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**An Approach for Assessing and Managing Wastewater
Effluent Quality for Federal Facilities — Final Report
June 1, 2000**

Document Prepared
for the

Federal Committee on Environmental Management Systems
Wastewater Working Group

Technical Secretariat
National Guidelines and Standards Office
Environmental Quality Branch
Environment Canada

Environmental Management Systems
Système de Gestion Environnementale

Canada 

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Preface

This report has been prepared for the Wastewater Working Group of the Federal Committee on Environmental Management Systems (FCEMS). Two reports by Demeter Inc. and by the Cadmus Group Inc. expressing the views of these contractors have been consolidated into one. The Guidelines and Standards Division of Environment Canada served as the Scientific Technical Secretariat in the development of the present report with assistance from the National Programs Directorate. The custodial departments have reviewed the report and given their comments and suggestions to improve the document. These were addressed by Nadeo Experts-Conseils Inc. The report has been approved by the FCEMS Wastewater Working Group for tabling with the FCEMS Gap Committee. The report will serve to assist Environment Canada (Environmental Protection Service) in updating the *Guidelines for Effluent Quality and Waste Water Treatment at Federal Establishments* (Environment Canada 1976) to reflect today's modern EMS setting.

Acknowledgements

The co-Chairs of the FCEMS Wastewater Working Group would like to acknowledge the financial contribution by the custodial departments of the Working Group without which none of this work would have been possible. More importantly, we extend our thanks to the Working Group members for their time, assistance, and helpful suggestions. We are also aware that Working Group members solicited input from experts within their departments whose wealth of experience rendered realism and practicality to the report. Finally we thank the FCEMS Gap Committee and the FCEMS Parent Committee for their advice and support.

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1. INTRODUCTION

The approach to wastewater effluent quality presented in this document may be described as an “ecological approach” in which the Government of Canada demonstrates leadership through the adoption of sound environmental protection and engineering practices in the design, installation, and operation of wastewater treatment systems at federal facilities. Final effluent quality limits are specified and in the event that non-specified materials are found in sewage, a rational approach for determining permitted effluent limits is presented.

1.1 Purpose of Framework and Guidelines

The cabinet decision of June 8, 1972, entitled “Control and Abatement of Pollution from Federal Activities — Cleanup and Prevention”, calls for the cleanup of existing sources of pollution from federal establishments and for the screening of all new projects initiated by the federal government for potential adverse environmental effects. This was further reinforced by Canadian Environmental Protection Act (CEPA) and the Fisheries Act under which decisions related to effluent discharges must be made in the most environmentally responsible manner. The purpose of this framework and guidelines is to indicate the degree of treatment and effluent quality that will be applicable to all wastewater discharged from existing and proposed federal installations. Use of this framework and guidelines is intended to promote a consistent approach towards the cleanup and prevention of water pollution and to ensure that the best practicable control technology is used. Compliance with this framework and guidelines would support a defence of due diligence in the event of a Fisheries Act Section 36(3) enforcement action.

It is the intent of this framework and guidelines to assist federal facilities in achieving the goal of minimizing the environmental impact of wastewater discharge on the receiving environment. Further to this goal, a model framework has been developed and is presented in [Section 3.0](#). This model framework represents a suggested process only. Federal facilities are encouraged to develop a process that accomplishes the stated goal within their specific needs and capabilities.

1.2 Application of Framework and Guidelines

The present framework and guidelines apply to and are in fulfillment of Bill C-32 (*CEPA 1999*, Part 9 under Section 208 (1) titled, Departments, boards and agencies of the government of Canada). They apply to all liquid effluents, domestic and nondomestic, discharged from land-based federal facilities. Vehicles and vessels are excluded. Vessels should comply with the Canada Shipping Act.

It is intended that the framework and guidelines will be revised and amended from time to time in order to reflect new developments in technology and changing circumstances.

1.3 Policy

It is the policy of the federal government to set and maintain a high national standard in keeping with a role of national leadership in environmental protection with respect to its own activities. Water pollution control systems serving federal facilities are to reflect sound engineering and best practicable technology regardless of dilution available from receiving waters. Effluent guidelines for wastewater from federal facilities are to be equal to or more stringent than the established standards or requirements of any federal or provincial regulatory agency. Such an approach is designed to demonstrate leadership on the part of the federal government.

Furthermore, the Operational Environmental Policy and Guiding Principles of the Federal Code of Environmental Stewardship state that the federal government “will ensure that all Federal operations and facilities meet or exceed Federal environmental statutes, regulations and standards, and are compatible with Provincial, Territorial, and Municipal environmental statutes, regulations and standards for the jurisdiction in which they are located”. Thus, federal departments are required to prepare sustainable development strategies that are intended to improve the environmental performance of each department’s policies and operations. These strategies lead to the development and implementation of environmental management systems (EMS).

The present document intends to set out a consistent approach to managing and monitoring wastewater effluents from federal facilities to ensure that receiving environments are not directly or indirectly adversely impacted. The framework and guidelines provide an approach to assessing the site-specific needs of federal facilities. Within this framework, wastewater management and monitoring requirements are determined by the nature of the operations at the facility and the receiving water into which wastewater is discharged. The framework and guidelines should be applied in the most environmentally responsible manner, in a way to prevent federal wastewaters from directly or indirectly adversely affecting the environment. Ultimately, it is the responsibility of federal facility managers to take all reasonable steps to ensure that wastewater management and monitoring programs protect the receiving environment from progressive or irreversible deleterious effects.

2. EFFLUENT QUALITY

2.1 General

Effluents from federal facilities are to be treated before being discharged to receiving waters so that they do not contain the following:

Hazardous materials¹ in such concentrations (quantities, concentrations, combinations) that are or may be of public health significance, may unduly impair beneficial uses, or may be toxic or progressively or irreversibly harmful to wildlife².

Toxic substances in such concentrations (concentrations, quantities, and combinations) that may impair beneficial uses or cause progressive or irreversible adverse effects on wildlife. Toxic substances identified in Schedule 1 of the Canadian Environmental Protection Act that are track 1 (see the federal *Toxic Substances Management Policy* criteria) should not be present at any level in the effluent.

Deleterious materials (e.g., heat) in such concentrations or at levels that may unduly impair beneficial uses or cause progressive or irreversible adverse effects on wildlife.

Floating suspended or submerged matter in concentrations that may cause, progressively or irreversibly, undue nuisance or objectionable conditions or that may impair beneficial uses or cause adverse effects on wildlife in receiving waters.

Excess nutrient concentrations (e.g., P, NO₃-NO₂) that could cause visible algal growths or other nuisance aquatic growths that unduly impair beneficial uses of receiving waters.

Oxygen-demanding materials in concentrations that may result in an anaerobic condition in receiving waters.

Sediments or other settling materials in quantities that may unduly impair beneficial uses or may form undue objectionable or harmful sediment deposits, or cause progressive or irreversible adverse effects on wildlife. Determination of impairment shall be based on water quality monitoring and surveillance.

Any materials, alone or in combination, producing color, turbidity, taste, or odor that causes undue nuisance or progressive or irreversible adverse effects on wildlife in receiving waters.

¹ Hazardous materials are those defined under the FCEMS Hazardous Materials list.

² Wildlife is now widely defined under the Federal Wildlife Policy to include animals, plants, birds, fish, and microorganisms.

2.2 Specific Limits

Effluents should receive treatment before being discharged to receiving waters such that they will not directly or indirectly adversely affect the environment. An effluent of such quality can be achieved efficiently by working within the framework described in [Section 3.0](#) of the present document.

2.3 Compliance with Effluent Quality Requirements

Treatment systems should be designed and operated so that the effluent quality described in [Sections 2.1](#) and [2.2](#) will be achieved consistently. Existing treatment systems should be monitored by means of sampling and analytical procedures that are in accordance with latest edition of Standard Methods (For The Examination of Water and Wastewater) as published by the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation. In general, compliance with the numerical limits should be based on 24-hour composite samples, with the exception of those parameters that require grab sampling.

Some allowance will be given for samples to exceed the limits specified because of unrepresentative sampling and normal treatment plant upsets. For both composite and grab samples, 80 percent of a statistically reliable number of samples (minimum of five samples) in any consecutive 30-day period should not exceed the limits specified, nor should any single sample exceed five times the specified limit. Chlorine residual should be measured by the treatment plant operator as often as required (at least once every two days; twice daily for some systems) to ensure surface water quality is protected.

2.4 Dilution

Dilution of an effluent prior to its discharge for the expressed purpose of attaining the specific limits specified in [Sections 2.1](#) and [2.2](#) is not acceptable.

When feasible, cooling water and other clean water should be segregated from the wastewater and discharged to storm drainage systems.

2.5 Violation of Receiving Water Quality Objectives

When an effluent complying with the effluent guidelines specified herein results in a violation of the water quality requirements or objectives specified by another pollution control agency, appropriate action should be taken to meet whatever effluent limits are necessary to ensure compliance with the water quality requirements of such other agency. In the case where no water quality objectives are in effect for a particular receiving water, the acceptability of the effluent should be based on consultations between the appropriate federal and provincial agencies. In receiving bodies of water where water quality objectives are already exceeded upstream of the discharge point, the effluent should be of such quality as to maintain or

enhance the quality of the receiving water downstream from the point of discharge.

The point of discharge and the sampling location may vary, depending on the type of wastewater treatment. For example, if a facility discharges their treated effluent directly to a receiving water body, the end of pipe will constitute the point of discharge and sampling area; however, there are situations where a discharge from sewage lagoons enters a natural wetland area. In such cases, the point of discharge should be at the wetlands' outfall. Therefore, locations for the point of the sewage discharge should be selected independently and based on specific design characteristics of treatment systems.

2.6 Zones of Influence

In assessing the effect of an effluent on a receiving water, an opportunity should be allowed for the mixture of an effluent with its receiving water. The design and location of an outfall should be established on a case-by-case basis in consultation with the local Environmental Protection Service office, and should be based on the following:

1. the physical, chemical, and biological characteristics of the body of water
2. the present and anticipated use and water quality of the body of water. In addition, the zone of influence should be so established as to assure a reasonable zone of passage for aquatic life in the stream.

3. THE WASTEWATER EFFLUENT QUALITY MANAGEMENT FRAMEWORK

The number of substances or parameters having the potential to adversely affect the environment is very large. It is impossible to measure the concentration of each of these substances in the effluent. In fact, it is also unnecessary, as many of these substances are not present in the influent. Thus, substances or parameters to be measured will vary from one federal facility to another. The framework is therefore essential as it provides a consistent general approach for all federal facilities while allowing decisions and results to be different between facilities in accordance with facility and site-specific conditions.

A framework is, by definition, a structure or process intended to delimit and support an ideology or concept. A framework may be accompanied by other documents such as protocols, codes of practice, and specific application guides. It is meant to be general, but can present or refer to some tools that can be used for solving specific problems. The current Wastewater Effluent Quality Management Framework is presented to assist facility managers in adopting an "ecological approach" in the management of their wastewaters.

The Wastewater Effluent Quality Management Framework for Federal Facilities ([Figure 1](#)) has been designed to efficiently achieve effluents of the quality required by [Section 2.0](#) and [Appendix A](#) of this document. The first steps of the framework go through a logical analysis, resulting in a list of substances that are of concern at a given federal facility. The Wastewater Effluent Quality Management Framework then employs a tiered approach to decision making to facilitate consistent and practical decisions based on the best available science at each

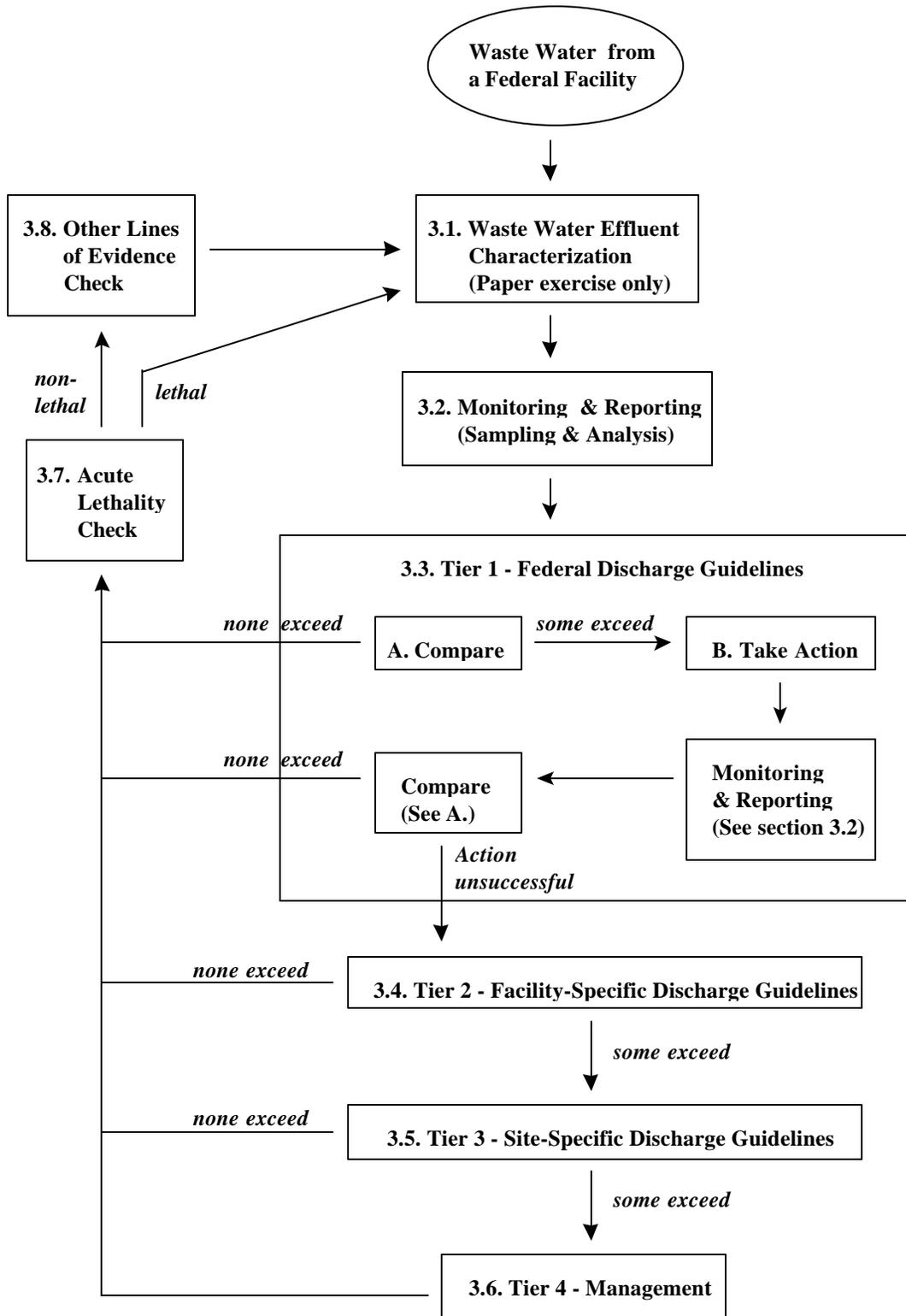
tier (EC 1997; Llewellyn 1998). Through the use of the scientifically based Canadian water quality guidelines (CWQGs) (CCME 1999), tiers 1 to 3 have built-in risk assessment procedures and, as such, are designed to ensure the protection of the receiving waters. Tier 4 is designed to facilitate risk management; risk is defined here as the possibility that the final effluent will adversely affect the receiving environment. The tiers progressively increase in complexity.

Tier 1 is a screening level tier designed to quickly identify potential wastewater problems using the Federal Discharge Guidelines (Appendix A) or the CWQGs (CCME 1999) and to take action in a way to reduce or eliminate the problematic substances from the effluent. Tier 1 allows the wastewater manager to focus on only those wastewater contaminants or parameters that may pose a threat to a receiving water body and exclude those contaminants or parameters that likely pose negligible risks. Almost all cases should be resolved at the tier 1 level.

Tiers 2 to 4 were designed to handle exceptional cases. In tier 2, facility-specific information is used to develop a facility-specific dilution factor. Canadian water quality guidelines (CCME 1999) are then used along with the facility-specific dilution factor to derive a facility-specific discharge guideline. In tier 3, site-specific objectives based on the generic CWQGs (CCME 1999) are used to examine the specific risk associated with wastewater at the given facility, where risk is defined as “a comparison of the magnitudes of estimated environmental concentrations to toxicological test endpoints for a contaminant” (Suter 1995). Site-specific objectives take into account a number of site-specific factors (e.g., water hardness and pH), which along with the site-specific dilution factor are used to derive a site-specific discharge guideline. If contaminants or parameters pass through tiers 1 to 3 of the proposed framework, extraordinary steps must be taken to address the identified problem. In tier 4, an assessment of the possible solutions is made and decisions are taken on how to reduce contaminant concentrations or parameters to acceptable levels. They could include upgrading technology, holding pond construction, or other upgrades or additions to the facility.

A full description of the proposed framework is presented in [Figure 1](#).

Figure 1. Wastewater Effluent Quality Management Framework for Federal Facilities



3.1 Wastewater Effluent Characterization

This first step is a paper exercise. It should be done for all federal facilities, regardless of the fact that they are discharging directly to receiving waters, or indirectly, through municipal systems. No chemical analysis should be performed at this stage. The goal of this first step is to identify, through a logical analysis, the substances or parameters that are potentially present in the wastewater effluents of a specific facility and that might adversely affect the receiving environment. The expected final product of this first step is, for a given specific federal facility, a list of substances and parameters of potential concern. In the rest of this document, this list will be referred to as the Facility-Specific Substances of Concern List (FSSCL). The FSSCL must be produced for each facility by completing the following tasks:

1. Develop and maintain an up-to-date inventory of substances and parameters used at, or relevant to, the specific facility (e.g., through purchase orders or other means). This inventory is hereinafter referred to as the Facility-Specific Inventory of Substances.
2. Compare the Facility-Specific Inventory of Substances with lists of substances and parameters of known environmental or human health concern (see [Appendix D](#)) (e.g., National Pollutant Release Inventory [NPRI]; ARET [Action on the Release and Elimination of Toxics] list; FCEMS Hazardous Materials list; guidelines and exclusions set out by municipal bylaws [for facilities discharging into municipal treatment systems]; environmental statutes, regulations, standards, guidelines, and exclusions set out by provincial, territorial, and municipal governments for the jurisdiction in which the facility is located ([for facilities discharging directly to receiving waters]; and other lists specific to industry or facility-types [e.g., airports and facilities using radionuclides]) and identify substances and parameters of concern present in the Facility-Specific Inventory of Substances.
3. Characterize the receiving environment (paper exercise, no chemical analysis should be performed at this stage) to identify potential situations where particular sensitivities to one or more of the substances and parameters used at, or relevant to, the federal facility might exist. Shellfish sites, fish-spawning sites, and the presence of rare or endangered species should be determined. The water quality of the receiving bodies of water should also be estimated by identifying other sources of contamination located upstream and substances or parameters that have naturally high background levels in the specific area where the federal facility is located. Existing water quality data from provincial and municipal agencies should be reviewed.
4. Compare the results of task 3 to the Facility-Specific Inventory of Substances and identify substances and parameters of potential concern.
5. Group substances and parameters identified under tasks 2 and 4 in a single list. This list is the FSSCL.

Substances or parameters could be added to the FSSCL if there is reason to expect (e.g., a change in the chemicals used at the facility) the substance or parameter may be released in

the effluent or deleted from that list if a modification in facility operations now precludes a substance from entering the effluent discharge (e.g., substance is no longer in use). All deletions should be justified and documented. The inventory of substances used and relevant parameters should be updated on a regular basis.

3.2 Monitoring and Reporting

General

Appropriate monitoring and reporting of chemical or parameter levels in effluent must be performed by a series of tests. While details of the monitoring strategy are facility specific, sampling and analysis should be as consistent and accurate as possible. The objective of any sampling program is to obtain representative samples that accurately reflect the composition of the effluent stream from which they were collected. Sampling may have to extend over many diurnal cycles to obtain a representative sample. Chemicals and parameters to be monitored are those present on the FSSCL. Levels of these chemicals and parameters in the effluent are required for comparison to Federal Discharge Guidelines in tier 1 for comparison with Facility-Specific Guidelines in tier 2, for comparison with the Site-Specific Discharge Guidelines in tier 3, and as the basis for the assessment in tier 4. If, at a given tier, the comparison process indicates that concentration levels in effluent exceed guidelines, then action must be taken to reduce chemical or parameter concentration levels. If action is unsuccessful, the chemical or parameter passes on to the next tier. Monitoring and reporting are also required after tier 4 so that the effectiveness of the management decision can be evaluated. Without some form of monitoring, appropriate decisions on managing wastewater at the facility cannot be made. Reporting on the results of the monitoring should be as clear and concise as possible to ensure the monitoring data collected can be easily understood and disseminated to decision makers, the public, and any other stakeholders. Monitoring of the receiving environment is suggested to compare values with the CWQGs (CCME 1999) as further lines of evidence.

Procedure

1. Develop a monitoring program and schedule based on facility type and uses and on the sensitivities of the receiving environment. Parameters to be monitored should include volume/flow rate, pH, temperature, and substances and parameters listed in the FSSCL.
2. Using appropriate sampling procedures and analytical methods, measure, in the wastewater effluent from the specific federal facility, the parameters identified in step 1 of the monitoring and reporting procedure.
3. Verify that in the wastewater effluent, floating suspended or submerged matter of any kind is not in concentrations that may cause nuisance or objectionable conditions or that may impair beneficial uses and adversely affect wildlife in receiving waters.
4. Verify that in the wastewater effluent, any materials present will not, alone or in combination (e.g., heat, chemicals), produce color, turbidity, taste, or odor that causes a

nuisance or adversely affect wildlife in receiving waters.

5. Report the results of the monitoring in a clear and concise manner.

3.3 Tier 1 — Federal Discharge Guidelines

General

Tier 1 of the Wastewater Effluent Quality Management Framework is intended to provide a quick, inexpensive, and conservative screening level examination of the wastewater discharged by a federal facility. Federal Discharge Guidelines provided in [Appendix A](#) should be followed. When Federal Discharge Guidelines are not available for a given substance or parameter, the CWQGs (CCME 1999) are used multiplied by a generic dilution factor of 10. These are nationally accepted science-based guidelines developed for the protection of water quality. They exist for a wide range of physical parameters and chemical contaminants.

In a first step, contaminant concentrations and parameter levels are compared to the Federal Discharge Guidelines provided in [Appendix A](#) or to the CWQGs (CCME 1999) when Federal Discharge Guidelines are not available. Those contaminants and parameters not in exceedence are not considered further. By excluding those contaminants or parameters that do not exceed the Federal Discharge Guidelines at this stage, the process is focused only on those contaminants or parameters that may be cause for concern, thereby reducing the resources and time required to evaluate wastewater discharges from a federal facility.

In a second step, existing or conventional technology is applied to manage contaminants or parameters that exceed the guidelines. If the use of existing technology would not resolve the problem, then the contaminant or parameter is taken to tier 2. Only a minority of federal facilities should have contaminants or parameters entering tier 2.

Procedure

Please refer to [Figure 1](#) before reading this sub-section. As shown in [Figure 1](#), tier 1 is divided into two steps: the “compare” step, represented by tasks A.1 to A.7 (below), and the “take action” step, represented by tasks B.1 to B.4 (below). The compare step (tasks A.1 to A.7) should be performed first. If tasks A.1 to A.7 do not indicate any exceedences, perform Lethality Check ([Section 3.7](#)) and Other Lines of Evidence Check ([Section 3.8](#)). Where tasks A.1 to A.7 indicate exceedences, take action as suggested by tasks B.1 to B.4. If action has already been taken without success, perform tier 2 ([Section 3.4](#)). Those substances and parameters that are not in exceedence are not considered further.

A. Tier 1 — Compare Step

The tier 1 – compare step requires that the following tasks be performed:

A1. Compare the measured concentrations presented in the monitoring report to the Federal Discharge Guidelines presented in [Appendix A](#). If no Federal Discharge

Guideline exist for a given substance or parameter, see if there is a CWQG (CCME 1999) for that substance or parameter. If there is, compare the measured concentration presented in the monitoring report to the resulting Canadian water quality guideline value. In cases where no CWQG (CCME 1999) exists for that substance or parameter, then take the lowest existing recent guideline used in any Canadian jurisdiction (i.e., national, provincial, or municipal) with appropriate documentation and compare the measured concentration presented in the monitoring report to that value.

- A2. Compare the measured concentrations presented in the monitoring report to the CEPA Schedule 1 toxic substances list. The intent of Schedule 1 - track 1 substances is that these should not be present at any level in the effluent. If Schedule 1 substances are present, facility managers should contact the appropriate authority at Environment Canada regarding rules and regulations on specific track 1 substances identified in Schedule 1 of the *Canadian Environmental Protection Act*.
- A3. If radionuclides are present in the effluent, please refer and conform to the Atomic Energy Control Act and the Nuclear Safety Control Act.
- A4. For facilities which discharge into municipal treatment systems, compare the measured concentrations presented in the monitoring report to guidelines and exclusions set out in provincial regulations and municipal sewer use by-laws. Verify that the contaminants present in the Federal wastewater effluent are effectively removed by the municipal treatment system to the levels recommended by the Federal framework and guidelines ([Appendix A](#) and [Figure 1](#)).
- A5. For facilities which discharge directly to receiving water, also compare the measured concentrations presented in the monitoring report to environmental statutes, regulations, standards, guidelines, by-laws, and exclusions set out by Provincial, Territorial, and Municipal governments for the jurisdiction in which the facility is located. Federal facilities should comply with all Federal, Provincial, Territorial, and Municipal environmental guidelines, statutes, standards, regulations, by-laws, and exclusions.
- A6. Examine the monitoring report to ensure that floating suspended or submerged matter of any kind is not in concentrations that may cause nuisance or objectionable conditions or that may impair beneficial uses and adversely affect wildlife in receiving waters.
- A7. Examine the monitoring report to ensure that any materials present will not, alone or in combination (e.g., heat, chemicals), produce color, turbidity, taste or odor that cause a nuisance or adversely affect wildlife in receiving waters.
- A8. Compare receiving water quality with the CWQGs (CCME 1999). In receiving bodies of water where the CWQGs (CCME 1999) are already exceeded upstream of the discharge point due to other sources of contamination or high natural levels, the effluent should be of such quality as to maintain or enhance the quality of the receiving water downstream from the point of discharge.

B. Tier 1 — Take Action Step

Set aside all contaminants and parameters of concern (from the FSSCL) that were shown in the compare step not to exceed the guidelines; concentrate, from now on, on the contaminants and parameters that were shown to be in exceedence. The tier 1 – take action step requires that the following tasks be performed to achieve the parameters limits:

- B1. Verify that good housekeeping and auditing of existing treatment facilities are in effect to ensure efficient operation.
- B2. Examine pretreatment or other methods to reduce use and release of substances or parameters, including methods such as material substitution, material use minimization, at-source waste separation, and separate treatment and/or recovery (e.g., solvent purification by re-distillation, solid waste collection and special disposal). This includes laboratory practices. The facility should consider, as needed, the purchase and installation of new equipment (such as neutralization tanks), the maintenance of same where they are present, or changes in laboratory practice where the tanks are both present and operational (for example for pH control).
- B3. Implement training and other education programs for users, especially for users of problem materials (e.g., those that were in exceedence) on how to minimize use, alternative materials, and collection and disposal methodology.
- B4. Consider a change to the waste treatment system. This could include a pretreatment system (e.g., at source location) for particular types of wastes; direction of laboratory wastes to a treatment system such as an aerated tank that will allow it to be retained for blending with other wastewater; or other systems such as activated carbon treatment systems, flotation, or settling systems for solids removal or biological treatment for BOD removal.
- B5. Consider undertaking an optimization study to determine the problems that might be leading to the poor operation with recommendations for remedial measures that can be all-encompassing (deal with any aspect of the design and operation of the treatment system).

Once action has been taken and new measures are in place, repeat the monitoring-reporting and the tier 1-A compare step. If tasks A.1 to A.7 do not indicate any exceedences, perform the Lethality Check ([Section 3.7](#)) and the Other Lines of Evidence Check ([Section 3.8](#)). Where tasks A.1 to A.7 indicate exceedences, return to the tier 1-B take action step. Existing or conventional wastewater treatment technology must be implemented to the extent necessary to achieve the effluent quality specified in [Section 2.0](#) of this document. If all possible actions have been performed and substances or parameters are still in exceedence, the exceeding substances or parameters should enter tier 2 of the Wastewater Effluent Management Framework. Only a minority of facilities should go to tier 2. Those substances and parameters that are not in exceedence are not considered further.

3.4 Tier 2 — Facility-Specific Discharge Guidelines

General

Tier 2 of the Wastewater Effluent Quality Management Framework for Canadian federal facilities relies on site-specific dilution factors. It is consistent with procedures used in Canadian provinces and territories and therefore closes the regulatory gap. Tier 2 requires more information on the facility discharging wastewater and the water body receiving the discharge. A site-specific dilution factor is applied to a CWQG to obtain a Facility-Specific Discharge Guideline. The site-specific dilution factor should take into account the effluent discharge rate, receiving water flow, and any other factor that may impact on dilution at the specific facility (e.g., factors causing incomplete mixing).

There are numerous models available that estimate dilution of wastewater in receiving water bodies (Jirka et al. 1996; Llewellyn 1998; McCutcheon 1989). For example, some models use the geometry of the receiving water body and the dilution characteristics of the mixing zone to estimate plume length and width and reductions in chemical concentrations with distance following discharge. A complete discussion of the appropriateness of the chosen method and the uncertainties and assumptions involved in its use must be provided when developing the site-specific dilution factor. Some Canadian provinces and U.S. states use dilution factors calculated under low flow conditions (e.g., 7Q10 — the minimum 7-day average flow with a 10-year recurrence period) for the receiving waters (CCME 1999).

Procedure

1. Calculate a site-specific dilution factor using a recognized model. Include a complete discussion of the appropriateness of the chosen method and the uncertainties and assumptions involved in its use.
2. Multiply the CWQG (CCME 1999) by the calculated site-specific dilution factor to obtain a Facility-Specific Discharge Guideline.
3. Compare the concentrations of the substances or parameters that have been found to be in exceedence of the tier 1 screening guideline to the Facility-Specific Discharge Guideline.

If none of the substances or parameters exceeds the Facility-Specific Discharge Guideline, perform the Lethality Check ([Section 3.7](#)) and the Other Lines of Evidence Check ([Section 3.8](#)). If the Facility-Specific Discharge Guidelines are exceeded, then the exceeding substances or parameters should enter tier 3 of the Wastewater Effluent Quality Management Framework. Those substances or parameters that do not exceed the Facility-Specific Discharge Guideline are not considered further.

3.5 Tier 3 — Site-Specific Discharge Guidelines

General

Tier 3 of the proposed framework examines the relationship between wastewater releases and the receiving water body in more detail. This is accomplished by using site-specific water quality objectives developed for the receiving water body and the site-specific dilution factor to arrive at a Site-Specific Discharge Guideline.

Federally, water quality objectives (WQOs) are defined as “numerical concentrations or narrative statements that have been established to support and protect designated uses of water at a specified site” (CCREM 1987). Site-specific water quality objectives (SSWQOs) are science-based tools generally expressed as numerical concentrations or narrative statements that establish the conditions necessary to support and protect the most sensitive designated use of water at a specified site (MacDonald 1997).

The science-based CWQGs (CCME 1999), modified to account for site-specific factors, are the basis for the development of SSWQOs (CCREM 1987). Details on the development of SSWQOs for federal facilities are provided in MacDonald (1997). Factors that may be considered include the local environmental conditions that modify chemical bioavailability (e.g., dissolved organic carbon, temperature, and pH) and absence of sensitive species locally. Guidance on the site-specific factors generally considered when modifying the CWQGs has been prepared by the CCME (CCREM 1987). Recent examples of site-specific objective development in Canada include an SSWQO for atrazine in the Yamaska River, Quebec (Caux and Kent 1995) and an examination of methods for deriving SSWQOs in British Columbia and Yukon (MacDonald 1997). The SSWQOs derived will be based on the best scientific data available. If there is no CWQG available on which to base the SSWQO, then the lowest existing, most recent (i.e., >1976) guideline used in any Canadian jurisdiction (i.e., national, provincial, or municipal) could be substituted with appropriate documentation. If there are not enough data to develop an SSWQO, a conservative interim SSWQO would be developed with available data and applied with caution. The interim SSWQO should be updated as data gaps are addressed.

Procedure

1. Develop an SSWQO or an interim SSWQO using the procedures described in MacDonald (1997) and CCREM (1987).
2. Multiply the SSWQO or interim SSWQO by the site-specific dilution factor developed in tier 2 to derive a Site-Specific Discharge Guideline.
3. Compare the concentrations of the substances or parameters that have been found to be in exceedence of the tier 2 guideline to the Site-Specific Discharge Guideline.

If none of the substances or parameters exceeds the Site-Specific Discharge Guideline, perform the Lethality Check ([Section 3.7](#)) and the Other Lines of Evidence Check ([Section 3.8](#)). If contaminant concentrations or parameters of the wastewater exceed the Site-Specific Discharge Guideline, then the chemical or parameter enters tier 4. Contaminants or parameters that have concentrations or levels below the Site-Specific Discharge Guidelines are not considered further.

3.6 Tier 4 — Risk Management

General

If a particular contaminant or parameter or group of contaminants and/or parameters passes through tiers 1 to 3, decisions must be made on how to reduce contaminant concentrations or parameters to acceptable levels. Social, economic, and legal issues are also incorporated into the decision-making process at this stage. The large number and diversity of federal facilities in Canada (e.g., army bases to office buildings) implies that the decision-making process will vary greatly between facilities. In some cases, full public involvement, negotiations with other facilities, and other consultations may be required. In others, the decision may rest solely with the facility caretaker. In all cases, however, the decision-making process in tier 4 should be transparent and open to stakeholders, clients, and other interested parties. This is desirable to demonstrate that the facility is addressing or has addressed any issues that may lead to adverse environmental effects in the receiving water body.

Risk managers entering tier 4 should be concerned about potential environmental impacts of their effluents. They should have a good knowledge of the environmental monitoring methods and environmental regulations of the federal, provincial, and territorial governments. A rational plan of action should ensue, depending on the information obtained in the previous tiers

Procedure

Managers may choose to conduct biological effects-based sampling and analysis to get information about fish populations and the health of benthos (EC 1998). If effects are found at these levels of organization, a site-specific ecological risk assessment may be required. Managers in tier 4 may also pursue further lethal and sublethal tests to ensure they have adequately addressed potential impacts from their effluent.

3.7 Lethality Check

Perform a 96-hour rainbow trout acute lethality test and a 48-hour *Daphnia magna* acute lethality test on the wastewater effluent from the specific facility using standardized test methods (EPS1/RM/13 and EPS1/RM/14 are suggested, respectively).

3.8 Other Lines of Evidence Check

There are a number of situations where evidence other than an exceedence of the discharge guidelines may indicate potential problems in the receiving water environment. For example, contaminant concentrations or parameter levels in the ambient environment may be found to exceed the CWQGs (CCME 1999) or sampling of the receiving water body biota may indicate that aquatic communities are degraded.

These other lines of evidence should be considered when assessing the impact of effluents to receiving water bodies. It is suggested that federal facilities maintain environmental effects

monitoring (EEM) programs including the regular testing and reporting of effluent toxicity and receiving water status. Guidance on EEM procedures can be obtained from the Environmental Effects Monitoring Division of Environment Canada or from Environment Canada's Web site at: www3.ec.gc.ca/eem.

The results of EEM programs, as well as any additional information regarding the effluent or receiving water body, can be factored into the analysis. Any number of factors may contribute to exceedences of CWQGs (CCME 1999), degraded aquatic communities, or toxic effluents even when discharge guidelines are not being exceeded. For example, a group of facilities releasing similar effluents to the same water body may meet discharge guidelines but the combined effluents released may cause adverse biological effects and exceed the CWQGs (CCME 1999).

In keeping with the stated federal policy to set and maintain a high national standard and take a leadership role in environmental protection with respect to its own activities, federal facilities are compelled to act in a conservative fashion when considering environmental impacts. If any other line of evidence indicates there is a cause for concern, steps must be taken to address the issue. This may involve reducing or eliminating outflow to the receiving water until the issue can be addressed through discussions/negotiation with other facilities releasing wastewater into the same receiving water body. Other actions may also be required.

4. WASTEWATER TREATMENT: OVERVIEW AND SUGGESTIONS

This section is included in the present document for information purposes. It is by no means exhaustive, limiting, or exclusive. New cost-effective technologies are welcomed and should be encouraged as a step forward in environmental protection. In all cases, federal facilities should conform to the federal discharge framework and guidelines and to applicable provincial and municipal regulations and bylaws.

4.1 Minimum Treatment

Generally, treatment should reflect the inputs to the system, the quality of the receiving waters, and no lethality in fish lethality tests. Treatment systems should be properly designed, operated, and maintained to meet these requirements.

The following wastewater systems, among others, can be considered: activated sludge processes (conventional and upgraded sequencing batch reactors [SBRs]), trickling filters, rotating biological contractors, and natural processes (lagoons, wetlands). Two-cell lagoon systems should be designed with a minimum of annual retention (longer retention periods where climatic extremes warrant). The frequency of discharge may vary depending on the jurisdiction. Procedures for discharging can be obtained from local Environmental Protection Service offices. Land disposal systems such as one-celled total retention lagoons or fully controlled spray irrigation should be considered acceptable provided soil, groundwater, and climatic conditions are satisfactory. In fully controlled spray irrigation systems, the irrigation water, as a minimum requirement, should meet the effluent quality guidelines specified in [Appendix A](#), with the exception of spray irrigation of food crops, orchards, pasture lands, or

recreational areas, where more stringent guidelines on irrigation water are necessary because of a public health risk. In these cases, the appropriate CCME 1999 guidelines should be followed. Septic tanks with subsurface disposal systems should be considered satisfactory when soil, groundwater, and climatic conditions are suitable as determined by on-site investigations or when water going out to the subsurface disposal system can be shown to conform to guideline values. Holding tanks are not considered a viable long-term solution, but should be considered acceptable provided their operation constitutes no threat to public health or does not impair the aesthetic conditions of the site at which they are used. The contents of such holding tanks should be disposed of on a regular basis in accordance with the requirements and guidelines outlined in this document. Septic tanks or Imhoff tanks discharging directly to surface waters are not considered acceptable. Other treatment systems (e.g., SBRs, extended aeration, and membrane systems) able to meet minimum effluent limits can also be acceptable.

4.2 Small Treatment Systems

In applying these guidelines, special consideration should be given to small installations where the use of the above-mentioned treatment systems is not feasible. In such cases, the method of wastewater treatment and disposal selected should be based on public health considerations, aesthetics, and the need to protect the local environment. An example of a small treatment system to be used in such situations is a package plant. Small treatment systems should comply with the Federal framework and guidelines, and with local regulations, statutes and by-laws. Some small treatment systems, such as the "Shoot Out" system, pose a high health risk to the public and therefore are considered unsuitable.

4.3 Disinfection

The discharge of a chlorinated effluent from a federal establishment to a receiving stream may, in some instances, prove hazardous to the habitat and life of fish and shellfish native to that body of water. Non-chlorine options must be pursued wherever possible. (Note: Chlorinated wastewater effluents are CEPA toxic.)

Disinfection processes should effectively inactivate bacteria, viruses, and protozoa in the wastewater.

Chlorine, if used for disinfection until alternative methods of disinfection or dechlorination are implemented, should be measured in the effluent as often as required (twice daily for some systems) to ensure surface water quality is protected.

4.4 Advanced Wastewater Treatment

Technology is available that will permit the installation of advanced wastewater treatment systems when an effluent quality higher than the minimum contained in Appendix A is required. Locations for such installations should be based on receiving water quality and the

presence of environmentally sensitive areas.

4.5 Reliability

The treatment facility should be capable of satisfactory operation during emergencies, maintenance shut downs, and power failures. This type of reliability may be achieved through such measures as standby or alternate units, holding tanks, or standby power sources, with flexibility of piping and pumping facilities to permit re-routing of flows under emergency conditions. Designers must include such features in their product.

4.6 Discharges to Shellfish, Water Supply Areas or Recreational Waters

Discharges within 150-meter radius to shellfish beds, public water supply areas or contact recreation areas should be avoided. Where such discharges are unavoidable, the type of treatment and/or disinfection should be determined based on specific site characteristics and nature of the problem.

4.7 Elimination of By-Passes and Overflows

Every effort shall be made to eliminate the discharge of untreated or partially treated wastewater to receiving waters by using detention facilities, physical treatment and disinfection of bypasses and overflows, correction of excessive infiltration, and segregation of clean water for discharge to the storm drainage system.

4.8 Environmental Compatibility

All wastewater treatment systems serving federal establishments should take into account all aspects of environmental protection and energy conservation. Efforts should be made to conserve natural resources and to preserve natural beauty, wildlife, recreational areas, historic sites, and private property.

4.9 Pretreatment

In cases where the discharge of an effluent from a federal establishment may cause fire or explosion or be injurious in any other way to a collection or treatment facility, or cause the violation of applicable effluent or receiving water standards or sewer bylaws, pretreatment or prohibition of the discharge of such materials to the sewer system is required.

4.10 Discharge to Municipal Systems

The use of municipal facilities for treatment and disposal of effluents from federal establishments shall be encouraged provided the municipality itself complies with Federal

Discharge Guidelines and provincial regulations or intends to do so within a reasonable time frame. In cases where municipal systems are inadequate, the impact of the effluent from the federal establishment should be assessed, in consultation with the municipality and an appropriate action plan to bring the effluent to within acceptable limits established.

Facilities discharging wastewater other than domestic wastewater to a municipal treatment system should adopt pollution prevention (and pretreatment) approaches. Many municipal sewer use bylaws have specific prohibitions regarding CEPA schedule 1 - track 1 substances. Any substances or parameters listed on CEPA, schedule 1 that are track 1, should not enter into the municipal system.

Federal facilities should inform municipalities of known discharges to municipal systems. Substance or parameter must not be used or disposed into a wastewater system or storm drainage system in an amount or at a rate of release that could impair the following:

- the integrity of the wastewater collection system or the storm drainage collection system
- the operation or performance of a wastewater treatment plant or storm drainage treatment facility
- the quality of storm drainage or treated wastewater and gases and sludge produced in the treatment process
- the health and safety of municipal workers
- the quality of biosolids.

4.11 Operation and Maintenance

In the design of any wastewater treatment system, consideration must be given to anticipated expansion or development, operational and maintenance requirements, and the qualifications of the personnel who will be responsible for its operations. All treatment systems will require some degree of attention. Therefore, it will be necessary to assign this responsibility to specific individuals who are qualified to operate the system efficiently and effectively so as to achieve the highest level of treatment at all times. Operators should be trained and certified under existing provincial and federal programs.

4.12 Storm Sewer Discharges

In addition to sewage, municipal wastewater also includes stormwater and combined sewer overflows which also may be contaminated and not in compliance with the Fisheries Act. Urban stormwater is precipitation runoff primarily from streets, parking areas, and roofs. Storm sewers are designed to capture and carry surface run-off to the nearest creek, stream, river or receiver. Generally, stormwater is not significantly contaminated but may be in situations where the originating surface is contaminated or is subject to spills or unauthorized disposal. Discharges that are acceptable include roof and foundation drains and, depending

upon the activity carried out, runoff from ground and paved areas. Nothing but uncontaminated water should be discharged to a storm sewer. Unpolluted cooling water may be discharged to storm sewers provided the temperature guidelines noted in Appendix A are not exceeded. Where stormwater is contaminated, control at the source of the contamination may be all that is required for the stormwater to meet acceptable discharge criteria. In rare situations further management options, such as end-of-pipe treatment, may be required.

Combined sewer discharges occur when a combination of sewage and stormwater overflow directly to the environment. This normally occurs during precipitation incidents where sewage and stormwater are collected in the same pipe system and the system is unable to handle the increased flow. Federal facilities that have combined systems should develop a plan to separate the sewage and stormwater systems. In the interim there are management approaches that can be applied to minimize combined discharges and their impacts.

In order to ensure that any proposed discharges to the storm drainage are acceptable and will not degrade receiving water quality, the Environmental Protection Branch should be consulted, giving the source of discharge, the volume, and if possible, its expected quality.

Federal facilities should comply with all provincial and municipal regulations and by-laws regarding stormwater discharge.

4.13 Treatment and Disposal of Sludge

The disposal of untreated sewage sludge must be to a facility designed for the handling and disposing of sludge. The discharge of untreated sewage sludge to the environment is not considered an acceptable practice. Untreated sewage sludge includes raw sludge removed from septic tanks and holding tanks, as well as unprocessed sludge removed from wastewater treatment systems indicated earlier in [Sections 3.1](#), [3.2](#), and [3.4](#). Treated sludge should not be discharged into receiving waters or treatment plant effluents. Ocean dumping of treated sludge is not permitted.

The design, operation, and maintenance of sludge treatment and disposal facilities will ensure protection of the receiving environment and safety to public health. Processes involving the treatment and disposal of sludge should reflect the best practicable technology available, as well as integrate uniformly into wastewater treatment systems. The method of disposal of treated sewage sludge should comply with the requirements of concerned municipal and provincial authorities. Technical assistance for selecting and managing sludge disposal systems is available from the local Environmental Protection Service offices.

References

- Bailey, J.E., and D.F. Ollis. 1977. Biological Reactors, Substrates, and Products II: Mixed Microbial Populations in Applications and Natural Systems. *In*. Biochemical Engineering Fundamentals. McGraw-Hill, Inc., New York. ISBN 0-07-003210-6.
- Caux, P.Y and R.A. Kent. 1995. Towards the Development of a Site-Specific Water Quality Objective for Obtrusion in the Imasco River, Quebec, for the Protection of Aquatic Life. *Water Qual. Res. J. Can.* 30(2):157–178.
- CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Environmental Quality Guidelines. Canadian Council of Ministers of the Environment, Winnipeg.
- CCREM (Canadian Council of Resource and Environment Ministers). 1987. Appendix IV— Factors to Consider When Using Canadian Guidelines to Develop Site-Specific Water Quality Objectives. *In*. Canadian Water Quality Guidelines. Prepared by the Task Force on Water Quality Guidelines of the Canadian Council of Ministers of the Environment.
- EC (Environment Canada). 1976. Guidelines for Effluent Quality and Waste Water Treatment at Federal Establishments. EPS 1-EC-76-1.
- . 1997. Environmental Assessments of Priority Substances under the Canadian Environmental Protection Act - Guidance Manual Version 1.0. Chemicals Evaluation Division, Commercial Chemicals Evaluation Branch, Environment Canada. EPS/2/CC/3E.
- . 1998. Pulp and Paper Technical Guidance for Aquatic Environmental Effects Monitoring. EEM/1998/1.
- . 1999. Canadian Environmental Protection Act Priority Substance List Assessment for Phenol - Supporting Document.
- Encyclopedia Britannica. 1999-2000. Environmental Works.
<<http://www.britannica.com/bcom/eb/article/8/0,5716,127658+12+117295,00.html>>
(Britannica.com Inc. 1999-2000).
- Jirka, G.H., R.L. Doneker, and S.W. Hinton. 1996. User's Manual for Cormix: A Hydrodynamic Mixing Zone Model and Decision Support System for Pollutant Discharges into Surface Waters. Office of Science and Technology, U.S. Environmental Protection Agency, Washington, D.C. Cooperative Agreement No. CX824847-01-0.
- Llewellyn, G. 1998. Pollutant Dispersion Modelling in Water. *In*. Pollution Risk Assessment and Management, P.E.T. Douben, ed. Ecological & Environmental Toxicology Series. John Wiley & Sons, Toronto. ISBN 0-471-97297-5.
- MacDonald, D.D. 1997. Methods for Deriving Site-Specific Water Quality Objectives in British Columbia and Yukon. Prepared by: D.D. MacDonald, MacDonald Environmental Sciences Ltd., 1733 Idaho Place, Nanaimo, B.C. V9X 1C6. Prepared for: N. Nagpal, Water Management Branch, B.C. Ministry of Environment Lands and Parks, 2975 Jutland Road, Victoria, B.C. V8W 9M1 and B. Godin, Environmental Contaminants Section, Environment Canada, Mile 917.6 Alaska Highway, Building B, Whitehorse, Yukon, Y1A 5X7.
- McCutcheon, S.C. 1989. Water Quality Modeling. Volume I: Transport and Surface Exchange in Rivers. R.H. French, ed. CRC Press Inc., Boca Raton, Florida.

- Regulations of Ontario. 1999. Sewage Systems RRO 1990 reg.358-
<http://209.195.107.57/cgi-bin/om_isapi.dll?clientID=1259&infobase=Regulations%20of%20Ontario&softpage=Browse_Frame_Pg> (1 January 1999).
- Rhyner, C.R., L. J. Schwartz, R.B. Wenger, and M.G. Kohrell. 1995. Wastewater Treatment. *In*. Waste Management and Resource Recovery. Lewis Publishers, New York. ISBN 0-87371-572-1.
- Suter II, G.W. 1995. Introduction to Ecological Risk Assessment for Aquatic Toxic Effects. *In*. Fundamentals of Aquatic Toxicology - Effects, Environmental Fate, and Risk Assessment Second Edition. G.M. Rand ed. Taylor & Francis, Washington, D.C. ISBN 1-56032-091-5.

APPENDIX A: Federal Discharge Guidelines

It is intended that the Environmental Protection Service of Environment Canada will revise and amend these guidelines from time to time in order to reflect changing processes in facilities, new developments in technology, and further understanding of the impacts of wastewater on the environment.

Discharge guidelines were selected from the guidelines already in place in Canadian jurisdictions. To select the discharge guidelines, the most stringent of the guidelines in place in Canadian jurisdictions was compared to the CWQGs. If, through this comparison, the most stringent of the guidelines in place in Canadian jurisdictions was found to be science-based, reasonable, and protective of the environment, it was retained and became the Federal Discharge Guideline as presented in [Table 1](#).

Table 1. Federal Discharge Guidelines for Wastewater at Point of Discharge

Parameter	Discharge Guideline (in mg· L ⁻¹ unless indicated)		Reference to Guidelines	Canadian Water Quality Guideline for the Protection of Aquatic Life** (in mg· L ⁻¹ unless indicated)	
Biological Oxygen Demand (BOD)	Freshwater lakes, low flow streams	5	Nova Scotia Sewage Treatment Plant Effluent Discharge Policy ¹	-	-
	Rivers and estuaries	20		-	-
	Open coastline	30		-	-
Fecal Coliform	100/100 mL		Manitoba Surface Water Quality Guidelines (×10 safety factor)	-	-
Total Coliform	1000/100 mL		Alberta Standards and Guidelines for Municipal Waterworks, Waste Water and Storm Drainage Systems	-	-
Total Suspended Solids (TSS)	Freshwater lakes, low flow streams	5	Nova Scotia Sewage Treatment Plant Effluent Discharge Policy ²	Clear Flow: 25 mg· L ⁻¹ increase from background for short durations (e.g., 24 h), 5 mg· L ⁻¹ for long durations (e.g., 30 d) High Flow: 25 mg· L ⁻¹ increase from background of 25–250 mg· L ⁻¹ and 10% over background when background >250 mg· L ⁻¹	
	Rivers and estuaries	20			
	Open coastline	30			
Reactive Chlorine	0.01 or current limit of detection		Revised Federal Water Quality Guidelines	0.005	
pH	6 to 9		Guidelines for Effluent Quality from Federal	6.5–9.0	7.0–8.7 ³

Parameter	Discharge Guideline (in mg· L ⁻¹ unless indicated)	Reference to Guidelines	Canadian Water Quality Guideline for the Protection of Aquatic Life** (in mg· L ⁻¹ unless indicated)	
		Establishments, 1976		
Phenols (monohydric and dihydric)	0.02	Guidelines for Effluent Quality from Federal Establishments, 1976	0.004	-
Oil and Grease	5	Yukon effluent guidelines (for discharge license or permit) ⁴	-	-
Temperature	Not to alter ambient by more than 1°C	Guidelines for Effluent Quality from Federal Establishments, 1976	See note ⁵	Not to exceed ± 1°C ⁶
Ammonia	1.0	Manitoba effluent limits ⁷	0.01–32 (pH dependent) ⁸	-
Nitrates	10	Newfoundland Environmental Control Water and Sewage Regulations	Concentrations that stimulate weed growth should be avoided.	-
Sulphides	0.5	Guidelines for the Discharge of Treated Municipal Waste Water in the Northwest Territories ⁹	-	-
Glycols: Ethylene glycol Propylene glycol	100	Canadian Environmental Protection Act: glycol guideline	192 mg· L ⁻¹ 500 mg· L ⁻¹	-
Hexachloro-benzene	0.001	Federal Hazardous Waste Regulations	-	-
Aluminum (total)	2	Guidelines for the Discharge of Treated Municipal Waste Water in the Northwest Territories		
Arsenic	0.05		0.005	0.0125
Barium	1.0		-	-
Boron	5.0		-	-
Cadmium	0.005		0.000017	0.00012
Chromium	0.05		See Cr (III) and Cr (IV)	
Chromium	0.05		Newfoundland Environmental	0.001

Parameter	Discharge Guideline (in mg· L ⁻¹ unless indicated)	Reference to Guidelines	Canadian Water Quality Guideline for the Protection of Aquatic Life** (in mg· L ⁻¹ unless indicated)	
(hexavalent)		Control Water and Sewage Regulations		
Chromium (trivalent)	1.0		0.0089	0.056
Cobalt	0.1	Guidelines for the Discharge of Treated Municipal Waste Water in the Northwest Territories	-	-
Copper	0.2		0.002–0.004	-
Cyanide	0.025		0.005	-
Fluoride	5.0		Under development	-
Iron	0.3		0.3	-
Lead	0 (limit of detection)	United Nations Economic Commission for Europe (U.N. E.C.E.) Agreement on Heavy Metals	0.001–0.007	-
Manganese	0.05	Guidelines for the Discharge of Treated Municipal Waste Water in the Northwest Territories	-	-
Mercury	0 (limit of detection)	U.N. E.C.E Agreement on Heavy Metals	0.0001	-
Methylene Blue Active Substances (MBAS)	5.0	Guidelines for the Discharge of Treated Municipal Waste Water in the Northwest Territories	-	-
Molybdenum (total)	0.2		0.073	-
Nickel	0.3		0.025–0.15	-
Phosphorous	1.0	B.C. Waste Management Act Municipal Sewage Regulation	-	-
Ortho-phosphates ¹⁰	0.5		-	-
Phosphorous	0.0005	Newfoundland Environmental	-	-

Parameter	Discharge Guideline (in mg· L ⁻¹ unless indicated)	Reference to Guidelines	Canadian Water Quality Guideline for the Protection of Aquatic Life** (in mg· L ⁻¹ unless indicated)	
(elemental)		Control Water and Sewage Regulations		
Selenium	0.05	Guidelines for the Discharge of Treated Municipal Waste Water in the Northwest Territories	0.001	0.001
Silver	0.1		0.0001	-
Tin	5.0		-	-
Zinc	0.5		0.03	-
Schedule 1 substances that are track 1 of the Canadian Environmental Protection Act	0 (limit of detection)	In accordance with CEPA, Schedule 1	See CCME 1999	

**CCME 1999.

APPENDIX B: Glossary

advanced wastewater treatment: Treatment systems designed to remove pollutants that are not adequately removed by conventional secondary treatment processes.

best practicable technology: Involves the use of production processes, activity practices, and control equipment that are technically feasible and economically possible. It is dynamic and will be progressively updated in the light of new developments in technology, social attitudes, and pressures of continued growth.

biochemical oxygen demand (BOD): The quantity of oxygen used in the biochemical oxidation of organic matter in five days at 20°C under aerobic conditions.

chlorine residual: The amount of chlorine (combined and free available chlorine) remaining in effluents after a specified contact time.

contaminant: Any chemical substance whose concentration exceeds background concentrations or that does not naturally occur in the environment.

chlorination: (1) The process of introducing one or more chlorine atoms into a compound. (2) The application of chlorine to water, sewage, or industrial wastes for disinfection or for other biological or chemical results.

effluents: Any wastewater discharged directly or indirectly to surface waters or to any storm sewer, and the runoff from land used for disposal of wastewater sludge, spray irrigation, or other wastes, but does not otherwise include land runoffs.

framework: Structure intended to delimit and support a piece of work. That part of a structure that gives shape and support.

Imhoff tank: In wastewater treatment, a tank without aeration or oxygenation where solids settle out. The solids are digested in a separate compartment in the bottom.

grab sample: A single sample of wastewater taken at neither a set time or flow.

land runoff: Water reaching the receiving streams or other body of water directly or indirectly as runoff from precipitation.

pH: A value taken to represent the acidity or alkalinity of an aqueous solution. It is defined as the negative logarithm of the hydrogen ion activity of the solution.

primary treatment: In primary treatment, the most easily separated contaminants are removed. This includes removal of readily separated solids, oil films, and other "light" components. Primary treatment removes about 60% of total suspended solids and about 35% of BOD and 50% pathogens; dissolved impurities are not removed. It is usually used as a first step before secondary treatment.

proprietary aerobic sewage treatment plant: A unit that is available commercially and that consists of one or more watertight vaults or compartments in which sewage is collected for the purpose of removing scum, grease and solids from the liquid and in which sewage is brought into contact with air to cause oxidation of the sewage and that discharges effluent for further treatment or for disposal into the soil.

receiving water (or receiving environment): Surface water or groundwater that has either treated or untreated wastes discharged to it.

risk assessment: A set of scientific methods for defining and estimating the probability and magnitude of undesired effects to receptors resulting from a specific event, such as human action, a natural catastrophe, or an exposure to a substance.

runoff: The portion of the total precipitation on an area that flows into stream channels. Water from surface runoff does not enter the soil. Water from groundwater runoff or seepage flow enters the soil before reaching the stream.

secondary treatment: A combination of biological or chemical processes with mechanical and/or gravitational methods to remove dissolved, colloidal, and suspended matter. This degree of treatment is considered to result in the removal of at least 85% of suspended solids and BOD.

septic tank: A watertight vault in which sanitary sewage is collected for the purpose of removing scum, grease and solids from the liquid without the addition of air and where solids settling and anaerobic digestion of the sanitary sewage takes place. The effluent is then discharged for further treatment or for disposal into the soil.

sewage lagoon: Sewage lagoons are man-made earthen basins (ponds) used for the treatment of wastewater by applying natural processes of mainly bacteria, light and algae to reduce organic matter to acceptable levels. The types of lagoons that are utilized for the treatment include aerobic, facultative and anaerobic ponds.

small treatment systems: Small treatment systems are systems of relatively small wastewater flows servicing rural communities with populations ranging from 100 to 2000 and more residents. Treatment options that are usually considered for such systems include: small package plants, stabilization ponds, septic systems, constructed wetlands and other.

spray irrigation: System with long tubes fixed on both end of the water source to dispose and recycle wastewater from a municipal system.

stormwater: Water from rainfall or other natural precipitation or drainage or melting of snow or ice.

suspended solids: Solid matter that either floats or is suspended in water, sewage, or other liquids and that can be removed largely by laboratory filtering.

tertiary treatment: Tertiary treatment uses chemical addition, or physical or biological

processes to improve the quality of effluent beyond secondary wastewater treatment. When more than 85% of total solids and BOD must be further reduced, or when concentrations of nitrogen and phosphorus must be reduced, tertiary treatment methods are used. Tertiary processes can remove more than 99% of all the impurities from sewage. The object of tertiary treatment (also called advanced treatment) is to produce a high quality effluent using the best available technology.

tertiary sewage treatment unit: A sewage treatment unit that has been designed by its manufacturer to produce effluent that contains 10 milligrams per litre or less of total suspended solids and BOD.

total phosphorous: The sum of all forms of phosphate normally present in domestic wastewater, including ortho-phosphates, polyphosphates, metaphosphates, pyrophosphates, and organic phosphates, expressed in terms of concentration of P.

toxic: Causing or having the potential to cause adverse effects to organisms or populations.

24-hour composite sample: A sample that consists of several effluent portions (usually one per hour) collected in a 24-hour period and composited according to flow.

two-celled lagoon system: System to remove and dispose of biosolids.

waste: Useless, unwanted, or discarded materials resulting from normal activities at federal installations. Waste include solids, liquids, and gases.

wastewater: The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In recent years. The term wastewater has taken precedence over the term sewage.

wastewater manager: General term meant to include everyone having something to do with the technical and administrative tasks and decisions related to wastewater treatment and discharge.

wildlife: In reference to tissue residue guidelines, wildlife encompasses mammalian, avian, reptilian, and amphibian species that consume aquatic biota.

APPENDIX C: Abbreviations and Acronyms

ARET: Action on the Release and Elimination of Toxics

BOD: biochemical oxygen demand

CEPA: Canadian Environmental Protection Act

CWQG: Canadian Water Quality Guideline

EEM: Environmental Effects Monitoring

EMS: Environmental Management Systems

FSSCL: Facility-Specific Substances of Concern list

NPRI: National Pollutant Release Inventory

SBR: sequencing batch reactor

SSWQO: Site-Specific Water Quality Objectives

TSS: total suspended solids

WQO: Water Quality Objectives

APPENDIX D: Lists of Substances of Potential Concern**1) National Pollutant Release Inventory**

SCHEDULE I:

National Pollutant Release Inventory Substances

Chemical name	CAS Number
1. Acetaldehyde	75-07-0
2. Acetone	67-64-1
3. Acetonitrile	75-05-8
4. Acrylamide	79-06-1
5. Acrylic acid (and salts)	2 79-10-7
6. Acrylonitrile	107-13-1
7. Allyl alcohol	107-18-6
8. Allyl chloride	107-05-1
9. Aluminum (fume / dust)	7429-90-5
10. Aluminum oxide(fibrous forms)	1344-28-1
11. Ammonia (total) ³	*
12. Aniline (and its salts)	62-53-3 12
13. Anthracene	120-12-7 13
14. Antimony (and its compounds)	*
15. Arsenic (and its compounds)	*
16. Asbestos (friable form)	1332-21-4
17. Benzene	71-43-2
18. Benzoyl chloride	98-88-4
19. Benzoyl peroxide	94-36-0
20. Benzyl chloride	100-44-7
21. Biphenyl	92-52-4
22. Bis(2-ethylhexyl) adipate	03-23-1
23. Bis(2-ethylhexyl) phthalate	117-81-7
24. Bromomethane	74-83-9
25. 1,3-Butadiene	106-99-0
26. Butyl acrylate	141-32-2
27. i-Butyl alcohol	78-83-1
28. n-Butyl alcohol	71-36-3
29. sec-Butyl alcohol	78-92-2
30. tert-Butyl alcohol	75-65-0
31. Butyl benzyl phthalate	85-68-7
32. 1,2-Butylene oxide	106-88-7
33. Butyraldehyde	123-72-8
34. Acid Green 3	4680-78-8
35. Basic Green 4	569-64-2
36. Basic Red 1	989-38-8

37. Disperse Yellow 3	2832-40-8
38. Food Red 15	81-88-9
39. Solvent Orange 7	3118-97-6
40. Solvent Yellow 14	842-07-9
41. Cadmium (and its compounds)	*
42. Calcium cyanamide	156-62-7
43. Carbon disulphide	75-15-0
44. Carbon tetrachloride	56-23-5
45. Catechol	120-80-9
46. Chlorine	7782-50-5
47. Chlorine dioxide	10049-04-4
48. Chloroacetic acid (and salts)	79-11-8
49. Chlorobenzene	108-90-7
50. Chloroethane	75-00-3
51. Chloroform	67-66-3
52. Chloromethane	74-87-3
53. Chromium (and compounds)	*
54. Cobalt (and compounds)	*
55. Copper (and compounds)	*
56. Cresol (mixed isomers and salts)	1319-77-3
57. m-Cresol (and its salts) 2	108-39-4
58. o-Cresol (and its salts) 2	95-48-7
59. p-Cresol (and its salts) 2	106-44-
60. Cumene	98-82-8
61. Cumene hydroperoxide	80-15-9
62. Cyanides (ionic)	*
63. Cyclohexane	110-82-7
64. Decabromodiphenyl oxide	1163-19-5
65. 2,4-Diaminotoluene (and salts)	95-80-7
66. Dibutyl phthalate	84-74-2
67. o-Dichlorobenzene	95-50-1
68. p-Dichlorobenzene	106-46-7
69. 1,2-Dichloroethane	107-06-2
70. Dichloromethane	75-09-2
71. 2,4-Dichlorophenol (and salts)	120-83-2
72. 1,2-Dichloropropane	78-87-5
73. Diethanolamine (and its salts)	111-42-2
74. Diethyl phthalate	84-66-2
75. Diethyl sulphate	64-67-5
76. N,N-Dimethylaniline (and salts)	121-69-7
77. Dimethyl phthalate	131-11-3
78. Dimethyl sulphate	77-78-1
79. 4,6-Dinitro-o-cresol (and salts)	534-52-1
80. 2,4-Dinitrotoluene	121-14-2
81. 2,6-Dinitrotoluene	606-20-2
82. Dinitrotoluene (mixed isomers)	25321-14-6

83. Di-n-octyl phthalate	117-84-0
84. 1,4-Dioxane	123-91-1
85. Epichlorohydrin	106-89-8
86. 2-Ethoxyethanol	110-80-5
87. 2-Ethoxyethyl acetate	111-15-9
88. Ethyl acrylate	140-88-5
89. Ethylbenzene	100-41-4
90. Ethyl chloroformate	541-41-3
91. Ethylene	74-85-1
92. Ethylene glycol	107-21-1
93. Ethylene oxide	75-21-8
94. Ethylene thiourea	96-45-7
95. Formaldehyde	50-00-0
96. Hexachlorocyclopentadiene	77-47-4
97. Hexachloroethane	67-72-1
98. Hydrazine (and its salts) 2	302-01-2
99. Hydrochloric acid	7647-01-0
100. Hydrogen cyanide	74-90-8
101. Hydrogen fluoride	7664-39-3
102. Hydroquinone (and its salts)	123-31-9
103. Isobutyraldehyde	78-84-2
104. Isopropyl alcohol	67-63-0
105. p,p'-Isopropylidenediphenol	80-05-7
106. Isosafrole	120-58-1
107. Lead (and its compounds)	*
108. Maleic anhydride	108-31-6
109. Manganese (and its compounds)	*
110. Mercury (and its compounds)	*
111. Methanol	67-56-1
112. 2-Methoxyethanol	109-86-4
113. 2-Methoxyethyl acetate	110-49-6
114. Methyl acrylate	96-33-3
115. Methyl tert-butyl ether	1634-04-4
116. p,p'-Methylenebis(2-chloroaniline)	101-14-4
117. Methylenebis(phenylisocyanate)	101-68-8
118. p,p'-Methylenedianiline	101-77-9
119. Methyl ethyl ketone	78-93-3
120. Methyl iodide	74-88-4
121. Methyl isobutyl ketone	108-10-1
122. Methyl methacrylate	80-62-6
123. Michler's ketone (and its salts)	90-94-8
124. Molybdenum trioxide	1313-27-5
125. Naphthalene	91-20-3
126. Nickel (and its compounds)	*
127. Nitrate ion (sol. pH => 6.0)	*
128. Nitric acid	7697-37-2

129.Nitrilotriacetic acid (and salts)	139-13-9
130.Nitrobenzene	98-95-3
131.Nitroglycerin	55-63-0
132.p-Nitrophenol (and its salts)	100-02-7
133.2-Nitropropane	79-46-9
134.N-Nitrosodiphenylamine	86-30-6
135.Peracetic acid (and its salts)	79-21-0
136.Phenol (and its salts)	2 108-95-2
137.p-Phenylenediamine (and salts)	106-50-3
138.o-Phenylphenol (and salts)	290-43-7
139.Phosgene	75-44-5
140.Phosphoric acid	7664-38-2
141.Phosphorus (yellow or white)	7723-14-0
142.Phthalic anhydride	85-44-9
143.Propionaldehyde	123-38-6
144.Propylene	115-07-1
145.Propylene oxide	75-56-9
146.Pyridine (and its salts) 2	110-86-1
147.Quinoline (and its salts) 2	91-22-5
148.p-Quinone	106-51-4
149.Safrole	94-59-7 1
150.Selenium (and compounds)	*
151.Silver (and its compounds)	*
152.Styrene	100-42-5
153.Styrene oxide	96-09-3
154.Sulphuric acid	7664-93-9
155.1,1,2,2-Tetrachloroethane	79-34-5
156.Tetrachloroethylene	127-18-4
157.Thiourea	62-56-6
158.Thorium dioxide	1314-20-1
159.Titanium tetrachloride	7550-45-0
160.Toluene	108-88-3
161.Toluene-2,4-diisocyanate	584-84-9
162.Toluene-2,6-diisocyanate	91-08-7
163.Toluenediisocyanate	26471-62-5
164.(mixed isomers)	
165.1,2,4-Trichlorobenzene	120-82-1
166.1,1,2-Trichloroethane	79-00-5
167.Trichloroethylene	79-01-6
168.1,2,4-Trimethylbenzene	5-63-6
169.Vanadium (fume or dust)	7440-62-2
170.Vinyl acetate	108-05-4
171.Vinyl chloride	75-01-4
172.Vinylidene chloride	75-35-4
173.Xylene (mixed isomers)	1330-20-7
174.m-Xylene	108-38-3

175.o-Xylene	95-47-6
176.p-Xylene	106-42-3
177.Zinc (and its compounds)	*

* No single CAS number applies to this NPRI listing.

2) List of the 73 New NPRI Substances for the 1999 Reporting Year

Chemical Name	CAS Number
Acetophenone	98-86-2
Alkanes, C6-18, chloro	68920-70-7
Alkanes, C10-13, chloro	85535-84-8
Boron trifluoride	7637-07-2
Bromine	7726-95-6
1-Bromo-2-chloroethane	107-04-0
2-Butoxyethanol	111-76-2
C.I. Direct Blue 218	28407-37-6
Calcium fluoride	7789-75-5
CFC-11	75-69-4
CFC-12	75-71-8
CFC-13	75-72-9
CFC-114	76-14-2
CFC-115	76-15-3
Chlorendic acid	115-28-6
3-Chloro-2-methyl-1-propene	563-47-3
3-Chloropropionitrile	542-76-7
Crotonaldehyde	4170-30-3
Cyclohexanol	108-93-0
2,6-Di-t-butyl-4-methylphenol	128-37-0
3,3'-Dichlorobenzidine dihydrochloride	612-83-9
Dicyclopentadiene	77-73-6
Dimethylamine	124-40-3
Dimethyl phenol	1300-71-6
Diphenylamine	122-39-4
Ethoxynonyl benzene	28679-13-2
Fluorine	7782-41-4
Formic acid	64-18-6
Halon 1211	353-59-3
Halon 1301	75-63-8
HCFC-22	75-45-6
HCFC-122 and all isomers 2	41834-16-6
HCFC-123 and all isomers 3	34077-87-7
HCFC 124 and all isomers 4	63938-10-3
HCFC-141b	1717-00-6
HCFC-142b	75-68-3

Hexachlorophene	70-30-4
n-Hexane	110-54-3
Hydrogen sulphide	7783-06-4
Iron pentacarbonyl	13463-40-6
Isophorone diisocyanate	4098-71-9
Isoprene	78-79-5
Lithium carbonate	554-13-2
2-Mercaptobenzothiazole	149-30-4
1,1-Methylenebis(4-isocyanatocyclohexane)	5124-30-1
N-Methylolacrylamide	924-42-5
2-Methylpyridine	109-06-8
N-Methyl-2-pyrrolidone	872-50-4
p-Nitroaniline	100-01-6
Nonylphenol	104-40-5
Nonylphenol hepta(oxyethylene) ethanol	27177-05-5
Nonylphenol, industrial	84852-15-3
Nonylphenol nona(oxyethylene) ethanol	27177-08-8
n-Nonylphenol 5	25154-52-3
Nonylphenol polyethylene glycol ether	9016-45-9
p-Nonylphenol polyethylene glycol ether	26027-38-3
Nonylphenoxy ethanol	27986-36-3
2-(p-Nonylphenoxy) ethanol	104-35-8
2-(2-(p-Nonylphenoxy)ethoxy) ethanol	20427-84-3
2-(2-(2-(2-(p-Nonylphenoxy)ethoxy)ethoxy)ethoxy) ethanol	7311-27-5
Paraldehyde	123-63-7
Pentachloroethane	76-01-7
Potassium bromate	7758-01-2
Propargyl alcohol	107-19-7
Sodium fluoride	7681-49-4
Sodium nitrite	7632-00-0
Sulphur hexafluoride	2551-62-4
1,1,1,2-Tetrachloroethane	630-20-6
Tetracycline hydrochloride	64-75-5
Tetraethyl lead	78-00-2
Triethylamine	121-44-8
2,2,4-Trimethylhexamethylene diisocyanate	16938-22-0
2,4,4-Trimethylhexamethylene diisocyanate	15646-96-5

1. CAS Registry Number denotes the Chemical Abstracts Service Registry Number, as appropriate.
2. The isomers include, but are not necessarily limited to, HCFC-122 (CAS# 354-21-2).
3. The isomers include, but are not necessarily limited to, HCFC-123 (CAS#306-83-2) and HCFC 123a (CAS#90454-18-5).
4. The isomers include, but are not necessarily limited to, HCFC 124 (CAS# 2837-89-0), and HCFC 124a (CAS# 354-25-6).

3) Canadian Environmental Protection Act (CEPA), 1999

Central to CEPA is the categorization of some substances as toxic. Solid scientific research is essential to the ongoing process of identifying guidelines for the safe use of substances and to the creation of regulations to control their use, when necessary.

If research studies determine that a substance specified on the Priority Substances List is toxic or capable of becoming toxic, and the Ministers are satisfied that:

- (a) the substance may have a long-term harmful effect on the environment and is:
 - (i) persistent and bioaccumulative in accordance with the regulations, and
 - (ii) inherently toxic to human beings or non-human organisms, as determined by laboratory or other studies, and

(b) the presence of the substance in the environment results primarily from human activity,

then the Ministers of the Environment and of Health will recommend that the substance be added to the List of Toxic Substances (CEPA Schedule 1) and, if deemed track 1 substances, recommend the implementation of virtual elimination of the substance.

The Governor in Council may, if satisfied that a substance is toxic, on the recommendation of the Ministers, make an order adding the substance to the List of Toxic Substances in Schedule 1 of CEPA 1999 (updated Schedule 1 to March 2000).

Section 65 of CEPA 1999 mandates the Ministers of the Environment and of Health to compile a list to be known as the Virtual Elimination List. The Ministers must specify the level of quantification for each substance on the List and, having done so, must prescribe the quantity or concentration of the substance that may be released into the environment either alone or in combination with any other substance from any source or type of source.

CEPA SCHEDULE 1, LIST OF TOXIC SUBSTANCES

1. Chlorobiphenyls that have the molecular formula $C_{12}H_{(10-n)}Cl_n$ in which "n" is greater than 2
2. Dodecachloropentacyclo [5.3.0.02,6.03,9.04,8] decane
3. Polybrominated Biphenyls that have the molecular formula $C_{12}H_{(10-n)}Br_n$ in which "n" is greater than 2
4. Chlorofluorocarbon: totally halogenated chlorofluorocarbons that have the molecular formula $C_nCl_xF_{(2n+2-x)}$
5. Polychlorinated Terphenyls that have a molecular formula $C_{18}H_{(14-n)}Cl_n$ in which "n" is greater than 2
6. Asbestos
7. Lead
8. Mercury

9. Vinyl Chloride
10. Bromochlorodifluoromethane that has the molecular formula CF_2BrCl
11. Bromotrifluoromethane that has the molecular formula CF_3Br
12. Dibromotetrafluoroethane that has the molecular formula $C_2F_4Br_2$
13. Fuel containing toxic substances that are dangerous goods within the meaning of section 2 of the Transportation of Dangerous Goods Act, 1992 and that:
 - (a) are neither normal components of the fuel nor additives designed to improve the characteristics or the performance of the fuel; or
 - (b) are normal components of the fuel or additives designed to improve the characteristics or performance of the fuel, but are present in quantities or concentrations greater than those generally accepted by industry standards.
14. Dibenzo-para-dioxin that has the molecular formula $C_{12}H_8O_2$
15. Dibenzofuran that has the molecular formula $C_{12}H_8O$
16. Polychlorinated dibenzo-para-dioxins that have the molecular formula $C_{12}H_{(8-n)}Cl_nO_2$ in which "n" is greater than 2
17. Polychlorinated dibenzofurans that have the molecular formula $C_{12}H_{(8-n)}Cl_nO$ in which "n" is greater than 2
18. Tetrachloromethane (carbon tetrachloride, CCl_4)
19. 1,1,1-trichloroethane (methyl chloroform, CCl_3-CH_3)
20. Bromofluorocarbons other than those set out in items 10 to 12
21. Hydrobromofluorocarbons that have the molecular formula $C_nH_xF_yBr_{(2n+2-x-y)}$ in which $0 < n < 3$
22. Methyl Bromide
23. Bis(chloromethyl) ether that has the molecular formula $C_2H_4Cl_2O$
24. Chloromethyl methyl ether that has the molecular formula C_2H_5ClO
25. Hydrochlorofluorocarbons that have the molecular formula $C_nH_xF_yCl_{(2n+2-x-y)}$ in which $0 < n < 3$
26. Benzene that has the molecular formula C_6H_6

CEPA Toxic Substances List - Updated Schedule 1 to March 2000

1. Chlorobiphenyls that have the molecular formula $C_{12}H_{10-n}Cl_n$ in which "n" is greater than 2
2. Dodecachloropentacyclo [5.3.0.02,6.03,9.04,8] decane
3. Polybrominated Biphenyls that have the molecular formula $C_{12}H_{10-n}Br_n$ in which "n" is greater than 2
4. Chlorofluorocarbon: totally halogenated Chlorofluorocarbons that have the molecular formula $C_nC_{1-x}F_{(2n+2-x)}$
5. Polychlorinated terphenyls that have a molecular formula $C_{18}H_{14-n}Cl_n$ in which "n" is greater than 2
6. Asbestos
7. Lead
8. Mercury
9. Vinyl Chloride
10. Bromochlorodifluoromethane that has the molecular formula CF_2BrCl
11. Bromotrifluoromethane that has the molecular formula CF_3Br

12. Dibromotetrafluoroethane that has the molecular formula $C_2F_4Br_2$
13. Fuel containing toxic substances that are dangerous goods within the meaning of section 2 of the Transportation of Dangerous Goods Act and that:
 - (a) are neither normal components of the fuel nor additives designed to improve the characteristics or the performance of the fuel; or
 - (b) are normal components of the fuel or additives designed to improve the characteristics or performance of the fuels, but are present in quantities or concentrations greater than those generally accepted by industry standard
14. Dibenzo-para-dioxin that has the molecular formula of $C_{12}H_8O_2$
15. Dibenzofuran that has the molecular formula $C_{12}H_8O$
16. Polychlorinated Dibenzo-para-dioxins that have the molecular formula $C_{12}H_{(8-n)}O_2Cl_n$ where "n" is greater than 2
17. Polychlorinated dibenzofurans that have the molecular formula $C_{12}H_{(8-n)}OCl_n$ in which "n" is greater than 2
18. Tetrachloromethane (carbon tetrachloride) CCl_4
19. 1,1,1-trichloroethane (methyl chloroform) CCl_3-CH_3
20. Bromofluorocarbons other than those set out in items 10 to 12
21. Hydrobromofluorocarbons that have the molecular formula $C_nH_xF_yBr_{(2n+2-x-y)}$ in which $0 < n < 3$
22. Methyl Bromide
23. Bis(Chloromethyl) ether that has the molecular formula $C_2H_4Cl_2O$
24. Chloromethyl methyl ether that has the molecular formula C_2H_5ClO
25. Hydrochlorofluorocarbons that have the molecular formula $C_nH_xF_yCl_{(2n+2-x-y)}$ in which $0 < n < 3$
26. Benzene that has the molecular formula C_6H_6
27. (4-Chlorophenyl)cyclopropylmethanone,O-[(4-nitrophenyl)methyl]oxime that has the molecular formula $C_{17}H_{15}ClN_2O_3$
28. Inorganic arsenic compounds
29. Benzidine
30. Bis(2-ethylhexyl)phthalate
31. Inorganic cadmium compounds
32. Chlorinated wastewater effluents
33. Hexavalent chromium compounds
34. Creosote-impregnated waste materials from creosote-contaminated sites
35. 3,3'-Dichlorobenzidine
36. 1,2-Dichloroethane
37. Dichloromethane
38. Effluents from pulp mills using bleaching
39. Hexachlorobenzene
40. Inorganic fluorides
41. Refractory ceramic fibre
42. Oxidic, sulphidic and soluble inorganic nickel compounds
43. Polycyclic aromatic hydrocarbons
44. Tetrachloroethylene
45. Trichloroethylene
46. Tributyltetradecylphosphonium chloride that has the molecular formula $C_{26}H_{56}P \cdot Cl$

Proposed in Canada Gazette Part I May 19, 1999

4) PSL Lists

The Canadian Environmental Protection Act (CEPA 1999, section 76) requires the Ministers of the Environment and of Health to establish a Priority Substances List (PSL) that identifies substances to be assessed on a priority basis to determine whether they are toxic (as defined under Section 64 of the Act) and pose a significant risk to the health of Canadians or to the environment. Assessments of substances placed on the PSL are the shared responsibility of Environment Canada and Health Canada.

PSL1 Substances considered as "TOXIC" under Section 76 of CEPA

- Benzene
- Benzidine
- Bis (2-ethylhexyl) phthalate
- Bis (chloromethyl) ether
- Chlorinated wastewater effluents
- Chloromethyl methyl ether
- Creosote-contaminated sites
- 3,3'-Dichlorobenzidine
- 1,2-Dichloroethane
- Dichloromethane
- Effluents from pulp mills using bleaching
- Hexachlorobenzene
- Hexavalent chromium compounds
- Inorganic arsenic compounds
- Inorganic cadmium compounds
- Inorganic fluorides
- Oxidic, sulphidic and soluble, inorganic nickel compounds
- Polychlorinated dibenzodioxins
- Polychlorinated dibenzofurans
- Polycyclic aromatic hydrocarbons
- Refractory ceramic fibres
- Short chain chlorinated paraffins
- Tetrachloroethylene
- 1,1,1-Trichloroethane
- Trichloroethylene

PSL1 Substances not considered as "TOXIC" under Section 76 of CEPA

- Aniline
- Bis (2-chloroethyl) ether
- Chlorobenzene
- Dibutyl phthalate

Di-n-octyl phthalate
1,2-Dichlorobenzene
1,4-Dichlorobenzene
3,5-Dimethylaniline
Methyl tertiary butyl ether
Methyl methacrylate
Organotin compounds (non-pesticidal)
Pentachlorobenzene
Styrene
Tetrachlorobenzenes
1,1,2,2-Tetrachloroethane
Toluene
Trichlorobenzenes
Waste crankcase oils
Xylenes

PSL2 Substances

The second Priority Substances List was published in 1995, and these substances are currently being assessed.

Acetaldehyde
Acrolein
Acrylonitrile
Aluminum chloride, aluminum nitrate, aluminum sulphate
Ammonia in the aquatic environment
1,3-Butadiene
Butylbenzylphthalate
Carbon disulphide
Chloramines
Chloroform
N,N-Dimethylformamide
Ethylene glycol
Ethylene oxide
Formaldehyde
Hexachlorobutadiene
2-Methoxy ethanol, 2-ethoxy ethanol, 2-butoxy ethanol
N-Nitrosodimethylamine
Nonylphenol and its ethoxylates
Phenol
Releases from primary and secondary copper smelters and copper refineries
Releases from primary and secondary zinc smelters and zinc refineries
Releases of radionuclides from nuclear facilities (impacts on non-human species)
Respirable particulate matter less than or equal to 10 microns
Road salts

Textile mill effluents

5) ARET Candidate Substances List

Following is the ARET list of substances for action. These substances have been selected from a list of chemicals detected in the Canadian environment. There is evidence that these substances: 1) may have the potential to have harmful effects on human, animal, or plant life; 2) may tend to degrade very slowly in the environment; and/or 3) may tend to accumulate in living organisms.

This listing is meant as a preliminary guide to priorities, and is not meant to imply that actual harm is currently being caused by these substances. The ARET substances have been rank-ordered based on their intrinsic properties. Decisions concerning priority for action will be made by the managers of emitting facilities based on additional criteria specific to each situation.

The substances have been categorized by chemical grouping and are accompanied by Chemical Abstract Service Registry Number (CASRN) for ease of use with WHMIS (Workplace Hazardous Materials Information System) and NPRI (National Pollutant Release Inventory) data management systems.

LIST A-1

(meet or exceed criteria for toxicity, bioaccumulation and persistence)

ARET's vision for substances on this list is the virtual elimination of emissions into the environment from human activities. The short-term goal is for a 90 per cent reduction in emissions by 2000.

Polychlorinated Biphenyls (PCBs)

Polycyclic Aromatic Hydrocarbons (PAHs) as a group

(The following specific PAHs met or exceeded the criteria for List A-1.)

	CASRN
Benz(a)anthracene	56-55-3
Benzo(a)pyrene	50-32-8
Benzo(e)pyrene	192-97-2
Benzo(b)fluoranthene	205-99-2
Benzo(j)fluoranthene	205-82-3
Benzo(k)fluoranthene	207-08-9
Benzo(g,h,i)perylene	191-24-2
Chrysene	218-01-9
Dibenz(a,h)anthracene	53-70-3
Dibenzo(a,i)pyrene	189-55-9
Dibenz(a,j)acridine	224-42-0
7H-dibenzo(c,g)carbazole	194-59-2

Fluoranthene	206-44-0
Indeno(1,2,3-c,d)pyrene	193-39-5
Perylene	198-55-0
Phenanthrene	85-01-8
Pyrene	129-00-0
Nitro-PAHs	
1,6-dinitropyrene	42397-64-8
1,8-dinitropyrene	42397-65-9
Chlorinated Organics	
Hexachlorobenzene	118-74-1
alpha-hexachlorocyclohexane	319-84-6
gamma-hexachlorocyclohexane	58-89-9
4,4'-methylenebis(2-chloroaniline)	101-14-4
Octachlorostyrene	29082-74-4
Pentachlorophenol	87-86-5
2,3,7,8-tetrachlorodibenzofuran	51207-31-9
2,3,7,8-tetrachlorodibenzo-p-dioxin	1746-01-6
Metal compounds	
*Methyl mercury	22967-92-6
Tributyltin	688-73-3

*For prevention/control actions, mercury should be addressed (see List B-2)

LIST A-2

ARET's goal for substances on this list is for the reduction of emissions to levels that are insufficient to cause harm. The short-term goal is for significant reduction in emissions.

	CASRN
*1,4 dichlorobenzene	106-46-7

**Cadmium compounds (respirable & soluble inorganic forms)

*The toxicity criterion was met for possible carcinogenicity by accepting IARC (International Agency for Research on Cancer) classification of "possible human carcinogen."

**The selection process was unable to take into account specific metal compounds, and therefore scores for metals were based on a composite score for several metal species. For cadmium, actions may be tailored to such compounds as CdCO₃, Cd(OH)₂, CdCl₂, CdO, and CdSO₄. The concept of virtual elimination of discharges for metals is under discussion and was not resolved by ARET.

LIST B

For the List B substances, the vision is reduction of emissions to levels that are insufficient to cause harm. The short-term goal is a 50 per cent reduction by 2000.

LIST B-1

(meet or exceed criteria for toxicity and bioaccumulation)

PAHs	CASRN
Anthracene	120-12-7
7,12-dimethylbenz(a)anthracene	57-97-6
Dimethylnaphthalene	28804-88-8
Chlorinated organics	
3,3' dichlorobenzidine	91-94-1
Hexachlorocyclopentadiene	77-47-4
2,4,6-trichlorophenol	88-06-2
Other	
bis(2-ethylhexyl)phthalate	117-81-7
*Tetraethyl lead	78-00-2

*Degrades to lead, which is persistent (see List B-2).

LIST B-2

(meet or exceed persistence and toxicity criteria)

PAHs	CASRN
Benzo(a)fluorene	238-84-6
Benzo(b)fluorine	0777-19-6
Dibenz(a,h)acridine	226-36-8
Chlorinated organics	
alpha-chlorotoluene	100-44-7
bis(2-chloroethyl)ether	111-44-4
Bromodichloromethane	75-27-4
Carbon tetrachloride	56-23-5
Chloroform	67-66-3
Chlorodibromomethane	124-48-1
1,2 dichloroethane	107-06-2
Methylene chloride	75-09-2
1,1,2,2-tetrachloroethylene	127-18-4
2,3,4,6-tetrachloropheno	158-90-2
Metal compounds	
Arsenic (inorganic)	N/A*
Asbestos	1332-21-4
Beryllium	7440-41-7
Chromium (Cr6+)	N/A*
Cobalt (inorganic, soluble)	N/A*
Copper (inorganic salts)	N/A*

**Lead (all forms except alkyl)	N/A*
***Mercury (elemental and inorganic)	N/A*
Nickel (inorganic, respirable, soluble)	N/A*
Silver (soluble inorganic salts)	N/A*
Uranium (inorganic, respirable, soluble)	N/A*
Zinc (inorganic, respirable, soluble)	N/A*
Other	
o-anisidine	90-04-0
Cyanides	57-12-5
4,6 dinitro-o-cresol	534-52-1
1,4 dioxane	123-91-1
Ethylene oxide	75-21-8
2-naphthylamine	91-59-8
2-nitropropane	79-46-9
Thiourea	62-56-6

*CASRN not applicable. The selection process was unable to take into account specific metal compounds, and therefore scores for metals were based on a composite score for several metal species.

**See also tetraethyl lead on List B-1

**See also tetraethyl lead on List B-1

***See also methyl mercury on List A-1

Chlorinated organics	CASRN
bis(chloromethyl) ether	542-88-1
Epichlorohydrin	106-89-8
1-bromo-2-chloroethane	107-04-0
1-chloro-4-nitrobenzene	100-00-5
1,2-dibromo-3-chloropropane	96-12-8
1,2-dichlorobut-3-ene	760-23-6
2,4-dichlorophenol	120-83-2
1,3 dichloropropene	542-75-6
1,1,2-trichloroethylene	79-01-6
Aromatics	
4-aminoazobenzene	60-09-3
4-aminobipheny	192-67-1
Aniline	62-53-3
Benzene	71-43-2
Benzidine	92-87-5
Dimethylphenol (mixed isomers)	1300-71-6
2,6 dimethylphenol	576-26-1
2,4 dinitrotoluene	121-14-2
2,6 dinitrotoluene	606-20-2

1,2 diphenylhydrazine	122-66-7
2-methylpyridine	109-06-8
Phenol	108-95-2
Toluene diisocyanates	26471-62-5
Nitrosamines	
N-nitrosodimethylamine	62-75-9
N-nitrosodiphenylamine	86-30-6
N-nitroso-di-n-propylamine	621-64-7
Other	
Acetaldehyde	75-07-0
Acetamide	60-35-5
Acrolein	107-02-8
Acrylamide	79-06-1
Acrylonitrile	107-13-1
1,3 butadiene	106-99-0
Chlorine dioxide	10049-04-4
n-dodecane	112-40-3
Ethanol	64-17-5
Ethylene dibromide	106-93-4
Ethylene thiourea	96-45-7
Formaldehyde	50-00-0
Hydrazine	302-01-2
Hydrogen sulphide	7783-06-4
Methyl isobutyl ketone	108-10-1
4-nitrosomorpholine	59-89-2
Quinoline	91-22-5
Tetramethylthiuram disulphide	137-26-8
Vinyl bromide	593-60-2

Substance Selection

The ARET Stakeholders Committee developed scientific criteria for selecting substances for action. The final list of substances was based on recommendations from a full multistakeholder subcommittee which included representation from governments, industry, health, and environmental and labour groups.

6) Toxic Substances Management Policy (TSMP)

The federal government's Toxic Substances Management Policy was announced in Parliament on June 2, 1995. This policy provides a science-based framework for the management of toxic substances. The key management objectives in the policy are: virtual elimination of releases to the environment of toxic substances that are persistent and bioaccumulative and are present in the environment primarily due to human activity (Track 1); and management of other toxic substances and substances of concern throughout their life cycles to prevent or minimize their release into the environment (Track 2).

For substances declared to be toxic under CEPA, the policy provides directional guidance in selecting management objectives.

The Toxic Substances Management Policy Interdepartmental Forum, representing 12 key departments, co-ordinates the implementation of the TSMP. The initial list of 12 substances which meet the criteria for management under Track 1 of TSMP was published in Part 1 of the Canada Gazette on July 4, 1998. They are:

- aldrin
- chlordane
- DDT
- dieldrin
- endrin
- heptachlor
- hexachlorobenzene (HCB)
- mirex
- polychlorinated biphenyls (PCBs)
- polychlorinated dibenzo-p-dioxins (PCDDs)
- polychlorinated dibenzofurans (PCDFs)
- toxaphene

All 12 substances are persistent organic pollutants (POPs), which also enter the Canadian environment from foreign sources through long-range atmospheric transport. Within Canada, action has already been taken to severely limit or ban the production, use or release of these 12 substances. Nine of these substances were active ingredients in pesticides that are now prohibited in Canada.