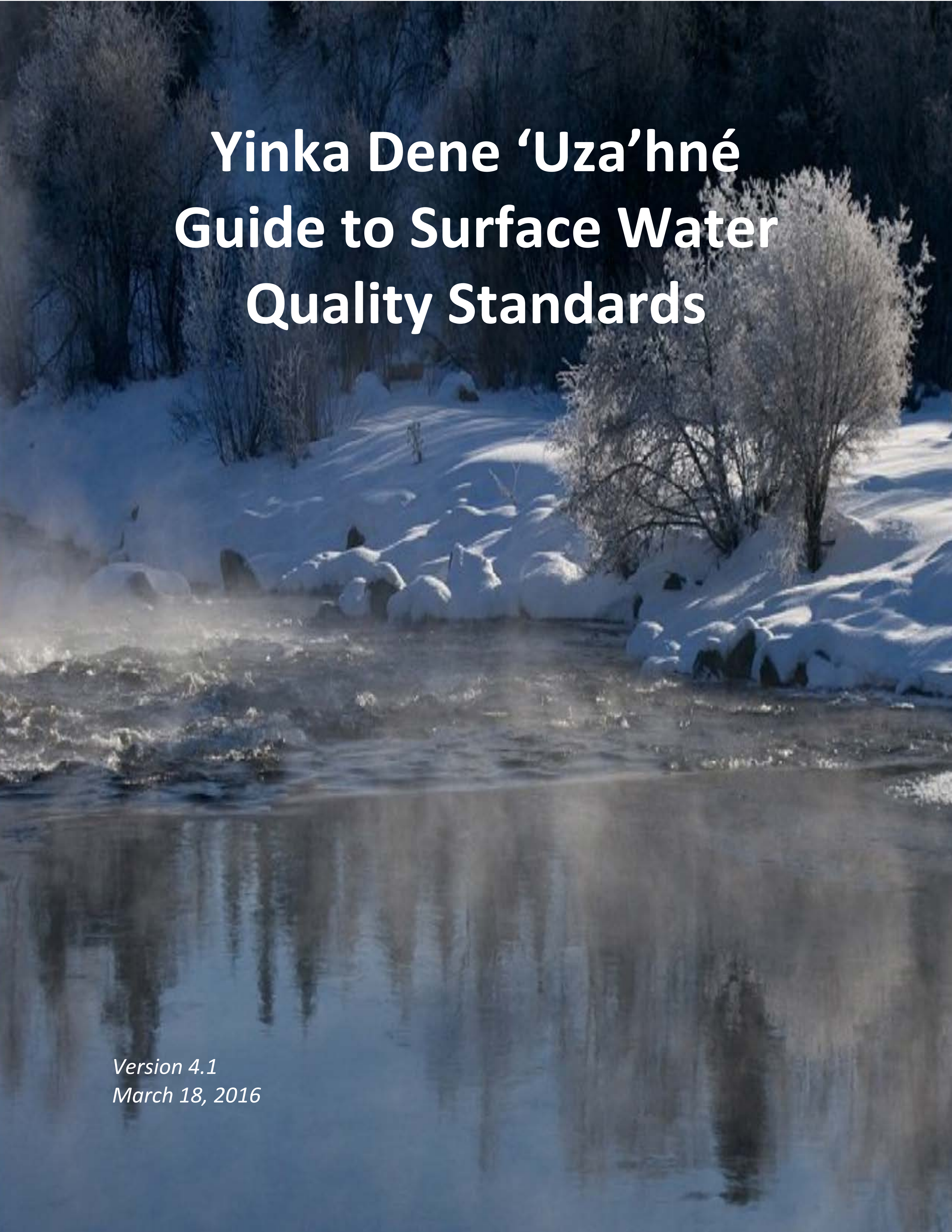

Yinka Dene 'Uza'hné Guide to Surface Water Quality Standards

Version 4.1
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CONTENTS

LIST OF ACRONYMS

AEMP	=	Aquatic Effects Monitoring Program
AMP	=	adaptive management plan
B.C.	=	British Columbia
CIP	=	continuous improvement plan
COPC	=	chemical of potential concern
CSM	=	conceptual site model
EEMP	=	Environmental Effects Monitoring Program
EQC	=	effluent quality criteria
ha	=	hectare
IDZ	=	initial dilution zone
RCP	=	Reclamation and Closure Plan
SBEB	=	science-based environmental benchmark
SNP	=	surveillance network program
SSWQO	=	site-specific water quality objective
SSWQS	=	site-specific water quality standard
WQS	=	water quality standard
WMP	=	Water Management Plan

1. INTRODUCTION TO THE *YINKA DENE 'UZA'HNÉ GUIDE TO SURFACE WATER QUALITY STANDARDS*

As provided for in Section 2 of the *Yinka Dene 'Uza'hné Surface Water Management Policy*, the policy has three distinct technical elements:

- Narrative water management objectives;
- Water classification system; and
- Numerical WQSs.

The first two elements are described within the *Yinka Dene 'Uza'hné Surface Water Management Policy*. With respect to numerical WQSs, this *Yinka Dene 'Uza'hné Guide to Surface Water Quality Standards* is intended to support implementation of the *Yinka Dene 'Uza'hné Surface Water Management Policy* by:

- Describing the process for establishing numerical water quality standards (WQSs) for each class of water;
- Describing procedures for deriving site-specific WQSs;
- Providing guidance for implementing the *Yinka Dene 'Uza'hné Surface Water Management Policy*; and
- Articulating expectations related to the implementation of WQSs.

2. NUMERICAL WATER QUALITY STANDARDS

A step-wise process has been developed for establishing WQSs for surface waters located within our Territories. More specifically, the WQS establishment process involves the following steps:

- Classify the surface water system relative to the level of protection that needs to be provided. Surface water bodies that support unique cultural uses, support species-at-risk, provide unique habitats, or support unique species assemblages shall be classified as Class I - Waters of High Cultural or Ecological Significance. Waters that support sensitive taxa or species of concern and/or important traditional resource uses shall be classified as Class II - Sensitive Waters. All other surface water bodies shall be classified as Class III - Typical Waters;
- Evaluate existing and potential land and water uses to support identification of chemicals of potential concern (COPCs; MacDonald *et al*. 2009; Clark *et al*. 2010 for guidance on evaluating water quality issues and concerns); and
- Develop numerical WQSs for COPCs using procedures that are appropriate for the water body under consideration. Class I - Waters of High Cultural or Ecological Significance should not be degraded by land or water use activities (i.e., should not

be substantially altered in terms of quality or quantity). For these water bodies, WQSs shall be developed by applying the non-degradation strategy (i.e., using the background concentration procedure; BCP). Class II - Sensitive Waters should be afforded an enhanced level of protection by establishing WQSs that allocate no more than 50% of the assimilative capacity of receiving waters. Class III - Typical Waters should be managed to protect the designated uses of the aquatic ecosystem. For these water bodies, WQSs shall be developed by applying the use-protection strategy.

The procedures that may be used to establish numerical WQSs using the three water management strategies are described in the following sections of this document. It is important to note that these procedures are focussed on the derivation of numerical WQSs for water chemistry. In addition, WQSs may be required for other environmental attributes including:

- Surface water toxicity;
- Sediment chemistry;
- Sediment toxicity;
- Invertebrate-tissue chemistry;
- Fish-tissue chemistry;
- Bird-tissue chemistry; and/or
- Mammal-tissue chemistry.

The need for such additional WQSs will depend on the nature of the activities that are being conducted within the watershed, the types of COPCs that may be released into the environment and the fate of the COPCs that are released from each contaminant source. The methods for developing effluent quality criteria (EQC) based on WQSs as well as guidance on the establishment of initial dilution zones (IDZs), are provided in Sections 4(b) through 4(d).

(a) Derivation of WQS for Class I Waters: High Cultural or Ecological Significance Waters

Using the non-degradation strategy, numerical WQSs are established to avoid degradation of baseline water quality conditions (i.e., using the BCP). The BCP provides a basis for deriving numerical WQSs that can be applied to maintain background conditions or restore water quality to pre-development conditions. In this procedure, the natural background concentrations of COPCs at a site are determined and used to define the acceptable water quality conditions for the area (MacDonald 1997). Natural background concentrations are those concentrations that have not been significantly altered by local human activities (although water quality conditions may be altered somewhat by regional or global activities). Whenever possible, water quality data collected prior to development are used to determine background conditions within a watershed. When such data are not available, water quality data collected at stations located upstream of human activities within the watershed or at appropriately-selected reference sites must be used to establish background conditions (BCMOE 2013a).

Numerical WQSs can be established in a number of ways using the BCP. However, all of these methods are based on first determining background water quality conditions within the water body under consideration and then defining WQSs that reflect temporal variability in background water quality conditions. Because the concentrations of many water quality variables can exhibit substantial daily, seasonal, and/or annual variability, WQSs can be established at the upper limit of background concentrations (e.g., the 95th percentile of the data). However, this approach results in WQSs that are strongly biased towards conditions that occur within the receiving water during only a portion of the year (e.g., during turbid flow conditions). For this reason, it is essential to determine background conditions for relevant time periods (e.g., based on months, seasons, flow periods) by normalizing to water quality conditions (i.e., turbidity levels) and/or forms of the COPC (e.g., concentrations of dissolved metals are typically less variable than total metals). Once background conditions have been defined using appropriate statistical methods (i.e., by calculating the 95% upper prediction limit of the mean for long-term average WQS and the 95th percentile for the maximum WQS), the numerical WQSs can be established at background levels or at a level that is slightly (e.g., 10%) above background levels (MacDonald 1997; CCME 2003). WQSs are typically expressed in terms of a monthly mean and maximum concentration for each COPC.

For Class I Waters - Waters of High Cultural and Ecological Significance, numerical WQSs need to be established using the non-degradation approach. Table 1 provides a listing of the water quality stations that were used to estimate background water quality conditions within our Territories (i.e., using water quality data for the Endako River, Francois Lake, and the Stellako River) and reference water quality conditions (i.e., using water quality data for the Babine River). Table 2 summarizes the background water quality conditions, while Table 3 summarizes reference water quality conditions in the Babine River. These data provide a basis for establishing preliminary WQSs for Class I - Waters of High Cultural or Ecological Significance within our Territories.

(b) <u>Derivation of WQS for Class II Waters: Sensitive Waters</u>

For Class II - Sensitive Waters, the water management objectives are to provide an enhanced level of protection for aquatic organisms, minimize the degradation of receiving waters, and protect traditional uses of natural resources. These objectives can be realized by allocating no more than 50% of the assimilative capacity of a water body. Application of this procedure requires determination of background conditions and compilation of numerical water quality guidelines (WQGs) for the most sensitive water use for each COPC. The numerical WQS for each COPC is then determined using the following equation:

$$WQS = [BKGD] + ([WQG]-[BKGD]) \times 0.5$$

Where [BKGD] is the background concentration of a COPC and WQG is the WQG for the most sensitive water use. Such WQSs will provide ecological receptors with enhanced protection by maintaining COPC concentrations substantially below the WQGs. The above equation provides a basis for calculating WQSs for waters where 50% of the assimilative capacity is allocated to facilitate resource development. The equation can be adjusted to calculate alternative WQSs, as well (e.g., 40% of assimilative capacity - substitute 0.4 for 0.5 in the equation). For bioaccumulative COPCs, human health needs to be afforded an enhanced level of protection.

(c) Derivation of WQS for Class III Waters: Typical Waters

The use-protection strategy provides a consistent scientific basis for establishing WQSs that accommodate multiple water uses of aquatic ecosystems. Using this strategy, ambient WQSs are established using the following procedure:

- Identify designated water uses;
- Compile numerical WQGs for each water use for each COPC [i.e., B.C. WQGs and Canadian Council of Ministers of the Environment (CCME) WQGs; select the lower of the two values for use in WQS development];
- For each COPC, select the WQG for the most sensitive water use (e.g., aquatic life, wildlife, human health) as the preliminary WQS. Adjust the WQGs to reflect the conditions at the site under consideration (i.e., WQGs may need to be adjusted to reflect site water hardness);
- Compare the preliminary WQS to the upper limit of background concentrations to determine if the WQS is consistently achievable at the station under consideration; and
- Adjust the preliminary WQS, as necessary, to ensure that it is consistently achievable from the perspective of background concentrations by implementing the BCP (note: no adjustment is permissible to address loadings of COPCs from local anthropogenic sources; such adjustments are typically conducted by considering an alternative form of the COPC; e.g., dissolved metals). Procedures for adjusting preliminary WQSs to account for site-specific factors are described in Section 3 of this document.

The water uses that must be protected in surface waters within our Territories include:

- Raw water for drinking water supply;
- Recreation and aesthetics;
- Freshwater aquatic life;
- Wildlife; and
- Agriculture (including irrigation and livestock watering).

A summary of the B.C. WQGs for the protection of aquatic life for selected COPCs is provided in Table 4. Table 5 provides a summary of the CCME WQGs for the protection of aquatic life. Table 6 provides a listing of the preliminary WQSs that have been established for typical surface waters within our Territories. It is important to note that these WQSs do not include tissue-based WQSs or toxicity-based WQSs. For water quality variables that have WQGs that are dependent on pH, temperature, and/or water hardness, background levels of these toxicity-modifying factors should be used to calculate the WQSs.

3. PROCEDURES FOR DERIVING SITE-SPECIFIC WATER QUALITY STANDARDS

For most surface waters within our Territories, preliminary WQSs can be established using the procedures specified for the class of water under consideration. The WQSs, so derived, apply to surface waters throughout our Territories unless it can be demonstrated that site-specific water quality standards (SSWQSs) are required for certain COPCs to support water management activities. In such cases, SSWQSs may be developed, provided that they are derived using approved procedures (i.e., MacDonald 1997; BCMOE 2013a; MacDonald *et al*. 2016). Any SSWQSs that are derived for surface waters within our Territories must be reviewed and approved by Nadleh Whut'en and Stellat'en, including the rationale for deriving SSWQSs, work plans, water quality data and information, toxicity testing results, and SSWQSs documentation.

Four procedures have been described for deriving SSWQSs (MacDonald 1997; CCME 2003), including:

- Background concentration procedure (BCP);
- Recalculation procedure;
- Water-effect ratio (WER) procedure; and
- Resident species procedure.

The BCP is described in Section 2(a). The other three procedures are briefly described below. Additional guidance on the application of these procedures is provided in MacDonald (1997), CCME (2003), BCMOE (2013a) and MacDonald *et al*. (2016).

The recalculation procedure represents one option for deriving SSWQSs. The recalculation procedure is used when there are differences between the taxa (i.e., type of species) present at the site under consideration and the taxa that were included in the aquatic toxicity data set used to calculate the generic WQG for a substance (MacDonald 1997; BCMOE 2013a). This procedure accounts for any differences in sensitivities of taxa present at the site compared to those used to derive the generic WQG. With the recalculation procedure, taxa that are not present (now or historically) at the site or nearby waters are eliminated from the toxicological data set that was used to calculate the generic WQG (MacDonald 1997; BCMOE 2013a). In addition, taxa not reflected in the database that occur at the site are added to the data set, provided the necessary toxicity data are available. Then, a SSWQS is calculated using the remaining data in the same way that the generic WQG was calculated, provided that the minimum data requirements for deriving the WQG are still met. If they are not, additional toxicity testing on resident species in laboratory water must be performed to generate enough data to calculate a SSWQS (MacDonald 1997; BCMOE 2013al MacDonald *et al*. 2016).

The second option for deriving SSWQSs is the WER procedure. This procedure provides a robust method for modifying generic WQGs to account for unique characteristics at the site in question. The premise of the WER procedure is that physical and/or chemical characteristics of water can differ among sites and may affect the bioavailability and, hence, toxicity of environmental contaminants (MacDonald 1997; CCME 2003; BCMOE 2013a). For example, increased water hardness is known to decrease the acute toxicity of certain metals (e.g., cadmium, copper, lead, nickel, and zinc) to fish (CCREM 1987; Nagpal 1999). Similarly, the toxicity of ammonia to fish is affected by pH and temperature (MacDonald *et al*. 1987). These factors are accounted for in the derivation of generic WQGs. However, there may be other factors (e.g., dissolved organic carbon, suspended particulate matter) at a site that could affect the bioavailability of the COPC under investigation. These factors are typically not accounted for in the derivation of the generic WQGs. The WER procedure provides a science-based method for accounting for such factors, thereby deriving SSWQSs that are specific to site conditions (MacDonald 1997; BCMOE 2013a).

To develop a WER, acute and/or short-term chronic (i.e., to evaluate sub lethal effects) toxicity tests are conducted with indicator and/or resident species using both site water and laboratory water. Indicator species are non-resident species that are known to be acceptable surrogates for resident species (MacDonald 1997; BCMOE 2013a). Rainbow trout (*Oncorhynchus mykiss*), fathead minnow (*Pimephales promelas*), the water flea *Ceriodaphnia dubia*, and the alga *Selenastrum capricornutum* (now known as *Pseudokirchneriella subcapitata*) are commonly used as indicator species because they are widely available, easy to culture, and consistently provide reliable results (Willingham 1988; MacDonald et al. 1989). In addition, these species are representative of those that are frequently present in waters within B.C. (MacDonald 1997; CCME 2003; MacDonald *et al*. 2016). The results of these toxicity tests are used to calculate the ratio of the toxicity of the COPC in site water to its toxicity in laboratory water (that is, the WER; MacDonald 1997; BCMOE 2013a). Toxicity data on at least one fish and one invertebrate species are needed to calculate the geometric mean WER, which is then applied to the generic WQG to convert it to a SSWQS (USEPA 1994). For example, if a COPC is half as toxic in site water as it is in laboratory water, the generic WQG would be multiplied by a WER of two to obtain the SSWQS (BCMOE 2013a).

The final approach for calculating SSWQSs is the resident species procedure. The resident species procedure accounts for both the sensitivity of species present at the site in question and the influence of water quality characteristics on toxicity at that site (MacDonald 1997; CCME 2003; BCMOE 2013a). To apply this procedure, new toxicity tests are conducted with species that are resident at the site, using water from the site (i.e., upstream of any discharges from point or non-point sources). When enough data are generated to meet the minimum data requirements for deriving WQGs, SSWQSs are developed following the protocol for deriving generic WQGs (MacDonald 1997; CCME 2007; BCMOE 2012; 2013a). Although the resident species procedure generates very accurate SSWQSs, the cost of conducting all the required bioassays is often substantial and can be prohibitive (MacDonald 1997; BCMOE 2013a).

4. GUIDANCE FOR YINKA DENE ‘UZA’HNÉ SURFACE WATER MANAGEMENT POLICY

The *Yinka Dene* ‘*Uza’hné Surface Water Management Policy* describes narrative water management objectives, a water classification system, and technical procedures for establishing narrative and numeric water quality standards. Implementation of the *Yinka Dene* ‘*Uza’hné Surface Water*

Management Policy also requires guidance on various related issues, such as technical procedures for characterising baseline water quality conditions, objectives for waste discharges, guidelines for IDZ delineation, procedures for deriving EQC, and guidelines for aquatic effects monitoring. Additional information on these topics is provided in this section.

(a) Guidelines for Characterising Baseline Water Quality Conditions

Determination of water quality conditions in a watershed under baseline (i.e., pre-development) conditions represents an important element of the overall water management process. In our Territories, proponents are required to design and implement a baseline monitoring program that provides sufficient data and information on the physical, chemical, and biological characteristics of water bodies potentially affected by their project to:

- Characterize aquatic resources at risk;
- Identify the pathways and mechanisms through which aquatic resources could be affected by the project;
- Support the evaluation of the nature, magnitude, spatial extent, and significance of any project-related impacts and the effectiveness of any mitigation activities that are proposed to address the predicted impacts;
- Support the development of numerical WQSs that can be used in the environmental assessment and permitting processes; and
- Facilitate the design of an Aquatic Effects Monitoring Program (AEMP) that will enable "before and after" and "control and influenced" (BACI) evaluations of water quality conditions.

While the need for baseline monitoring data is apparent, neither the federal government nor provincial government agencies have established detailed guidance that fully defines the requirements for collecting, evaluating, and compiling baseline water quality data and related information to support environmental assessments and subsequent permitting. Without a clear understanding of the baseline data requirements for either of these processes, the data that have been collected by the project proponents, to characterize baseline conditions, have frequently been inadequate or incomplete.

Nadleh Whut'en and Stellat'en have established the following guidelines for characterizing baseline water quality conditions. Such monitoring programs must:

- Be designed in accordance with "Guidance on the Development of Baseline Monitoring Programs for Oil and Gas Development Projects in the NWT" (SFF 2008) and in general accordance with "Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories" (INAC 2009a to 2009h);

- Include collection of data on the physical, chemical, and biological characteristics of the water body (ies) under consideration for a period of not less than three years, including, at minimum, monthly sampling and two 5-in-30-day sampling events at each station each year;

- Include a quality assurance/quality control (QA/QC) program sufficient to assure the quality of the baseline data;

- Include an evaluation of the resultant data quality (i.e., data validation) to determine which data can be used to assess baseline conditions;

- Compile the resultant data in a project database in an appropriate format that facilitates access to the data by all interested parties over the entire life of the project; and,

- Include a detailed evaluation of baseline conditions, including annual reporting of the monitoring results and associated data analyses.

(b) General Objectives for Effluent Discharges to Receiving Waters

Numerical WQSs define the conditions that need to be achieved in receiving waters to ensure that the narrative WQSs are met. While such numerical WQSs provide essential tools for managing water resources, they do not provide a comprehensive basis for ensuring that the narrative WQSs are met. In addition, general objectives for effluent discharges, guidelines for IDZs, and numerical EQCs are required to ensure that wastewater discharges do not adversely affect receiving waters. The general objectives for effluent discharges are discussed in this section, while requirements related to IDZs and EQCs are described in the following sections of this chapter (i.e., Sections 4(c) and 4(d)).

To guide the development of permit conditions that are consistent with the guiding principles established by Nadleh Whut'en and Stellat'en related to the deposit of waste from a project to the receiving environment, the following objectives for effluent discharges must be met:

- Water quality and quantity in the receiving environment shall be maintained at a level that allows for current and future water quality requirements to be met (such requirements are determined using the water classification system); and,

- The amount of waste to be deposited to the receiving environment shall be minimized.

The following waste prevention/minimization hierarchy of preferred options is intended to guide waste management practices for development projects that includes:

- Source Reduction - Waste should be prevented or reduced at the source whenever feasible;

- Reuse/Recycle - Waste that cannot be prevented should be reused or recycled in an environmentally-safe manner whenever feasible;

- Treatment - Waste that cannot be prevented or recycled/reused should be treated in an environmentally-safe manner whenever feasible; and,

- Discharge - Discharge or deposit of waste into the environment should be employed only as a last resort and must meet EQCs.

In all cases, the intent of prescribing specific waste management practices is to achieve the objectives for effluent discharges listed above. In addition to these overarching objectives, a series of general objectives for effluent discharges need to be met to ensure that the narrative intent of the WQSs is achieved, including:

- Effluent discharges must be free from substances in concentrations or combinations that are acutely toxic or may be harmful to human, animal, or aquatic life;

- Effluent discharges must be free from substances that settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect wildlife;

- Effluent discharges must be free from debris, oil, grease, scum, or other materials in amounts sufficient to be noticeable in the receiving water;

- Effluent discharges must be free from colour, turbidity, or odour-producing materials that would adversely affect aquatic life or wildlife, significantly alter the natural colour of the receiving water, or result in undesirable taste or odour in treated water; and

- Effluent discharges must be free from nutrients in concentrations that create nuisance growths of aquatic weeds or algae, or that result in an unacceptable degree of eutrophication of the receiving water.

(c) <u>Guidelines for Establishing and Regulating Initial Dilution Zones</u>

A physical mixing zone can be defined as the area within which an effluent mixes with receiving water, such that complete mixing has occurred outside the limits of the physical mixing zone (CCME 2009). The dimensions of the physical mixing zone depend on the characteristics of the effluent discharge (e.g., density, outfall design, temperature, flow rate, COPC concentrations) and the characteristics of the receiving water body (e.g., depth, current velocity, turbulence, wave action). Accordingly, the size and location of the physical mixing zone can change over time. In addition to determining the characteristics of the physical mixing zone, environmental managers typically establish an allocated mixing zone to provide a basis for regulating effluent discharges. According to CCME (2009), the allocated mixing zone or IDZ is defined as the area contiguous with a point source (effluent discharge site) or a delimited non-point source where:

> The discharge mixes with ambient water and where concentrations of some substances may not comply with water quality guidelines or objectives. The mixing

zone is an area of acceptable, but not acutely toxic, impact that does not affect the overall quality of the receiving water. In general, the integrity of the water body as a whole is protected even if environmental quality objectives (EQOs) are exceeded within the mixing zone, as long as the effluent does not cause significant mortality inside the zone and respects the EQOs at the edge of the zone.

The following criteria for IDZs are intended to support consistency in the regulation of effluent discharges to receiving water bodies within our Territories (Hatfield 2012), including:

- The dimensions of an IDZ should be restricted to avoid adverse effects on the designated uses of the receiving water system (i.e., the mixing zone should be as small as possible), as follows;

  (i) For lakes, IDZs should have a maximum radius of 100 m or 25% of the width of the lake, whichever is smaller. In addition, IDZs should not exceed 10% of the available lake volume and not extend closer to shore than the mean low water mark, and

  (ii) For streams and rivers, IDZs should not exceed (a) the lesser of the maximum width, perpendicular to the path of the stream, or 100 m, or 25% of the width of the stream, and (b) the maximum length, parallel to the path of the stream, of a point 100 m upstream of the discharge and a point downstream, which is the lesser of 100 m or the distance at which the width of the effluent plume equals the maximum allowable width of the mixing zone;

- IDZs should not impinge on critical fish or wildlife habitats (e.g., spawning or rearing areas of fish, over-wintering habitats of migratory waterfowl);

- IDZs must not be established such that drinking water intakes are contained therein and must be established to maintain a minimum of 1 km separation from the drinking water intake in lakes and 1 km in the downstream direction in rivers;

- IDZs should not be allocated for persistent, toxic and bioaccumulative substances;

- The placement of IDZs must not block the migration of fish or other aquatic organisms into tributaries;

- Conditions at the edge of the IDZ must not be chronically toxic to aquatic organisms;

- Conditions within IDZs should not result in unacceptable levels of eutrophication or the presence of toxic blooms of algae;

- Conditions within IDZs should not result in attraction of aquatic life or wildlife, thereby causing increased exposure to COPCs. Where discharges produce hazardous ice conditions, wildlife access to such areas should be barred;

- Mixing zones should not be used as an alternative to reasonable and practical pollution prevention, including wastewater treatment;

- Accumulation of toxic substances in sediment to toxic levels should not occur in the mixing zone. The potential for such conditions to occur may be evaluated using Canadian sediment quality guidelines and/or assessed using standardized sediment toxicity tests;

- IDZs should be free from debris, oil, grease, scum, or other materials in amounts sufficient to be noticeable in the receiving water; and

- IDZs should be free from colour, turbidity, or odour-producing materials that would adversely affect aquatic life or waterfowl, significantly alter the natural colour of the receiving water, or directly or through interaction among themselves or with chemicals used in water treatment, result in undesirable taste or odour in treated water.

These criteria represent a key element of the framework for managing water quality conditions in our Territories.

(d) Methods for Deriving Effluent Quality Criteria

Effluent quality criteria are narrative statements and/or numerical values that must be met to assure protection of receiving waters. In our Territories, effluent quality criteria (i.e., discharge limits) need to be established at levels that will ensure that narrative and numeric WQSs are met at the edge of the IDZ. For riverine receiving water systems, the numerical EQC are determined using information on the flow of the effluent (EF), the flow of the receiving water body (RF), total flow after mixing (TF), average background concentrations of COPCs in the water body (BKGD), and the WQSs or WQOs, generally as follows:

$$WQS = [(BKGD*RF) + (EQC*EF)] / TF$$

or, isolating the EQC term:

$$EQC = [(WQS*TF) - (BKGD*RF)] / EF$$

For lake environments, information on initial dilution rates following effluent discharge is needed to calculate the EQC (i.e., based on the rate of effluent discharge, the volume of the IDZ, and the rate of effluent dispersion). Effluent dispersion models are typically employed to support these calculations.

In addition to numerical EQCs, narrative EQCs will be established for most effluent discharges. Section 4(c) identifies general criteria for regulating effluent discharges. Effluent quality must be maintained such that all of these criteria are met. Furthermore, effluents must not be acutely toxic to aquatic organisms, based on the results of short-term toxicity tests with fish and aquatic invertebrates.

(e) Guidelines for Aquatic Effects Monitoring

Aquatic effects monitoring is required in the vicinity of developmental projects to address issues and concerns raised by communities and regulatory agencies relative to the environmental effects of the project on the aquatic ecosystem. More specifically, AEMPs attempt to measure changes, over time, in the water quality, sediment quality and/or biological characteristics of the receiving waterbody in response to wastewater discharges and/or other activities associated with the project. Such AEMPs are usually designed to:

- Determine if there has been a change in the measured variables from baseline conditions;
- Determine if project-related activities are the source of the change in the measured variables;
- Determine if the measured results exceed predictions made in the environmental assessment; and/or
- Determine if the measured change is likely to cause a significant adverse environmental impact.

As aquatic effects monitoring is commonly included as a condition for the *Environmental Management Act* (EMA) permits issued in B.C., there is a need to provide project proponents with guidance on the design of AEMPs. The federal government recently developed "*Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories*," which includes:

- Plain Language Summary of the Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories (INAC 2009a);
- Guidelines for Designing and Implementing Aquatic Effects Monitoring Programs for Development Projects in the Northwest Territories: Overview Report (INAC 2009b);
- Recommended Procedures for Identifying Issues and Concerns Associated with Development Projects (INAC 2009c);
- Recommended Procedures for Problem Formulation to Support the Design of Aquatic Effects Monitoring Programs (INAC 2009d);
- Recommended Procedures for Developing Data Quality Objectives and a Conceptual Study Design for Aquatic Effects Monitoring Programs (INAC 2009e);
- Recommended Procedures for Detailed Designs for Aquatic Effects Monitoring Programs (INAC 2009f);
- Recommended Procedures for Documenting and Verifying Conceptual and Detailed Designs of Aquatic Effects Monitoring Programs (INAC 2009g); and

- Recommended Procedures for Evaluating, Analysing, Interpreting, and Reporting Data and Information Collected under Aquatic Effects Monitoring Programs (INAC 2009h).

Collectively, these documents provide project proponents with clear guidance for developing and implementing AEMPs that provide the data and information needed to assess the effects on the aquatic environment associated with discharges of wastewater and other activities associated with development projects. This guidance shall be used to design AEMPs that will be conducted within our Territories.

5. CONSIDERATIONS FOR IMPLEMENTING WATER QUALITY STANDARDS

The methods for developing preliminary WQSs were described in the previous sections of this document (see MacDonald *et al*. 2016 for more information). In addition, the procedures for evaluating the applicability of the preliminary WQSs and establishing numerical WQSs were described. This chapter further supports the WQS-development process by articulating expectations for documenting the derivation of WQSs and for monitoring for evaluating attainment of the WQSs.

(a) Documenting the Development of WQS

Water quality standards represent essential science-based tools for managing aquatic ecosystems. The development of such WQSs needs to be documented to support their review and evaluation. The documentation prepared to support review and evaluation of the WQSs that are proposed for a water body in our Territories must include:

- ***Introduction*** - This section of the document needs to include a description of the study area (including the class of water under investigation), a description of the issues and concerns in the watershed, a brief description of the rationale for deriving WQSs and an overview of the approach that will be applied to derive the WQSs.

- ***Water Uses in the Study Area*** - This section of the document needs to describe all of the designated water uses of the water body, all of the consumptive and non-consumptive uses of water that could influence water quality conditions (e.g., industrial water uses, municipal water uses, hydro power generation), and all of the designated uses in downstream areas.

- ***Contaminant Sources*** - This section of the document needs to describe all of the existing point and non-point sources of contaminants in the watershed. In addition, any development projects that are proposed in the watershed need to be described, including potential effects on water quality conditions. The information on contaminant sources should be used to establish a list of COPCs in the water body, as well as the rationale for the COPCs that were identified.

- ***Baseline Water Quality Conditions*** - This section of the document should describe the historical sources of baseline water quality data and the baseline monitoring program(s) that have been implemented in the study area. In addition, this section of the document should provide a description of the quality (i.e., usability) of the baseline water quality data that were compiled. Summaries of the baseline water quality data that are available also need to be provided.

- ***Baseline Hydrological and/or Limnological Conditions*** - This section of the document needs to describe the available information on the hydrology and/or limnology of the water body(ies) under investigation. Summaries of the available climatic data also need to be provided in this section.

- ***Structure of the Aquatic Ecosystem*** - This section of the document needs to describe the historical sources of information on the aquatic organisms and aquatic-dependent wildlife that occur or ought to occur in the study area. In addition, any biological surveys that have been conducted in the study area need to be described and the results of these surveys need to be summarized. Lists of species that occur or ought to occur at the site need to be prepared and included in the document. An evaluation of the adequacy of the information for identifying the aquatic organisms that occur or ought to occur at the site is also required.

- ***Water Quality Standards*** - This section of the document needs to identify the substances for which numerical WQSs are required, describe the procedures that were used to derive the numerical WQSs, present any and all data and information that were used to derive the WQS, and present the proposed WQSs for each water quality variable (i.e., COPC). The proposed WQSs must clearly describe where and when they are intended to apply.

- ***Proposed Monitoring Program*** - This section of the document needs to describe the monitoring program that is proposed to provide the data and information needed to evaluate attainment of the WQSs. The proposed monitoring program should identify all of the proposed sampling stations and rationale for their selection, describe the proposed frequency and timing of sampling and identify all of the media types and variables that will be measured.

- ***Summary and Recommendations*** - This section needs to provide a succinct summary of the information presented in the document, present the recommended WQSs, and describe any recommendations for further work that is needed to reduce uncertainty in the WQSs.

- ***Literature Cited*** - This section of the document needs to include a comprehensive list of all of the documents and information that were used during the course of the investigation.

- ***Appendices*** - All of the raw data and information used in the WQS derivation process should be compiled and presented in appendices to the document.

(b) Monitoring for Attainment of Narrative WQS

Monitoring to assess attainment of the narrative WQSs typically includes physical, chemical, biological and toxicological indicators (i.e., with an AEMP). Guidance on the design, implementation and interpretation of the results of such monitoring programs is provided in the Guidelines for Aquatic Effects Monitoring (INAC 2009a to 2009g). In general, proponents will assume the primary responsibility for designing and implementing attainment monitoring programs; however, Nadleh Whut'en and Stellat'en will be responsible for review and approval of conceptual design documents, field sampling plans, quality assurance project plans, data reports and interpretive reports.

(c) Monitoring for Compliance with Numerical WQS

To be effective, a monitoring program must have both a well-defined purpose and objectives that support effective management of water resources (Ward 1979; Schilperoort and Groot 1983). Whitfield (1988) summarized the reasons for conducting water quality monitoring into five categories, including:

- Assessment of compliance with WQSs;
- Trend assessment;
- Estimation of mass;
- Environmental impact; and/or
- General.

Whitfield and Clark (2001) developed a systematic method for optimizing the design of water quality monitoring programs, and demonstrated the cost-effectiveness of monitoring programs designed to target key ecosystem characteristics likely to be responsive to specific types of interventions. This method relies on knowledge of the forces that drive change, in conjunction with signal analysis, to focus monitoring programs on the data most likely to yield information on the sensitivity and resilience of the ecosystem (Whitfield et al. 1999). This approach is consistent with the data quality objectives (DQOs) process described by USEPA (2009) and summarized in Clark et al. (2010). DQOs optimize the collection of water quality data since only data needed to support the decision are collected. Additionally, DQOs provide a high level of transparency in decisions related to monitoring program design.

Water quality conditions are known to vary substantially both temporally and spatially. This underlying variability in water quality data makes it challenging to distinguish patterns in water quality conditions from the apparent noise in the system. Potential sources of variability and strategies to address them are summarized in Table 4. Acquisition and evaluation of data characterizing sources of variability in water quality conditions provide a means of designing and optimizing sampling programs for assessing status and trends.

One of the principal objectives of status assessment monitoring programs is to determine whether or not specific water quality targets (e.g., WQSs) are being met (Whitfield 1988). The effectiveness of compliance monitoring programs is often expressed as the ratio of detected violations to actual violations of the targets (Schilperoort and Groot 1983), with the true frequency of exceedance established through continuous monitoring or intensive surveys of water quality.

In some cases, the sampling required to assess compliance is specified in the WQS itself. For example, the water quality guideline for fecal coliforms is written as a geometric mean concentration of five samples collected at equal intervals over a 30-day period (Nagpal et al. 2006). Therefore, monitoring to assess compliance with the WQS must involve separate collections of samples at six-day intervals. Accordingly, the WQS defines a fixed-frequency sampling program as the most appropriate for assessing compliance.

In other cases, practitioners are afforded more latitude in the design of compliance monitoring programs, with the most appropriate sampling strategies being those that have high effectiveness to cost ratios. Whitfield (1988) identified two additional monitoring approaches that could be used to cost-effectively assess compliance with WQSs, including sequential sampling and Markovian sampling (which is a type of exceedance-driven sampling).

Sequential sampling is a hypothesis testing-driven approach that involves random or stratified sampling, with decisions related to future sampling determined by the monitoring results. More specifically, the sampling data are used to determine if the system is in compliance (null hypothesis; H_o; i.e., WQS has not been exceeded), out of compliance (alternate hypothesis; H_a; i.e., WQS has been exceeded), or the outcome is uncertain (i.e., the result is within the range of uncertainty for the measurement; e.g., WQS + 20%). In the case of the third option, the water quality assessment is continued by making additional observations.

Markovian sampling is an approach that involves collection of samples at a variable frequency, depending on the status of the system under investigation. That is, infrequent sampling is undertaken when the system is in control and more frequent sampling is conducted when the system is tending towards non-compliance. In this approach, water quality at a particular station is viewed as a continuous process that can be scaled into levels of acceptability. For example, the possible range of outcomes for a water quality variable can be divided into multiple categories based on proximity to the WQS value (e.g., <0.1 x WQS - safe; 0.1-<0.5 x WQS - marginal; 0.5- 0.99 x WQS - alert; and, >WQS - non-compliance). Decisions about the frequency of sampling are then made based on the measured concentrations of each analyte and the period of time that the analyte concentration has been within a particular range. Where a suite of different variables needs be analysed on each sampling occasion, the frequency is determined by those variables closest to non-compliance, or most often non-compliant.

In general, exceedance-driven sampling is considered to be the most appropriate for assessing compliance with acute-type WQSs, while fixed-frequency sampling is most relevant for assessing compliance with chronic-type WQSs. One advantage of the fixed-frequency sampling approach is that the number of samples and, hence, costs, can be determined prior to program implementation. This is not the case for exceedance-driven sampling. One of the advantages of the exceedance-driven approach is that it supports determination of the optimum number of samples before implementing the program, if sufficient information exists to estimate the probability of observing outcomes in each category. However, incomplete knowledge of the true variability in water quality conditions can negate this advantage. In addition, the amount of time needed to analyse the samples can render the exceedance driven approach difficult to implement.

6. SUMMARY AND CONCLUSIONS

The *Yinka Dene* '*Uza'hné Guide to Surface Water Quality Standards* is intended to support implementation of the *Yinka Dene 'Uza'hné Surface Water Management Policy*. This supporting policy framework consists of four distinct elements:

- Numerical water quality standards;
- Procedures for deriving water quality standards;
- Guidance for implementing the *Yinka Dene* '*Uza'hné Surface Water Management Policy*; and
- Considerations for implementing water quality standards.

This document provides additional resources that are essential for implementing the policy in a manner that ensures that the narrative water management objectives are consistently met throughout our Territories.

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TABLE 1: SUPPORTING DATA FOR THE CHARACTERIZATION OF BACKGROUND CONDITIONS

Water Body / Station	Station Description	Start Date	End Date
Babine River			
BAB-01	Babine River	September 2011	September 2012
Endako River			
E209353	Endako River - Upstream of Endako Mine	August 1998	November 2014
Francois Lake			
E224945	Francois Lake West End - Deep Station	February 1997	May 2008
E224946	Francois Lake East End - Deep Station	February 1997	May 2008
E271703	Francois Lake Centre - Deep Station	May 2008	May 2008
Stellako River			
0400405	Stellako River - 10 m Upstream of CNR Bridge	May 1982	August 1984
E206563	Stellako River - 500 m Upstream of Endako River	May 1982	August 1986
STK-01	Stellako River - Upstream of Endako River	September 2011	September 2013
STK-02	Stellako River - Downstream of Endako River	September 2011	September 2013

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Water Body / Group / Chemical	Fraction	Units	Count	% Non-Detect	Minimum	Maximum	Mean	Upper Confidence Limit	Standard Deviation	Percentiles				
										5th	25th	50th	75th	95th
Endako River														
Conventionals														
pH	Total	pH	101	0	6.48	8.52	7.8	7.88	0.418	6.9	7.63	7.92	8.09	8.27
TSS	Total	mg/L	102	26.5	<1	58.7	6.74	8.39	8.4	1.22	1.5	4	8	21.2
Alkalinity	Total	mg/L	1	0	126	126	126	NA	NA	126	126	126	126	126
Hardness	Total	mg/L	12	0	46.8	118	78.7	95.1	25.7	47.1	58.3	79.9	91.9	116
Major Ions														
Sulphate	Dissolved	mg/L	102	41.2	<0.5	23	2.45	3.14	3.53	0.25	0.25	1.4	3	6.98
Specific Conductivity	Total	µS/cm	81	0	94.7	228	161	169	35.3	104	133	168	186	214
Metals														
Aluminum	Dissolved	mg/L	4	25	0.0022	0.0417	0.0142	0.0439	0.0187	0.00231	0.00272	0.00645	0.0179	0.0369
Aluminum	Total	mg/L	4	0	0.0547	0.2	0.117	0.215	0.0612	0.0608	0.0852	0.107	0.139	0.188
Antimony	Dissolved	mg/L	4	100	<0.0001	<0.05	0.00629	0.0261	0.0125	0.00005	0.00005	0.00005	0.00629	0.0213
Antimony	Total	mg/L	4	100	<0.0001	<0.05	0.00629	0.0261	0.0125	0.00005	0.00005	0.00005	0.00629	0.0213
Arsenic	Dissolved	mg/L	4	25	0.00066	<0.05	0.00697	0.0261	0.012	0.000712	0.000922	0.00111	0.00715	0.0214
Arsenic	Total	mg/L	4	25	0.00065	<0.05	0.0071	0.0261	0.0119	0.000743	0.00112	0.00138	0.00737	0.0215
Barium	Dissolved	mg/L	4	0	0.022	0.0358	0.0267	0.0368	0.00633	0.0221	0.0226	0.0246	0.0287	0.0344
Barium	Total	mg/L	4	0	0.0211	0.0437	0.0291	0.045	0.01	0.0217	0.024	0.0258	0.0308	0.0411
Beryllium	Dissolved	mg/L	4	100	<0.0001	<0.0002	0.0000625	0.000102	0.000025	0.00005	0.00005	0.00005	0.0000625	0.0000925
Beryllium	Total	mg/L	4	100	<0.0001	<0.0002	0.0000625	0.000102	0.000025	0.00005	0.00005	0.00005	0.0000625	0.0000925
Bismuth	Dissolved	mg/L	4	100	<0.0005	<0.05	0.00644	0.0261	0.0124	0.00025	0.00025	0.00025	0.00644	0.0213
Bismuth	Total	mg/L	4	100	<0.0005	<0.05	0.00644	0.0261	0.0124	0.00025	0.00025	0.00025	0.00644	0.0213
Boron	Dissolved	mg/L	4	100	<0.008	<0.01	0.00475	0.00555	0.0005	0.00415	0.00475	0.005	0.005	0.005
Boron	Total	mg/L	4	100	<0.008	<0.01	0.00475	0.00555	0.0005	0.00415	0.00475	0.005	0.005	0.005
Cadmium	Dissolved	mg/L	4	100	<0.00001	<0.002	0.000254	0.00105	0.000498	0.000005	0.000005	0.000005	0.000254	0.000851
Cadmium	Total	mg/L	4	75	<0.00001	<0.002	0.000256	0.00105	0.000496	0.000005	0.000005	0.0000085	0.000259	0.000852
Calcium	Dissolved	mg/L	4	0	13	32.8	21.6	35.6	8.84	13.5	15.5	20.2	26.4	31.5

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Calcium	Total	mg/L	4	0	12.9	33.7	21.8	36.4	9.18	13.5	15.7	20.3	26.4	32.2
Chromium	Dissolved	mg/L	4	75	<0.0001	<0.005	0.000708	0.00261	0.0012	0.00005	0.00005	0.00014	0.000798	0.00216
Chromium	Total	mg/L	4	25	0.0002	<0.005	0.000895	0.00262	0.00108	0.000212	0.00026	0.00044	0.00108	0.00221
Metals (cont.)														
Cobalt	Dissolved	mg/L	4	100	<0.0001	<0.005	0.000662	0.00261	0.00123	0.00005	0.00005	0.00005	0.000662	0.00213
Cobalt	Total	mg/L	4	100	<0.0001	<0.005	0.000662	0.00261	0.00123	0.00005	0.00005	0.00005	0.000662	0.00213
Copper	Dissolved	mg/L	101	55.4	0.0005	0.03	0.00578	0.00694	0.00587	0.00066	0.003	0.005	0.005	0.021
Copper	Total	mg/L	4	25	0.00112	<0.005	0.00188	0.00279	0.000571	0.00124	0.00171	0.00196	0.00213	0.00243
Iron	Dissolved	mg/L	103	0	0.119	0.657	0.267	0.287	0.102	0.14	0.193	0.248	0.327	0.43
Iron	Total	mg/L	4	0	0.277	0.542	0.406	0.6	0.122	0.286	0.32	0.403	0.49	0.532
Lead	Dissolved	mg/L	88	100	<0.00005	<0.05	0.0218	0.0236	0.00816	0.0005	0.025	0.025	0.025	0.025
Lead	Total	mg/L	4	50	<0.00005	<0.03	0.00387	0.0157	0.00742	0.0000325	0.0000625	0.000218	0.00402	0.0128
Lithium	Dissolved	mg/L	3	33.3	<0.0005	0.00135	0.000933	0.00242	0.000597	0.000345	0.000725	0.0012	0.00128	0.00134
Lithium	Total	mg/L	3	0	0.0006	0.0015	0.00118	0.00244	0.000506	0.000685	0.00102	0.00145	0.00148	0.0015
Magnesium	Dissolved	mg/L	4	0	3.59	7.92	5.44	8.53	1.95	3.68	4.06	5.12	6.49	7.63
Magnesium	Total	mg/L	4	0	3.55	8.25	5.47	8.85	2.12	3.63	3.97	5.04	6.55	7.91
Manganese	Dissolved	mg/L	4	0	0.0121	0.0409	0.0301	0.0513	0.0133	0.0145	0.024	0.0337	0.0398	0.0407
Manganese	Total	mg/L	4	0	0.0156	0.069	0.0467	0.0827	0.0226	0.0204	0.0396	0.0512	0.0583	0.0669
Mercury	Dissolved	mg/L	3	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Mercury	Total	mg/L	3	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Molybdenum	Dissolved	mg/L	102	75.5	0.000742	<0.13	0.0179	0.0212	0.017	0.004	0.015	0.015	0.015	0.0547
Molybdenum	Total	mg/L	4	0	0.00123	0.009	0.00431	0.00958	0.00331	0.00154	0.00278	0.00351	0.00503	0.00821
Nickel	Dissolved	mg/L	4	75	<0.0005	<0.008	0.00134	0.0042	0.0018	0.00025	0.00025	0.000555	0.00164	0.00353
Nickel	Total	mg/L	4	50	<0.0005	<0.008	0.00141	0.00418	0.00175	0.000294	0.000468	0.00069	0.00163	0.00353
Phosphorus	Total	mg/L	4	100	<0.05	<0.1	0.0312	0.0511	0.0125	0.025	0.025	0.025	0.0312	0.0462
Potassium	Dissolved	mg/L	4	0	1	1.72	1.31	1.86	0.345	1.01	1.04	1.26	1.53	1.68
Potassium	Total	mg/L	4	0	1.04	2	1.59	2.27	0.425	1.11	1.38	1.66	1.88	1.98
Selenium	Dissolved	mg/L	4	100	<0.0001	<0.03	0.00379	0.0157	0.00748	0.00005	0.00005	0.00005	0.00379	0.0128
Selenium	Total	mg/L	4	100	<0.0001	<0.03	0.00379	0.0157	0.00748	0.00005	0.00005	0.00005	0.00379	0.0128
Silicon	Dissolved	mg/L	3	0	3.01	5.18	4.16	6.86	1.09	3.14	3.64	4.28	4.73	5.09
Silicon	Total	mg/L	3	0	3.09	5.5	4.32	7.31	1.21	3.22	3.72	4.36	4.93	5.39
Silver	Dissolved	mg/L	4	100	<0.00001	<0.01	0.00125	0.00523	0.0025	0.000005	0.000005	0.000005	0.00125	0.00425
Silver	Total	mg/L	4	100	<0.00001	<0.01	0.00125	0.00523	0.0025	0.000005	0.000005	0.000005	0.00125	0.00425

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Sodium	Dissolved	mg/L	4	0	3.57	6.01	4.74	6.48	1.09	3.66	4.01	4.7	5.43	5.89
Sodium	Total	mg/L	4	0	3.29	7	4.81	7.48	1.68	3.36	3.62	4.48	5.67	6.73
Strontium	Dissolved	mg/L	4	0	0.0774	0.203	0.132	0.223	0.0573	0.0799	0.0899	0.123	0.165	0.195
Metals (cont.)														
Strontium	Total	mg/L	4	0	0.0785	0.216	0.138	0.236	0.0616	0.0817	0.0946	0.128	0.171	0.207
Sulfur	Dissolved	mg/L	4	0	0.6	1.42	0.925	1.56	0.396	0.601	0.608	0.84	1.16	1.37
Sulfur	Total	mg/L	4	0	0.6	1.5	0.965	1.63	0.421	0.609	0.645	0.88	1.2	1.44
Tellerium	Dissolved	mg/L	1	100	<0.05	<0.05	0.025	NA	NA	0.025	0.025	0.025	0.025	0.025
Tellerium	Total	mg/L	1	100	<0.05	<0.05	0.025	NA	NA	0.025	0.025	0.025	0.025	0.025
Thallium	Dissolved	mg/L	4	100	<0.00001	<0.03	0.00375	0.0157	0.0075	0.000005	0.000005	0.000005	0.00375	0.0128
Thallium	Total	mg/L	4	100	<0.00001	<0.03	0.00375	0.0157	0.0075	0.000005	0.000005	0.000005	0.00375	0.0128
Tin	Dissolved	mg/L	4	100	<0.0001	<0.02	0.00254	0.0105	0.00498	0.00005	0.00005	0.00005	0.00254	0.00851
Tin	Total	mg/L	4	100	<0.0001	<0.02	0.00254	0.0105	0.00498	0.00005	0.00005	0.00005	0.00254	0.00851
Titanium	Dissolved	mg/L	4	100	<0.003	<0.01	0.00412	0.00691	0.00175	0.00202	0.00412	0.005	0.005	0.005
Titanium	Total	mg/L	4	75	0.004	<0.01	0.00475	0.00555	0.0005	0.00415	0.00475	0.005	0.005	0.005
Uranium	Dissolved	mg/L	3	0	0.000126	0.00076	0.00045	0.00124	0.000317	0.00016	0.000296	0.000465	0.000612	0.00073
Uranium	Total	mg/L	3	0	0.00014	0.000876	0.000496	0.00141	0.000369	0.000173	0.000306	0.000471	0.000674	0.000836
Vanadium	Dissolved	mg/L	4	100	<0.001	<0.005	0.001	0.00259	0.001	0.0005	0.0005	0.0005	0.001	0.0022
Vanadium	Total	mg/L	4	100	<0.001	<0.005	0.001	0.00259	0.001	0.0005	0.0005	0.0005	0.001	0.0022
Zinc	Dissolved	mg/L	4	25	0.0017	0.0155	0.00852	0.0204	0.00744	0.00182	0.0023	0.00845	0.0147	0.0153
Zinc	Total	mg/L	4	25	<0.005	0.134	0.0501	0.143	0.0584	0.00523	0.0162	0.0319	0.0658	0.12
Zirconium	Dissolved	mg/L	1	100	<0.005	<0.005	0.0025	NA	NA	0.0025	0.0025	0.0025	0.0025	0.0025
Zirconium	Total	mg/L	1	100	<0.005	<0.005	0.0025	NA	NA	0.0025	0.0025	0.0025	0.0025	0.0025
Nutrients														
Ammonia	Dissolved	mg N/L	1	0	0.011	0.011	0.011	NA	NA	0.011	0.011	0.011	0.011	0.011
Nitrate	Dissolved	mg N/L	2	50	<0.005	0.01	0.00625	0.0539	0.0053	0.00288	0.00438	0.00625	0.00812	0.00962
Nitrite + Nitrate	Dissolved	mg N/L	2	0	0.006	0.016	0.011	0.0745	0.00707	0.0065	0.0085	0.011	0.0135	0.0155
Total Dissolved Phosphorus	Dissolved	mg/L	4	100	<0.05	<0.1	0.0312	0.0511	0.0125	0.025	0.025	0.025	0.0312	0.0462
Other														
CN	Total	mg/L	101	54.5	<0.005	0.022	0.00571	0.00652	0.00409	0.0025	0.0025	0.0025	0.0089	0.013
Cyanide (WAD)	Dissolved	mg/L	33	72.7	<0.005	0.01	0.00333	0.00391	0.00161	0.0025	0.0025	0.0025	0.005	0.005

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Francois Lake													
Conventionals													
Colour	Total	Col	20	15	<5	15	6.88	8.71	3.93	2.5	5	5	7	15
pH	Total	pH	10	0	5.96	7.8	7.36	7.89	0.737	5.96	7.64	7.7	7.73	7.77
TOC	Total	mg/L	10	0	5.7	6.9	6.03	6.31	0.386	5.7	5.8	5.9	6.07	6.72
TSS	Total	mg/L	27	100	<4	<5	2.31	2.41	0.246	2	2	2.5	2.5	2.5
Turbidity	Total	NTU	29	6.9	<0.05	0.8	0.298	0.362	0.167	0.047	0.19	0.3	0.42	0.488
Hardness	Total	mg/L	75	0	20	41.2	35.3	36	3.34	32.1	33.5	34.6	38	40
Major Ions													
Bromide	Dissolved	mg/L	9	100	<0.05	<0.05	0.025	NA	0	0.025	0.025	0.025	0.025	0.025
Chloride	Dissolved	mg/L	20	5	0.322	0.9	0.503	0.579	0.163	0.318	0.387	0.455	0.6	0.71
Fluoride	Dissolved	mg/L	20	0	0.04	0.07	0.051	0.0536	0.00553	0.0495	0.05	0.05	0.05	0.0605
Sulphate	Dissolved	mg/L	20	0	3.8	6.1	4.81	5.15	0.72	3.9	4.38	4.65	5.52	6
Specific Conductivity	Total	µS/cm	20	0	2	99	76.8	89.1	26.1	2	81.8	84	86.5	93.3
TDS	Dissolved	mg/L	10	0	66	80	70.2	73	3.94	66	68.5	70	70	76.4
Metals													
Aluminum	Dissolved	mg/L	29	31	0.0023	1	0.0629	0.14	0.202	0.00234	0.0042	0.0071	0.025	0.31
Aluminum	Total	mg/L	29	34.5	0.0034	<0.06	0.021	0.0263	0.0138	0.00376	0.0085	0.0231	0.03	0.0448
Antimony	Dissolved	mg/L	29	58.6	<0.000005	<1	0.0414	0.0899	0.128	0.0000025	0.00005	0.00005	0.025	0.31
Antimony	Total	mg/L	29	55.2	<0.000005	<0.06	0.0104	0.0159	0.0145	0.0000025	0.00004	0.00007	0.03	0.03
Arsenic	Dissolved	mg/L	37	48.6	0.0001	<1	0.0326	0.0705	0.114	0.0001	0.00025	0.00027	0.025	0.12
Arsenic	Total	mg/L	37	43.2	<0.0001	<0.06	0.00831	0.0128	0.0134	0.00009	0.00025	0.0003	0.03	0.03
Barium	Dissolved	mg/L	29	3.45	0.0124	0.06	0.016	0.0192	0.00853	0.013	0.014	0.0144	0.015	0.0166
Barium	Total	mg/L	29	0	0.013	0.021	0.0149	0.0156	0.00184	0.013	0.0133	0.015	0.016	0.018
Beryllium	Dissolved	mg/L	29	100	<0.000002	<0.03	0.00117	0.00263	0.00384	0.000001	0.000005	0.000005	0.0005	0.0092
Beryllium	Total	mg/L	29	100	<0.000002	<0.001	0.000175	0.000266	0.00024	0.000001	0.000005	0.000005	0.0005	0.0005
Bismuth	Dissolved	mg/L	19	94.7	<0.000005	0.00011	0.0000105	0.0000223	0.0000243	0.0000025	0.0000025	0.0000025	0.00001	0.00002
Bismuth	Total	mg/L	19	94.7	<0.000005	0.00044	0.0000279	0.000076	0.0000999	0.0000025	0.0000025	0.0000025	0.00001	0.000053
Boron	Dissolved	mg/L	29	93.1	<0.002	0.9	0.0637	0.138	0.195	0.001	0.005	0.005	0.025	0.37

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Boron	Total	mg/L	29	96.6	<0.002	<0.05	0.0123	0.0165	0.0109	0.001	0.005	0.005	0.025	0.025
Metals (cont.)															
Cadmium	Dissolved	mg/L	37	73	<0.000005	<0.1	0.00327	0.00706	0.0114	0.0000025	0.000005	0.00004	0.0025	0.012
Cadmium	Total	mg/L	37	62.2	<0.000005	<0.006	0.000854	0.0013	0.00133	0.0000025	0.000006	0.00005	0.003	0.003
Calcium	Dissolved	mg/L	35	0	8	11.9	10	10.4	0.918	8.97	9.4	9.9	10.8	11.5
Calcium	Total	mg/L	23	0	8.8	11.5	10.1	10.4	0.749	8.93	9.55	10	10.8	11.2
Chromium	Dissolved	mg/L	29	82.8	<0.0001	<0.1	0.00433	0.00916	0.0127	0.00005	0.00005	0.0002	0.0025	0.0314
Chromium	Total	mg/L	29	55.2	<0.0001	0.017	0.00254	0.00412	0.00417	0.00005	0.00005	0.0002	0.003	0.0096
Cobalt	Dissolved	mg/L	29	34.5	0.000009	<0.1	0.00415	0.009	0.0127	0.00001	0.000014	0.000017	0.0025	0.031
Cobalt	Total	mg/L	29	31	<0.000005	0.006	0.00125	0.00197	0.00187	0.000007	0.000011	0.00003	0.003	0.0048
Copper	Dissolved	mg/L	29	34.5	0.00056	<0.1	0.00464	0.00943	0.0126	0.000618	0.0007	0.00087	0.0025	0.031
Copper	Total	mg/L	29	34.5	0.00057	<0.006	0.00165	0.00205	0.00105	0.0006	0.00074	0.00113	0.003	0.003
Iron	Dissolved	mg/L	29	20.7	<0.005	<0.1	0.0177	0.0239	0.0162	0.0025	0.006	0.012	0.023	0.0524
Iron	Total	mg/L	29	0	0.007	0.111	0.0333	0.0437	0.0272	0.0074	0.016	0.024	0.043	0.0944
Lead	Dissolved	mg/L	37	62.2	<0.000005	<1	0.0325	0.0704	0.114	0.0000025	0.000012	0.00015	0.025	0.12
Lead	Total	mg/L	37	37.8	<0.000005	0.09	0.0101	0.0163	0.0186	0.000005	0.000022	0.0003	0.03	0.03
Lithium	Dissolved	mg/L	19	15.8	0.00016	0.0006	0.000375	0.000457	0.000172	0.00016	0.000235	0.00028	0.0005	0.0006
Lithium	Total	mg/L	19	31.6	0.00014	0.0007	0.000329	0.000413	0.000174	0.000176	0.000215	0.00025	0.0005	0.00061
Magnesium	Dissolved	mg/L	35	5.71	2.18	3	2.5	2.61	0.313	1.98	2.42	2.5	2.65	2.86
Magnesium	Total	mg/L	23	0	2.24	2.9	2.54	2.62	0.172	2.3	2.44	2.5	2.6	2.89
Manganese	Dissolved	mg/L	29	3.45	0.00014	0.04	0.00367	0.00705	0.00887	0.00017	0.00049	0.001	0.002	0.0199
Manganese	Total	mg/L	29	3.45	0.00001	0.00888	0.00273	0.00356	0.00218	0.000352	0.001	0.0022	0.0032	0.00721
Molybdenum	Dissolved	mg/L	29	34.5	0.0029	<0.3	0.0161	0.0302	0.0372	0.003	0.005	0.00601	0.007	0.0952
Molybdenum	Total	mg/L	29	34.5	0.0029	0.0143	0.00616	0.00718	0.00266	0.00298	0.005	0.005	0.00638	0.0123
Nickel	Dissolved	mg/L	29	34.5	0.0003	<0.5	0.0203	0.0445	0.0638	0.000324	0.00035	0.00056	0.01	0.154
Nickel	Total	mg/L	29	34.5	0.00032	<0.02	0.00379	0.00553	0.00459	0.000358	0.00047	0.00063	0.01	0.01
Phosphorus	Total	mg/L	46	41.3	<0.002	<0.1	0.022	0.0285	0.0217	0.004	0.00525	0.006	0.05	0.05
Potassium	Dissolved	mg/L	35	5.71	0.66	<3	0.824	0.886	0.18	0.687	0.745	0.8	0.81	1.09
Potassium	Total	mg/L	23	0	0.7	0.9	0.793	0.826	0.0771	0.7	0.7	0.8	0.865	0.9
Selenium	Dissolved	mg/L	37	70.3	<0.00004	<1	0.0333	0.0712	0.114	0.00002	0.00005	0.0001	0.025	0.14
Selenium	Total	mg/L	37	62.2	<0.00004	0.09	0.0099	0.0161	0.0187	0.00004	0.00005	0.0001	0.03	0.03
Silicon	Dissolved	mg/L	29	0	1	2.31	1.56	1.67	0.282	1.28	1.4	1.53	1.64	2.14
Silicon	Total	mg/L	29	0	1.21	2.3	1.56	1.66	0.265	1.3	1.38	1.46	1.69	2.11
Silver	Dissolved	mg/L	29	96.6	<0.000005	<0.3	0.0117	0.0263	0.0384	0.0000025	0.0000025	0.00001	0.005	0.092

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Metals (cont.)														
Silver	Total	mg/L	29	96.6	<0.000005	<0.01	0.00173	0.00265	0.00242	0.0000025	0.0000025	0.00001	0.005	0.005
Sodium	Dissolved	mg/L	35	5.71	2.72	3.8	3.11	3.26	0.453	2.35	3.09	3.12	3.36	3.52
Sodium	Total	mg/L	23	0	2.7	3.44	3.07	3.17	0.225	2.71	2.9	3.1	3.25	3.39
Strontium	Dissolved	mg/L	29	0	0.07	0.106	0.0853	0.0884	0.00804	0.076	0.079	0.0838	0.09	0.0992
Strontium	Total	mg/L	29	0	0.075	0.102	0.0861	0.0889	0.00723	0.0764	0.0802	0.0857	0.091	0.0996
Sulfur	Dissolved	mg/L	28	64.3	1.26	3380	217	527	799	1.28	1.5	1.5	1.5	1740
Sulfur	Total	mg/L	16	37.5	1.28	<3	1.47	1.53	0.112	1.28	1.41	1.5	1.5	1.62
Thallium	Dissolved	mg/L	19	84.2	<0.000002	0.000005	0.00000137	0.00000186	0.00000101	0.000001	0.000001	0.000001	0.000001	0.0000032
Thallium	Total	mg/L	19	100	<0.000002	<0.000002	0.000001	NA	0	0.000001	0.000001	0.000001	0.000001	0.000001
Tin	Dissolved	mg/L	29	37.9	<0.00001	<1	0.0414	0.0899	0.128	0.00002	0.00002	0.00006	0.025	0.31
Tin	Total	mg/L	29	34.5	0.00002	<0.06	0.0104	0.0159	0.0145	0.00002	0.00003	0.00016	0.03	0.03
Titanium	Dissolved	mg/L	29	58.6	<0.0005	<0.05	0.00279	0.00516	0.00623	0.00025	0.0008	0.001	0.001	0.017
Titanium	Total	mg/L	29	58.6	<0.0005	0.005	0.00136	0.0018	0.00117	0.00025	0.0008	0.001	0.0015	0.0036
Uranium	Dissolved	mg/L	19	0	0.00003	0.000079	0.0000555	0.0000612	0.0000119	0.000039	0.0000485	0.000055	0.00006	0.0000754
Uranium	Total	mg/L	19	0	0.00003	0.000077	0.0000575	0.0000629	0.0000111	0.000039	0.000055	0.000057	0.00006	0.0000734
Vanadium	Dissolved	mg/L	29	62.1	<0.0002	<0.3	0.0119	0.0265	0.0383	0.0001	0.0001	0.0003	0.005	0.092
Vanadium	Total	mg/L	29	72.4	<0.0002	<0.01	0.00187	0.00275	0.00232	0.0001	0.0001	0.00028	0.005	0.005
Zinc	Dissolved	mg/L	29	24.1	<0.0001	0.05	0.00442	0.00832	0.0102	0.00014	0.0004	0.001	0.0029	0.0214
Zinc	Total	mg/L	29	20.7	0.0002	0.012	0.00169	0.00256	0.0023	0.000212	0.0005	0.001	0.0019	0.00406
Nutrients														
Ammonia	Dissolved	mg N/L	22	63.6	<0.002	0.013	0.00432	0.00587	0.00349	0.00107	0.0025	0.0025	0.00475	0.0118
Nitrate	Dissolved	mg N/L	20	0	0.002	0.067	0.0496	0.057	0.0159	0.0258	0.0418	0.0525	0.063	0.066
Nitrite + Nitrate	Dissolved	mg N/L	61	49.2	<0.002	0.07	0.0329	0.04	0.0275	0.001	0.0025	0.034	0.061	0.07
Orthophosphate	Dissolved	mg P/L	19	47.4	0.001	<0.05	0.0126	0.0184	0.0121	0.001	0.001	0.003	0.025	0.025
Total Dissolved Phosphorus	Dissolved	mg/L	27	63	0.003	<3	0.141	0.296	0.392	0.0033	0.0045	0.05	0.05	1.06
Total Kjeldahl Nitrogen	Total	mg/L	11	0	0.12	0.17	0.142	0.155	0.0194	0.12	0.13	0.13	0.16	0.17
Total Nitrogen	Total	mg/L	30	3.33	<0.02	0.32	0.222	0.248	0.0679	0.093	0.2	0.235	0.265	0.306
Total Organic Nitrogen	Total	mg/L	11	0	0.12	0.17	0.142	0.155	0.0194	0.12	0.13	0.13	0.16	0.17

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Stellako River														
Conventionals														
Colour	Total	Col	6	0	8.4	11	9.56	10.8	1.14	8.43	8.69	9.28	10.5	11
pH	Total	pH	19	0	7.6	8.3	7.95	8.06	0.216	7.6	7.85	7.9	8.13	8.28
TOC	Total	mg/L	6	0	5.8	7.42	6.52	7.12	0.564	5.9	6.22	6.45	6.77	7.27
TSS	Total	mg/L	11	45.5	2	63	7.61	20	18.4	1.5	1.5	2	2.63	33.5
Turbidity	Total	NTU	8	0	0.23	0.7	0.409	0.548	0.167	0.234	0.292	0.38	0.473	0.665
Acidity	Total	mg/L	6	0	1.6	3.6	2.48	3.41	0.89	1.63	1.8	2.2	3.24	3.59
Alkalinity	Total	mg/L	6	0	37.5	41	38.8	40.5	1.62	37.6	37.8	37.8	40	40.9
Hardness	Total	mg/L	6	0	35.6	37.2	36.3	37.1	0.681	35.7	35.8	36.2	36.9	37.2
Major Ions														
Bromide	Dissolved	mg/L	6	100	<0.05	<0.05	0.025	0.025	0	0.025	0.025	0.025	0.025	0.025
Chloride	Dissolved	mg/L	15	46.7	<0.5	2.1	0.583	0.87	0.518	0.25	0.25	0.5	0.6	1.61
Fluoride	Dissolved	mg/L	6	0	0.052	0.058	0.0554	0.0579	0.00233	0.0525	0.0542	0.0552	0.0574	0.058
Sulphate	Dissolved	mg/L	6	0	5.61	5.95	5.78	5.93	0.138	5.61	5.67	5.84	5.84	5.92
Specific Conductivity	Total	µS/cm	19	0	77	98	86	88.6	5.34	77.9	82	87	88.8	94.4
TDS	Dissolved	mg/L	11	0	62	90	66.9	72.4	8.22	62	62.2	64	67.5	80.5
Metals														
Aluminum	Dissolved	mg/L	6	100	<0.003	<0.003	0.0015	NA	0	0.0015	0.0015	0.0015	0.0015	0.0015
Aluminum	Total	mg/L	6	0	0.0037	0.0144	0.00931	0.0135	0.00401	0.00418	0.00652	0.0102	0.0116	0.0138
Antimony	Dissolved	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Antimony	Total	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Arsenic	Dissolved	mg/L	6	0	0.00027	0.00031	0.00029	0.000304	0.000013	0.000274	0.000286	0.00029	0.000294	0.000306
Arsenic	Total	mg/L	6	0	0.00029	0.00035	0.000316	0.000339	0.000022	0.000292	0.000301	0.000312	0.000328	0.000345
Barium	Dissolved	mg/L	6	0	0.0132	0.0144	0.0137	0.0142	0.000401	0.0133	0.0136	0.0138	0.0138	0.0143
Barium	Total	mg/L	6	0	0.014	0.015	0.0142	0.0146	0.000408	0.014	0.014	0.014	0.014	0.0148
Beryllium	Dissolved	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Beryllium	Total	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Bismuth	Dissolved	mg/L	6	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Bismuth	Total	mg/L	6	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Metals (cont.)														

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Boron	Dissolved	mg/L	6	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Boron	Total	mg/L	6	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Cadmium	Dissolved	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Cadmium	Total	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Calcium	Dissolved	mg/L	6	0	10	10.6	10.3	10.6	0.223	10	10.2	10.3	10.5	10.6
Calcium	Total	mg/L	6	0	10.2	11	10.6	10.9	0.291	10.3	10.4	10.6	10.8	11
Chromium	Dissolved	mg/L	6	33.3	<0.0001	0.00014	0.0001	0.000142	0.0000404	0.00005	0.0000638	0.000115	0.000129	0.000138
Chromium	Total	mg/L	6	16.7	<0.0001	0.00019	0.00014	0.00019	0.0000472	0.0000725	0.000142	0.000152	0.000155	0.000181
Cobalt	Dissolved	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Cobalt	Total	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Copper	Dissolved	mg/L	6	0	0.0006	0.0007	0.000675	0.000717	0.0000397	0.000615	0.000669	0.000695	0.000699	0.0007
Copper	Total	mg/L	6	0	0.00079	0.00087	0.000822	0.000852	0.0000282	0.000792	0.000804	0.000822	0.00083	0.00086
Iron	Dissolved	mg/L	6	100	<0.03	<0.03	0.015	NA	0	0.015	0.015	0.015	0.015	0.015
Iron	Total	mg/L	6	100	<0.03	<0.03	0.015	NA	0	0.015	0.015	0.015	0.015	0.015
Lead	Dissolved	mg/L	6	100	<0.00005	<0.00005	0.000025	NA	0	0.000025	0.000025	0.000025	0.000025	0.000025
Lead	Total	mg/L	6	100	<0.00005	<0.00005	0.000025	NA	0	0.000025	0.000025	0.000025	0.000025	0.000025
Lithium	Dissolved	mg/L	6	16.7	0.00045	0.00066	0.000534	0.0007	0.000158	0.0003	0.000488	0.000603	0.000631	0.000655
Lithium	Total	mg/L	6	0	0.00051	0.00085	0.000629	0.000752	0.000117	0.000525	0.000578	0.0006	0.000634	0.000799
Magnesium	Dissolved	mg/L	6	0	2.47	2.61	2.56	2.63	0.0598	2.48	2.53	2.6	2.61	2.61
Magnesium	Total	mg/L	6	0	2.52	2.68	2.62	2.69	0.0608	2.54	2.6	2.64	2.66	2.68
Manganese	Dissolved	mg/L	6	0	0.0001	0.00039	0.000197	0.000309	0.000107	0.000106	0.000134	0.00016	0.000224	0.000354
Manganese	Total	mg/L	6	0	0.00127	0.00198	0.00164	0.00196	0.000308	0.00127	0.00136	0.00171	0.00186	0.00195
Mercury	Dissolved	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Mercury	Total	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Molybdenum	Dissolved	mg/L	6	0	0.00915	0.0111	0.00992	0.0107	0.000742	0.00921	0.00945	0.00965	0.0104	0.0109
Molybdenum	Total	mg/L	6	0	0.0096	0.0114	0.0103	0.0111	0.000753	0.00962	0.00975	0.01	0.0108	0.0113
Nickel	Dissolved	mg/L	6	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Nickel	Total	mg/L	6	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Phosphorus	Dissolved	mg/L	6	100	<0.3	<0.3	0.15	NA	0	0.15	0.15	0.15	0.15	0.15
Phosphorus	Total	mg/L	19	31.6	0.006	<0.3	0.0581	0.0904	0.0669	0.0069	0.0075	0.012	0.15	0.15
Potassium	Dissolved	mg/L	6	0	0.782	0.821	0.803	0.82	0.0166	0.783	0.789	0.804	0.817	0.821
Potassium	Total	mg/L	6	0	0.8	0.844	0.815	0.834	0.0182	0.801	0.804	0.806	0.825	0.841
Metals (cont.)														
Selenium	Dissolved	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Selenium	Total	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Silicon	Dissolved	mg/L	6	0	0.97	1.06	1.02	1.06	0.0339	0.978	1	1.03	1.05	1.06
Silicon	Total	mg/L	6	0	0.98	1.13	1.07	1.13	0.057	0.99	1.04	1.08	1.1	1.12
Silver	Dissolved	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Silver	Total	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Sodium	Dissolved	mg/L	6	0	3.35	3.8	3.53	3.74	0.194	3.36	3.4	3.45	3.69	3.79
Sodium	Total	mg/L	6	0	3.4	3.9	3.69	3.91	0.211	3.42	3.54	3.72	3.88	3.9
Strontium	Dissolved	mg/L	6	0	0.091	0.0975	0.0954	0.098	0.0025	0.0918	0.0945	0.0965	0.097	0.0974
Strontium	Total	mg/L	6	0	0.0956	0.105	0.0992	0.103	0.00338	0.0958	0.0969	0.099	0.1	0.104
Thallium	Dissolved	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Thallium	Total	mg/L	6	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Tin	Dissolved	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Tin	Total	mg/L	6	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Titanium	Dissolved	mg/L	6	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Titanium	Total	mg/L	6	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Uranium	Dissolved	mg/L	6	0	0.000066	0.000079	0.0000712	0.0000767	0.00000526	0.0000665	0.0000681	0.0000687	0.0000746	0.0000784
Uranium	Total	mg/L	6	0	0.000072	0.0000815	0.0000757	0.0000795	0.00000368	0.000072	0.0000726	0.0000752	0.0000775	0.0000806
Vanadium	Dissolved	mg/L	6	100	<0.001	<0.001	0.0005	NA	0	0.0005	0.0005	0.0005	0.0005	0.0005
Vanadium	Total	mg/L	6	100	<0.001	<0.001	0.0005	NA	0	0.0005	0.0005	0.0005	0.0005	0.0005
Zinc	Dissolved	mg/L	6	83.3	0.0023	<0.003	0.00163	0.00198	0.000327	0.0015	0.0015	0.0015	0.0015	0.0021
Zinc	Total	mg/L	6	100	<0.003	<0.003	0.0015	NA	0	0.0015	0.0015	0.0015	0.0015	0.0015
Nutrients														
Ammonia	Dissolved	mg N/L	20	60	<0.005	0.012	0.00418	0.00538	0.00256	0.0025	0.0025	0.0025	0.00526	0.00811
Nitrate	Dissolved	mg N/L	16	68.8	<0.005	0.04	0.0135	0.0201	0.0123	0.0025	0.00812	0.01	0.0123	0.04
Nitrite	Dissolved	mg N/L	25	76	<0.001	<0.005	0.00171	0.00208	0.000905	0.0005	0.001	0.0025	0.0025	0.0025
Nitrite + Nitrate	Dissolved	mg N/L	18	50	0.009	0.04	0.0198	0.0264	0.0132	0.00985	0.01	0.01	0.03	0.04
Orthophosphate	Dissolved	mg P/L	24	70.8	<0.001	0.006	0.0016	0.00218	0.00136	0.0005	0.0005	0.0015	0.0015	0.004
Total Dissolved Phosphorus	Dissolved	mg/L	13	0	0.003	0.017	0.00685	0.00895	0.00348	0.0036	0.005	0.007	0.007	0.0122

Nutrients (cont.)

TABLE 2: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE BACKGROUND WATER QUALITY CONDITIONS

Total Kjeldahl Nitrogen	Total	mg/L	19	0	0.11	0.3	0.206	0.226	0.043	0.164	0.185	0.2	0.224	0.282
Total Nitrogen	Total	mg/L	9	0	0.11	0.28	0.206	0.242	0.0472	0.138	0.19	0.21	0.22	0.268
Total Organic Nitrogen	Total	mg/L	10	0	0.11	0.29	0.202	0.239	0.0518	0.137	0.172	0.195	0.22	0.281
Total Phosphorus	Total	mg/L	6	0	0.00335	0.00545	0.00492	0.00577	0.000814	0.00369	0.00485	0.0053	0.00538	0.00544
Other														
Chlorophyll *a*	Total	mg/L	1	0	0.001	0.001	0.001	NA	NA	0.001	0.001	0.001	0.001	0.001
Fecal Coliforms	Total	MPN	1	0	2	2	2	NA	NA	2	2	2	2	2

Col = colour; MPN = most probable number; N = nitrogen; NA = not applicable; NTU = nephelometric turbidity units; P = phosphorus; TDS = total dissolved solids; TOC = total organic carbon; TSS = total suspended solids; WAD = weak acid dissociable.

TABLE 3: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE REFERENCE WATER QUALITY CONDITIONS USING DATA FOR THE BABINE RIVER

Water Body / Group / Chemical	Fraction	Units	Count	% Non-Detect	Minimum	Maximum	Mean	Upper Confidence Limit	Standard Deviation	Percentiles				
										5th	25th	50th	75th	95th
Babine River														
Conventionals														
Colour	Total	Col	2	0	16	17.5	16.8	26.3	1.06	16.1	16.4	16.8	17.1	17.4
pH	Total	pH	2	0	7.98	8.07	8.02	8.6	0.0636	7.98	8	8.02	8.05	8.07
TOC	Total	mg/L	2	0	6.12	7.43	6.78	15.1	0.926	6.19	6.45	6.78	7.1	7.36
TSS	Total	mg/L	2	100	<3	<3	1.5	NA	0	1.5	1.5	1.5	1.5	1.5
Turbidity	Total	NTU	2	0	0.6	0.78	0.69	1.83	0.127	0.609	0.645	0.69	0.735	0.771
Acidity	Total	mg/L	2	0	2.3	4	3.15	14	1.2	2.38	2.72	3.15	3.58	3.92
Alkalinity	Total	mg/L	2	0	39	39.7	39.4	43.8	0.495	39	39.2	39.4	39.5	39.7
Hardness	Total	mg/L	2	0	40.1	40.4	40.2	42.2	0.212	40.1	40.2	40.2	40.3	40.4
Major Ions														
Bromide	Dissolved	mg/L	2	100	<0.05	<0.05	0.025	0.025	0	0.025	0.025	0.025	0.025	0.025
Chloride	Dissolved	mg/L	2	100	<0.5	<0.5	0.25	NA	0	0.25	0.25	0.25	0.25	0.25
Fluoride	Dissolved	mg/L	2	0	0.037	0.044	0.0405	0.085	0.00495	0.0373	0.0387	0.0405	0.0422	0.0436
Sulphate	Dissolved	mg/L	2	0	4.27	4.58	4.42	6.39	0.219	4.29	4.35	4.42	4.5	4.56
Specific Conductivity	Total	µS/cm	2	0	84.5	88.4	86.4	111	2.76	84.7	85.5	86.4	87.4	88.2
TDS	Dissolved	mg/L	2	0	63	66	64.5	83.6	2.12	63.2	63.8	64.5	65.2	65.8
Metals														
Aluminum	Dissolved	mg/L	2	0	0.0064	0.0074	0.0069	0.0133	0.000707	0.00645	0.00665	0.0069	0.00715	0.00735
Aluminum	Total	mg/L	2	0	0.0258	0.0286	0.0272	0.045	0.00198	0.0259	0.0265	0.0272	0.0279	0.0285
Antimony	Dissolved	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Antimony	Total	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Arsenic	Dissolved	mg/L	2	0	0.00029	0.0003	0.000295	0.000359	0.00000707	0.00029	0.000292	0.000295	0.000298	0.0003
Arsenic	Total	mg/L	2	0	0.00031	0.00033	0.00032	0.000447	0.0000141	0.000311	0.000315	0.00032	0.000325	0.000329
Barium	Dissolved	mg/L	2	0	0.0183	0.0197	0.019	0.0279	0.00099	0.0184	0.0186	0.019	0.0194	0.0196

TABLE 3: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE REFERENCE WATER QUALITY CONDITIONS USING DATA FOR THE BABINE RIVER

Barium	Total	mg/L	2	0	0.019	0.02	0.0195	0.0259	0.000707	0.019	0.0192	0.0195	0.0198	0.02
Beryllium	Dissolved	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Beryllium	Total	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Bismuth	Dissolved	mg/L	2	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Metals (cont.)														
Bismuth	Total	mg/L	2	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Boron	Dissolved	mg/L	2	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Boron	Total	mg/L	2	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Cadmium	Dissolved	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Cadmium	Total	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Calcium	Dissolved	mg/L	2	0	11.2	11.7	11.4	14.6	0.354	11.2	11.3	11.4	11.6	11.7
Calcium	Total	mg/L	2	0	12	12.2	12.1	13.4	0.141	12	12	12.1	12.1	12.2
Chromium	Dissolved	mg/L	2	0	0.00016	0.00018	0.00017	0.000297	0.0000141	0.000161	0.000165	0.00017	0.000175	0.000179
Chromium	Total	mg/L	2	0	0.00017	0.00019	0.00018	0.000307	0.0000141	0.000171	0.000175	0.00018	0.000185	0.000189
Cobalt	Dissolved	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Cobalt	Total	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Copper	Dissolved	mg/L	2	0	0.00149	0.00156	0.00152	0.00197	0.0000495	0.00149	0.00151	0.00152	0.00154	0.00156
Copper	Total	mg/L	2	0	0.00172	0.00182	0.00177	0.00241	0.0000707	0.00172	0.00174	0.00177	0.0018	0.00182
Iron	Dissolved	mg/L	2	0	0.036	0.048	0.042	0.118	0.00849	0.0366	0.039	0.042	0.045	0.0474
Iron	Total	mg/L	2	0	0.067	0.112	0.0895	0.375	0.0318	0.0693	0.0782	0.0895	0.101	0.11
Lead	Dissolved	mg/L	2	100	<0.00005	<0.00005	0.000025	NA	0	0.000025	0.000025	0.000025	0.000025	0.000025
Lead	Total	mg/L	2	100	<0.00005	<0.00005	0.000025	NA	0	0.000025	0.000025	0.000025	0.000025	0.000025
Lithium	Dissolved	mg/L	2	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Lithium	Total	mg/L	2	100	<0.0005	<0.0005	0.00025	NA	0	0.00025	0.00025	0.00025	0.00025	0.00025
Magnesium	Dissolved	mg/L	2	0	2.71	2.96	2.84	4.42	0.177	2.72	2.77	2.84	2.9	2.95
Magnesium	Total	mg/L	2	0	2.84	2.87	2.86	3.05	0.0212	2.84	2.85	2.86	2.86	2.87
Manganese	Dissolved	mg/L	2	0	0.00023	0.00061	0.00042	0.00283	0.000269	0.000249	0.000325	0.00042	0.000515	0.000591
Manganese	Total	mg/L	2	0	0.00686	0.00888	0.00787	0.0207	0.00143	0.00696	0.00736	0.00787	0.00838	0.00878
Mercury	Dissolved	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Mercury	Total	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Molybdenum	Dissolved	mg/L	2	0	0.0005	0.0005	0.0005	NA	0	0.0005	0.0005	0.0005	0.0005	0.0005
Molybdenum	Total	mg/L	2	0	0.0006	0.0006	0.0006	NA	0	0.0006	0.0006	0.0006	0.0006	0.0006
Nickel	Dissolved	mg/L	2	50	<0.0005	0.0005	0.000375	0.00196	0.000177	0.000263	0.000312	0.000375	0.000438	0.000488

TABLE 3: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE REFERENCE WATER QUALITY CONDITIONS USING DATA FOR THE BABINE RIVER

Nickel	Total	mg/L	2	50	<0.0005	0.00051	0.00038	0.00203	0.000184	0.000263	0.000315	0.00038	0.000445	0.000497
Phosphorus	Dissolved	mg/L	2	100	<0.3	<0.3	0.15	NA	0	0.15	0.15	0.15	0.15	0.15
Phosphorus	Total	mg/L	2	100	<0.3	<0.3	0.15	NA	0	0.15	0.15	0.15	0.15	0.15
Metals (cont.)														
Potassium	Dissolved	mg/L	2	0	0.515	0.561	0.538	0.83	0.0325	0.517	0.526	0.538	0.55	0.559
Potassium	Total	mg/L	2	0	0.532	0.536	0.534	0.559	0.00283	0.532	0.533	0.534	0.535	0.536
Selenium	Dissolved	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Selenium	Total	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Silicon	Dissolved	mg/L	2	0	1.73	1.83	1.78	2.42	0.0707	1.74	1.76	1.78	1.81	1.82
Silicon	Total	mg/L	2	0	1.81	1.92	1.86	2.56	0.0778	1.82	1.84	1.86	1.89	1.91
Silver	Dissolved	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Silver	Total	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Sodium	Dissolved	mg/L	2	0	2.1	2.4	2.25	4.16	0.212	2.12	2.18	2.25	2.32	2.38
Sodium	Total	mg/L	2	0	2.3	2.4	2.35	2.99	0.0707	2.3	2.32	2.35	2.38	2.4
Strontium	Dissolved	mg/L	2	0	0.07	0.071	0.0705	0.0769	0.000707	0.07	0.0703	0.0705	0.0707	0.071
Strontium	Total	mg/L	2	0	0.0732	0.0776	0.0754	0.103	0.00311	0.0734	0.0743	0.0754	0.0765	0.0774
Thallium	Dissolved	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Thallium	Total	mg/L	2	100	<0.00001	<0.00001	0.000005	NA	0	0.000005	0.000005	0.000005	0.000005	0.000005
Tin	Dissolved	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Tin	Total	mg/L	2	100	<0.0001	<0.0001	0.00005	NA	0	0.00005	0.00005	0.00005	0.00005	0.00005
Titanium	Dissolved	mg/L	2	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Titanium	Total	mg/L	2	100	<0.01	<0.01	0.005	NA	0	0.005	0.005	0.005	0.005	0.005
Uranium	Dissolved	mg/L	2	0	0.000025	0.000027	0.000026	0.0000387	0.00000141	0.0000251	0.0000255	0.000026	0.0000265	0.0000269
Uranium	Total	mg/L	2	0	0.000027	0.000029	0.000028	0.0000407	0.00000141	0.0000271	0.0000275	0.000028	0.0000285	0.0000289
Vanadium	Dissolved	mg/L	2	100	<0.001	<0.001	0.0005	NA	0	0.0005	0.0005	0.0005	0.0005	0.0005
Vanadium	Total	mg/L	2	100	<0.001	<0.001	0.0005	NA	0	0.0005	0.0005	0.0005	0.0005	0.0005
Zinc	Dissolved	mg/L	2	100	<0.003	<0.003	0.0015	NA	0	0.0015	0.0015	0.0015	0.0015	0.0015
Zinc	Total	mg/L	2	100	<0.003	<0.003	0.0015	NA	0	0.0015	0.0015	0.0015	0.0015	0.0015
Nutrients														
Ammonia	Dissolved	mg N/L	2	0	0.0101	0.011	0.0106	0.0163	0.000636	0.0101	0.0103	0.0106	0.0108	0.011
Nitrate	Dissolved	mg N/L	2	0	0.0339	0.0379	0.0359	0.0613	0.00283	0.0341	0.0349	0.0359	0.0369	0.0377
Nitrite	Dissolved	mg N/L	2	100	<0.001	<0.001	0.0005	NA	0	0.0005	0.0005	0.0005	0.0005	0.0005
Orthophosphate	Dissolved	mg P/L	2	100	<0.001	<0.001	0.0005	NA	0	0.0005	0.0005	0.0005	0.0005	0.0005

TABLE 3: SUMMARY OF THE WATER QUALITY DATA COMPILED TO ESTIMATE REFERENCE WATER QUALITY CONDITIONS USING DATA FOR THE BABINE RIVER

Nutrients (cont.)														
Total Kjeldahl Nitrogen	Total	mg/L	2	0	0.232	0.247	0.24	0.335	0.0106	0.233	0.236	0.24	0.243	0.246
Total Phosphorus	Total	mg/L	2	0	0.0074	0.0075	0.00745	0.00809	0.0000707	0.0074	0.00742	0.00745	0.00748	0.0075

Col = colour; N = nitrogen; NA = not applicable; NTU = nephelometric turbidity units; P = phosphorus; TDS = total dissolved solids; TOC = total organic carbon; TSS = total suspended solids.

TABLE 4: BRITISH COLUMBIA WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE

Chemical	BCMOE (2015) WQG		Units
	Long-Term Average	Short-Term Maximum	
Conventionals			
Hardness	*No WQG*	*No WQG*	mg/L
pH	6.5 - 9.0	*No WQG*	pH Scale
Alkalinity	*No WQG*	*No WQG*	mg/L
Temperature	*Species/life stage dependent*[1]	*Species/life stage dependent*[1]	°C
Total Suspended Solids (TSS)	*Based on background TSS*[2]	*Based on background TSS*[2]	mg/L
Dissolved Organic Carbon (DOC)	*Based on background DOC*[3]	*No WQG*	mg/L
Dissolved Oxygen (DO)	8[4]	5[5]	mg/L
Nutrients			
Ammonia as Total Ammonia Nitrogen [6]	Babine River: 0.611 Endako River: 0.396 Francois Lake: 1.07 Stellako River: 0.396	Babine River: 4.49 Endako River: 2.91 Francois Lake: 7.82 Stellako River: 2.91	mg/L
Nitrate as Nitrogen	3.0	32.8	mg/L
Nitrite as Nitrogen	0.02	0.06	mg/L
Phosphorus (total)	0.005 - 0.015	*No WQG*	mg/L
Major Ions			
Chloride	150	600	mg/L
Calcium	*No WQG*	*No WQG*	mg/L
Fluoride [7]	1.0 [8]	Babine River: 0.967 Endako River: 1.03 Francois Lake: 0.877 Stellako River: 0.920	mg/L
Magnesium	*No WQG*	*No WQG*	mg/L
Potassium	*No WQG*	*No WQG*	mg/L
Sodium	*No WQG*	*No WQG*	mg/L
Sulphate [7]	218 [9]	*No WQG*	mg/L
Total Dissolved Solids (TDS)	*No WQG*	1000/ 3000 [10]	mg/L
Metals (Based on the Dissolved Fraction)			

TABLE 4: BRITISH COLUMBIA WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE

Aluminum	50 [11]	100 [11]	µg/L
Arsenic	5	*No WQG*	µg/L
Cadmium [7]	Babine River: 0.0151 Endako River: 0.0173 Francois Lake: 0.0125 Stellako River: 0.0137	*No WQG*	µg/L
Chromium (III)	8.9	*No WQG*	µg/L
Chromium (VI)	1	*No WQG*	µg/L
Copper [7]	2	Babine River: 5.77 Endako River: 6.43 Francois Lake: 5.02 Stellako River: 5.36	µg/L
Lead [7]	Babine River: 4.31 Endako River: 4.53 Francois Lake: 4.06 Stellako River: 4.17	Babine River: 25.5 Endako River: 31.3 Francois Lake: 19.2 Stellako River: 22.0	µg/L
Mercury (Inorganic)	0.00125 - 0.02 [12]	*No WQG*	µg/L
Molybdenum	1000	50 / 2000 [13]	µg/L
Nickel [7]	25 [14]	*No WQG*	µg/L
Selenium	2	*No WQG*	µg/L
Silver [7]	0.05 [15]	0.1 [15]	µg/L
Vanadium	6	*No WQG*	µg/L
Zinc [7]	7.5 [16]	33 [16]	µg/L

BCMOE = British Columbia Ministry of Environment; DO = dissolved oxygen; DOC = dissolved organic carbon; TDS = total dissolved solids; TSS = total suspended solids; WQG = water quality guideline.

[1] The water quality guidelines vary according to the species and life stage present in the water body. See BCMOE (2015) for details at: http://www.env.gov.bc.ca/wat/wq/BCguidelines/temptech/temperature.html.

[2] The WQG is based on background TSS concentration; see the explanation from BCMOE (2015) at the following link: http://www.env.gov.bc.ca/wat/wq/BCguidelines/turbidity/turbidity.html.

[3] The WQG is equal to the 30-day median ± 20% of the median background concentration (BCMOE 2015).

[4] This is the 30-day mean minimum value for all life stages other than buried embryo/alevin. Buried embryo/alevin life stages require a minimum of 11 mg/L oxygen in the water column and 8 mg/L oxygen in the interstitial water (BCMOE 2015).

[5] This is the instantaneous minimum for all life stages other than buried embryo/alevin. Buried embryo/alevin life stages require a minimum of 9 mg/L oxygen in the water column and 6 mg/L oxygen in the interstitial water (BCMOE 2015).

[6] WQG at a temperature of 20°C and the 95th percentile pH of the water body (Babine River = 8.07, Endako River = 8.27, Francois Lake = 7.77, Stellako River = 8.28). See Tables 3 and 4 in the Overview Report under "Nitrogen - nitrate, nitrite, ammonia" at the following BCMOE (2015) link to determine the short-term and long-term WQGs, respectively, at other temperature and pH combinations: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html.

[7] These WQGs are hardness-dependent and are displayed at the 5th percentile hardness of the water body (Babine River = 40.1 mg/L $CaCO_3$, Endako River = 47.1 mg/L $CaCO_3$, Francois Lake = 32.1 mg/L $CaCO_3$, Stellako River = 35.7 mg/L $CaCO_3$). To calculate the WQGs at a different hardness, see BCMOE (2015) at http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html

[8] WQG for the protection of wildlife (30-day mean).

[9] WQG at a hardness of 31 - 75 mg/L $CaCO_3$.

[10] Working WQG for the protection of livestock. 1000 mg/L is the maximum for sensitive species and 3000 mg/L is the maximum for other species (BCMOE 2015).

[11] WQG at pH ≥ 6.5.

[12] This WQG depends on the percentage of methylmercury (MeHg). When MeHg is 0.5% of total mercury (THg), the WQG = 0.02 µg/L. When MeHg is 1.0% of THg, the WQG = 0.01 µg/L. When MeHg is 8.0% of THg, the WQG = 0.00125 µg/L (BCMOE 2015).

[13] The WQG for the protection of wildlife is 50 µg/L and the WQG for the protection of aquatic life is 2000 µg/L (BCMOE 2015).

[14] WQG at a hardness ≤ 60 mg/L $CaCO_3$.

[15] WQG at a hardness ≤ 100 mg/L $CaCO_3$.

[16] WQG at a hardness ≤ 90 mg/L $CaCO_3$.

TABLE 5: CCME WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE

Chemical	CCME (2015a) WQG		Units
	Long-Term Average	**Short-Term Maximum**	
Conventionals			
Hardness	*No WQG*	*No WQG*	mg/L
pH	6.5 - 9.0	*No WQG*	pH Scale
Alkalinity	*No WQG*	*No WQG*	mg/L
Temperature	*Narrative statement*[1]	*Narrative statement*[1]	°C
Total Suspended Solids (TSS)	*Based on background TSS*[2]	*Based on background TSS*[2]	mg/L
Dissolved Organic Carbon (DOC)	*No WQG*	*No WQG*	mg/L
Dissolved Oxygen (DO)	*Species/life stage dependent*[3]	*No WQG*	mg/L
Nutrients			
Ammonia as Total Ammonia Nitrogen [4]	Babine River: 0.141 Endako River: 0.141 Francois Lake: 0.410 Stellako River: 0.141	*No WQG*	mg/L
Nitrate as Nitrogen	3.0	124	mg/L
Nitrite as Nitrogen	0.06	*No WQG*	mg/L
Phosphorus (total)	*Narrative statement*[5]	*No WQG*	mg/L
Major Ions			
Chloride	120	640	mg/L
Calcium	*No WQG*	*No WQG*	mg/L
Fluoride	0.12	*No WQG*	mg/L
Magnesium	*No WQG*	*No WQG*	mg/L
Potassium	*No WQG*	*No WQG*	mg/L
Sodium	*No WQG*	*No WQG*	mg/L
Sulphate	*No WQG*	*No WQG*	mg/L
Total Dissolved Solids (TDS)	*No WQG*	3000 [6]	mg/L

TABLE 5: CCME WATER QUALITY GUIDELINES FOR THE PROTECTION OF AQUATIC LIFE

Metals (Based on the Dissolved Fraction)			
Aluminum	100	*No WQG*	µg/L
Arsenic	5	*No WQG*	µg/L
Cadmium [7]	Babine River: 0.07 Endako River: 0.08 Francois Lake: 0.06 Stellako River: 0.07	Babine River: 0.83 Endako River: 0.98 Francois Lake: 0.66 Stellako River: 0.74	µg/L
Chromium (III)	8.9	*No WQG*	µg/L
Chromium (VI)	1	*No WQG*	µg/L
Copper [7]	2 [8]	*No WQG*	µg/L
Lead [7]	1 [9]	*No WQG*	µg/L
Mercury (Inorganic)	0.026	*No WQG*	µg/L
Molybdenum	73	*No WQG*	µg/L
Metals (Based on the Dissolved Fraction; cont.)			
Nickel [7]	25 [10]	*No WQG*	µg/L
Selenium	1	*No WQG*	µg/L
Silver [7]	0.1	*No WQG*	µg/L
Vanadium	*No WQG*	*No WQG*	µg/L
Zinc [7]	30	*No WQG*	µg/L

BCMOE = British Columbia Ministry of Environment; DO = dissolved oxygen; DOC = dissolved organic carbon; TDS = total dissolved solids; TSS = total suspended solids; WQG = water quality guideline.

[1] Thermal additions to receiving waters should be such that the maximum weekly average temperature is not exceeded. Thermal additions to receiving waters should be such that the short-term exposures to maximum temperatures are not exceeded. Exposures should not be so lengthy or frequent as to adversely affect the important species. For more information see CCME (2015a) at: http://st-ts.ccme.ca/en/index.html?lang=en&factsheet=209.

[2] The WQG is based on background TSS concentration; see the explanation from CCME (2015a) at the following link: http://st-ts.ccme.ca/en/index.html?lang=en&factsheet=218.

[3] Lowest acceptable dissolved oxygen concentration:
for warm water biota: early life stages = 6 mg/L
for warm water biota: other life stages = 5.5 mg/L
for cold water biota: early life stages = 9.5 mg/L
for cold water biota: other life stages = 6.5 mg/L (CCME 2015a).

[4] WQG at a temperature of 20°C and the 95th percentile pH of the water body (Babine River = 8.07, Endako River = 8.27, Francois Lake = 7.77, Stellako River = 8.28). See CCME (2015a) at the following link to determine the WQG at other temperature and pH combinations: http://st-ts.ccme.ca/en/index.html?lang=en&factsheet=5.

[5] CCME (2015a) provides trigger ranges for total phosphorus depending on the nutrient status of the water body. See the following link for details: http://st-ts.ccme.ca/en/index.html?lang=en&factsheet=167.

[6] WQG for the protection of livestock (CCME 2015b).

[7] These WQGs are hardness-dependent and are displayed at the 5th percentile hardness of the water body (Babine River = 40.1 mg/L $CaCO_3$, Endako River = 47.1 mg/L $CaCO_3$, Francois Lake = 32.1 mg/L $CaCO_3$, Stellako River = 35.7 mg/L $CaCO_3$). To calculate the WQGs at a different hardness, see CCME (2015a) at http://st-ts.ccme.ca/en/index.html?chems=all&chapters=1.

[8] WQG at a hardness ≤ 82 mg/L $CaCO_3$.

[9] WQG at a hardness ≤ 60 mg/L $CaCO_3$.

[10] WQG at a hardness ≤ 60 mg/L $CaCO_3$.

TABLE 6: LISTING OF PRELIMINARY WATER QUALITY STANDARDS FOR CLASS III WATERS

Chemical	Water Quality Standard		Units
	Long-Term Average	Short-Term Maximum	
Conventionals			
Hardness	*No WQS*	*No WQS*	mg/L
pH	6.5 - 9.0	*No WQS*	pH Scale
Alkalinity	*No WQS*	*No WQS*	mg/L
Temperature	*Species/life stage dependent*[1]	*Species/life stage dependent*[1]	°C
Total Suspended Solids (TSS)	*Based on background TSS*[2]	*Based on background TSS*[2]	mg/L
Dissolved Organic Carbon (DOC)	*Based on background DOC*[3]	*No WQS*	mg/L
Dissolved Oxygen (DO)	8[4]	5[5]	mg/L
Nutrients			
Ammonia as Total Ammonia Nitrogen [6]	Babine River: 0.141 Endako River: 0.141 Francois Lake: 0.410 Stellako River: 0.141	Babine River: 4.49 Endako River: 2.91 Francois Lake: 7.82 Stellako River: 2.91	mg/L
Nitrate as Nitrogen	3.0	32.8	mg/L
Nitrite as Nitrogen	0.02	0.06	mg/L
Phosphorus (total)	0.005 - 0.015	*No WQS*	mg/L
Major Ions			
Chloride	120	600	mg/L
Calcium	*No WQS*	*No WQS*	mg/L
Fluoride [7]	0.12	Babine River: 0.967 Endako River: 1.03 Francois Lake: 0.877 Stellako River: 0.920	mg/L

TABLE 6: LISTING OF PRELIMINARY WATER QUALITY STANDARDS FOR CLASS III WATERS

Magnesium	*No WQS*	*No WQS*	mg/L
Potassium	*No WQS*	*No WQS*	mg/L
Sodium	*No WQS*	*No WQS*	mg/L
Sulphate [7]	218 [8]	*No WQS*	mg/L
Total Dissolved Solids (TDS)	*No WQS*	1000/ 3000 [9]	mg/L
Metals (Based on the Dissolved Fraction)			
Aluminum	50 [10]	100 [10]	µg/L
Arsenic	5	*No WQS*	µg/L
Cadmium [7]	Babine River: 0.0151 Endako River: 0.0173 Francois Lake: 0.0125 Stellako River: 0.0137	Babine River: 0.83 Endako River: 0.98 Francois Lake: 0.66 Stellako River: 0.74	µg/L
Chromium (III)	8.9	*No WQS*	µg/L
Chromium (VI)	1	*No WQS*	µg/L
Metals (Based on the Dissolved Fraction; cont.)			
Copper [7]	2 [11]	Babine River: 5.77 Endako River: 6.43 Francois Lake: 5.02 Stellako River: 5.36	µg/L
Lead [7]	1 [12]	Babine River: 25.5 Endako River: 31.3 Francois Lake: 19.2 Stellako River: 22.0	µg/L
Mercury (Inorganic)	0.00125 - 0.02 [13]	*No WQS*	µg/L
Molybdenum	73	50 / 2000 [14]	µg/L
Nickel [7]	25 [15]	*No WQS*	µg/L
Selenium	1	*No WQS*	µg/L
Silver [7]	0.05 [16]	0.1 [16]	µg/L
Vanadium	6	*No WQS*	µg/L
Zinc [7]	7.5 [17]	33 [17]	µg/L

TABLE 6: LISTING OF PRELIMINARY WATER QUALITY STANDARDS FOR CLASS III WATERS

BCMOE = British Columbia Ministry of Environment; DO = dissolved oxygen; DOC = dissolved organic carbon; TDS = total dissolved solids; TSS = total suspended solids; WQS = water quality standard.

[1] The water quality guidelines vary according to the species and life stage present in the water body. See BCMOE (2015) for details at: http://www.env.gov.bc.ca/wat/wq/BCguidelines/temptech/temperature.html.

[2] The WQS is based on background TSS concentration; see the explanation from BCMOE (2015) at the following link: http://www.env.gov.bc.ca/wat/wq/BCguidelines/turbidity/turbidity.html.

[3] The WQS is equal to the 30-day median ± 20% of the median background concentration (BCMOE 2015).

[4] This is the 30-day mean minimum value for all life stages other than buried embryo/alevin. Buried embryo/alevin life stages require a minimum of 11 mg/L oxygen in the water column and 8 mg/L oxygen in the interstitial water (BCMOE 2015).

[5] This is the instantaneous minimum for all life stages other than buried embryo/alevin. Buried embryo/alevin life stages require a minimum of 9 mg/L oxygen in the water column and 6 mg/L oxygen in the interstitial water (BCMOE 2015).

[6] WQS at a temperature of 20°C and the 95th percentile pH of the water body (Babine River = 8.07, Endako River = 8.27, Francois Lake = 7.77, Stellako River = 8.28). See Tables 3 and 4 in the Overview Report under "Nitrogen - nitrate, nitrite, ammonia" at the following BCMOE (2015) link to determine the short-term and long-term WQSs, respectively, at other temperature and pH combinations: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html.

[7] These WQSs are hardness-dependent and are displayed at the 5th percentile hardness of the water body (Babine River = 40.1 mg/L $CaCO_3$, Endako River = 47.1 mg/L $CaCO_3$, Francois Lake = 32.1 mg/L $CaCO_3$, Stellako River = 35.7 mg/L $CaCO_3$). To calculate the WQSs at a different hardness, see BCMOE (2015) at http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html

[8] WQS at a hardness of 31 - 75 mg/L $CaCO_3$.

[9] Working WQS for the protection of livestock. 1000 mg/L is the maximum for sensitive species and 3000 mg/L is the maximum for other species (BCMOE 2015).

[10] WQS at pH ≥ 6.5.

[11] WQS at a hardness ≤ 82 mg/L $CaCO_3$.

[12] WQS at a hardness ≤ 60 mg/L $CaCO_3$.

[13] This WQS depends on the percentage of methylmercury (MeHg). When MeHg is 0.5% of total mercury (THg), the WQS = 0.02 µg/L. When MeHg is 1.0% of THg, the WQS = 0.01 µg/L. When MeHg is 8.0% of THg, the WQS = 0.00125 µg/L (BCMOE 2015).

[14] The WQS for the protection of wildlife is 50 µg/L and the WQS for the protection of aquatic life is 2000 µg/L (BCMOE 2015).

[15] WQS at a hardness ≤ 60 mg/L $CaCO_3$.

[16] WQS at a hardness ≤ 100 mg/L $CaCO_3$.

[17] WQS at a hardness ≤ 90 mg/L $CaCO_3$.