Protocol of Accepted

Drinking Water

Testing Methods

Version 3.0

Drinking Water and Environmental Compliance Division, Central Region, Laboratory Licensing Compliance Program

Ministry of the Environment, Conservation & Parks

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PROTOCOL OF ACCEPTED DRINKING WATER TESTING METHODS

# INTRODUCTION

# The purpose of this document is to provide a compilation of reference methods that the Ministry of Environment, Conservation and Parks (referred to as the Ministry) recognizes as acceptable for drinking water testing licensing. This document also provides information on the Ministry’s review process in relation to method licensing. The parameters included in this document are chemical and microbiological parameters listed in the [Ontario Drinking Water Quality Standards regulation](https://www.ontario.ca/laws/regulation/030169) (O. Reg. 169/03/ODWQS) made under the [*Safe Drinking Water Act, 2002*](https://www.ontario.ca/laws/statute/02s32)(SDWA) and additional parameters specified in the [Drinking Water Systems regulation](https://www.ontario.ca/laws/regulation/030170) (O. Reg. 170/03) which is also made under the SDWA. This document is incorporated by reference in the [Drinking Water Testing Services regulations](https://www.ontario.ca/laws/regulation/030248) (section 11(1)(a) of O. Reg. 248/03) made under the SDWA.

## 1.1 Laboratory Licensing for Drinking Water Testing in Ontario

# Under Part VII of the SDWA, only licensed laboratories in Ontario and eligible out-of-province laboratories may conduct tests on samples of Ontario drinking water. MECP laboratory licensing of an analytical method ensures that the testing procedures are appropriate for drinking water testing and produce quality results for comparison with the regulatory standard(s). As a prerequisite for licensing, laboratories and their testing methods must be accredited to the current ISO/IEC17025 international standard *General Requirements for the Competence of Testing and Calibration Laboratories.* Laboratory licensing requires that the laboratory appropriately document and validate its testing methods, and that the laboratory demonstrate competence to perform the methods it employs.

# The reference methods that are included in this document have been shown to meet Ministry requirements for drinking water testing. They contain sufficiently detailed instructions to enable laboratories to test the target analytes, and they can typically be performed without significant modification. Requirements of the SDWA, regulations under the SDWA or conditions of the drinking testing licence may supercede the reference methods listed in this document.

# The Ministry uses this Protocol of Accepted Drinking Water Testing Methods document (Protocol) to determine the scope of the review process for its approval of laboratory licence applications. Appendix A provides a list of the documents that a laboratory must include with its drinking water testing licence application. Appendix B provides general guidance on method modifications that a laboratory can make after the Ministry has approved a testing method for licensing. Appendix C provides a summary of the Ministry’s requirements for sample collection and handling.

1.1.1. Accepted Reference Methods

The accepted reference methods are listed in Section 2 (Microbiology) and Section 3 (Chemistry) according to the type of parameter for which each method may be used. The standard for each parameter is included as set out in the ODWQS or O. Reg. 170/03, respectively. The required reporting detection limit (RDL) is also included in the parameter tables in this document.

These methods have well documented performance characteristics and are compiled from recognized sources. Those specific references are listed in Section 2 and 3, beneath the parameter tables to which they apply. The Part VII, SDWA, Director will update the list of accepted testing reference methods as this Protocol is amended from time to time.

In general, laboratories should use the most recent revision of the relevant reference method. This Protocol only includes testing methods intended for use at a licensed laboratory. It does not include testing methods intended for operational parameters or in-line monitoring tests done at a Drinking Water System. Radiological testing methods have not been included in this Protocol. For information on specific reference methods for radiological tests, contact the MECP Laboratory Licensing Compliance Program at LaboratoryLicensingSDWB@ontario.ca.

# Reference methods can be obtained from the following sources:

1. Licensed methods used by the MECP Laboratory Services Branch (LaSB) for the testing of drinking water can be requested from MECP-LaSB at [LaboratoryServicesBranch@ontario.ca](mailto:LaboratoryServicesBranch@ontario.ca). These methods are identified in this Protocol as **LaSB Method(s).**
2. Methods described in the reference Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association (AWWA) and Water Environmental Federation are available from <https://www.standardmethods.org>. These methods are identified in this Protocol as **AWWA Method(s).**
3. Methods of the United States Environmental Protection Agency (US EPA) are available through the USEPA ([www.epa.gov](http://www.epa.gov)), the National Technical Information Service, Springfield, Virginia, or the National Environmental Methods Index ([www.nemi.gov](http://www.nemi.gov)). These methods are identified in this Protocol as **US EPA Method(s).**
4. Methods of ASTM International (formerly the **American Society for Testing and Materials) (ASTM) are** available from [www.astm.org](http://www.astm.org). These methods are identified in this protocol as **ASTM Method(s).**
5. Methods of the International Organization for Standardization (ISO) are available from www.iso.org. These methods are identified in this protocol as **ISO Method(s)**.

1.1.2. Alternate Reference Methods and In-House Developed Methods

Since new reference methods are constantly being developed, this Protocol does not include all existing reference methods. There may be alternative reference methods that can produce suitable results for the purposes of meeting licensing requirements. Laboratories can contact the Ministry to request that a review of a new/alternate method for inclusion in this Protocol document.

A laboratory may apply for the licensing of a method based on either an alternate reference method not listed in this document or a chemistry method developed in-house by the laboratory. Microbiology methods developed in-house by the laboratory are generally not accepted for licensing. To be considered for licensing, such alternate methods or techniques must not have been identified by the Ministry as inappropriate for the target analyte(s). Methods based on alternate reference method or in-house development by the laboratory must produce analytical data that is consistent with or superior to an accepted reference method. The proposed alternate methods must also have sample collection and handling procedures that are suitable for drinking water and consistent with an appropriate accepted test reference method listed in this document.

## 1.2 Requirements for Licensing

# The laboratory’s licence application must include a completed application form and the items listed in Appendix A below. Laboratories applying for licensing are required to include supporting validation data relating to the analyte’s specific performance requirements as set out in sections 1.2.1 and 1.2.2 below.

# The Ministry uses the following criteria when reviewing and approving licence applications:

# methods based on an accepted reference method are reviewed based on the criteria outlined in Section 1.2.1

# methods based on either an accepted reference method with modifications or an alternate reference/in-house developed method are reviewed based on the criteria outlined in Section 1.2.1 and additional criteria in 1.2.2.

# The Ministry may also have additional requirements depending on the known sources of error or limitations associated with the reference method in question. Reference methods such as the US EPA SW-846 series that are general guidance methods and not prescriptive procedures may require additional validation as described in Alternate/In House Methods Section 1.2.2.

1.2.1 Criteria for Licensing - Accepted Reference Method

*Authorization/Fit for purpose*

The laboratory must have assessed and deemed the method validation as being “fit for the purpose.” The laboratory may document this in the method or in a method validation summary. The method must be reviewed, approved for adequacy and issued by laboratory as a controlled document. The method must include at a minimum; a unique identifier, indicate the current revision status, and date of issue and/or revision number.

*Accreditation status*

Accreditation is a prerequisite for licensing. All parameters in the licence application, with the exception of calculated parameters, must be accredited and listed on the laboratory’s current Scope of Accreditation issued by their accreditation body.

*Review of Method*

The laboratory must include a copy of its authorized analytical method with the application. The methodology must clearly document the instrumentation involved in the test’s analysis, sample preparation, and the analytical procedures. Additionally, it must include the test’s reporting detection limits and working range as follows:

1. The method or supporting procedures must ensure that there are no delays in the immediate processing and reporting of results as required by regulations. The laboratory may document its overall process for ensuring there are no undue delays in a policy or procedure that is separate from the analytical method material. Microbiology tests must not include delayed or extended overnight refrigerated incubation.
2. The laboratory must document deviations from the reference methods in its method. The Ministry will review methods that involve significant deviations from the accepted reference method as alternate reference methods/In House methods. A microbiology test must not deviate from the full incubation time specified in the reference method.
3. The method’s working range should encompass the relevant concentration required by the O. Reg. 169/03 Ontario Drinking Water Quality Standard.
4. Where possible, the method must ensure appropriate techniques to assess and mitigate known interferences with the parameter.
5. The laboratory must prepare calibration standards as frequently as, or more frequently than, prescribed by the Reference Method. For microbiology methods, an appropriate daily positive control must be included.
6. The volume of the sample required for analysis (test volume) must be appropriately documented in the method and must be suitable for drinking water analysis.

Sample Collection, Containers and Holding Time

The sample volume requirements of a method specify the amount of water that must be collected by the sampler. This volume must be sufficient to ensure a representative sample is provided to the laboratory. Additionally, the sample volume must be enough for the prescribed test volume, additional quality control tests (e.g. duplicates or matrix spikes) and the method’s RDL requirement. The sample collection volumes, containers and holding times are summarized in Appendix C, Sample Collection and Handling Requirements Table.

Proficiency Testing

The applicant must demonstrate satisfactory proficiency testing by submitting the most recent set of results as part of the application. A minimum of one set of successful proficiency tests is required by the Ministry. Where possible proficiency tests should encompass the analyte concentration range appropriate for drinking water.

In some cases, proficiency tests may not be available for the parameter. In these cases, the laboratory must provide validation demonstrating the accuracy of the test method.

Method Detection Limit (MDL)

# The laboratory must demonstrate that the method detection limit (MDL) meets or is less than the MECP’s required reporting detection limit (RDL). Both the laboratory’s calculated MDL and the RDL used for reporting purposes must meet the MECP’s RDL requirements.

# The MECP’s required RDLs are listed in Sections 2 and 3 of this Protocol. These are typically one tenth of the regulatory standard and are listed in the most commonly used units of measure. The laboratory may use alternate units of measure for the MDL determination.

The minimum validation data that the Ministry requires for licensing is a summary of the calculation of the MDL. The laboratory must validate the MDL and determine any impact of the matrix effects from drinking water and any preservative(s). It is best practice to validate the MDL appropriately using a matrix representative of the drinking water to be tested (e.g. chlorinated tap water with appropriate preservative). The laboratory should calculate the MDL in accordance with the laboratory’s polices and at a minimum it should follow the criteria in AWWA Method 1020B “Quality Control”. For microbiology methods, the test volume used and inter- and intra-analyst precision data must demonstrate that it is suitable to achieve the required RDL and that the method performance is consistent with the accepted reference method.

*Data Reporting*

The laboratory’s test results reported must:

* be expressed in appropriate and defensible significant figures; and,
* include one additional digit more than the ODWQS concentration where possible

Reporting Overgrown Microbiology tests

The method must include an appropriate definition for overgrown “over-crowding/confluent/non-identifiable microbial growth” results. The method must be written to ensure that overgrown results are reported appropriately as adverse test results.

*Accuracy, Precision and Other Requirements*

If accuracy and precision validation data are not fully documented in the reference method, then the laboratory must submit a summary of this validation with its licence application. It is a best practice for a laboratory to include accuracy and precision validation data with its licence application submission.

1.2.1.1 Licensing – Methods modified from Accepted Reference Methods

A laboratory may request licensing for a method that is modified from an accepted reference method.

The Ministry may approve a licensing application for a method modified from an accepted reference, if the modified method can produce analytical data that is equivalent or superior to the reference method.

In its licence application, the laboratory must identify the method as a modification of a reference method and the modifications must be appropriately detailed in the method. Modifications must remain consistent with the quality control (QC) procedures and any other aspects critical for drinking water analysis as specified in the reference method. However, Heterotrophic Plate Count is one exception, where the methods may be modified not to test every sample in duplicate. For microbiology tests, the incubation time may not be modified. For all other microbiology modifications including media formulation modifications, the method developer must demonstrate that the modification produces consistent or superior data to the reference method. The laboratory should evaluate the modification following procedure in the international standard ISO 17994 “Water quality -- Requirements for the comparison of the relative recovery of microorganisms by two quantitative methods.”

# Unless specified below, the Ministry will review applications for methods modified from accepted reference methods according to the criteria in Section 1.2.2.

**Accepted Method Modifications**

1. **Minor variations to Instrumental/apparatus conditions**

The Ministry may permit minor changes in instrumental/apparatus conditions to facilitate equivalent equipment/technology or improved analytical performance.

1. **Modifying Sample Volume Requirements**

The Ministry will review changes to methods’ sample volume requirements according to the same criteria that apply to an accepted reference method, if the volume requirements are supported by a secondary accepted reference method(s).

1.2.2. Additional Criteria – Alternate Reference/In-house Methods

a) Confirmation of Identity

The analytical technique must be an appropriate means of establishing confirmation of identity. The laboratory must demonstrate that the response produced by the method is attributable to the analyte of interest. Chemical analyte identity is often confirmed by analyzing an authentic reference standard and/or Certified Reference Material (CRM). For microbiology tests, an appropriate type culture such as an American Type Culture Collection (ATCC) or equivalent can be used.

b) Selectivity

The selectivity of a method is its ability to measure analyte(s) of interest in the presence of other chemicals.

Selectivity is often achieved by employing a variety of sample preparation and sample clean-up techniques and separatory techniques such as gas chromatography which isolate the analyte of interest when presenting it to the measurement device.

The effects of interferences between chemicals include co-eluting peaks and analyte degradation due to interaction with either injector port, transfer line or column (chromatographic methods), overlapping of spectral lines causing either positive or negative signal enhancement (spectroscopic methods), etc.

Demonstration of selectivity is accomplished by analyzing samples containing various suspected interfering materials in the presence of the analytes of interest and by using appropriate statistical techniques to establish that there are no significant differences in the test results between those samples containing interfering substances and those that are free of interfering substances. Laboratories should choose such potentially interfering materials based on scientific judgement with consideration of the interference that could occur. Paired t-test and analysis of variance (ANOVA) / Factorial analysis are statistical tools that laboratories may employ to demonstrate selectivity. For microbiology methods, selectivity can be demonstrated through testing target organisms for positive results and potentially interfering non-target micro-organisms for negative results.

c) Working and Linear Ranges

The laboratory must provide validation of the calibration linearity that supports the method’s working range.

The laboratory should evaluate the working range by visually examining the plot of response versus analyte concentration. If there is a linear relationship, the laboratory must apply appropriate statistical methods to check for linearity and calculate the regression line by the method of least squares. The lowest and highest result that can be reported must be established by analyzing appropriate standards. To establish working linearity the laboratory must prepare, in triplicate, a minimum of 5 concentrations between upper and lower limit of the working range and analyze them.

Sometimes it is difficult to establish deviations from linearity by visual inspection. In such cases, laboratories can plot the deviations from the regression line versus the concentrations. For linear ranges, negative and positive values must be approximately equally distributed.

d) Bias, Precision and Recovery

The performance of laboratories methods, including, bias, precision and recovery, must align with the performance of one of the accepted reference methods for the target analyte. Laboratories should use the most similar accepted reference method to the alternate/In house developed method for the purpose of method performance comparison.

e) Ruggedness

Ruggedness is the ability of the method to be unaffected by slight changes in testing conditions including laboratory environmental conditions. Examples of testing conditions include chromatographic parameters (i.e. flow rate, column temperature, injection volume, detection wavelength or mobile phase composition etc.) Other testing conditions include digestion temperature, pH of buffers, normality of acids etc. Ideally, ruggedness is demonstrated by varying testing conditions and laboratory environmental conditions within previously specified tolerance and establishing that these changes do not significantly affect the measurement result, employing factorial analysis and/or Youden Ruggedness Tests*.* At a minimum, inter- and intra-analyst precision must be evaluated.

f) Sample Containers, Preservative and Holding Times

# The sample container, sample volume, preservative and holding requirements of the proposed alternate method must be supported by an appropriate accepted reference method. These details are summarized in Appendix C.

# If the chemistry of an extract is different from an accepted reference method or MECP Sample Collection and Holding Time Requirements, then the laboratory must prepare an extract holding time validation study.

# In these cases, the laboratory must provide a validation summary that supports the sample/extract hold time and storage conditions in the method. The hold time validation must include sufficient replicates and monitoring frequency of the analyte to confirm that the analyte is stable throughout the hold time. The document entitled “ASTM D4841 – 88 Standard Practice for Estimation of Holding Time for Water Samples Containing Organic and Inorganic Constituents” as amended from time to time, provides guidance for how to validate holding times and determine the number of replicates.

# g) Comparison with an accepted reference – Microbiology

# Depending on the rigor of peer review and validation of the alternate reference method source, the applicant may be required to perform an additional method comparison in accordance with ISO 17994 “Water quality -- Requirements for the comparison of the relative recovery of microorganisms by two quantitative methods” to demonstrate at a minimum, equivalence to an approved reference method.

# SCHEDULE 1, MICROBIOLOGICAL PARAMETERS

## 

## Total Coliform and *Escherichia coli* (*E. coli*)

As per Schedule 1 of O. Reg. 169/03, the ODWQS is “not detectable” for Total Coliforms and *Escherichia coli* respectively.

The following table describes the methodology and results with required reporting units that are equivalent to “not detectable.”

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Membrane Filtration** | **Presence/Absence** | **MPN** |
| Total Coliforms | 0 CFU/100 mL | Absent/100 mL | 0 MPN/100 mL |
| *Escherichia coli* | 0 CFU/100 mL | Absent/100 mL | 0 MPN/100 mL |

Reporting units for Total Coliforms and *E. coli* are dependent on the methodology used. The ODWQS values provided in the table above include the appropriate reporting unit for each methodology. (See Section 4, Acronyms for a description of the reporting units.)

Required RDL: The required RDL for Total Coliforms and *E. coli* are both 0 cfu/100mL, 0 MPN/100mL or absent. MPN <1.1/100 mL is considered absent and is to be reported as 0 MPN/100 mL.

**2.1.1 Methods for both Total Coliforms and Escherichia coli (E. coli)**

LaSB Methods: Method E3407 – Membrane Filtration Method Using DC Agar for the Simultaneous Detection and Enumeration of Total Coliforms and Escherichia coli in Drinking Water

Method E3371 – A membrane Filtration Method for the Detection and Enumeration of Total Coliform, *Escherichia coli*, and Enterococci/Fecal Streptococci in Environmental Samples

Method E3561 - Presence-Absence Test for Coliform Bacteria, including *Escherichia coli*, in Drinking Water by Colilert® Quanti-Tray®

Method E3571 – Quantitative Test for Total Coliform and/or *Escherichia coli*, in Water by Colilert® Quanti-Tray®

AWWA Methods: Method 9221B Standard Total Coliform Fermentation Technique

Method 9221C – Estimation of Bacterial Density

Method 9221D – Presence - Absence Coliform Test

Method 9221F – *Escherichia coli* Procedure using Fluorogenic Substrate

Method 9222J – Simultaneous Detection of Total Coliform and *E. coli* by dual chromogen Membrane Filter Procedure

Method 9222K – Simultaneous Detection of Total Coliforms and *E. coli* by Fluorogen/Chromogen Membrane Filter Procedure

Method 9223 – Enzyme Substrate Coliform Test (Including Colilert®, Colilert-18® and Colisure® media available from IDEXX Laboratories Inc.)

US EPA Methods: Method 1103.1, *Escherichia coli* (*E. coli*) in Water by Membrane Filtration Using membrane-Thermotolerant *Escherichia coli* Agar (mTEC)

Method 1603, *Escherichia coli* (*E. coli*) in Water by Membrane Filtration Using Modified membrane-Thermotolerant *Escherichia coli* Agar (Modified mTEC)

Method 1604, Total Coliforms and *Escherichia coli* in Water by Membrane Filtration Using a Simultaneous Detection Technique (MI Medium)

Enzyme substrate methods as approved by the EPA, 40 CFR Part 122,136, et al, March 12, 2007

**2.1.2 Methods for Total Coliforms**

AWWA Methods: Method 9221B Standard Total Coliform Fermentation Technique

Method 9221C – Estimation of Bacterial Density

Method 9221D – Presence - Absence Coliform Test

Method 9221F – *Escherichia coli* Procedure using Fluorogenic Substrate

Method 9222B Standard Total Coliform Membrane Filter Procedure using Endo Media

US EPA Methods: Enzyme substrate methods as approved by the EPA, 40 CFR Part 122,136, et al, March 12, 2007

2.1.3 Methods for Escherichia coli

AWWA Methods: Method 9221B Standard Total Coliform Fermentation Technique

Method 9221C – Estimation of Bacterial Density

Method 9221D – Presence -Absence Coliform Test

Method 9221F – *Escherichia coli* Procedure using Fluorogenic Substrate

US EPA Methods: Method 1103.1, *Escherichia coli* (*E. coli*) in Water by Membrane Filtration Using membrane-Thermotolerant *Escherichia coli* Agar (mTEC)

Method 1603, *Escherichia coli* (*E. coli*) in Water by Membrane Filtration Using Modified membrane-Thermotolerant *Escherichia coli* Agar (Modified mTEC)

Enzyme substrate methods as approved by the EPA, 40 CFR Part 122,136, et al, March 12, 2007

## Heterotrophic Plate Count

Heterotrophic Bacteria (Heterotrophic Plate Count) – Technique and Reporting Units

| Technique | Reporting Units |
| --- | --- |
| Spread Plate | Count/CFU/0.1 mL |
| Pour Plate | Count/CFU/1 mL |
| Membrane Filtration | Count/CFU/1 to 100 mL |
| Enzyme Substrate | MPN /1 mL |

NOTE: The requirement to report Heterotrophic Plate Count as part of the Ontario Drinking Water Quality Standards was revoked in June 2006. However, certain drinking water systems are required to test for this parameter in accordance with O Reg. 170/03, a Ministry Order or Environmental Compliance Approval.

LaSB Method: Method E3408 – The Spread Plate Method for the Enumeration of Aerobic, Heterotrophic Bacteria in Drinking Water

AWWA Methods: Method 9215B - Pour Plate Method

Method 9215C - Spread Plate Method

Method 9215D - Membrane Filtration Method

Method 9215E - Enzyme Substrate Method (SimPlate® IDEXX Laboratories Inc.)

## *Clostridium*

| PARAMETER | Reporting Units |
| --- | --- |
| *Clostridium spp.* | CFU or P /A/100 mL,  CFU or P/A /1 L |

ASTM Method: D5916-96 (2002), Standard Test Method for Detection and Enumeration of *Clostridium perfringens* from Water and Extracted Sediments by Membrane Filtration (MF) (withdrawn 2011)

US EPA Method: ICR Microbial Laboratory Manual Section XI: Membrane Filtration for C. perfringens

## *Cryptosporidium and Giardia*

| PARAMETER | Reporting Units |
| --- | --- |
| *Cryptosporidium, Giardia* | Count or P/A/100 mL,  Count or P/A/10 L |

AWWA Method: Method 9711B – Detection of *Giardia* and *Cryptosporidium* in Water

US EPA Methods: Method 1623: *Cryptosporidium* and *Giardia* in Water by Filtration/IMS/FA

# CHEMICAL PARAMETERS

The units shown below for the ODWQS are standards listed in Schedule 2 to O. Reg. 169/03. The units shown below for required RDL’s are the units to be used when reporting to the Ministry.

Some reference methods may indicate detection limits that do not meet the MECP required RDL for certain elements. To be acceptable to the MECP for the analysis of Ontario drinking water samples, the laboratory must demonstrate that the method used meets or exceeds the applicable RDL listed.

## Volatile Organic Compounds (VOCs)

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| 1,1-Dichloroethylene | 75-35-4 | 0.014 | 1.4 |
| 1,2-Dichlorobenzene | 95-50-1 | 0.2 | 20 |
| 1,2-Dichloroethane | 107-06-2 | 0.005 | 0.5 |
| 1,4-Dichlorobenzene | 106-46-7 | 0.005 | 0.5 |
| Benzene | 71-43-2 | 0.001 | 0.5 |
| Carbon Tetrachloride | 56-23-5 | 0.002 | 0.2 |
| Dichloromethane | 75-09-2 | 0.05 | 5 |
| Ethylbenzene | 100-41-4 | 0.14 | 0.8 |
| Monochlorobenzene | 108-90-7 | 0.08 | 8 |
| Tetrachloroethylene (perchloroethylene) | 127-18-4 | 0.01 | 1 |
| Toluene | 108-88-3 | 0.06 | 2.4 |
| Trichloroethylene | 79-01-6 | 0.005 | 0.5 |
| Total Trihalomethanes (TTHMs)\* | n/a | 0.100 | 10 \* |
| Xylene, Total \*\* (Xylenes) | n/a | 0.09 | 2\*\* |
| Vinyl Chloride | 75-01-4 | 0.001 | 0.2 |

\* RDL for Total Trihalomethanes (TTHMs) applies to the sum of: Bromoform (CAS Number: 75-25-2) Bromodichloromethane(CAS Number 75-27-4), Chloroform (CAS Number 67-66-3) and Chlorodibromomethane (CAS Number 124-48-1).

The ODWQS for TTHMs is based on a running annual average of quarterly results (O. Reg. 169/03).

\*\* RDL for xylenes applies to the sum of ortho zylene (CAS Number 95-47-6 and meta/para xylene (CAS Numbers 108-38-3 and 106-42-3).

LaSB Method: E3132 – The Determination of Volatile Organohalides and Hydrocarbons in Water, Leachates and Effluents by Purge and Trap Gas Chromatography (GC) Mass Spectrometry

AWWA Methods: Method 6200B – Purge and Trap Capillary-Column Gas Chromatographic/Mass Spectrometric Method

Method 6200C – Purge and Trap Capillary-Column Gas Chromatographic Method

Method 6232 – Trihalomethanes and Chlorinated Organic Solvents

US EPA Methods: Method 502.2, Rev 2.1, Volatile Organic Compounds in Water by Purge and Trap Capillary Column Gas Chromatography with Photoionization and Electrolytic Conductivity Detectors in Series

Method 524.2, Rev 4.1, Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry

Method 524.3, Version 1.0, Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry

Method 524.4, Measurement of Purgeable Organic Compounds in Water by Gas Chromatography/Mass Spectrometry Using Nitrogen Purge Gas

SW-846, Method 5030C, Purge-and-Trap for Aqueous Samples

SW-846, Method 5021A, Volatile Organic Compounds in Various Sample Matrices using Equilibrium Headspace Analysis

SW-846, Method 8021B, Aromatic and Halogenated Volatiles by Gas Chromatography using Photoionization and/or Electrolytic Conductivity Detectors

SW-846, Method 8260D, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

## Trace Metals

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Antimony (Sb) | 7440-36-0 | 0.006 | 0.6 |
| Arsenic (As) | 7440-38-2 | 0.01 | 1 |
| Barium (Ba) | 7440-39-3 | 1.0 | 100 |
| Boron (B) | 7440-42-8 | 5.0 | 500 |
| Cadmium (Cd) | 7440-43-9 | 0.005 | 0.5 |
| Chromium (Cr) | 7440-47-3 | 0.05 | 5 |
| Lead (Pb) | 7439-92-1 | 0.010 | 1 |
| Selenium (Se) | 7782-49-2 | 0.05 | 5 |
| Uranium (U) | 7740-61-1 | 0.02 | 2 |

LaSB Methods: E3565 – The Determination of Trace Metals in Potable Waters by Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)

E3473 – The Determination of Trace Metals in Potable Waters by Dynamic Reaction Cell (DRC) Inductively Coupled Plasma – Mass Spectrometry (ICP-MS)

US EPA Methods: Method 200.5, Rev 4.2, Determination of Trace Elements in Drinking Water by Axially Viewed Inductively Coupled Plasma – Atomic Emission Spectrometry

Method 200.7 Rev 4.4, Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma -Atomic Emission Spectrometry

Method 200.8 Rev 5.4, Determination of Trace Metals in Waters and Wastes by Inductively Coupled Plasma - Mass Spectrometry

Method 200.15 Rev 1.2, Determination of Metals and Trace Elements in Water by Ultrasonic Nebulization Inductively Coupled Plasma-Atomic Emission Spectrometry

SW-846, Method 6010D, Inductively Coupled Plasma-Optical Emission Spectrometry

SW-846, Method 6020B, Inductively Coupled Plasma-Mass Spectrometry

AWWA Methods: Method 3120B – Metals by Plasma Emission Spectroscopy-Inductively Coupled Plasma (ICP) Method

Method 3125B – Metals by Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) Method

## Mercury

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Mercury | 7439-97-6 | 0.001 | 0.1 |

LaSB Method: E3526 – The Determination of Mercury in Aqueous Samples by Cold Vapour Atomic Fluorescence Spectrometry (CV-AFS)

US EPA Methods: Method 245.1 Rev 3.0, Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry – Manual

Method 245.2, Mercury (Automated Cold Vapor Technique)

Method 200.8 Rev 5.4, Trace Metals by ICP/Mass Spectrometry

Method 245.7 Rev 2.0, Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry

Method 1631 E, Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Absorption Fluorescence Spectrometry

SW-846, Method 6020B, Inductively Coupled Plasma-Mass Spectrometry

SW-846, Method 7472, Mercury in Aqueous Samples and Extracts by Anodic Stripping Voltammetry (ASV)

AWWA Method: Method 3112B – Metals by Cold-Vapor Atomic Absorption Spectrometry

## Nitrite and Nitrate

| PARAMETER | CAS Number | ODWQS mg/L | RDL mg/L |
| --- | --- | --- | --- |
| Nitrate (as nitrogen) | 14797-55-8 | 10.0 | 1 |
| Nitrite (as nitrogen) | 14797-65-0 | 1.0 | 0.1 |

LaSB Method: E3364 – The Determination of Ammonia Nitrogen, Nitrite Nitrogen, Nitrite plus Nitrate Nitrogen and Reactive Ortho-Phosphate in Waters by Colourimetry.

US EPA Methods: Method 300.0 Rev 2.1, Determination of Inorganic Anions by Ion Chromatography

Method 300.1 Rev 1.0, Determination of Inorganic Anions in Drinking Water by Ion Chromatography

Method 353.1 Rev 1, Nitrogen, Nitrate-Nitrite, (Colorimetric, Automated, Hydrazine Reduction)

Method 353.2 Rev 2.0, Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry

SW-846, Method 9056A, Determination of Inorganic Anions by Ion Chromatography

AWWA Methods: Method 4110B – Determination of Anions by Ion Chromatography with Chemical Suppression of Eluent Conductivity

Method 4110C –Single-Column Ion Chromatography with Direct Conductivity Detection

Method 4500-NO2‾ B – Colorimetric Method

Method 4500-NO3‾ D – Nitrate Electrode Method

Method 4500-NO3‾ E – Cadmium Reduction Method

Method 4500-NO3‾ F – Automated Cadmium Reduction Method

Method 4500-NO3‾ H – Automated Hydrazine Reduction Method

Method 4500-NO3‾ I – Cadmium Reduction Flow Injection Method

## Triazines (N-Containing Herbicides)

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Alachlor | 15972-60-8 | 0.005 | 0.5 |
| Atrazine + N-dealkylated metabolites | 1912-24-9/ | 0.005 | 1 |
| Metolachlor | 51218-45-2 | 0.05 | 5 |
| Metribuzin | 21087-64-9 | 0.08 | 8 |
| Prometryne | 7287-19-6 | 0.001 | 0.25 |
| Simazine | 122-34-9 | 0.01 | 1 |

LaSB Methods: E3553 - The Determination of Organophosphate and Triazine Pesticides in Water Matrices by Direct Aqueous Injection Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS)

E3435 – The Determination of Triazine Pesticides in Water Matrices by Gas Chromatography-Time of Flight-Mass Spectrometry

E3121 – The Determination of Triazine Herbicides in Water, Soils, Vegetation, and Toxicity Characteristic Leaching Procedure (TCLP) Leachate by Gas Chromatography/Mass Spectrometry (GC/MS) (2002)

US EPA Methods: Method 505 Rev 2.1, Analysis of Organohalide Pesticides and Commercial Polychlorinated Biphenyl (PCB) Products by Microextraction and Gas Chromatography

Method 508.1 Rev 2.0, Chlorinated Pesticides, Herbicides and Organohalides by Liquid-Solid Extraction and GC with an Electron Capture Detector

Method 523, Determination of Triazine Pesticides and Their Degradates in Drinking Water by Gas Chromatography/Mass Spectrometry (GC/MS)

Method 525.2 Rev 2.0, Organic Compounds by Liquid-Solid Extraction and Capillary Column GC/Mass Spectrometry

Method 525.3 Determination of Semivolatile Organic Chemicals in Drinking Water by Solid Phase Extraction and Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS)

Method 527, Rev 1.0, Determination of Selected Pesticides and Flame Retardants in Drinking Water by Solid Phase Extraction and Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS)

Method 536, Rev. 1.0, Determination of Triazine Pesticides and Their Degradates in Drinking Water by Liquid Chromatography Electrospray Ionization Tandem Mass Spectrometry (LC/ESI-MS/MS)

Method 551.1, Rev 1.0, Determination of Chlorinated Disinfection By-Products and Chlorinated Solvents by Liquid-Liquid Extraction and Gas Chromatography with an Electron Capture Detector

SW-846, Method 3510C, Separatory Funnel Liquid-Liquid Extraction

SW-846, Method 3520C, Continuous Liquid-Liquid Extraction

SW-846, Method 3535A, Solid-Phase Extraction (SPE)

SW-846, Method 8000D, Determinative Chromatographic Separations

SW-846, Method 8270E, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

## Carbamates

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Carbaryl | 63-25-2 | 0.09 | 9 |
| Carbofuran | 1563-66-2 | 0.09 | 9 |
| Triallate | 2303-17-5 | 0.23 | 23 |

LaSB Method: E3501 – The Determination of Carbamates and Phenyl Urea in Water by Direct Aqueous Injection Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) Analysis

US EPA Methods: Method 531.1 Rev 3.1, Measurement of N-Methylcarbamoyloximes and N-Methylcarbamates in Water by Direct Aqueous Injection HPLC with Post Column Derivatization [Excluding Triallate]

Method 531.2, Rev 1.0, Measurement of N-Methylcarbamoyloximes and N-Methylcarbamates in Water by Direct Aqueous Injection HPLC with Post Column Derivatization [Excluding Triallate]

SW-846, Method 3510C, Separatory Funnel Liquid-Liquid Extraction

SW-846, Method 3520C, Continuous Liquid-Liquid Extraction

SW-846, Method 3535A, Solid-Phase Extraction (SPE)

SW-846, Method 8000D, Determinative Chromatographic Separations

SW-846, Method 8318A, N-Methylcarbamates by High Performance Liquid Chromatography (HPLC) [Excluding Triallate]

SW-846, Method 8321B, Solvent Extractable Nonvolatile Compounds by High Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection

AWWA Method: Method 6610B – Carbamate Pesticides, High-Performance Liquid Chromatographic Method [Excluding Triallate]

## Polychlorinated Biphenyls (PCBs) and Trifluralin

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Polychlorinated Biphenyls (PCB)\* | 1336-36-3 | 0.003 | 0.3 |
| Trifluralin | 1582-09-8 | 0.045 | 4.5 |

\* sum of at least Arochlor 1254 and 1260

LaSB Method: E3488 - The Determination of Polychlorinated Biphenyl Congeners (PCBc), Organohalogenated Pesticides and Chlorobenzenes (CB) in water by Two-Dimensional Gas Chromatography Micro-Electron Capture Detection (GCxGC-μECD)

LaSB Method: E3400 – The Determination of Organochlorine Pesticides, Chlorobenzenes, PCB Aroclors, and Toxaphenes in Water, Effluent, and Waste Water by Hexane Microextraction and Gas Chromatography-Mass Spectrometry (GC- MS)

US EPA Methods: Method 505 Rev 2.1, Analysis of Organohalide Pesticides and Commercial Polychlorinated Biphenyl (PCB) Products by Microextraction and Gas Chromatography

Method 508A, Rev 3.1, Determination of Chlorinated Pesticides in Water by Gas Chromatography with an Electron Capture Detector

Method 508.1 Rev 2.0, Chlorinated Pesticides, Herbicides and Organohalides by Liquid-Solid Extraction and GC with an Electron Capture Detector

Method 525.2 Rev 2.0, Determination of Organic Compounds by Liquid-Solid Extraction and Capillary Column GC/Mass Spectrometry

Method 525.3 Rev 1.0, Determination of Semivolatile Organic Chemicals in Drinking Water by Solid Phase Extraction and Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS)

Method 551.1, Rev 1.0, Determination of Chlorinated Disinfection By-Products and Chlorinated Solvents by Liquid-Liquid Extraction and Gas Chromatography with an Electron Capture Detector (Trifluralin only)

SW-846, Method 3510C, Separatory Funnel Liquid-Liquid Extraction

SW-846, Method 3520C, Continuous Liquid-Liquid Extraction

SW-846, Method 3535A, Solid-Phase Extraction (SPE)

SW-846, Method 8000D, Determinative Chromatographic Separations

SW-846, Method 8081B, Organochlorine Pesticides by Gas Chromatography

SW-846, Method 8082A, Polychlorinated Biphenyls (PCBs) by Gas Chromatography

SW-846, Method 8270E, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

AWWA Methods: Method 6630C – Organochlorine Pesticides, Liquid-Liquid Extraction Gas Chromatographic Method II

Method 6410B Liquid-Liquid Extraction Gas Chromatographic/Mass Spectrometric Method

## Organophosphorus Pesticides

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Azinphos-methyl | 86-50-0 | 0.02 | 2 |
| Chlorpyrifos | 2921-88-2 | 0.09 | 9 |
| Diazinon | 333-41-5 | 0.02 | 2 |
| Dimethoate | 60-51-5 | 0.02 | 2.5 |
| Malathion | 121-75-5 | 0.19 | 19 |
| Phorate | 298-02-2 | 0.002 | 0.5 |
| Terbufos | 13071-79-9 | 0.001 | 0.5 |

LaSB Method: E3553 - The Determination of Organophosphate and Triazine Pesticides in Water Matrices by Direct Aqueous Injection Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS)

E3502 – The Determination of Organophosphorus Pesticides in Water by Direct Aqueous Injection Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) Analysis

US EPA Methods: Method 526, Rev 1.0, Determination of Selected Semivolatile Organic Compounds in Drinking Water by Solid Phase Extraction and Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS)

Method 527, Rev 1.0, Determination of Selected Pesticides and Flame Retardants in Drinking Water by Solid Phase Extraction and Capillary Column Gas Chromatography/Mass Spectrometry (GC/MS)

SW-846, Method 3510C, Separatory Funnel Liquid-Liquid Extraction

SW-846, Method 3520C, Continuous Liquid-Liquid Extraction

SW-846, Method 3535A, Solid-Phase Extraction (SPE)

SW-846, Method 8000D, Determinative Chromatographic Separations

SW-846, Method 8270E, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

## Chlorophenols (CPs) & Phenoxy Acids (PAs)

| PARAMETER | CAS Numbers | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| 2,4-Dichlorophenoxy acetic acid (2,4-D) | 94-75-7 | 0.1 | 10 |
| Bromoxynil | 1689-84-5 | 0.005 | 0.5 |
| Dicamba | 1918-00-9 | 0.12 | 12 |
| Diclofop-methyl | 51338-27-3 | 0.009 | 0.9 |
| 2-Methyl-4-chlorophenoxyacetic acid (MCPA) | 94-74-6 | 0.1 | 10 |
| Picloram | 1918-02-1 | 0.19 | 19 |
| 2,3,4,6-Tetrachlorophenol | 58-90-2 | 0.1 | 10 |
| 2,4,6-Trichlorophenol | 88-06-2 | 0.005 | 0.5 |
| 2,4-Dichlorophenol | 120-83-2 | 0.9 | 90 |
| Pentachlorophenol | 87-86-5 | 0.06 | 6 |

LaSB Methods: E3552 - The Determination of Chlorophenols (CPs) and Chlorophenyl Acid Herbicides (PAs) in aqueous Environmental Matrices by Liquid Chromatography – Tandem Mass Spectrometric (LC-MS/MS) Analysis

E3119 – The Determination of Chlorophenols (CPs) and Phenoxyacid Herbicides (PAs) in Environmental Matrices by Gas Chromatography-Mass Spectrometric (GC/MS) Analysis

US EPA Methods: Method 515.2 Rev 1.1, Determination of Chlorinated Acids in Water using Liquid-Solid Extraction and Gas Chromatography with an Electron Capture Detector

Method 515.1 Rev 4.1, Determination of Chlorinated Acids in Water by Gas Chromatography with an Electron Capture Detector

Method 515.3 Rev 1.0, Determination of Chlorinated Acids in Drinking Water by Liquid-Liquid Extraction, Derivatization and Gas Chromatography with Electron Capture Detection

Method 515.4 Rev 1.0, Determination of Chlorinated Acids in Drinking Water by Liquid-Liquid Microextraction, Derivatization and Fast Gas Chromatography with Electron Capture Detection

Method 525.2, Rev 2.0, Organic Compounds by Liquid-Solid Extraction and Capillary Column GC/Mass Spectrometry

Method 555, Rev 1.0. Determination of Chlorinated Acids In Water By High Performance Liquid Chromatography With A Photodiode Array Ultraviolet Detector

SW-846, Method 3510C, Separatory Funnel Liquid-Liquid Extraction

SW-846, Method 3520C, Continuous Liquid-Liquid Extraction

SW-846, Method 3535A, Solid-Phase Extraction (SPE)

SW-846, Method 8000D, Determinative Chromatographic Separations

SW-846, Method 8041A, Phenols by Gas Chromatography

SW-846, Method 8151A, Chlorinated Herbicides by GC using Methylation or Pentafluorobenzylation Derivatization

SW-846, Method 8321B, Solvent Extractable Nonvolatile Compounds by High-Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection

SW-846, Method 8270E, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

AWWA Method: Method 6640B – Acidic Herbicide Compounds, Micro Liquid-Liquid Extraction Gas Chromatographic Method

## Quaternary Ammonium Compounds

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Diquat (as the form of diquat cation) | 2764-72-9 | 0.07 | 7 |
| Paraquat (as the form of paraquat cation) | 4685-14-7 | 0.01 | 1 |

LaSB Methods: E3503 – The Determination of Quaternary Ammonium Pesticides (QUATS) in Water by Direct Aqueous Injection Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) Analysis

E3417 – The Determination of Diquat and Paraquat in Water and Environmental Matrices by Liquid Chromatography-(Electrospray Ionization) Mass Spectrometry (LC-(ESI)MS) (2010)

US EPA Method: Method 549.2 Rev 1.0, Determination of Diquat and Paraquat in Drinking Water by Liquid-Solid Extraction and HPLC with Ultraviolet Detection

## Urea Derivative

|  |  |  |  |
| --- | --- | --- | --- |
| **PARAMETER** | CAS Number | ODWQS mg/L | RDL µg/L |
| Diuron | 330-54-1 | 0.15 | 15 |

LaSB Methods: E3501 – The Determination of Carbamates and Phenyl Urea in Water by Direct Aqueous Injection Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) Analysis

E3436 – The Determination of Phenyl Ureas in Environmental Matrices by High Performance Liquid Chromatography and Mass Spectrometry-Mass Spectrometry (LC/MS-MS) Analysis (2010)

US EPA Methods: Method 532 Rev 1.0, Determination of Phenylurea Compounds in Drinking Water by Solid Phase Extraction and High Performance Liquid Chromatography with UV Detection

Method 553 Rev 1.1, Determination of Benzidines and Nitrogen-Containing Pesticides in Water by Liquid-Liquid Extraction or Liquid-Solid Extraction and Reverse Phase High Performance Liquid Chromatography/Particle Beam/Mass Spectrometry

SW-846, Method 3510C, Separatory Funnel Liquid-Liquid Extraction

SW-846, Method 8321B, Solvent-Extractable Nonvolatile Compounds by High-Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection

SW-846, Method 8325, Solvent Extractable Nonvolatile Compounds by High Performance Liquid Chromatography/Particle Beam//Mass Spectrometry (HPLC/PB/MS)

## Glyphosate

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Glyphosate | 1071-83-6 | 0.28 | 28 |

LaSB Methods: E3500 – The Determination Glyphosate, Glufosinate and Aminomethyl-Phosphonic Acid in Water by Direct Aqueous Injection Liquid Chromatography-Tandem Mass Spectrometry (LC-MS/MS) Analysis

E3415 – The Determination of Glyphosate and Aminomethylphosphonic Acid (AMPA) in Environmental Matrices by High Performance Liquid Chromatography-Electrospray Ionization-Mass Spectrometry (HPLC-ESI-MS) (2010)

US EPA Method: Method 547, Determination of Glyphosate in Drinking Water by Direct Aqueous Injection HPLC, Post Column Derivatization, and Fluorescence Detector

AWWA Method: Method 6651 – Glyphosate Herbicide by Liquid Chromatographic Post-Column Fluorescence Method.

## Fluoride

| PARAMETER | CAS Number | ODWQS mg/L | **RDL mg/L** |
| --- | --- | --- | --- |
| Fluoride | ‎16984-48-8 | 1.5 | 0.15 |

LaSB Method: E3172 – The Determination of Fluoride and Sulphate in Water, Leachates and Effluents by Automated Ion Chromatography

US EPA Methods: Method 300.0 Rev 2.1, Determination of Inorganic Anions by Ion Chromatography

Method 300.1 Rev 1.0, Determination of Inorganic Anions in Drinking Water by Ion Chromatography

Method 340.1, Rev 2, Fluoride, Total (Colorimetric, SPADNS with Bellack Distillation)

Method 340.2, Rev 1, Fluoride (Potentiometric, Ion Selective Electrode)

SW-846, Method 9056A, Determination of Inorganic Anions by Ion Chromatography

AWWA Methods: Method 4500\_F ‾ B – Preliminary Distillation Step

Method 4500\_F ‾ C – Ion-Selective Electrode Method

Method 4500\_F ‾ G – Ion-Selective Electrode Flow Injection Analysis

Method 4110B – Determination of Anions by Ion Chromatography with Chemical Suppression of Eluent Conductivity

Method 4110C – Determination of Anions by Single-Column Ion Chromatography with Direct Conductivity Detection

## Benzo(a)pyrene

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Benzo(a)pyrene | 50-32-8 | 0.00001 | 0.010 |

LaSB Method: E3480 – The Determination of Polycyclic Aromatic Hydrocarbons in Water by Gas Chromatography/Mass Spectrometry

US EPA Methods: Method 525.2 (1995), Determination of Organic Compounds in Drinking Water by Liquid-Solid Extraction and Capillary Column Gas Chromatography/Mass Spectrometry.

Method 550 (1990), Determination of Polycyclic Aromatic Hydrocarbons in Drinking Water by Liquid-Liquid Extraction and HPLC with Coupled Ultraviolet and Fluorescence Detection

Method 550.1 (1990), Determination of Polycyclic Aromatic Hydrocarbons in Drinking Water by Liquid-Solid Extraction and HPLC with Coupled Ultraviolet and Fluorescence Detection

Method 525.3 (2012), Determination of Semivolatile Organic Chemicals in Drinking Water by Solid Phase Extraction and Capillary Column Gas Chromatography/ Mass Spectrometry (GC/MS)

SW-846, Method 8270E, Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry

## Cyanide

| PARAMETER | CAS Number | ODWQS mg/L | RDL mg/L |
| --- | --- | --- | --- |
| Cyanide (free) | 57-12-5 | 0.2 | 0.02 |

The cyanide standard in O. Reg. 169/03 is based on the toxicity of free cyanide. A laboratory may choose to be licensed for total cyanide, free cyanide, or both. The licence must specify either cyanide, total or cyanide, free. Strong acid dissociable is considered to be total cyanide and weak acid dissociable is considered to be free cyanide. In order to provide test results for the purpose of the SDWA the laboratory must be licensed for free cyanide.

LaSB Method: E3015 – The Determination of Free and Total Cyanide in Environmental Samples by Colourimetry.

US EPA Methods: SW-846, Method 9010C, Total and Amenable Cyanide: Distillation

SW-846, Method 9012B, Total and Amenable Cyanide (Automated Colorimetric, with Off-Line Distillation)

SW-846, Method 9014, Titrimetric and Manual Spectrophotometric Determinative Methods for Cyanide [Spectrophotometric method only]

AWWA Methods: Method 4500 CN- E: Colorimetric method

Method 4500-CN- G – Cyanides Amenable to Chlorination after Distillation

Method 4500-CN- H – Cyanides Amenable to Chlorination without Distillation (Short-Cut Method)

## Dioxins and Furans – Toxic Equivalent Quantity

| PARAMETER | ODWQS mg/L | RDL pg/L TEQ 2,3,7,8-TCDD/L |
| --- | --- | --- |
| Dioxin and Furan | 0.000000015\* | 7.5 |

(\* Total toxic equivalents when compared with 2,3,7,8-TCDD (tetrachlorodibenzo-p-dioxin))

LaSB Method: E3418 – The Determination of Polychlorinated Dibenzo-p-dioxins (PCDD), Polychlorinated Dibenzofurans (PCDF) and Dioxin-like Polychlorinated Biphenyls (DLPCBs) in Environmental Matrices by Gas Chromatography-Mass Spectrometry (GC/MS).

US EPA Method: Method 1613B, Tetra- Through Octa-Chlorinated Dioxins by Isotope Dilution High Resolution Gas Chromatography/High Resolution Mass Spectrometry

### 3.16.1 Dioxins and Furans – Calculation of Toxic Equivalent Quantity (TEQ)

There are a total of 210 dioxins and furans. Only 17 are toxic (2,3,7,8-substituted congeners) and their toxicity is normalized to 2378-TCDD (the most toxic). The TEQ is determined (as shown in the following example) by multiplying the concentration of each detected 2,3,7,8-substituted congener by its respective toxic equivalent factor (TEF) to determine its toxic equivalence (TE). The TEFs in the following table are those provided by the World Health Organization (WHO), 2005, as amended from time to time. Laboratories must identify the source of the TEFs used for their calculations. For the 2,3,7,8-substituted congeners that are not detected, half of the detection limit is multiplied by the TEF to determine the TE for that congener. This converts each of the congeners to 2378-TCDD toxic equivalents. The sum of the 17 toxic equivalents (TEs) gives the TEQ (toxic equivalent quantity) for the sample normalized to 2378-TCDD. In this example, the result is 1.65 pg/L, which is well below the 15 pg/L ODWQS.

**TEQ EXAMPLE**

| Compound | CAS Number | Conc. pg/L | EDL pg/L | TEF pg/L  WHO (2005) | TE /congener pg/L |
| --- | --- | --- | --- | --- | --- |
| 2,3,7,8-TCDD | 1746-01-6 | ND | 1.1 | 1 | 0.55 |
| 1,2,3,7,8-PeCDD | 40321-76-4 | ND | 1 | 1 | 0.5 |
| 1,2,3,4,7,8-HxCDD | 39227-28-6 | ND | 1.2 | 0.1 | 0.06 |
| 1,2,3,6,7,8-HxCDD | 57653-85-7 | ND | 0.89 | 0.1 | 0.0445 |
| 1,2,3,7,8,9-HxCDD | 19408-74-3 | ND | 1 | 0.1 | 0.05 |
| 1,2,3,4,6,7,8-HpCDD | 35822-46-9 | ND | 1.1 | 0.01 | 0.0055 |
| OCDD | 3268-87-9 | 3.4 | n/a | 0.0003 | 0.00102 |
| 2,3,7,8-TCDF | 51207-31-9 | ND | 1 | 0.1 | 0.05 |
| 1,2,3,7,8-PeCDF | 57117-41-6 | ND | 1 | 0.03 | 0.015 |
| 2,3,4,7,8-PeCDF | 57117-31-4 | ND | 1 | 0.3 | 0.15 |
| 1,2,3,4,7,8-HxCDF | 70648-26-9 | ND | 0.82 | 0.1 | 0.041 |
| 1,2,3,6,7,8-HxCDF | 57117-44-9 | ND | 1.1 | 0.1 | 0.055 |
| 2,3,4,6,7,8-HxCDF | 60851-34-5 | ND | 1.1 | 0.1 | 0.055 |
| 1,2,3,7,8,9-HxCDF | 72918-21-9 | ND | 1.2 | 0.1 | 0.06 |
| 1,2,3,4,6,7,8-HpCDF | 67562-39-4 | ND | 0.95 | 0.01 | 0.0048 |
| 1,2,3,4,7,8,9-HpCDF | 55673-89-7 | ND | 1 | 0.01 | 0.005 |
| OCDF | 39001-02-0 | 1.8 | n/a | 0.0003 | 0.00054 |

**TOTAL TEQ 2,3,7,8-TCDD (0.5 DL) = 1.65 pg/L**

TEQ = Toxic Equivalent Quantity = sum of individual TE/congener

EDL = Estimated Detection Limit

TEF = Toxic Equivalent Factor (WHO, 2005)

TE/congener = Toxic Equivalence / congener

## Nitrilotriacetic Acid (NTA)

| PARAMETER | CAS Number | ODWQS mg/L | RDL mg/L |
| --- | --- | --- | --- |
| Nitrilotriacetic Acid (NTA) | 139-13-9 | 0.4 | 0.05 |

LaSB Method: E3406 – The Determination of Nitrilotriacetic Acid (NTA) in Aqueous Samples by Automated Ion Chromatography (IC).

US EPA Method: Method 430.2, NTA (Colorimetric, Automated, Zinc-Zincon)

## N-nitrosodimethylamine (NDMA)

|  |  |  |  |
| --- | --- | --- | --- |
| **PARAMETER** | **CAS Number** | **ODWQS mg/L** | RDL µg/L |
| N-Nitrosodimethylamine (NDMA) | 62-75-9 | 0.000009 | 0.00099 |

LaSB Method: E3388 – The Determination of N-nitrosamines in Water by Gas Chromatography-High Resolution Mass Spectrometry (GC-HRMS)

US EPA Method: Method 521, Rev 1.0, Determination of Nitrosamines in Drinking Water by Solid Phase Extraction and Capillary Column Gas Chromatography with Large Volume Injection and Chemical Ionization Tandem Mass Spectrometry (MS/MS)

AWWA Methods: Method 6450B – Carbonaceous-Resin Solid-Phase Extraction GC/MS Method [Nitrosamines]

Method 6450C – Micro Liquid-Liquid Extraction GC/MS Method [Nitrosamines]

## Bromate, Chlorate and Chlorite

| PARAMETER | CAS Number | ODWQS mg/L | RDL mg/L |
| --- | --- | --- | --- |
| Bromate | 15541-45-4 | 0.01 | 0.005 |
| Chlorate | 14866-68-3 | 1.0 | 0.1 |
| Chlorite | 14998-27-7 | 1.0 | 0.1 |

LaSB Method: E3462 – Determination of Bromide and Inorganic Oxyhalide Disinfection By-Products in Drinking Water by Ion Chromatography with Tandem Mass Spectrometry Detection

US EPA Methods: Method 317.0 Rev 2.0, Determination of Inorganic Oxyhalide Disinfection By-Products in Drinking Water Using Ion Chromatography with the Addition of a Postcolumn Reagent for Trace Bromate Analysis.

Method 326.0, Determination of Inorganic Oxyhalide Disinfection By-Products in Drinking Water Using Ion Chromatography Incorporating the Addition of a Suppressor Acidified Postcolumn Reagent for Trace Bromate Analysis.

Method 300.1, Determination of Inorganic Anions in Drinking Water by Ion Chromatography.

Method 302.0, Determination of Bromate in Drinking Waters Using Two-Dimensional Ion Chromatography with Suppressed Conductivity Detection (Bromate only)

Method 326.0, Determination of Inorganic Oxyhalide Disinfection By-Products in Drinking Water Using Ion Chromatography Incorporating the Addition of a Suppressor Acidified Postcolumn Reagent for Trace Bromate Analysis

AWWA Method: Method 4110D – Ion Chromatographic Determination of Oxyhalides and Bromide

## Microcystin LR

| PARAMETER | CAS Number | ODWQS mg/L | RDL µg/L |
| --- | --- | --- | --- |
| Microcystin LR | ‎101043-37-2 | 0.0015 | 0.15 |

LaSB Method: E3450 – The Determination of Microcystins and Anatoxin-A in Water by Two Dimensional Liquid Chromatography - (Electrospray Ionization) High Resolution Quadrupole Time of Flight Mass Spectrometry

### Screening Tests for Total Microcystins

LaSB Method: E3469 – The Screening and Semi-Quantitative Analysis of Water Samples for Microcystins by Enzyme-Linked Immunosorbent Assay (ELISA)

US EPA Methods: Method 546: Determination of Total Microcystins and Nodularins in Drinking Water and Ambient Water by Adda Enzyme-Linked Immunosorbent Assay

## Haloacetic Acids

| **PARAMETER** | ODWQS mg/L | RDL µg/L |
| --- | --- | --- |
| Haloacetic Acids (HAA5) \* | 0.08 | 8 |

\* The OWDQS for Haloacetic Acids (HAA5) is for the sum of:

* + Monochloroacetic acid (MCAA), CAS Number 79-11-8
  + Dichloroacetic acid (DCAA), CAS Number 79-43-6
  + Trichloroacetic acid (TCAA), CAS Number 76-03-9
  + Monobromoacetic acid (MBAA) CAS Number 79-08-3
  + Dibromoacetic acid (DBAA), CAS Number 631-64-1.

The ODWQS is expressed as a running annual average of quarterly results. The RDL applies to the sum of MCAA, DCAA, TCAA, MBAA and DBAA to determine Haloacetic Acids (HAA5).

LaSB Method: E3478 – The Determination of Haloacetic Acids (HAAs) and 2,2-Dichloropropionic Acid (2,2-DCPA) in Raw and Treated Water by Direct Aqueous Injection Liquid Chromatography- Tandem Mass Spectrometry (LC-MS/MS)

US EPA Methods: Method 552, Determination of Haloacetic Acids in Drinking Water by Liquid-Liquid Extraction, Derivatization, and Gas Chromatography with Electron Capture Detection (GC/ECD)

Method 552.1, Determination of Haloacetic Acids and Dalapon in Drinking Water by Ion-Exchange Liquid-Solid Extraction and Gas Chromatography with an Electron Capture Detector

Method 552.2, Determination of Haloacetic Acids and Dalapon in Drinking Water by Liquid-Liquid Extraction, Derivatization and Gas Chromatography with an Electron Capture Detector

Method 552.3, Determination of Haloacetic Acids and Dalapon in Drinking Water by Liquid-Liquid Microextraction, Derivatization, and Gas chromatography with Electron Capture Detection

Method 557, Determination of Haloacetic Acids, Bromate and Dalapon in Drinking Water by Ion Chromatography Electrospray Ionization Tandem Mass Spectrometry (IC-ESI-MS/MS)

AWWA Method: Method 6251B – Micro Liquid-Liquid Extraction Gas Chromatographic Method

## 3.22. Sodium

| PARAMETER | CAS Number | Reportable Adverse  (Sch. 16-3(1)8,  O. Reg.170/03)  mg/L | RDL mg/L |
| --- | --- | --- | --- |
| Sodium | 7440-23-5 | 20 | 2 |

Methods listed under section 3.2 Trace Metals may also be acceptable for the analysis of sodium.

LaSB Methods: E3171 – The Determination of Cations in Aqueous Samples by Atomic Absorption Spectrophotometry (AAS)

E3497 – The Determination of Metals in Water by Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES) Using an Apex Desolvation System

US EPA Methods: Method 200.7 Rev 4.4, Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry

SW-846, Method 6010C Rev 3.0, Inductively Coupled Plasma - Atomic Emission Spectrometry

SW-846, Method 7000B Rev 2, Flame Atomic Absorption Spectrophotometry

AWWA Methods: Method 3111 B - Metals by Flame Atomic Absorption Spectrometry - Direct Air-Acetylene Flame Method

Method 3500-Na B – Sodium by Flame Emission Photometric Method

Method 3120 B – Metals by Plasma Emission Spectroscopy - Inductively Coupled Plasma (ICP) Method

Method 3125 B - Metals by Inductively Coupled Plasma-Mass Spectrometry - Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) Method

ASTM Method: Method D6919-17, Standard Test Method for Determination of Dissolved Alkali and Alkaline Earth Cations and Ammonium in Water and Wastewater by Ion Chromatography Method

# ACRONYMS

| **Acronym** | **Definition** |
| --- | --- |
| µg/L | Micrograms per Litre |
| 1,2,3,4,6,7,8-HpCDD | 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin |
| 1,2,3,4,6,7,8-HpCDF | 1,2,3,4,6,7,8-heptachlorodibenzofuran |
| 1,2,3,4,7,8,9-HpCDF | 1,2,3,4,7,8,9-heptachlorodibenzofuran |
| 1,2,3,4,7,8-HxCDD | 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin |
| 1,2,3,4,7,8-HxCDF | 1,2,3,4,7,8-hexachlorodibenzofuran |
| 1,2,3,6,7,8-HxCDD | 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin |
| 1,2,3,6,7,8-HxCDF | 1,2,3,6,7,8-hexachlorodibenzofuran |
| 1,2,3,7,8,9-HxCDD | 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin |
| 1,2,3,7,8,9-HxCDF | 1,2,3,7,8,9-hexachlorodibenzofuran |
| 1,2,3,7,8-PeCDD | 1,2,3,7,8-pentachlorodibenzo-p-dioxin |
| 1,2,3,7,8-PeCDF | 1,2,3,7,8-pentachlorodibenzofuran |
| 2,3,4,6,7,8-HxCDF | 2,3,4,6,7,8-hexachlorodibenzofuran |
| 2,3,4,7,8-PeCDF | 2,3,4,7,8-pentachlorodibenzofuran |
| 2,3,7,8-TCDD | 2,3,7,8-tetrachlorodibenzo-p-dioxin |
| 2,3,7,8-TCDF | 2,3,7,8-tetrachlorodibenzofuran |
| AAS | Atomic Absorption Spectroscopy |
| AMPA | Aminomethyl-phosphonic Acid |
| ANOVA | Analysis of variance |
| ASTM | ASTM International (formerly the American Society for Testing and Materials) |
| ASV | Anodic Stripping Voltammetry |
| ATCC | American Type Culture Collection |
| AWWA | American Water Works Association |
| CALA | Canadian Association for Laboratory Accreditation |
| CAS | Chemical Abstract Services |
| CFU | Colony Forming Units |
| CPs | Chlorophenols |
| CRM | Certified Reference Material |
| CV-AFS | Cold Vapour Atomic Fluorescence Spectrometry |
| DBAA | Dibromoacetic acid (DBAA) |
| DC Agar | Differential Coliform Agar |
| DCAA | Dichloroacetic acid (DCAA) |
| DLPCBs | Dioxin-like Polychlorinated Biphenyls |
| E. coli | Escherichia coli |
| EDL | Estimated Detection Limit |
| ELISA | Enzyme-Linked Immunosorbent Assay |
| ESI-MS | Electro-Spray Ionization Mass Spectrometry |
| GC | Gas Chromatography |
| GC/MS | Gas Chromatography-Mass Spectrometry |
| GC/TOF-MS | Gas Chromatography Time-of-flight Mass Spectrometry |
| GC-HRMS | Gas Chromatography-High Resolution Mass Spectrometry |
| GCxGC-µECD | Two-dimensional Gas Chromatography - micro Electron Capture Detector |
| HAA5 | Haloacetic Acids - Sum of MCAA, DCAA, TCAA, MBAA and DBAA |
| HPLC | High Performance Liquid Chromatography |
| HPLC/TS/MS | High-Performance Liquid Chromatography -Thermospray-Mass Spectrometry |
| HPLC-ESI-MS | HPLC-ESI-MS- High-Performance Liquid Chromatography-Electrospray Ionization- Mass Spectrometry |
| HPLC-ESI-MS | High-Performance Liquid Chromatography-Electrospray Ionization- Mass Spectrometry |
| IC | Ion Chromatography |
| ICP | Inductively Coupled Plasma |
| ICP/MS | Inductively Coupled Plasma/Mass Spectrometry |
| ICP-OES | ICP-OES-Inductively Coupled Plasma - optical emission spectrometry |
| ISO/IEC | International Organization for Standardization/International Electrotechnical Commission |
| LaSB | Laboratory Services Branch |
| LC-(ESI)MS | LC-(ESI)MS- Liquid Chromatography-Electrospray Ionization- Mass Spectrometry |
| LC-(ESI)MS | Liquid Chromatography-Electrospray Ionization- Mass Spectrometry |
| LC-(ESI)MS/MS | LC-(ESI)MS/MS- liquid chromatography-electrospray ionization-tandem mass spectrometry |
| LC-(ESI)MS/MS | liquid chromatography-electrospray ionization-tandem mass spectrometry |
| LC/MS/MS | Liquid Chromatography – Tandem Mass Spectrometry |
| MBAA | Monobromoacetic acid (MBAA) |
| MCAA | MCAA Monochloroacetic acid |
| MDL | Method Detection Limit |
| MECP | Ministry of the Environment, Conservation and Parks |
| mg/L | Milligrams per Litre |
| MPN | Most Probable Number |
| MS-MS | Tandem Mass Spectrometry |
| NDMA | N-Nitrosodimethylamine |
| NTA | Nitrilotriacetic Acid |
| O. Reg. | Ontario Regulation |
| OCDD | 1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin |
| OCDF | 1,2,3,4,6,7,8,9-octachlorodibenzofuran |
| ODWQS | Ontario Drinking Water Quality Standards |
| P/A or P-A | Presence/Absence [applies to microbiological tests] |
| PAs | Phenoxy Acids |
| PCBs | Polychlorinated Biphenyls |
| PCDD | Polychlorinated Dibenzo-p-dioxins |
| PCDF | Polychlorinated Dibenzofurans |
| pg/L | Picograms per Litre |
| QC | Quality Control |
| RDL | Reporting Detection Limit |
| SDWA | Safe Drinking Water Act |
| SPE | Solid Phase Extraction |
| TCAA | Trichloroacetic acid (TCAA) |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TE | toxic equivalence |
| TEF | Toxic Equivalent Factor |
| TEQ | Toxic Equivalent Quantity |
| TTHMs | Total Trihalomethanes |
| US EPA | United States Environmental Protection Agency |
| UV | Ultraviolet |
| VOCs | Volatile Organic Compounds |
| WHO | World Health Organization |

# HISTORY OF CHANGES

# Original version (not numbered) was published May 26, 2003.

## 5.1 Version 1.0, March 17, 2008

Section 1

* added e-mail address for requesting copies of LaSB methods
* updated AWWA method references to include 21st Edition, 2005
* updated ASTM method references to the 2006 edition
* added AOAC International as a source of accepted methods
* added reference to MOECC document *Protocol for Acceptance of Alternate Methods*

NOTE: Additions and deletions of specific methods in Sections 2 and 3 have not been listed.

Section 2

* reformatted description of method principle for Total Coliforms (2.1) and *E. coli* (2.2)
* removed references to Fecal Coliforms
* removed references to Total Coliform background counts and included note that Heterotrophic Plate Count is no longer required to be reported (2.3)
* added sections 2.4 *Clostridium* and 2.5 *Cryptosporidium*

Section 3

* added CAS (Chemical Abstract Service) registry number for all applicable parameters
* updated ODWQS and RDL for Trichloroethylene to reflect changes made in 2006
* removed trace metals that are considered operational parameters, i.e. not included in O Reg 169/03 (3.2)
* updated significant figures for ODWQS for lead (O. Reg. 169/03 amended to O. Reg. 242/07)
* changed units for RDLs of Triazines (3.5) to correspond to units required in Drinking Water Information System (DWIS)
* changed units for RDLs of Carbamates (3.6) to correspond to units required in DWIS; also corrected RDL of Aldicarb to 1/10th of the ODWQS
* changed units for RDLs of Organochlorine Pesticides (3.7) to correspond to units required in DWIS
* changed units for RDLs of Chlorophenols & Phenoxy Acids (3.9) to correspond to units required in DWIS
* changed units for RDLs of Urea Derivative (3.11) to correspond to units required in DWIS; also added LaSB method reference number
* corrected the equations for the reactions (Figure 1) for Glyphosate (3.12)
* clarified analytical technique (colourimetry) for several methods referenced for Fluoride (3.13)
* updated toxic equivalent factors (TEF) for dioxins and furans from NATO values in the June 2003 version of this document to the 2006 values from the World Health Organization (WHO); included phrase that these values may be amended from time to time; included direction that laboratories must identify the source of the TEFs used for their calculations
* added section 3.20 Microcystin LR and 3.21 Chloramines

Section 4

* added CAS (Chemical Abstract Service) registry number for all applicable parameters
* removed references to the following operational parameters (i.e. not included in O Reg 169/03): Alkalinity, Chloride, Colour, Dissolved Organic Carbon, Hardness, pH, Sulphate, Sulphite, Total Dissolved Solids, and Turbidity
* added the following new parameters or target groups:

Ammonia (4.2) Biochemical Oxygen Demand (4.3)

Bromide, Chlorate and Chlorite (4.4) Chemical Oxygen Demand (4.5)

Haloacetic Acids (4.6) Hexavalent Chromium (4.7)

Ortho-phosphate (4.8) Phenolic Compounds – Total [4AAP] (4.9)

Silica (4.10) Taste and Odour Compounds (4.11)

Total Kjeldahl Nitrogen (4.12) Total Phosphorus (4.13)

Formaldehyde (4.14) Emerging Complex Contaminants (4.15)

Section 5

* added list of Acronyms

Section 6

* added History of Changes

## 5.2 Version 2.0, May 2010

Section 1

* added Canadian Association for Laboratory Accreditation (CALA) as an approved accrediting body
* updated ASTM method references to the 2008 edition

NOTE: Additions and deletions of specific methods in Sections 2 and 3 have not been listed.

Section 2

- Added section 2.20.1 Screening Tests for Total Microcystins

* updated acronyms

## 5.3 Version 3.0, [Insert - DATE of issue]

Section 1 Introduction

Revised to include:

-An outline of purpose and role of the document

-General information on laboratory licensing in Ontario (Section 1.1)

and Requirements for licensing (1.2)

-Section 1.1 now includes an overview of accepted refence methods (Section 1.1.1.) and Alternate Reference Methods and In house Developed Methods (Section 1.1.2.)

-an outline of the requirements for licensing (Section 1.2) this now includes criteria for licencing methods based on accepted reference methods (Section 1.2.1.) and methods modified from accepted reference methods (Section 1.2.1.1.) and additional criteria methods based on alternate/In-house developed method (Section 1.2.2.)

-The document no longer references the Protocol for the Acceptance of Alternate Methods 2005 (PAAM)

-material from the PAAM has now been updated and incorporated into the introduction of this document

Section 2 and 3 Parameters not associated with ODWQS or O. Reg. 170/03 were removed

Section 2 and 3 -Note: Addition and Deletion of Specific Methods have not been listed

- AOAC International (formerly the Association of Official Analytical Chemists) references were removed

-Section 2 and 3 LaSB Method Principles were removed

Section 2

Total Coliforms and E. coli

-Added a section for simultaneous detection Total Coliforms and E coli

-Added units for MPN

Clostridium – updated units to reflect current practices

Cryptosporidium – updated units, included Giardia to reflect current practices

Section 2 and 3 – ASTM reference methods that have not been previously used as reference methods for licensing were removed where there was another existing equivalent reference method or technique available

VOCs

The following changes were made to reflect current ODWQS and RDL requirements:

Benzene: ODWQS: 0.001 mg/L, RDL 0.5 µg/L

Carbon Tetrachloride: ODWQS: 0.002 mg/L, RDL: 0.2 µg/L

Ethylbenzene: ODWQS: 0.14 mg/L, RDL: 0.8 µg/L

Tetrachloroethylene (perchloroethylene): ODWQS :0.01 mg/L, RDL: 1 µg/L

Toluene: ODWQS :0.06 mg/L, RDL: 2.4 µg/L

Trichloroethylene: ODWQS :0.005 mg/L, RDL: 0.5 µg/L

Xylene, Total \*\* (Xylenes): ODWQS :0.09 mg/L, RDL: 2 µg/L

Vinyl Chloride: ODWQS :0.001 mg/L, RDL: 0.2 µg/L

Trace Metals

The following changes were made to reflect current ODWQS and RDL requirements:

-Arsenic ODWQS: 0.01 mg/L RDL: 1 µg/L

-Lead: RDL: 1 µg/L

-Selenium: ODWQS 0.05 mg/L

Nitrate and Nitrite

-“Nitrate + Nitrite” removed – no longer listed in ODWQS

Triazines

-RDL units changed from ng/L to µg/L

Diquat/Paraquat

Diquat and Paraquat were changed to cation forms to be consistent with the nomenclature of the ODWQS

Carbamates

-Aldicarb and Bendiocarb removed – no longer listed in ODWQS

- RDL units changed from ng/L to µg/L

Polychlorinated Biphenyls (PCBs) and Trifluralin;

-section name changed from Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs) to Polychlorinated Biphenyls (PCBs) and Trifluralin to reflect Organochlorine Pesticides no longer listed in ODWQS

-Removed parameters no longer listed in ODWQS: Aldrin + Dieldrin, Chlordane, Heptachlor + Heptachlor epoxide, DDT + metabolites (p,p-DDD; p,p-DDE; o,p-DDT and p,p-DDT), Lindane (Total) and Methoxychlor

-Changed RDL units from ng/L to µg/L

Organophosphorus Pesticides

-removed Parathion (ethyl) and Temephos; no longer listed in ODWQS

Chlorophenols and Phenoxy Acids

-Changed RDL units from ng/L to µg/L

-Added: 2-Methyl-4-chlorophenoxyacetic acid (MCPA) (listed in ODWQS); ODWQS 0.1 mg/L, RDL 10 µg/L

-Removed - 2,4,5-Trichlorophenoxy acetic acid (2,4,5-T); no longer listed in ODWQS

Urea Derivative

-Diuron Changed RDL units from ng/L to µg/L

Benzo(a)pyrene

- Changed RDL units from ng/L to µg/L

Dioxins and Furans

-TEQ example corrected TEFs to reflect the World Health Organization TEFs 2005 guideline

Bromate, Chlorate and Chlorite

-Added Chlorate and Chlorite (now both listed in ODWQS) ODWQS 1.0 mg/L and RDL 0.1 mg/L

Chloramines

–removed (operational parameter - testing required to be done at drinking water system)

Haloacetic Acids

now in ODWQS – Added January 2020

Sodium

– moved from additional parameters section to section 3, added note that methods listed under trace metals may be acceptable

Section 4 Additional Parameters Section -Removed these parameters not associated with an ODWQS

-additions, modifications and/or deletions of specific LaSB, AWWA, US-EPA and ASTM methods in Sections 2 and 3 have not been listed individually

updated acronyms

Added Appendix A – Licence Application Checklist

Added Appendix B – Modification to methods after licensing

Added Appendix C - MECP Sample Collection and Handling Requirements

# Appendix A Licence Application Checklist

* Licence Amendment Application Form
* Current Scope of Accreditation
* Method and any relevant supporting procedures
* Successful Proficiency Test Results
* Method Validation Summary\*

Accepted Reference method

* Validation summary of the MDL

Alternate Reference/In-house Methods

* Full method validation summary including:
  + Confirmation of Identity
  + Selectivity
  + Working and Linear Ranges
  + Accuracy and Precision
  + Ruggedness
  + Sample/Extract Hold Time
* Copy of the alternate reference method and relevant supporting references

\* Raw validation data does not need to be submitted with the application, but must be available for MECP review upon request

# Appendix B Modifications to Methods after Licensing

In cases where a laboratory is planning method changes after a method has been licensed, it must determine the impact of such changes. Where the changes are found to affect the original validation, the laboratory must perform a new method validation. It must receive a licence amendment application approval from the Ministry prior to implementing the modified method. The laboratory testing licence’s terms and conditions provide details on changes that are permitted and what changes require licence amendment approval by the MECP prior to implementation.

Any of the following changes require a laboratory to submit a licence amendment application and receive approval by the MECP prior to implementation:

* Changes to sample preservation requirements
* Increasing maximum hold time requirements
* Decreasing minimum sample volume requirements
* Changes in either the front end or determinative technique
* Changes that remove or reduce method Quality Control (QC) requirements
* Any change inconsistent with the analytical technique described in the laboratory’s licence or the applicable reference method
* Any change specifically prohibited by the applicable reference method
* Changes to the reference method except for reference method revision updates
* Changes to microbiology media formulation and incubation conditions
* Changes to any critical components of the analysis that are integral to the technique

The laboratory is permitted to make changes that optimize analytical conditions provided that the changes remain suitable and consistent with the reference method and the changes do not negatively impact method performance. All revisions must be documented in the method and must be done in accordance with the terms and conditions in the laboratory’s drinking water testing licence.

Appendix C MECP Sample Collection and Handling Requirements

## Microbiological Parameters

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Sample Container** | **Suggested Container Size** | **Preservative** | **Maximum Holding Time** | **Storage Conditions** | **Comments** | **Reference** |
| Total Coliforms, Escherichia Coli *(E. Coli*) | Glass or Plastic. Sterile | 250 mL \* Licence Condition | Sodium Thiosulphate | 48 hours | Cool | Transport chilled. Not Frozen | E3407 |
| Heterotrophic Plate Count | Glass or Plastic. Sterile | 250 mL | Sodium Thiosulphate | 48 hours | Cool | Transport chilled. Not Frozen | E3408 |

## Inorganic Parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Sample Container** | **Suggested Container Size** | **Preservative** | **Maximum Holding Time** | **Storage Conditions** | **Reference** |
| Metals (Antimony, Arsenic, Barium, Boron, Cadmium, Chromium, Lead, Selenium, Uranium, Sodium) | Polyethylene terephthalate (PET) or High-density polyethylene (HDPE) | 100 mL (previously in practices) | Nitric Acid pH < 2. Samples may be preserved at the laboratory up to 14 days after collection. The pH must be confirmed and at least 24h elapsed after preservation before analysis. | 60 Days Samples Licence Condition | na | E3473 and E3565 |
| Lead in Plumbing O Reg 170/03 (Section 15) and O Reg 243/07 | PET or HDPE | 1L (Regulatory Requirement) | Nitric Acid pH < 2. Samples may be preserved at the laboratory up to 14 days after collection. The pH must be confirmed and at least 24h elapsed after preservation before analysis. | 60 Days Samples. | na | E3473 and E3565 |
| Mercury | Plastic, Glass, Fluoropolymer | 500 mL (AWWA) | HNO3 to pH < 2 or alternatively preserve samples 2 mL/L 20% (w/v) K2Cr2O7 solution (prepared in 1 + 1 HNO3) [AWWA 3112B (Table 1060:I and 3010B)] or Approximately 2.5 mL (≈50-80 drops) of 6 molar (50% v/v) hydrochloric acid per 240 mL of sample.(E3526) or 12N hydrochloric acid (HCl) or bromine monochloride (BrCl) solution to pH < 2 - as per method EPA 1669 (EPA 1631E). | 28 days; 5 weeks for preserved (AWWA 3010B)  Caution: Mercury concentrations may increase in samples stored in plastic bottles in mercury-contaminated laboratories. (AWWA 3010B) | Cool AWWA 3112B; ambient temperature (E3526) | E3526; AWWA 3112B (Table 1060:I and 3010B); EPA 1631E |
| Nitrate, Nitrite | Glass or plastic | 200 mL AWWA | na | 7 days | Cool; Samples may be frozen | E3364 |
| Fluoride | Glass or PET | 100 mL AWWA | none required | 30 days | Cool | E3172 |
| Bromate, Chlorate and Chlorite | PET | 50 mL | Ethylenediamine (EDA); Samples treated with chlorine dioxide are to be sparged with an inert gas (such as helium, argon or nitrogen) | 28 days, (14 Days Chlorite) | Cool | E3462, EPA 300.1 |
| Cyanide | Plastic or Glass | 500 mL | Sodium Thiosulphate; NaOH pH> 12 | 14 days | Cool | E3015, AWWA 4500, EPA SW 846 9010C |

## Organic Parameters

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameter** | **Sample Container** | **Suggested Container Size** | **Preservative** | **Maximum Holding Time** | **Storage Conditions** | **Reference** |
| Volatile Organic Compounds | Glass; screw caps lined with Teflon-clad silicon rubber septa | 2 x 40 mL | NaHSO4 to pH <3, and samples dechlorinated by the addition of Na2S2O3 (E3132). HCl to pH <2; (chlorinated samples: ascorbic acid or sodium thiosulphate if chlorine present before HCl addition) AWWA 1060 and 6010B | Treated drinking water samples and samples preserved with NaHSO4 should be analyzed within 14 days of collection and un-preserved, un-treated samples within 7 days of collection. | Dark, Cool in a suitable refrigerator free from noncompatible chemicals | E3132; AWWA 1060 and 6010B |
| Triazines (N-containing herbicides)  (Alachlor, Atrazine + N-dealkylated metabolites, Metolachlor, Metribuzin, Prometryne and Simazine) | Amber glass, Teflon lined caps. | 1L or 40 mL | sodium thiosulphate for chlorinated water (E3553); ammonium acetate and 2-chloroacetamde (EPA 523). | 28 days below 6 degrees; extracts 28 days frozen (EPA 523); stabilized by addition of acetonitrile within 14 days of the sampling date and analyzed within 30 days (E3553) | Dark, Cool | E3553, EPA 523 |
| Carbamates (Carbaryl, Carbofuran, Triallate) | 1 L, amber glass bottles or 40  mL amber vials, Teflon-lined caps | 1L or 40 mL | Sodium thiosulphate for dechlorination. Adjust pH to ~3.8 to prevent hydrolysis of oxamyl, 3-hydroxycarbofuran, carbaryl, and methiocarb. | 28 days; extracts 28 days frozen | Dark, Cool | E3501, EPA 531.2 |
| Organochlorine Pesticides (Trifluralin) and Polychlorinated Biphenyls (PCBs) | Amber glass bottles, Teflon lined screw caps | 1L | no preservative (E3488), sodium thiosulphate for chlorinated water (AWWA 6410B) | 30 days PCBs, 20 days Trifluralin | Dark, Cool | E3488, AWWA 6410B |
| Organophosphorous Pesticides  Azinphos-methyl Chlorpyrifos Diazinon Dimethoate Malathion Phorate Terbufos | Amber glass bottles with Teflon-lined caps | 1L or 40 mL | sodium thiosulphate | 14 days; Samples received for analysis will be stabilized by addition of acetonitrile within 14 days of the sampling date and analyzed within 30 days thereafter. | Dark, Cool | E3553, E3502 |
| Chlorophenols (CPs) and Phenoxy Acids | Amber or clear glass | 40 mL or 1L | sodium thiosulphate or sodium sulfite | 14 days | Dark, Cool | E3552, AWWA 6410B |
| Quaternary Ammonium compounds Diquat and Parquat | Plastic | 500 mL MECP | sodium thiosulphate | 28 days | Dark, Cool | E3503 |
| Diuron | 1 L, amber glass bottles or 40- mL amber vials, Teflon-lined caps | 1L or 40 mL | sodium thiosulphate solution and adjust to pH between 3 and 5 with sulphuric acid or acidic buffer | 28 days | Dark, Cool | E3501 |
| Glyphosate | plastic or amber glass | 500 mL (MECP) | sodium thiosulfate | 20 days | Dark, Cool | E3500, EPA 547 |
| Benzo(a)pyrene | amber glass bottles with Teflon lined caps | 1L | sodium thiosulfate or ascorbic acid (EPA 525.3) | 20 days before extraction, 40 days after extraction at ≤ 10°C | Cool | E3480 |
| Dioxins and Furans | amber glass bottles with Teflon lined caps | 1L | none | 30 days until extraction, extracts within 60 days of sample collection | Dark, Cool | E3418 |
| Nitrotriacetic Acid (NTA) | polyethylene terephthalate (PET) | 50 mL | none | 30 days | Cool | E3406 |
| N-nitrosdimethylamine (NDMA) | amber glass bottles with Teflon lined caps | 1L | Dechlorinating agent (sodium sulfite, sodium thiosulfate or ascorbic acid) | 28 days | Cool | E3388, AWWA 6450B/C |
| Microcystin-LR - by ELISA Screening | amber bottles with Teflon lined caps | 500 mL or greater | sodium thiosulfate | Adverse samples must be sent and received by MECP-LaSB for confirmatory testing within 7 days of sample collection. | transported <10C; stored cool, preferably in the dark. | E3469, licence condition |
| Haloacetic Acids | glass vial with Teflon-lined caps | 40 mL | ammonium chloride | 14 days | Cool | E3478, AWWA 6251 |

For the purpose of this appendix, Cool = storage at any temperature range between > 0°C (above freezing point of water) and ≤ 8°C. For example, 5 ± 3°C; 4 ± 3 °C; or > 0°C (above freezing point of water) to ≤ 6°C, would all be acceptable temperature ranges.