 7.0 ⁷⁰	2 000	3 000 ¹²

Footnotes:

- ¹ Tabled values for pre-calculated extended range aquatic life SSSw for zinc appear in **bold**. For reference, additional CSR Schedule 3.2 standards for zinc, with ancillary corresponding Schedule 3.2 footnotes, are also presented. All values are in µg/L unless otherwise stated. Substances must be analyzed using methods specified in: the 2015 British Columbia Environmental Laboratory Manual as updated from time to time, a director's protocol, or alternate methods acceptable to a director.
- ^{2(a)} Aquatic life standards assume minimum 1:10 dilution available. Aquatic life standards are to protect freshwater and marine life unless otherwise indicated.
- ^{2(b)} Standards for all organic substances are for total substance concentrations. Any water sample to be analyzed for organic substances should not be filtered.
- ^{2(c)} Standards for surface water samples to be analyzed for heavy metals, metalloids and inorganic ions are total substance concentrations. In addition, it is recommended that surface water samples being analyzed for heavy metals, metalloids and inorganic ions should also be analyzed for dissolved substance concentrations.
- ^{2(d)} Standards for groundwater samples for heavy metals, metalloids and inorganic ions are for dissolved substance concentrations. In addition, it is recommended that groundwater samples being analyzed for metals, metalloids and inorganic ions should be analyzed for total substance concentrations.
- ^{2(e)} Standards for irrigation water apply to irrigation of all soil types, unless otherwise indicated.
- ³ Drinking water standards are for unfiltered samples obtained at the point of consumption. Heavy metals, metalloids and inorganic ions are expressed as total substance concentrations unless otherwise indicated.
- ⁵ Standard to protect freshwater aquatic life.
- ⁶ Standard to protect marine and estuarine aquatic life
- ¹² Standard is specific to protection of human health. Standard is derived with a TRV protective of adults. Standard may not adequately protect other age groups.
- ²¹ H means hardness in mg/L CaCO₃.
- ⁷⁰ Standard varies with soil pH.