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Performance Measurement Evaluation for Risk Management of Nonylphenol and Its Ethoxylates, eco-component

Canada

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Executive Summary

Performance measurement evaluations are an important part of the overall chemicals management process that provide Canadians with information on the effectiveness of risk management actions in place for toxic substances. This report measures the performance of the risk management strategy applied to nonylphenol and its ethoxylates (NP and NPEs) that were found to pose a risk to the environment.

Risk management of NP and NPEs was selected for performance measurement evaluation because the substance group met several readiness criteria outlined in the Performance Measurement Evaluation Strategy for Risk Management of Toxic Substances [1]. The criteria includes having risk management tools implemented for a sufficient amount of time to measure impact and the availability of key performance indicator data.

A Priority Substance List assessment was conducted for NP and NPEs by the Government of Canada in 2001 where NP and NPEs were concluded toxic under section 64 of CEPA 1999 (ECCC and HC 2001). A risk management strategy was developed in 2004 and risk management actions were taken to mitigate the risks of NP and NPEs by aiming to achieve ambient concentrations in Canadian waters that do not exceed the *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CCME 2002). To protect the environment, the Government of Canada put in place Pollution Prevention Planning Notices for products that contained NPEs and for textile mills that use wet processing. In addition, the pulp and paper sector voluntarily reduced its use of NPEs.

Overall, the performance measurement evaluation of NP and NPEs has found that the risk management strategy for NP and NPEs is meeting its intended objectives. The environmental objective has been met, as recent environmental levels of NP and NPEs across Canada are mostly well below historical levels and below guidelines for specific media. The risk management instruments have been very successful in reducing the quantity of NP and NPEs used in products and wet processing of textiles. The objectives set for Pollution Prevention Planning Notices for NP and NPEs in products and textile mill effluents have been met. Further, voluntary measures taken by pulp and paper mills appear to have greatly reduced the use of NP and NPEs in that sector. The information analysed in this report does not suggest that new commercial uses of NP and NPEs are a concern at this time given that import, manufacture, and use of NP and NPEs in Canada appears to have decreased over time.

Further risk assessment and risk management action for NP and NPEs is not recommended at this time. However, continued monitoring for NP and NPEs may help to expand the available data set and monitor trends over time for any future performance measurement evaluation of NP and NPEs.

[1] Strategic performance measurement: Evaluating the effectiveness of risk management actions on toxic substances in protecting Canadians and their environment - Canada.ca

Table of Contents

1 Introduction 2

1.1 Purpose of the Report 2

1.2 Background on the Substances 2

1.2.1 Summary of Risk Management Strategy 4

2 Performance Measurement and Evaluation Results 7

2.1 Analysis of the Progress Made 7

2.1.1 Environmental and Release Monitoring of NP and NPEs 8

2.1.2 Secondary Wastewater Treatment in Canada 16

2.1.3 Risk Management Actions for NP and NPEs in Products and Textile Mill Effluents 17

2.1.4 Voluntary Reductions of NP and NPEs in the Pulp and Paper Sector 18

2.1.5 Facility Releases of NP and NPEs to Water (National Pollutant Release Inventory) 19

2.1.6 Commercial Use Patterns of NP and NPEs 23

2.2 Limitations 24

3 Conclusion 25

3.1 Moving Forward 25

4 References 27

5 Annex 30

5.1 Annex A: Non-Exhaustive list of NP and NPE Compounds 30

5.2 Annex B: National Pollutant Release Inventory List of Substances 31

1 Introduction

1.1 Purpose of the Report

The Government of Canada aims to reduce the risks posed by substances found to be toxic to Canadians and their environment under the *Canadian Environmental Protection Act, 1999* (CEPA) through risk management actions under the Chemicals Management Plan. Performance measurement evaluations are an important part of the overall chemicals management process that provide Canadians with information on the effectiveness of risk management actions in place for toxic substances. The approach to evaluating the effectiveness of risk management actions and whether objectives for toxic substances have been met is set out in the Performance Measurement Evaluation (PME) Strategy for Risk Management of Toxic Substances (Environment and Climate Change Canada [ECCC] 2020)[2].

The intent of this PME Report is to evaluate the Government of Canada's risk management strategy on nonylphenol and its ethoxylates (NP and NPEs), specifically, to determine whether the objectives set for this substance have been met, additional action is required, or, the risk management strategy has not achieved the intended results.

1.2 Background on the Substances

Nonylphenol ethoxylates (NPEs) are a class of the broader group of compounds known as alkylphenol ethoxylates. Nonylphenol (NP) is a degradation product of NPEs. The NP and NPEs substance grouping includes a large number of compounds[3]. NP and NPEs are not produced naturally; their presence in the environment is a result of anthropogenic activity or transformation from parent compounds in the environment (ECCC and HC 2001, Lalonde and Garron 2021).

A Priority Substance List assessment was conducted for NP and NPEs by the Government of Canada in 2001[4]. Four NPE substances are described in the assessment (4-nonylphenol: CAS RN[5] 84852-15-3, p-nonylphenol: CAS RN 25154-52-3, Nonoxynol-4: CAS RNs 7311-27-5, 9016-45-9, and Nonoxynol-9: CAS RN 26027-38-3)[6]. The risk assessment found that NP and NPEs were "entering the environment in a quantity or concentration or under conditions that have or may have an immediate or long-term harmful effect on the environment or its biological diversity" and therefore were concluded toxic to the environment under section 64 of CEPA (ECCC and HC 2001). The assessment further stated that "the evaluation of options under CEPA to reduce exposure should be considered a priority" (ECCC and HC 2001). In 2002, NP and NPEs were added to the List of Toxic Substances in Schedule 1 of CEPA.

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[2] For more information, see the Strategic performance measurement: Evaluating the effectiveness of risk management actions on toxic substances in protecting Canadians and their environment - Canada.ca

[3] A comprehensive, non-exhaustive list of NPEs can be found in the Annex A.

[4] For the Priority Substance List Assessment Report for NP and NPEs, see the Priority Substances List Assessment Report for Nonylphenol and its Ethoxylates - Canada.ca

[5] CAS RN: Chemical Abstracts Service Registry Number. The Chemical Abstracts Service information is the property of the American Chemical Society and any use or redistribution, except as required in supporting regulatory requirements and/or for reports to the Government of Canada when the information and the reports are required by law or administrative policy, is not permitted without the prior, written permission of the American Chemical Society.

[6] Other compounds in the NP and NPEs group of substances have been selected for environmental monitoring and other activities described further in this report.

NP and NPEs have been used in Canada since the 1960s as detergents, emulsifiers, wetting agents and dispersing agents, and used in paints and emulsifiers in various industrial sectors (ECCC and HC 2001, Lalonde and Garron 2021). A 1997 survey found that the largest source of NP and NPEs releases were from the use of soaps and cleaning products ('down-the-drain' releases), followed by discharges from textile production and use of textile processing aids (EC 1998, ECCC and HC 2001, Lalonde and Garron 2021). Soap and cleaning products, textiles production products, and pulp and paper manufacturing products were together responsible for nearly 80% of the use and estimated releases of NP and NPEs in Canada. Table 1 indicates the percentage of total releases of NP and NPEs to the environment from sectors and products according to the survey.

Table 1: Sources and percentage of total releases of NP and NPEs (ECCC 1998).

Sources (Sectors and Products)	Total Release (%)
Soap and Cleaning Products	56
Textile Production Products	18
Agricultural Products – Pesticides[7]	8
Pulp and Paper Manufacturing Products	5
Other Products	4
Formulators/Distributors of Products	4
Plastic, Resins, Polymers Manufacturing Products	3
NP/NPEs Producers	1
Paints & Varnish	1
Toilet Preparations	<1
TOTAL	**100**

The major route for the release of NP and NPEs to the Canadian environment is through discharge of effluents. NP and NPEs may be released to the environment at various points in their lifecycle, however the primary contributors of NP and NPEs to the environment are industrial effluents, municipal wastewater treatment system (MWWTS) effluents, landfill, and biosolids applied to agricultural land (ECCC and HC 2001, Soares et al. 2008 cited in Lalonde and Garron 2021). Discharge to effluents may occur during primary production of NPEs (or octylphenol and its ethoxylates), manufacture of NPE-containing products, product use, and 'down-the-drain' disposal (ECCC and HC 2001, Lalonde and Garron 2021).

When NPEs are released to wastewater treatment systems, several transformations can occur. Under aerobic and anaerobic treatment conditions, biodegradation to more toxic (and estrogenic) metabolites occurs. These products are NP, nonylphenol ethoxylate (NP1EO), nonylphenol diethoxylate (NP2EO), nonylphenoxyacetic acid (NP1EC) and nonylphenoxyethoxyacetic acid (NP2EC). The intermediate and final products of metabolism are more persistent than the parent

[7] Although agricultural products were not a source of concern identified by the PSL assessment or risk management strategy, actions on NPEs in agricultural products have been taken the Pest Management Regulatory Agency of Health Canada. These actions are not evaluated in this PME Report.

NPEs, but these intermediates are expected to be ultimately biodegraded. In aquatic environments, primary biodegradation of NPEs is fast, but the resultant products, such as NP1EO, NP2EO, NP1EC, NP2EC and NP, are moderately persistent, especially under anaerobic conditions (ECCC and HC 2001, Lalonde and Garron 2021). In Canada, these chemicals have been historically found in fresh water, sediment, fish and beluga whale tissue, textile mill effluents, pulp and paper mill effluents, MWWTS influents, effluents and biosolids, and soil to which municipal biosolids had been applied (ECCC 2004a).

Nonylphenol is an endocrine disruptor and xenoestrogen (Mergel 2014 cited in Lalonde and Garron 2021). NPs and NPEs with only one or two EO groups are highly toxic to aquatic organisms (US EPA 2014 cited in Lalonde and Garron 2021).

Under use patterns at the time of the assessment in 2001, releases of NP and NPEs from textile mill, pulp and paper mill, and MWWTS effluents were considered to result in environmental concentrations that exceeded levels of concern (ECCC and HC 2001).

1.2.1 Summary of Risk Management Strategy

In 2002, the Canadian Council of Ministers of the Environment (CCME) established *Canadian Environmental Quality Guidelines* for NP and NPEs. *Canadian Water Quality Guidelines for the Protection of Aquatic Life* (CWQG) and *Canadian Sediment Quality Guidelines* (CSQG) were developed for NP and NPEs to provide nationally consistent, science-based benchmarks (CCME 2002). The *Risk Management Strategy for Nonylphenol and its Ethoxylates under CEPA (1999)* was then published in 2004 (ECCC 2004a). This report evaluates progress, up to 2019[8], in implementing the risk management strategy and achieving its environmental and risk management objectives, described below.

Environmental Objective

The environmental objective of all risk management actions applied to mitigate the risks of NP and NPEs is to achieve ambient concentrations in Canadian waters that do not exceed the CWQG established for NP and NPEs by the CCME (2002). The CCME established ambient guidelines of 1.0 µg/L (1000 ng/L) and 0.7 µg/L (700 ng/L) expressed in toxic equivalency units for nonylphenol (NP TEQ) for freshwater and marine waters, respectively.

Risk Management Objectives

Products containing NPEs

The risk management objective for products containing NPEs was to achieve a 95% reduction of NPEs in the formulation of soap and cleaning products, processing aids used in textile wet processing and pulp and paper processing aids for use in Canada. These product categories represented approximately 80% of the total NPEs use in Canada at the time (ECCC 1998). The reduction target was based on the best available and economically feasible techniques to reduce the environmental risks associated with these products that contain NPEs.

Textile Industry

Similar to the risk management objective for products containing NPEs, the objective for NPEs used and released in the textile industry was the reduction of NPEs use to levels that reflect the

[8] This PME report is based on performance data collected up to 2019.

best available techniques economically achievable. A study of the textile industry conducted for Environment Canada suggested that a 97% substitution of NP and NPEs was achievable within a short timeframe at modest cost to the industry. Therefore, the risk management objective for the textile sector was to reduce the annual use of NP and NPEs by at least 97% relative to the annual use for 1998 by 2009.

Risk Management Actions

Risk management actions may involve using regulatory and non-regulatory tools under CEPA, the *Canada Consumer Product Safety Act*, the *Food and Drugs Act*, the *Pest Control Products Act*, the *Fisheries Act*, or other legislation. After consideration of the sources of releases in Table 1 and consultation with stakeholders, the risk management strategy proposed the risk management actions outlined below, to reduce environmental risks associated with the use and releases of NP and NPEs and meet the above environmental and risk management objectives.

Risk management instruments were put in place for a reduction in the use and release of these compounds in the processing of textiles and pulp and paper, and in the manufacturing or importation of soap and cleaning products, with the intent to reduce environmental exposure (ECCC 2016 cited in Lalonde and Garron 2021). The three products addressed by the risk management objective covered the most significant product categories representing approximately 80 % of the total NPEs use in Canada at the time.

Products and the Textile Sector

Pollution prevention (P2) planning notices were chosen to manage NP and NPEs in products and the textile sector because they provide flexibility for site-specific solutions, minimize potential incompatibilities with existing or future provincial or municipal regulations, and allow for early action.

On December 4, 2004, the Minister of the Environment published the notice requiring the preparation and implementation of P2 plans in respect of NPEs contained in products. P2 plans were required from manufacturers and importers of soap and cleaning products, or processing aids (detergents or surfactants) used in the wet textile industry, or pulp and paper processing aids who purchased or otherwise acquired 2,000 kg or more of NP and NPEs over the course of at least one year between January 1, 2003, and December 31, 2012. The 2,000 kg threshold was determined during consultations such that the majority of products containing NPEs would be subject to the requirements of the P2 plans while excluding companies using or importing small quantities of NPEs.

Those who were subject to this notice were required to prepare and implement a P2 Plan that took into consideration the risk management objectives described in the Notice, including Phase 1 and Phase 2 reduction targets (see Table 2). The Phase 1 target was a 50% reduction from the base year (1998). Persons were required to consider reducing the total quantity of NP and NPEs used to manufacture products and imported in products from the base year (1998) by 50% and 95% in Phase 1 and Phase 2, respectively. Unless a person became subject to the Notice after the date of publication, timelines for each phase were the 2007 and 2010 calendar years, respectively.

Table 2: Phases of the P2 Notice for Products containing NPEs

	Persons subject to the Notice on the date of publication in the Canada Gazette	Persons subject to the Notice after the date of publication in the Canada Gazette
Phase 1	A 50% reduction from 1998 levels, of the total mass of NPEs used or imported annually by 2007	A 50% reduction from base year levels, of the total mass of NPEs used or imported annually by the year after the year in which the person became subject to the Notice
Phase 2	A 95% reduction from 1998 levels, of the total mass of NPEs used or imported annually by 2010	A 95% reduction from base year levels, of the total mass of NPEs used or imported annually by 2 years after the year in which the person became subject to the Notice

Also on December 4, 2004, the Minister of the Environment published a notice requiring the preparation and implementation of P2 plans in respect of effluents from textile mills that used wet processing and NPEs. The P2 planning requirement for textile mills was complementary to the P2 Planning requirement for products containing NPEs, as NPEs in textile mill effluents may not be captured by the import threshold included in the P2 planning for products containing NPEs. Persons subject to this notice included all wet processing textile mills that discharged their effluents to a MWWTS and had a daily effluent flow greater than 30 m^3/day, based on average annual discharge, at least one year between 1999 and 2003. Affected persons were required to prepare and implement a P2 plan that took into consideration objectives which included reducing, by 2009, the annual use of NP and NPEs by at least 97%, relative to the annual use for the base year (1998 for most mills).

Pulp and Paper Sector

Around 1998, while NPEs were being assessed, a number of pulp and paper mills took voluntary measures to replace NPEs-based products for substitutes that did not contain NPEs. To determine the extent of the reduction and understand the changing use of NPEs by the pulp and paper industry, Environment Canada, in conjunction with the Forest Products Association of Canada, conducted a national survey at all the pulp and paper mills in Canada in 2001. The survey results forecasted a 99.8% reduction in the use of products containing NPEs by the end of 2003. Risk management actions were therefore not proposed for the pulp and paper sector.

Municipal Wastewater Effluents

At the time of the assessment, NP and NPEs were found to be released to the environment from municipal wastewater treatment effluent and biosolids as a result of the use and disposal of down-the-drain type products (e.g., soap and cleaning products) and releases from textile mills that discharged their effluents into MWWTSs. No specific risk management action was targeted for NP and NPEs in municipal wastewater effluents, as risk management was applied upstream to product uses and textile mills to reduce NPEs released to MWWTSs.

Monitoring, Evaluation, and Subsequent Action

The risk management strategy proposed that a monitoring plan be used to estimate the amount of NP and NPEs being released into the environment and to evaluate the effectiveness of the P2

plans in reducing environmental releases of NPEs. The strategy proposed monitoring of surface water and municipal wastewater, monitoring through the National Pollutant Release Inventory (NPRI), and monitoring through reports submitted as part of P2 planning requirements. The strategy proposed that subsequent risk management action would be considered if the above monitoring results determined that the environmental and risk management objectives had not been met.

Activities in other Jurisdictions

The following activities have taken place in other jurisdictions since the publication of the PSL assessment and Risk Management Strategy, and may have indirectly impacted domestic consumption and use of NP and NPEs:

- In 2006, the European Union prohibited the marketing of substances and preparations containing NP and NPEs in concentrations of 0.1% or higher by mass, intended for specific applications (European Union 2006). These applications include industrial cleaning and institutional cleaning, domestic cleaning, textiles and leather processing, emulsifier in agricultural teat dips, metalworking, manufacturing of pulp and paper, cosmetic products, other personal care products, and coformulants in pesticides and biocides.
- In 2011, the United States Environmental Protection Agency (US EPA) released its final *Alternatives Assessment for Nonylphenol Ethoxylates (NPEs)*, which identifies eight safer alternatives to NPEs (US EPA 2011).
- The US EPA developed a NP/NPE Action Plan with five key tasks that include voluntary phase out of NP and NPEs in industrial laundry detergent as well as supporting and encouraging the elimination of NP and NPEs in other uses (US EPA 2010). Soap and detergent makers signed a phase-out agreement with the agency pledging to remove NPEs from liquid products by the end of 2013, and from powdered products by the end of 2014.

Additional Risk Management Activities

Further to the risk management actions outlined in the risk management strategy, additional initiatives and actions have been undertaken by the federal government on NP and NPEs.

Whales Initiative

The Whales Initiative is a federal government initiative for the protection of certain endangered whales. Alkylphenol ethoxylates, a category of substances that include NPEs, are substances of concern under the Whales Initiatives and are currently being monitored in fresh water, marine and freshwater sediment, landfill leachate, municipal wastewater, and fish.

2 Performance Measurement Evaluation Results

2.1 Analysis of the Progress Made

Progress in achieving the environmental objective for a substance is determined by identifying key performance indicators and analyzing the best available data for those indicators. Analyses of specific data sets contribute to the overall evaluation findings for a substance. As part of the overall analysis, evaluations also look at what influence a risk management strategy or tool has had on any observed trends or changes. Results from performance measurement evaluations help to demonstrate how effectively risks from substances are being managed in Canada, and help to

determine the ongoing relevance and effectiveness of a strategy or tool in meeting objectives and where improvements can be made, if necessary.

2.1.1 Environmental and Release Monitoring of NP and NPEs

The Chemicals Management Plan Monitoring and Surveillance program collects environmental monitoring data on four NP and NPE substances: 4-nonylphenols (4-NP, CAS 84852-15-3); 4-nonylphenol monoethoxylates (NP1EO); 4-nonylphenol diethoxylates (NP2EO); and 4-n-octylphenol (4-n-OP, CAS 1806-26-4). Data has been collected at selected sites for these substances in surface water from 2014 to 2019, in sediment from 2015 to 2016, and in wastewater from 2010 to 2012, 2014, 2015, and 2019. Environmental monitoring can be used as an indicator of concentrations of NP and NPEs in the environment before, during, and/or after risk management implementation.

Environmental Monitoring in Surface Water

Studies have shown that prior to the implementation of risk management actions, use of NP and NPEs in Canada resulted in environmental concentrations at levels of concern, largely released from consumer products, textile mills, pulp and paper mills, and MWWTS effluents. According to certain data sets, in the late 1990s in Canada, concentrations of NP and NPEs compounds in fresh water ranged from < 10 to more than 9000 ng/L downstream of textile mills, pulp and paper mills, and MWWTS (Bennie et al. 1997, 1998, 2003). In the 1990s, untreated textile mill effluent was often discharged directly to adjacent surface water (Lalonde and Garron 2021), thus it is expected that NP and NPEs concentrations in surface water would have been higher in the past. Data published between 1997 and 1998 showed that Canadian fresh water contained concentrations of NP that ranged from <20 ng/L to 4250 ng/L. NPEs were found in rivers, lakes and harbours in Canada at concentrations of up to 2300 ng/L, 5070 ng/L and 1030 ng/L, respectively (Bennie et al. 1997, ECCC and HC 2001).

Other studies have found that NPE concentrations downstream of MWWTSs that receive discharge from textile mills decreased 89% from 2003 to 2010 (Gauthier et al. 2013). Surface water testing in Quebec has demonstrated a decrease of NP and NPEs between 89% and 99% at seven test sites, selected due to their proximity to textile facilities, between 2000-2003 and 2009-2010 (Gauthier et al. 2013). Over the same time period, the resulting median concentrations dropped from 8140 ng/L to 590 ng/L.

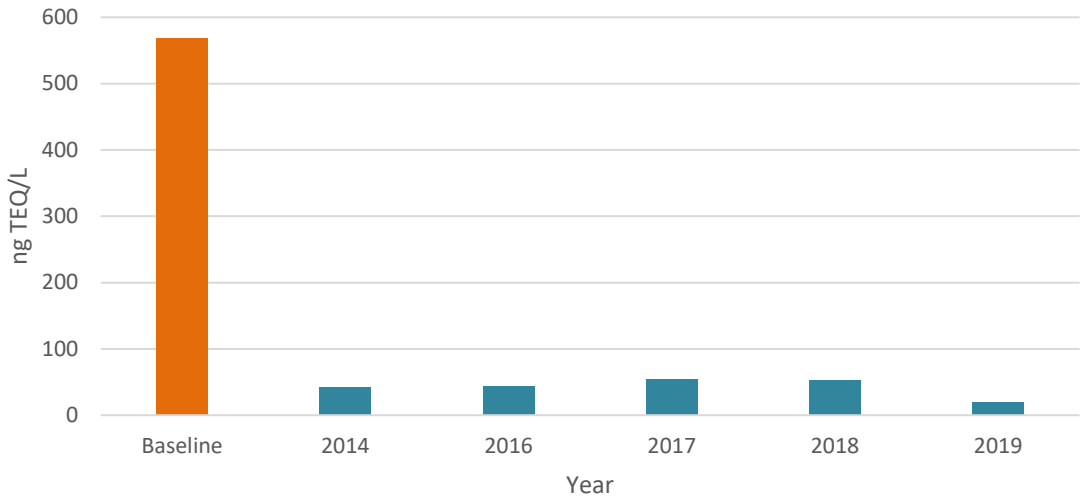

Figure 1: Average total NP TEQ in surface water, per year, compared to baseline levels (1991-1998)

More recent data also suggests that concentrations of NP and NPEs after the implementation of risk management actions are substantially lower than historical levels, as shown in Figure 1. From 2014 to 2019 under the Chemicals Management Plan Monitoring and Surveillance Program, samples of surface water were collected and analysed at 42 fresh water sites in Canada. The sites were downstream from MWWTSs, textile mills, urban areas, and mixed-use sites. Given that previous studies in Canada have demonstrated that NP, and NPE releases to surface water environments were largely from MWWTSs and textile industry discharges (Klecka et al. 2010; ECCC and HC 2001), sampling has focussed largely on sites downstream of these activities. Sampling sites were categorised into five groups based on the dominant activities present upstream in their watersheds: mixed use sites; MWWTS-associated sites; textile mill-associated sites; urban; and reference sites.

Concentrations of each substance at each site for each year data was collected ranged from 0.28 ng/L to 477.22 ng/L, all well below the CWQG of 1000 ng NP/L. The Toxic Equivalent (TEQ) was calculated for each site, for each year, by multiplying concentrations of each NP and NPE substance by the Toxic Equivalent Factor according to the CWQG, and adding these values together to calculate the total NP TEQ for each sample. Total NP TEQs ranged from 0.92 to 608.22 ng TEQ/L, all below the 1000 ng TEQ/L guideline (figure 2).

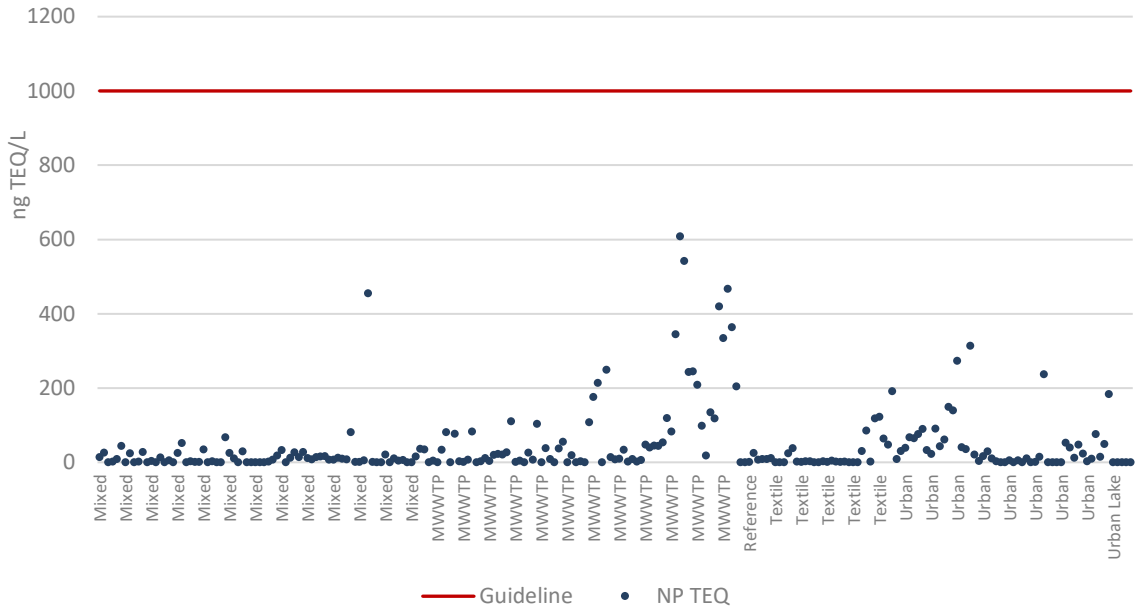

Figure 2: Total NP TEQ per surface water site sampled, in comparison to the CWQG guideline

In some cases, certain NP and NPE compounds were not detected in samples. Non-detected concentrations (censored values) were estimated by using half the sample's detection limit. A recent study by Lalonde and Garron (2021), to determine current concentrations of NP and NPEs in surface water and to determine if risk management actions by the Canadian government were beneficial to the environment, was based on the same surface water data set. Lalonde and Garron used nonparametric methods included in the Nondetects And Data Analysis (NADA) user-written package for R to describe the data set[9]. Despite differences in the methods used to estimate censored values for non-detects, Lalonde and Garron's study and the analysis conducted for this report reached very similar conclusions regarding concentrations of NP and NPEs in surface water. Overall, all surface water samples for each NPE substance, as well as for the NP TEQ, at every site, for every year, were found to be well below the 1000 ng TEQ/L guideline; there were no exceedances.

Concentrations of NP TEQ were relatively more elevated in samples collected in the urban and MWWTS-associated sites than other site types. Overall, all four substances were detected more frequently in urban and MWWTS-associated sites than at other locations. Surface water data was also collected from urban lake sites, however all samples for all substances and all years from these sites have had non-detectable levels of NP and NPEs. The surface water data does not show that concentrations of NP and NPEs are increasing over time overall or at certain site types (figure 3). In addition, Lalonde and Garron's study on the same data set found a statistically significant ($p < 0.05$) downward temporal trend in NP concentrations in Canadian surface waters from 2014 to 2019 (Lalonde and Garron 2021).

[9] The details of these methods are described by Helsel (2005, 2012).

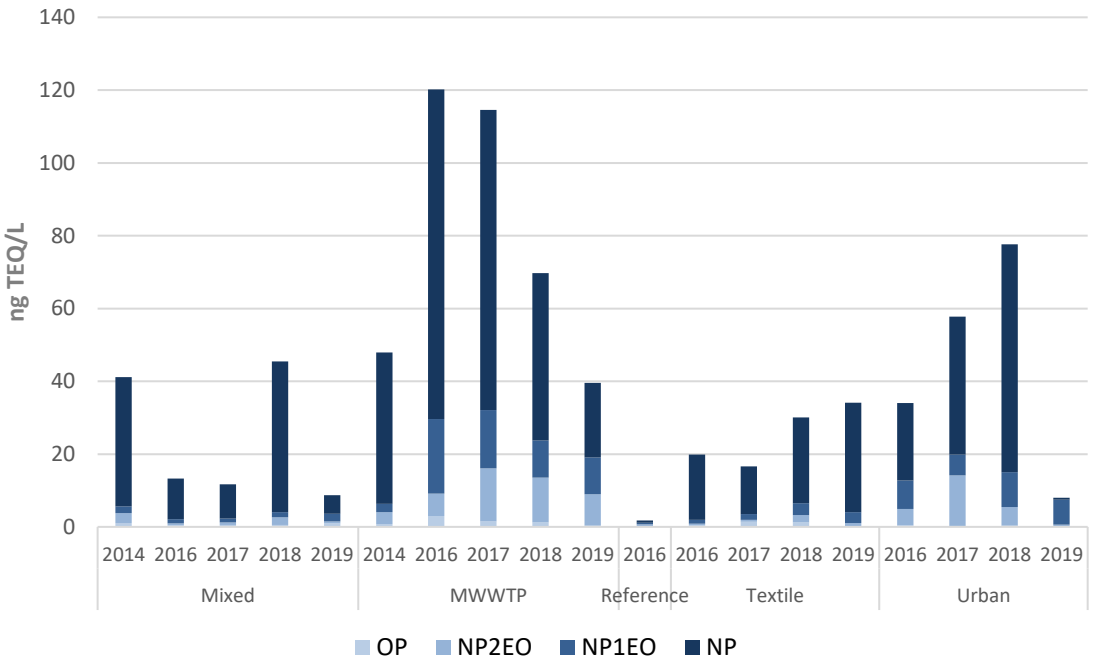

Figure 3: Average TEQ of NPEs in surface water per substance, per site type, per year

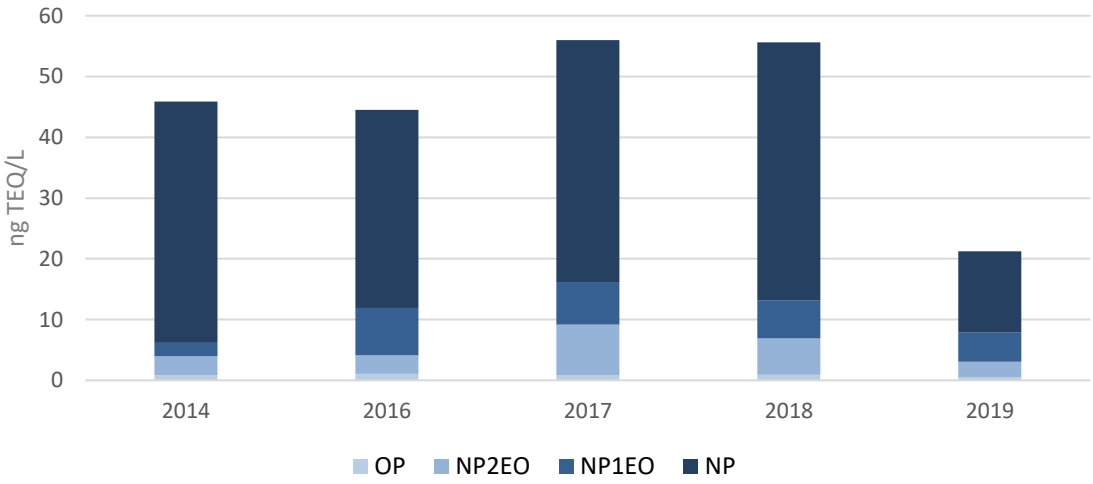

Figure 4: Average total TEQ of NPEs in surface water with proportion per substance, per year

The environmental objective of all risk management actions is to achieve ambient concentrations in Canadian waters that do not exceed the CWQG established for NP and NPEs at 1000 ng TEQ/L

☑ **The Environmental Objective has been achieved**

for freshwater and 700 ng TEQ/L for marine water. As such, surface water concentrations are one of the more direct indicators of progress towards achieving the environmental objective. The surface water environmental monitoring data collected and analysed to date suggests that the Environmental objective has been met. Although only freshwater data has been collected and analysed in this report, all ambient levels in surface water of all substances analysed, as well as the total NP TEQs, are all well below the freshwater guideline of 1000 ng TEQ/L and there are no signs of upward trends approaching the guideline.

Environmental Monitoring in Sediments

Sediments are likely to be a major sink of NP and NPEs in the environment, and studies have identified NPEs as of potential concern in sediment in both the Canadian and American areas of the Great Lakes Basin (Lalonde and Garron 2021, Bennett and Metcalf 2000, Hull et al. 2015).

Freshwater sediment samples from 27 sites across Canada were collected and analysed in 2015 and 2016, and compared to the *Canadian Sediment Quality Guidelines* for freshwater sediment of 1.4 mg/kg (1400 ng/g). At each site, samples were tested for each of the four NP and NPE substances. There were high rates of non-detected NPE substances across these samples. Overall, 24 sites had detectable concentrations of at least one NPE substance, and 3 sites had no detection of any of the four NPE substances. Non-detected concentrations (censored values) were estimated by using half the sample's detection limit. All values were then multiplied by the Toxic Equivalent Factor according to the CSQG, and added together to calculate the NP TEQ for each sample.

The freshwater sediment data shows there is one exceedance over the CSQG 1400 ng/g guideline. A sample taken from the Still Creek area in Burnaby, British Columbia shows a concentration of 5879 ng TEQ/g. By contrast, all other sites had concentrations of NP TEQ significantly below the 1400 ng TEQ/g guideline (Figure 5).

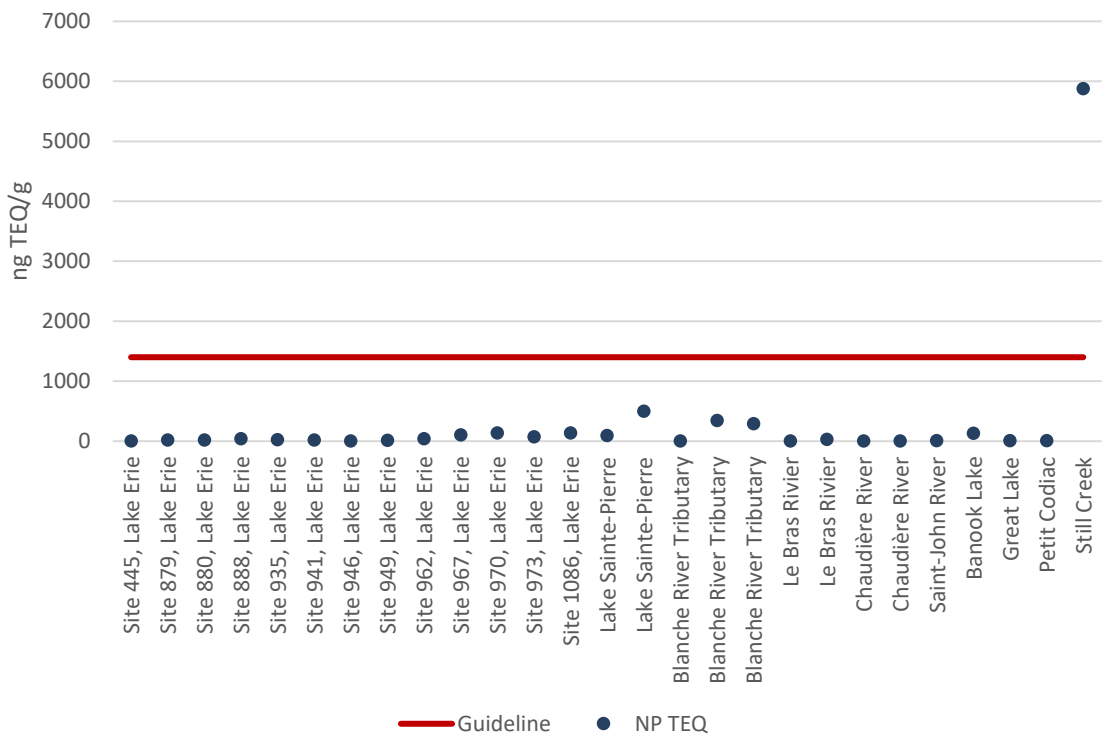

Figure 5: NP TEQ per sediment site sampled, in comparison to the NP TEQ guideline

Several of the sampled sites are located in Lake Erie and include 7 samples from the Canadian side of Lake Erie and 7 samples from the American side. The NP TEQ concentrations range from 6.5 to 137 ng/g for both Canadian and American samples, all significantly below the 1400 ng/g guideline. The average concentration for Canadian samples is 54 ng/g and for American samples 47 ng/g. Thus, there is negligible difference between the average concentrations in sediments on either side of the border. Samples towards the western side of the lake (Toledo, Point Pelee region), both on the Canadian and American sides, have higher concentrations, with concentrations decreasing eastward (Figure 6). This west-to-east trend of decreasing concentrations is expected; many studies have found similar patterns of higher levels of contamination in the western portion of Lake Erie compared to the eastern portion (e.g. see Burniston et al. 2012).

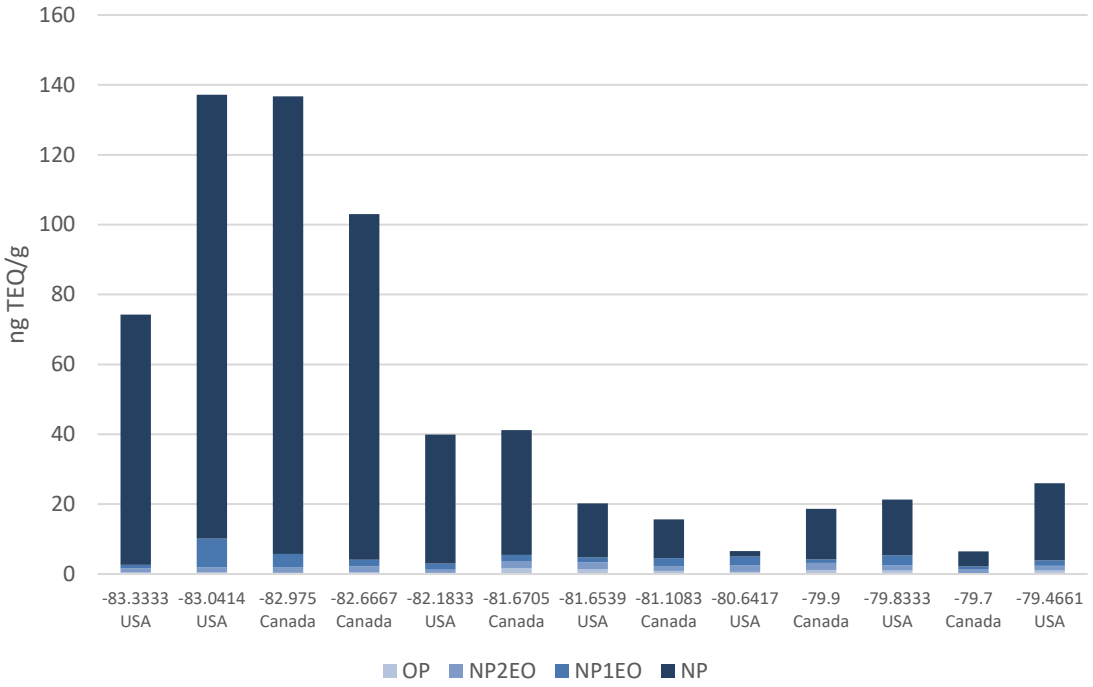

Figure 6: NP TEQ from sediment sites in Lake Erie, from West to East

The sediment data suggests that progress has been made towards achieving the CSQG guideline in many regions of Canada. However, it is difficult to draw conclusions for this indicator from such a small data set. Additional sampling of sediment at these sites, over multiple years, may help to confirm that levels of NP and NPEs in sediment are below the guideline. While most of the sediment samples show concentrations of NP TEQ and individual NPE substances well below the guideline, one sample (Still Creek) is well above this guideline. In fact, this sample is over 4 times higher than the guideline, and exceeds the guideline for NP TEQ, as well as for 4-NP and NP1EO individually. Further monitoring and research may help to confirm and explain this result. Further sampling could help confirm the concentration of NPEs in this water body, and further research may help to understand why levels of NPEs are high at this site in particular, and if there is an emerging source of concern in the vicinity contributing to the high levels of NPEs.

Release Monitoring in Wastewater

Given that down-the-drain disposal of products that contain NPEs and releases from certain industrial uses of NPEs enter the environment via wastewater treatment systems, the levels of NP and NPEs in WWTS effluents is an indicator of the progress of actions taken to address releases from upstream sources.

Historically, untreated or partially treated industrial effluents (e.g. textile mill effluents) and municipal effluents in Canada contained very high concentrations (8,811,000 ng/L) of NPEs before the implementation of risk management actions (HC and ECCC 2001).

NP and NPEs were monitored at 12 WWTSs across Canada under the Chemicals Management Plan Monitoring and Surveillance Program between 2010 and 2012. This monitoring work included sampling of raw influent, final effluent, and treated biosolids. It also included sampling in winter

and summer months across a range of wastewater treatment systems. Additional sampling of wastewater influent, effluent, and biosolids took place in 2014, 2015, and 2019.

The wastewater monitoring data from all sampling years shows that there is no increasing or decreasing trend over time (Figure 7). The highest annual concentrations appear to have occurred in 2011 when the median NP TEQ concentration was approximately 665 ng TEQ/L, however, certain samples contain NP TEQ concentrations as high as nearly 10,000 ng TEQ/L.

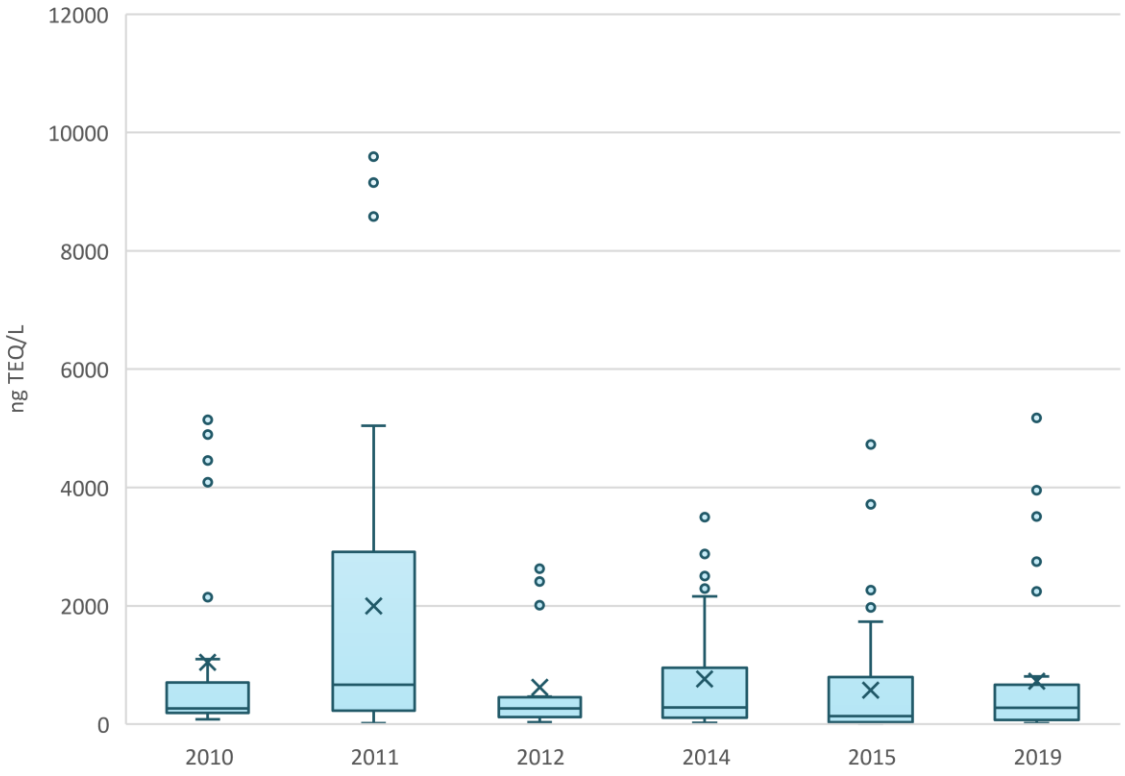

Figure 7: Box Plot of total NP TEQ in wastewater effluent, per year

The highest concentrations in influent were measured in samples collected in 2010, however there is no obvious increasing or decreasing trend over time.

No risk management action was taken specifically for addressing NP and NPEs in wastewater, as concentrations of NPEs in wastewater are likely indicative of NPEs released from down-the-drain use of products that contain NPEs and of industrial activities that discharge to MWWTs. An internal report based on wastewater data from 2010 to 2012 concluded that the results suggested that risk management for NP and NPEs had been effective (Shah and Smyth 2013).

Canada-wide guidelines for NP and NPEs in wastewater have not been developed. However, the City of Toronto sets restrictions on certain substances discharged into the city's wastewater system and natural watercourses, including applying concentration limits for NP and NPEs discharged to the city's wastewater systems (City of Toronto 2016). The City of Toronto has set a discharge concentration limit of 200,000 ng/L for NP and 20,000 ng/L for NPEs discharged to the

city's wastewater facilities that receive domestic and industrial wastewater**.** Measurements of wastewater influent across Canada are mostly below these limits.

2.1.2 Secondary Wastewater Treatment in Canada

While the wastewater treatment process itself is not a source of NPEs and addressing NPEs at the source is more cost-effective than targeted risk management at wastewater treatment plants, additional wastewater treatment contributes to reducing NPE levels in the receiving environment. The level of wastewater treatment (primary, secondary or tertiary) greatly influences the concentrations of NPEs released to the environment. The concentrations of NPEs found in effluents discharged by wastewater treatment systems using secondary or tertiary treatment are usually lower than effluents discharged from wastewater treatment systems using primary treatment because NPEs biodegrade during secondary or tertiary treatment (ECCC 2004). The proportion of the volume of municipal wastewater effluents receiving secondary or tertiary treatment was examined as a performance indicator, given that a higher proportion may correspond to higher removal of NPEs from final wastewater effluents.

In 2012, the Government of Canada published the *Wastewater Systems Effluents Regulations* (WSER) under the *Fisheries Act* (ECCC 2012c). The objective of the Regulations is to reduce the threats to fish, fish habitat and human health from fish consumption by decreasing the level of deleterious substances deposited to Canadian surface water from wastewater effluent. To achieve this objective, the Regulations set national effluent quality standards that require secondary level of wastewater treatment or equivalent in wastewater systems designed to collect an average daily influent volume of 100 m^3/day or more across Canada. These standards came into effect in January 2015. Owners or operators of wastewater systems requiring time to upgrade in order to meet the WSER effluent quality standards could apply for a transitional authorization to exceed the WSER effluent quality limits for a limited time. Authorizations were issued to 65 systems, expiring at the end of 2020, 2030, or 2040 based on a system's level of risk determined by criteria set out in the WSER (ECCC 2019).

Based on data from Statistics Canada, 72% of effluent volumes from MWWTSs in Canada with a daily flow of 100m^3/day or more were receiving secondary level of treatment or better in 2013, before the WSER came into effect, and remained unchanged in 2016. Data reported to ECCC 5 years after WSER implementation, in 2020, showed a small increase to 73% in the wastewater effluent volumes receiving secondary level of treatment or better. Currently, the increase in secondary treatment or better appears to be modest; however upgrades to systems holding a 2020 transitional authorization are not reflected in this number since the upgrades were only completed at the end of 2020. Progress can continue to be tracked until 2040, when all authorizations to exceed the WSER effluent quality limits are set to expire.

Although NP and NPEs remain present in wastewater influent, effluent, and biosolids, the implementation of the WSER may lead to lower concentrations in effluent as an increasing number of wastewater treatment systems upgrade to secondary level treatment going forward. The data collected so far suggests that the percentage of wastewater treatment systems using secondary or better wastewater treatment has increased, although the increase so far has been modest. As authorizations to exceed the WSER limits expire up to 2040, the percentage of wastewater treated to secondary or higher level of treatment is expected to reach 100%. Further monitoring may help to confirm if this increasing trend continues and is linked to reduced levels of NPEs in final effluents and in receiving waters.

2.1.3 Risk Management Actions for NP and NPEs in Products and Textile Mill Effluents

Actions to reduce NP and NPEs In Products

To achieve the risk management objective of reducing NP and NPEs in products by 95% by December 31, 2010, the Minister of the Environment published the *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans in Respect of Nonylphenol and its Ethoxylates Contained in Products* on December 4, 2004 (ECCC 2004b). The P2 Planning Notice applied to importers and manufacturers of soap and cleaning products, or processing aids used in the wet textile industry, or pulp and paper processing aids who purchased or otherwise acquired 2,000 kg or more of NP and NPEs over the course of at least one year. A person whose facility or facilities met the criteria listed in the P2 Planning Notice between January 1, 2003, and December 31, 2012, was required to prepare a P2 plan taking into consideration the risk management objective and reduction targets. There were 77 facilities subject to the P2 Planning Notice and these facilities were expected to prepare and implement a P2 plan.

According to reports submitted under the P2 Notice, approximately 2,100,000 kg of NP and NPEs were used to manufacture products and 850,000 kg of NP and NPEs were imported in products in 1998. In 2014, after facilities implemented their P2 plan, annual use of NP and NPEs in product manufacturing decreased to 86,000 kg, and annual import of NP and NPEs in products decreased to 27,000 kg. This represents an overall reduction of 96% in NP and NPEs used to manufacture products and an overall reduction of 97% in NP and NPEs imported in products.

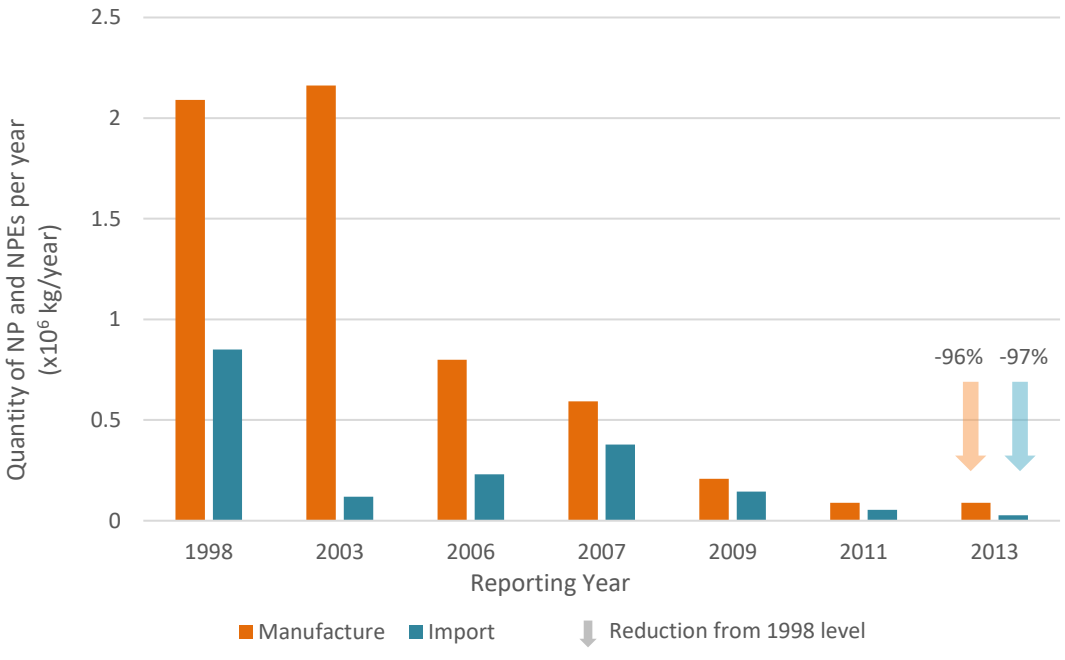

Figure 7: NP and NPEs used or imported in products from 1998 to 2013

The risk management objective for the P2 planning Notice for NP and NPEs in products is considered achieved. In reviewing the reports submitted under the P2 Notice, the majority of facilities met the risk management objective through 100% elimination of NP and NPEs in products (ECCC 2016). The reports also revealed that five facilities that did not meet the risk management objective within the specified timeline did commit to either meeting the target at a later date or to eliminate the use of NP and NPEs altogether (for example, when its entire existing inventory was consumed).

Actions to Reduce NP and NPEs in Textile Mill Effluents

In 2004, the Minister of the Environment published the *Notice Requiring the Preparation and Implementation of Pollution Prevention Plans in Respect of Nonylphenol and its Ethoxylates Used in the Wet Processing Textile Industry and Effluents from Textile Mills that Use Wet Processing.* Persons subject to the Notice included all wet processing textile mills that discharged their effluents to a MWWTS and had a daily effluent flow greater than 30 m^3/day, based on average annual discharge, at least one year between 1999 and 2003. Affected persons were required to prepare and implement a P2 plan that took into consideration the objective of reducing, by 2009, the annual use of NP-NPEs by at least 97%, relative to the annual use for the base year (1998 for most mills[10]) and;

A performance report for NP and NPEs in textile mill effluents was published in November 2012 (ECCC 2012b). The NP and NPE reduction target of 97% from base year was surpassed. NP and NPE use was reduced by 99.99% in 2009 from the base year (1998 for most mills). The amount of NP and NPEs used declined from over 207 000 kg in the base year to 20 kg in the implementation year.

Identifying themselves to be subject to the Notice, over 60 textile mills submitted Declarations that plans were prepared and implemented. The majority of these mills were located in Quebec (59%) and Ontario (38%). The remainder were located in Nova Scotia (3%).

The risk management objective to reduce the quantity of NPEs used in wet processing of textiles for this P2 Planning Notice has been met. The achievement of risk management objectives for both P2 Planning Notices that progress has been made in meeting the environmental objective.

2.1.4 Voluntary Reductions of NP and NPEs in the Pulp and Paper Sector

In 1997, the Canadian pulp and paper industry began to voluntarily phase out the use of NP and NPEs. Voluntary reductions of 99.8% were forecasted to have been completed by 2003, according to a 2001 survey conducted by the Forest Products Association of Canada in conjunction with Environment Canada (Tardif 2003). According to the survey, 40 pulp and paper mills reported stocking or using products containing NP and NPEs. Of these 40 mills, 32 mills already had a substitution plan in place to substitute NP and NPEs. Most mills had either already completed their substitution plans or were targeting completion by 2003, however, some mills had not set a specific date (these mills would no longer purchase NPE-containing products but would continue to use existing stocks until exhausted).

While there is the possibility that NPE products could be reintroduced by the pulp and paper industry, this does not seem very likely. The existence of viable alternatives to NPEs in products

[10] For most mills, the base year reduction target used was 1998. Mills that did not have sufficient NP and NPE data for the 1998 calendar year could use another calendar year, from 1999 to no later than 2005, for which there was sufficient NP and NPE data as the base year.

and their proven toxicity would make it unlikely that a mill would return to their use. Other indicators examined in this evaluation, including facility releases to water and industry reported commercial use patterns appear to confirm the reductions in use of NP and NPEs from this sector (see sections 2.1.5, and 2.1.6).

2.1.5 Facility Releases of NP and NPEs to Water (National Pollutant Release Inventory)

The National Pollutant Release Inventory (NPRI) is Canada's legislated, publicly accessible inventory of pollutant releases (to air, water and land), disposals and transfers for recycling. Sections 46–53 of CEPA contain information-gathering provisions that allow the Minister of the Environment to require reporting of information on substances.

Since 1999, facilities meeting certain criteria, which have changed over time, have been required to report releases of NP and NPEs to the NPRI. Initially, facilities that manufactured, produced or otherwise used (MPO) a total of 10 tonnes or greater of "NP and its ethoxylates and derivatives", which included 28 distinct substances, were required to report. In 2003, thirteen individually listed nonylphenols and ethoxylates were replaced by "Nonylphenol and its ethoxylates". This substance grouping includes additional nonylphenols, ethoxylates and derivatives not listed previously[11], and is reported to the NPRI as a total for the "Nonylphenol and its ethoxylates" category. The reporting threshold was lowered as of the 2014 reporting year and facilities are now required to report if the total (MPO) is greater than 1 tonne[12]. Facilities handling less than this amount are not required to report.

Information received by NPRI can be used as an indicator of NP and NPEs used and released to bodies of water. From 1999 to 2001, reported releases of NP and NPEs to water are specifically of the substance Nonylphenol polyethylene glycol ether. In 2002, reported releases to water are of Nonylphenol polyethylene glycol ether as well as the Nonyphenol and the Nonylphenoxy ethanol categories. From 2003 to 2019, reported releases of NP and NPEs to water averaged 43,660 kg per year, with a median of 49,640 kg per year (figure 9).

[11] See Annex B for a list of substances currently subject to reporting to the NPRI.

[12] Facilities are required to report to the NPRI if NP and NPEs are manufactured, processed or otherwise used at the facility in a quantity of 1000 kg (1 tonne) or more and employees worked 20,000 hours or more in a calendar year.

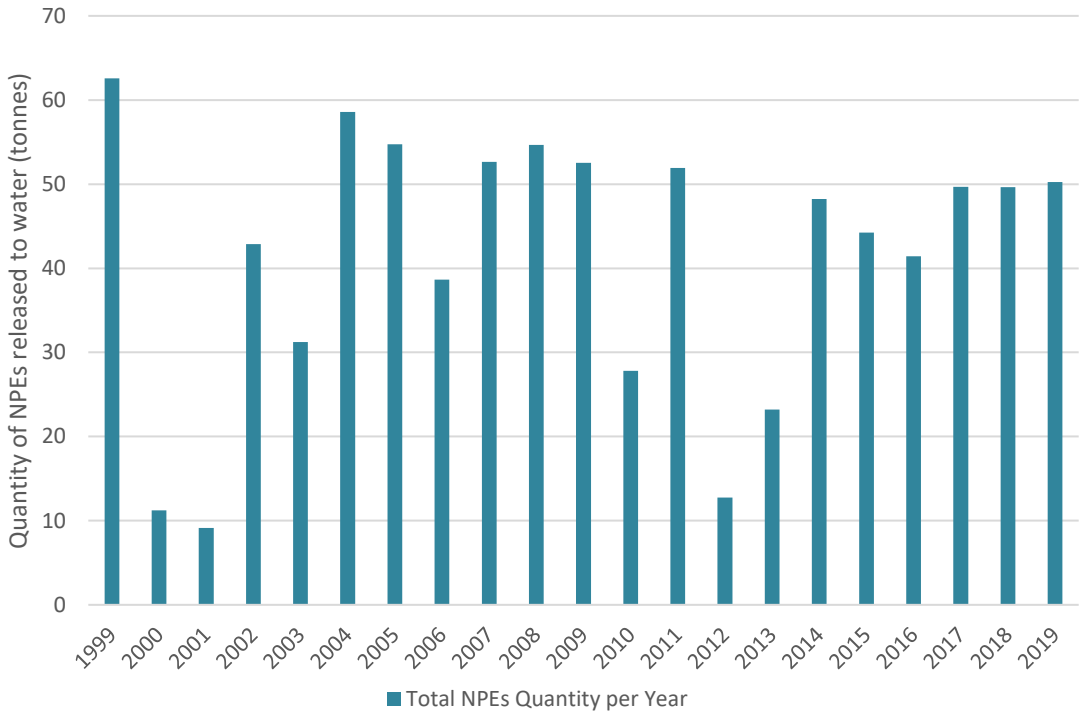

Figure 8: Total quantity of NPEs released to water, as reported to NPRI from 1999 to 2019

There has been an increase in the number of facilities reporting releases of NPEs to bodies of water from 1999 to 2019, including a significant increase in 2014 that coincides with the change to a lower reporting threshold. Despite the overall higher number of facilities reporting during this period, there is a noticeable downward tendency in number of reporters from 2014 to 2019 (figure 10). There was an average of 8 facilities reporting in the period from 1999 to 2013 and an average of 15 facilities reporting in the period from 2014 to 2019.

There have been significant changes in the types of sectors reporting releases to water bodies of NPEs since 1999. From 1999 to 2001, the sectors reporting releases were primarily in the pulp and paper sector, and included newsprint mills, paperboard mills, and especially chemical pulp mills. One facility in the iron and steel mills and ferro-alloy manufacturing category also reported releases in this time period. The decline in reported releases from the pulp and paper mill sector coincides with information received from a 2001 survey of pulp and paper mills using NPEs (Tardif 2003).

As of 2002, sewage treatment facilities (described by North American Industry Classification System [NAICS] code 221320) account for the majority of facilities reporting releases of NPEs to bodies of water, with relatively larger amounts released in Vancouver and the southwest of Lake Ontario. In fact, from 2016 to 2019, sewage treatment facilities are the only sector reporting releases to water bodies. Up until 2014, the average number of sewage treatment facilities reporting releases was 5 per year. From 2014 onwards, the average more than doubled to 11 sewage treatment facilities reporting releases to water per year, although there is a downward trend from 2014 to 2019. This is likely due to the lower reporting threshold that came into effect

in 2014. Despite the doubling in the number of facilities reporting, the average quantity reported by sewage treatment facilities only increased by approximately 13%.

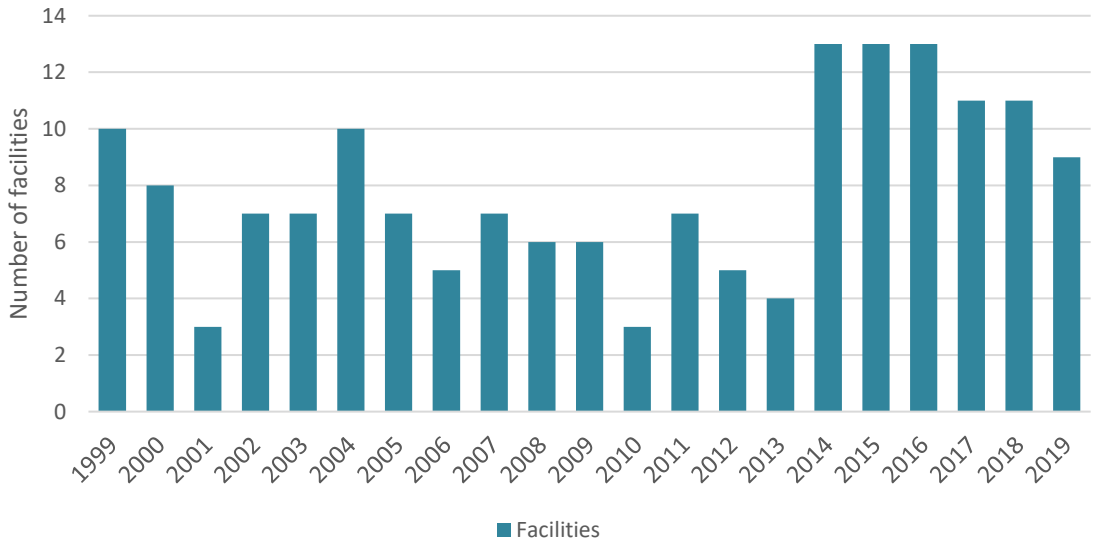

Figure 9: Number of facilities reporting NPE released to water from 1999 to 2019

The sewage treatment sector includes MWWTSs. Given that this sector has the most facilities reporting releases of NPEs to water underscores the role of MWWTSs as a conduit for release of NPEs from products and textile mills to the environment. It is noted, however, none of the facilities that became subject to the P2 Planning Notice for NP and NPEs in products reported any releases of NPEs to water between 2003 and 2012.

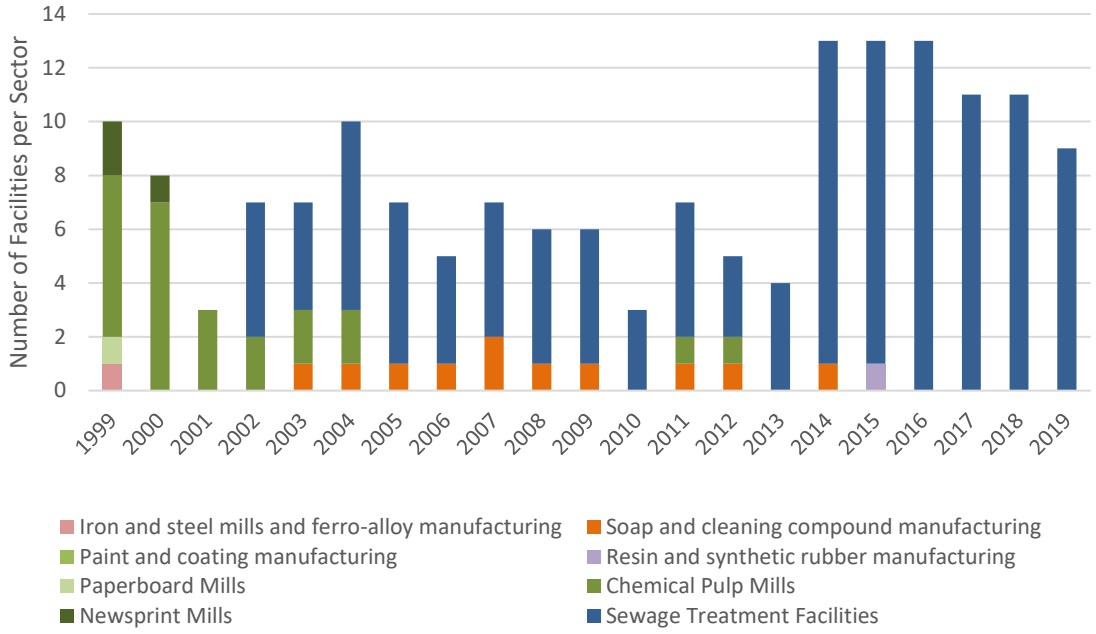

Figure 10: Number of facilities reporting NPE releases to water per sector, per year

There are few reports of releases of NPEs to water from the soap and cleaning compound manufacturing sector to NPRI. On average, there is one facility in this sector reporting releases of NPEs to bodies of water from 2003 to 2014. In 2015, a facility in the resin and synthetic rubber manufacturing sector reported a release of NPEs to water. However, there were no other reported releases from this facility or sector. There have been no reported releases to water from facilities in the textile mill sector from 1999 to 2019. Overall, the number of facilities related to sources of concern of NP and NPEs reporting releases to water, including soap and cleaning compound manufacturing and pulp and paper sectors, has decreased over time and/or ceased completely after 2014, and there have never been any reported releases directly to water from the textile mill sector.

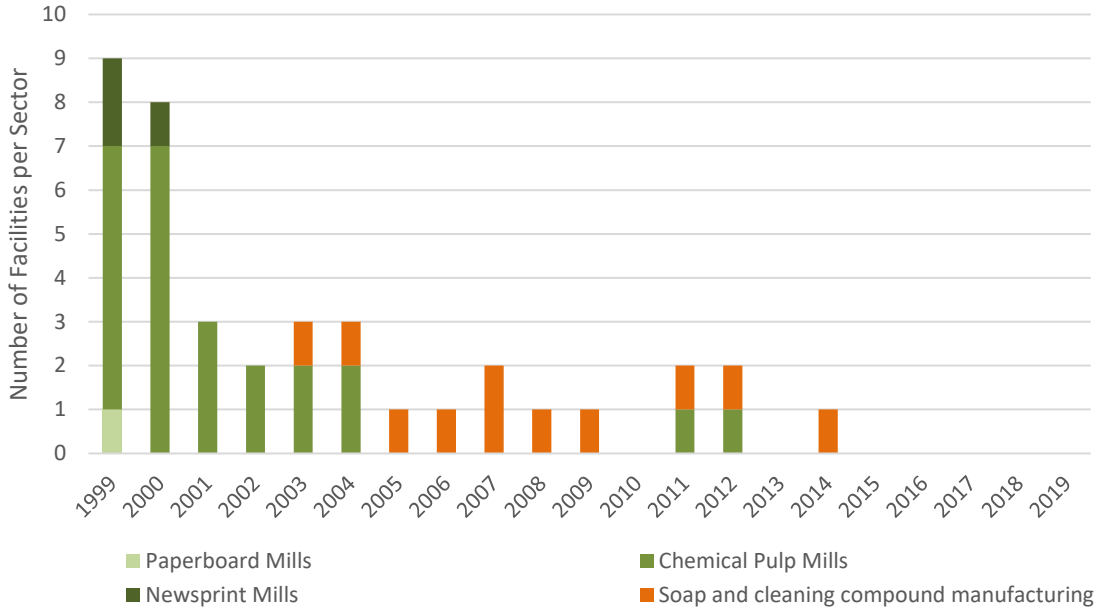

Figure 11: Number of facilities from sectors of concern reporting releases to water from 1999 to 2019

The data reported to the NPRI indicates that there has not been a significant increase over time in the quantity of NPEs reported to be released to water. Further, the number of facilities associated with sectors of concern have decreased since 1999 and have ceased to report releases as of 2015. While there is an overall increase in the number of facilities reporting to NPRI from when reporting began, the increase is likely due to changes in the reporting threshold, and there is a decreasing tendency over the last few years.

2.1.6 Commercial Use Patterns of NP and NPEs

Changes over time in commercial use patterns for NP and NPEs may help to determine if there are increases in the quantities of these substances manufactured, imported and used in Canada. Additionally, this information may be used to determine if commercial uses are increasing in sectors of concern or in other sectors and facilities not previously identified as sources of concern.

In 2017, a notice was issued under section 71 of CEPA 1999 which applied to a number of substances including NP and NPEs. This survey notice was used to gather information to inform decision-making for the risk management of implicated substances, including informing performance measurement. Information was gathered from manufacturers, importers and users of these substances to identify commercial use quantities and applications of these substances in Canadian commerce for the 2015 and 2016 reporting years.

Previously, a similar survey was issued in 1997 under authority of Section 16 of CEPA 1988 to determine the uses of priority chemicals to inform risk assessments (ECCC 1997a). Information collected on the quantity of NP and NPEs produced, imported, exported, and used in Canada during the 1995 and 1996 reporting years was analysed for the PSL assessment of NP and NPEs (ECCC 1997b).

According to information collected by the 1997 and 2017 surveys, the total quantity of NP and NPEs manufactured in Canada decreased significantly from 1995-1996 to 2015-2016. The total NPEs reported to be manufactured in Canada was 265,575 kg for the 2015-2016 period. In 1995, 32,700,000 kg were reported to be manufactured (though 12,600,000 kg were exported[13], leaving 20,100,000 kg for use in Canada) and in 1996, 25,600,000 kg were manufactured (though 11,100,000 kg were exported, leaving 14,500,000 kg for use in Canada).

Similarly, a significant decrease in the total quantity of NP and NPEs used in Canada was observed between the 1995-1996 period and 2015-2016. The total NPEs used in Canada was reported to be 42,800,000 kg in 1995-1996, and 3,304,657 kg in 2015-2016.

Finally, the total quantity of NPEs imported decreased from the 1995-1996 period to 2015-2016. There were 8,200,000 kg of NPEs imported to Canada in the 1995-1996 reporting period and 5,473,293 kg in the 2015-2016 reporting period.

The sectors reporting use of NPEs to the 2017 survey are mostly in the Manufacturing Sector (60% of submissions), Wholesale Trade (19%), and Mining, Quarrying, and Oil and Gas Extraction (9%). Reporting subsectors within the Manufacturing sector category are primarily Chemical Manufacturing (which includes Paint, Coating, and Adhesive Manufacturing), and to a lesser degree Coal and Petroleum Products Manufacturing, and Plastics and Rubber Manufacturing.

The data shows that in the reporting years 2015-2016, few facilities were using NPEs for purposes related to the sources of concern identified in the 2001 PSL assessment. Less than 4% of submissions to the survey reported use of NPEs under NAICS code 3256, Soap and Cleaning Compound Manufacturing. Even fewer submissions reported use for NAICS code 3133, Textile and fabric finishing and fabric coating, and for codes related to pulp and paper mills such as NAICS code 321 Wood Products Manufacturing, NAICS code 322 Paper Manufacturing, and NAICS code 323 Printing and related support activities.

The commercial use data indicates that manufacture, import, and use of NP and NPEs reported to the information gathering initiatives decreased from one survey in 1995-1996 to another survey in 2015-2016. In addition, the latter survey data suggests that there is overall low usage of NP and NPEs in sectors related to sources of concern.

2.2 Limitations

Progress in achieving the environmental objective for a substance is determined by analyzing the best available data. Analyses of specific datasets contribute to the overall evaluation findings for a substance. As part of the overall analysis, evaluations also look at the influence a risk management strategy has had on any observed trends or changes. While efforts are made to identify links between findings and the implementation of risk management strategies, these linkages are challenging considering multiple external variables. The aim is to identify links based on information available while acknowledging uncertainties.

There may be limitations to conclusions based on environmental monitoring data due to media sampled, sample locations, and data collection frequency. Selected data collection sites are proxies for the ambient environment in Canada and help to inform whether it is likely that the environmental objective has been met. However, there may be areas in Canada outside of these selected sampling sites in which the environmental objective is not being met. Further,

[13] It should be noted that the 2017 survey did not collect information on the exportation of NPEs.

environmental monitoring data has not been consistently collected in years before, during, and after risk management action implementation which limits the ability to determine correlations between risk management actions taken and the direct impact on the ambient environment. While some older data sets are available to provide historical information, there are limitations to comparing past data to the more current data collected as part of the Chemicals Management Plan Monitoring and Surveillance Program. This includes increasing sensitivity and accuracy of analytical methods and instruments over time. The available sediment monitoring data is currently insufficient to determine if there are any increasing or decreasing trends over time. No marine surface water or sediment data has been collected to date.

Some of the data used in this performance evaluation relies on information that is self-reported by industry, including information collected by NPRI, information gathering surveys under CEPA 1988 and 1999, and information provided as part of the survey on the use of products containing NPEs in the Canadian pulp and paper industry in 2001. Self-reported data, and in particular data that is based on estimation methods, may not always be consistent between reporters. Further, not all those required to report may have done so.

3 Conclusion

The performance measurement evaluation process helps to ensure that risk management measures are applied where needed to protect Canadians and the environment from toxic substances. The performance measurement evaluation of NP and NPEs demonstrates that the environmental objective has been met, and that implementation of risk management actions have contributed to meeting the environmental objective.

Recent environmental levels of NP and NPEs across Canada are mostly well below historical levels and below guidelines that have been set for specific media. The environmental objective that was set for NP and NPEs in the risk management strategy for these substances aimed to achieve ambient concentrations in Canadian waters that do not exceed the CWQG established for NP and NPEs at 1000 ng/L and 700 ng/L NP TEQ for freshwater and marine waters, respectively. The best available information suggests that surface freshwater concentrations of NP and NPEs are well below the CWQG and do not show any concerning increasing trends. The majority of freshwater sediment samples had concentrations of NP and NPEs below the CSQG. As such, the environmental objective for NP and NPEs can be considered achieved.

The risk management instruments have been very successful in reducing the quantity of NP and NPEs used in products and wet processing of textiles. The objectives set for the P2 Planning Notices for NP and NPEs in products and textile mill effluents have been met. Further, voluntary measures taken by pulp and paper mills appear to have greatly reduced the use of NP and NPEs in that sector. The information analysed in this report does not suggest that new commercial uses of NP and NPEs are a concern at this time.

3.1 Moving Forward

Given that surface freshwater concentrations of NP and NPEs are below the CWQG and there are no indications of new sources of concern, further risk assessment and risk management action is not recommended at this time. However, additional research, information gathering, and monitoring and surveillance activities may be warranted.

Continued periodic environmental monitoring at wastewater treatment facilities, the primary pathway for NP and NPEs to enter the environment, as well as continued reporting of NP and NPEs released to bodies of water to the NPRI and collection of information on commercial use

patterns may help to further track trends in the use and release of NP and NPEs to water. In addition, ambient surface water monitoring should be continued and compared to the CWQG guideline to ensure the environmental objective continues to be met.

Continued monitoring for NP and NPEs in sediment over multiple years would help to expand the data set and monitor trends over time, in particular in the Still Creek area where concentrations of NP and NPEs have exceeded the guideline for freshwater sediment. Should concentrations of NP and NPEs continue to exceed the guideline at this site, further research may help to establish the source of NP and NPEs in Still Creek and identify concerns.

If, in the process of monitoring NP and NPEs and during future PME analysis, it is determined that the environmental objective is no longer being met, options for future risk management action should be considered, such as regulatory and/or non-regulatory instruments.

Reporting under the WSER may also be tracked until all authorizations to exceed the standards expire in 2040. Changes in the percentage of wastewater effluents treated to at least secondary level treatment may be considered in any future performance measurement evaluation of NP and NPEs.

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5 Annex

5.1 Annex A: Non-Exhaustive list of NP and NPE Compounds

Name and synonyms	CAS RN
4-Nonylphenol monoethoxylates	
4-Nonylphenol diethoxylates	
Phenol, 4-nonyl-	104-40-5
Isononylphenol	11066-49-2
Poly(oxy-1,2-ethanediyl), α-(4-nonylphenyl)-ω-hydroxy-, branched	127087-87-0
Dinonylphénol; Phenol, dinonyl-	1323-65-5
Oxirane, methyl-, polymer with oxirane, 1-ethoxyethyl 4-tripropylenephenyl ether	160799-28-0
4-n-Octylphenol	1806-24-4
p-nonylphenol; Phenol, nonyl-	25154-52-3
Nonoxynol-9; Tergitol NP-9; Poly(oxy-1,2-ethanediyl), α-(4-nonylphenyl)-ω-hydroxy-	26027-38-3
Phenol, nonyl-, 1,1',1''-phosphite	26523-78-4
3,6,9,12,15,18,21-Heptaoxatricosan-1-ol, 23-(nonylphenoxy)-	27177-05-5
Octylphenol	27193-28-8
Ethanol, 2-(nonylphenoxy)-	27986-36-3
Phenol, nonyl-, barium salt (2:1)	28987-17-9
Poly(oxy-1,2-ethanediyl), α-sulfo-ω-(4-nonylphenoxy)-, ammonium salt (1:1)	31691-97-1
Poly(oxy-1,2-ethanediyl), α-(isononylphenyl)-ω-hydroxy-	37205-87-1
Oxirane, 2-methyl-, polymer with oxirane, mono(nonylphenyl) ether	37251-69-7
Poly(oxy-1,2-ethanediyl), α-(nonylphenyl)-ω-hydroxy-, phosphate	51811-79-1
Phosphorous acid, dinonylphenyl bis(nonylphenyl) ester	54771-30-1
3,6,9,12,15,18,21,24-Octaoxahexacosan-1-ol, 26-(nonylphenoxy)-, dihydrogen phosphate	66197-78-2
Poly(oxy-1,2-ethanediyl), α-(nonylphenyl)-ω-hydroxy-, branched, phosphates	68412-53-3
Poly(oxy-1,2-ethanediyl), α-(nonylphenyl)-ω-hydroxy-, branched	68412-54-4
Barium, carbonate nonylphenol complexes	68515-89-9
Nonoxynol-4; Poly(oxy1,2ethanediyl), α-(nonylphenyl)-ω-hydroxy-	7311-27-5
4-nonylphenol; Phenol, 4-nonyl-, branched	84852-15-3
Phenol, dinonyl-, branched	84962-08-3
Poly(oxy-1,2-ethanediyl), α-sulfo-ω-(nonylphenoxy)-, sodium salt (1:1)	9014-90-8
Poly(oxy-1,2-ethanediyl), α-(dinonylphenyl)-ω-hydroxy-	9014-93-1
Nonoxynol-4; Poly(oxy1,2ethanediyl), α-(nonylphenyl)-ω-hydroxy-	9016-45-9
Poly(oxy-1,2-ethanediyl), α-sulfo-ω-(nonylphenoxy)-, ammonium salt (1:1)	9051-57-4

5.2 Annex B: National Pollutant Release Inventory List of Substances

The National Pollutant Release Inventory (NPRI) collects and publishes information about substances that may pose a risk to the environment and health. Substances may be added, removed, renamed, grouped, or be listed with new reporting requirements over time. In 1999, 13 nonylphenol and ethoxylate substances were included in the list of substances subject to reporting under the NPRI. In 2003, individually listed nonylphenols and ethoxylates were replaced by the "Nonylphenol and its ethoxylates" group of substances. This group of 28 substances includes additional nonylphenols, ethoxylates, and derivatives not listed previously before 2003 and is reported as a total for the group:

	Substance Name	CAS Number	Listed separately on NPRI before 2003
	NP/NPE Grouping		
Nonylphenols			
	Nonylphenol	104-40-5	YES
	n-Nonylphenol (mixed isomers)	25154-52-3	YES
	Nonylphenol, industrial	84852-15-3	YES
	Phenol, dinonyl	1323-65-5	NO
	Phenol, nonyl-,phosphite[a]	26523-78-4	NO
	Phenol, nonyl-, barium salt	28987-17-9	NO
	Phenol, nonyl derivatives	68081-86-7	NO
	Barium, carbonate nonylphenol complexes	68515-89-9	NO
	Phenol, nonyl derives., sulphides	68515-93-5	NO
Nonylphenol Ethoxylates			
	2-(*p*-Nonylphenoxy) ethanol	104-35-8	YES
	2-(2-(*p*-Nonylphenoxy)ethoxy) ethanol	20427-84-3	YES
	p-Nonylphenol polyethylene glycol ether	26027-38-3	YES
	Nonylphenol hepta(oxyethylene)ethanol	27177-05-5	YES
	Nonylphenol nona(oxyethylene)ethanol	27177-08-8	YES
	Ethoxynonyl-benzene	28679-13-2	YES
	Nonylphenoxy ethanol	27986-36-3	YES
	Oxirane, methyl-, polymer with oxirane, mono(nonylphenyl) ether	37251-69-7	YES
	2-(2-(2-(2-(*p*-Nonylphenoxy)ethoxy) ethoxy)ethoxy) ethanol	7311-27-5	YES
	Nonylphenol polyethylene glycol ether	9016-45-9	YES
	Ethanol, 2-[2-(nonylphenoxy)ethoxy]-	27176-93-8	NO
	Nonylphenol ethoxylate	37340-60-6	NO
	Poly(oxy-1,2-ethanediyl), alpha-(nonylphenyl)-omega-hydroxy-, phosphate	51811-79-1	NO
	Poly(oxy-1,2-ethanediyl), alpha-(2-nonylphenyl)-omega-hydroxy-	51938-25-1	NO
	Nonylphenol ethoxylate	68412-53-3	NO

	Substance Name	CAS Number	Listed separately on NPRI before 2003
	Ammonium salt of sulphated nonylphenol ethoxylate	9051-57-4	NO
	Poly(oxy-1,2-ethanediyl), alpha(isononylphenyl) omega-hydroxy	37205-87-1	NO
	Poly(oxy-1,2-ethanediyl), alpha(nonylphenyl) omega-hydroxy, branched	68412-54-4	NO
	Poly(oxy-1,2-ethanediyl), alpha(4-nonylphenyl) omega-hydroxy, branched	127087-87-01	NO