

April 5, 2016

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Chair, Canadian Section
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Dear Co-Chairs Pollack and Walker,

As part of its approved 2015 – 2016 work plan the Great Lakes Water Quality Board's Legacy Issues Work Group focused much of its efforts of the past year on legacy pollutants and contaminants as it endeavoured to develop and provide advice and recommendations related to Great Lakes Water Quality Agreement that may be of use to the Commission.

The attached report entitled Polybrominated Diphenyl Ethers (PBDEs) in the Great Lakes provides a brief overview of the issue of PBDEs in the Great Lakes and specifically, their use as additives in consumer products, which provides pathways for their release during product manufacture, use and end-of-life actions. The report also provides recommendations with regard to the development of strategies by the governments of Canada and the United States, to manage PBDE-containing products in order to reduce the release of PBDEs to the environment.

The Board believes that the recommended strategy components presented in the report, while specific to PBDEs could also be adapted for other substances and be of use to the Parties, policymakers and other Great Lakes stakeholders. The Board also notes that it is very important to engage a variety of stakeholders for the successful development and implementation of any strategy to address toxic substances in the Great Lakes and this will be the focus of PBDE related work that the WQB is proposing for the upcoming year.

Thank you for your consideration of the report and we look forward to continuing to assist the Commission by assessing the adequacy of the regulatory framework for representative legacy contaminants and providing advice and recommendations to further restore and protect the Great Lakes

Sincerely,



David Ullrich
U.S. Co-Chair
Great Lakes Water Quality Board



Rob de Loë
Canadian Co-Chair
Great Lakes Water Quality Board

POLYBROMINATED DIPHENYL ETHERS (PBDEs) IN THE GREAT LAKES

Prepared by

**Great Lakes Water Quality Board
Legacy Issues Work Group**

FINAL REPORT – MARCH 2016

Executive Summary

This report provides the recommendations of the Water Quality Board's Legacy Issues Work Group, with regard to the development of a strategy by the governments of Canada and the United States to address polybrominated diphenyl ethers (PBDEs) in the Great Lakes. The recommendations summarized below are those that have been identified as priority recommendations by the work group, based on a consultant's report that includes numerous, additional valuable recommendations.

Recommendation 1: The Canadian and United States federal governments should designate PBDEs as a Chemical of Mutual Concern under Annex 3, Part B, Sec. 2 of the Great Lakes Water Quality Agreement.

Recommendation 2: The entire basin should be protected by equally effective restrictions on the manufacture, use and sale of PBDEs and PBDE-containing products. As part of the federal governments' strategy for addressing PBDEs, they should assess the various regulatory and non-regulatory methods that they can use to protect the basin from PBDE-contamination and ensure that equally powerful actions are taken throughout the basin

Recommendation 3: The federal governments should develop a plan for reducing and eliminating potential releases of PBDEs in products during the recycling and disposal stages. This plan should be developed in cooperation with a wide range of stakeholders.

Recommendation 3A: The federal governments should develop and promote guidance for industry, municipalities and the public, incorporating best practices, for product end-of life management, such as recycling and disposal that provides equal protections in all parts of the Great Lakes basin.

Recommendation 3B: The responsible governments (federal, provincial and state) should develop and implement Extended Producer Responsibility programs throughout the basin to require industry to be responsible for their products after use and to ensure that they are properly recycled and disposed, to be undertaken in 2 phases:

Phase 1: electronics, appliances, carpets, mattresses, and furniture

Phase 2: construction, renovation and demolition wastes

Recommendation 4A: The federal, provincial and state governments should develop and distribute guidance for industry on methods to assess PBDE substitutes and encourage use of methods for addressing flammability concerns that are less reliant on chemicals, if at all.

Recommendation 4B: The federal governments should require industry, in advance of making a substitution, to demonstrate to governments the basis for their decision and to obtain government approval for the substitution.

Recommendation 5A: The federal governments should establish a product registry identifying which products contain PBDEs and how much they contain. This will help determine which products need the most control on their disposal, and will help governments, industry and the public make wise, informed choices in their purchasing.

Recommendation 5B: The responsible government jurisdictions (federal, provincial and state) should ensure that research and monitoring is carried out to improve the understanding of the extent to which and how PBDEs are released to the environment in the recycling and disposal stages.

Recommendation 5C: The responsible government jurisdictions (federal, provincial and state) should continue and increase monitoring of PBDEs in environmental media (water, sediment, air, biota [fish, gull eggs, etc.]) in order to assess effectiveness of polices aimed at reducing PBDEs in the environment.

Legacy Issues Work Group Members and Consultants

The Legacy Issues Work Group gratefully acknowledges the contributions of the work group and WQB membership and the IJC staff support of Antonette Arvai, John Wilson and Clayton Sereres of the Great Lakes Regional Office. The work group wishes to recognize the excellent and thorough work of the consultants who produced the report upon which the work group's recommendations are based. We also acknowledge the hard work of Kennan Zhou, IJC Intern, who produced a background document on PBDEs. Finally, a special thank you is extended to the external work group experts who provided review and valuable input on both the consultant's report and the PBDEs background document.

Water Quality Board Work Group Members

Canadian Members

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History and Background of the Project

In 2015 the Water Quality Board formed the Legacy Issues Work Group, which identified the impact of polybrominated diphenyl ethers on the Great Lakes as a priority issue. PBDEs have been widely used as flame retardants since the 1970s and have been deliberately added to a wide range of commercial and consumer products, such as electronic devices, plastics, mattresses and carpets. Numerous studies have demonstrated adverse impacts on the environment and wildlife from exposure to PBDEs, which have been identified as persistent, toxic, and bioaccumulative. Adverse impacts on wildlife include increased mortality rates, malformations, and thyroid system and metabolic impairment.

All five Great Lakes contain some level of PBDEs, with Erie and Ontario having the highest concentrations in water.¹ Waters with cooler temperatures, larger volumes and lower productivity, such as Lake Superior, can cause PBDE concentrations to decrease more slowly. Over the past decade Canada and the United States have

¹ Venier, M., Dove, A., Romanak, K., Backus, S., & Hites, R., 2014. Flame retardants and legacy chemicals in Great Lakes' water. Environmental Science & Technology. 48(16), 9563-9572.

phased-out the manufacture and import of some PBDE chemicals and developed strategies to reduce their levels in the environment. These phase-outs have been correlated with declining concentrations of PBDEs in various Great Lakes environmental media. However, products that contain PBDEs are still imported and widespread in the basin. It has been estimated that between 1970 and 2013, total PBDE use within the basin ranged between 15,000 and 80,000 tonnes. Forty percent of the peak value is expected to remain in the use phase by 2020.² Product use and end-of-product-life actions can be a significant source of PBDE contamination to the environment. As a result, a life-cycle management approach is needed to reduce loading to the Great Lakes. Management of PBDEs and the products that contain them presents a particular challenge in the Great Lakes region due to the large size of the basin and its relatively closed nature, which means that contaminants stay in and build up in the Great Lakes basin to a greater extent than in faster flowing river systems. Also, the multiple U.S. and Canadian jurisdictions within the basin mean that effective measures have to be taken in a multiplicity of jurisdictions. This can be a challenge unless a cooperative strategy is taken by all government jurisdictions in the basin.

In order to properly assess the status of response to the presence of PBDEs in the Great Lakes region, the work group undertook a binational assessment of: (1) the handling of products containing PBDEs during and after use and (2) the adequacy of actions by governments and other institutions to minimize the release and consequent presence of PBDEs in the Great Lakes basin. The ultimate goal of this work is to provide the International Joint Commission (IJC), and ultimately governments, with advice to minimize the release and environmental impact of PBDEs during the product's life cycle.

Précis of Report Content

This report provides a brief overview of the issue of PBDEs in the Great Lakes and specifically, their use as additives in consumer products, which provides pathways for their release during product manufacture, use and end-of-life actions. The report further provides the recommendations of the Water Quality Board's Legacy Issues Work Group, with regard to the development of strategies by the governments of Canada and the United States, to manage PBDE-containing products in order to reduce the release of PBDEs to the environment. The findings and recommendations presented are those that have been identified as priority recommendations by the work group, based on a consultant's report that includes numerous, additional valuable recommendations. The consultant's report, as well as an IJC Intern developed PBDE background document, are provided as appendices to this report.

² Abbasi, G., Diamond, M., Soehl, A., & Murray, M., 2014. Great Lakes PBDE reduction project summary paper No. 1: PBDE product inventory. Great Lakes Commission.

Link to Full Report

This WQB report is available for download at http://www.ijc.org/en/_pbdes.

Work Group Key Findings and Recommendations

At the time of writing this report, PBDEs and HBCD (part of the flame retardants group) have been recommended by the co-chairs of the Annex 3 (Chemicals of Mutual Concern) Subcommittee to the Great Lakes Executive Committee for designation as “chemicals of mutual concern” under the 2012 Great Lakes Water Quality Agreement (GLWQA). We strongly urge the governments of Canada and the United States to accept these recommendations, so that they may begin to develop a binational strategy to address them.

Recommendation 1: The Canadian and United States federal governments should designate PBDEs as a Chemical of Mutual Concern under Annex 3, Part B. Sec. 2 of the Great Lakes Water Quality Agreement.

Our remaining recommendations are aimed at providing suggestions for governments in developing a strategy to address PBDEs in the Great Lakes. The priority strategy components are based on a mix of relatively easy and quick “low hanging fruit” and long-term, more challenging solutions. Both are needed to solve the problem of PBDEs in the Great Lakes basin. The governments are urged to involve a range of stakeholders, including industry, municipalities, environmental groups, etc., in the development of the strategy.

Restrictions and bans on PBDE manufacture, use and import

Various governments in the Great Lakes basin have placed bans or restrictions on the manufacture, use, sale, import and distribution of certain PBDEs.³ These actions have already had substantial impact, with levels of PBDEs declining in the Great Lakes basin.⁴ However, as we have observed with other substances that have been banned, after an initial period of decline in levels, these declines may slow down or even start to increase again. The Canadian and U.S. federal governments have taken actions on the same list of PBDEs (c-penta-BDE, c-octa-BDE, tetra-BDE, hexa-PDE, hepta-BDE, nona-BDE, and deca-BDE). However, the nature of the actions varies substantially between the two jurisdictions. In Canada, the approach for all of the PBDEs listed above has been on regulations to restrict or ban the manufacture and use of these substances. In the United States, in only two cases (c-penta-BDE and c-octa-BDE) has the federal government used regulations to restrict or ban the use of these substances. For the others, the U.S. approach has been on non-regulatory measures combined with the

³ For details see Duncan Bury Consulting, October 30, 2015. Polybrominated Diphenyl Ethers in the Great Lakes Basin: Final Report. Submitted to the International Joint Commission. Sections 4.2 – 4.4, Tables 4 and 6.

⁴ For details see Zhou, K., August 10, 2015 Background Document on Polybrominated Diphenyl Ethers. Submitted to the Legacy Issues Work Group. Section 6.1 and 8.1.

threat of regulations. This has resulted in voluntary commitments by major manufacturers to restrict the manufacture and import of these types of PBDEs.

Because of the focus on a non-regulatory approach to PBDEs by the U.S. government, some Great Lakes states have passed legislation to restrict the manufacture and use of some PBDEs. Four of the Great Lakes states (Illinois, Michigan, Minnesota, and New York) have passed regulations restricting the manufacturing, processing or distribution of products depending on whether the concentration of c-penta-BDE or c-octa-BDE exceeds 0.1%. Ontario did not pass such regulations. Instead Ontario has been assessing the effectiveness of the federal government's actions to determine whether additional provincial action is needed.

Government actions targeting the import or sale of products containing PBDEs are scarce in the Great Lakes jurisdictions. Likewise, only rarely are their programs aimed at controlling the disposal of PBDE-containing products.

A diversity of restrictions in the jurisdictions of the Great Lakes basin on manufacture and sale of PBDEs and the almost total absence of restrictions on the import or sale of PBDE-containing products within the basin fails to provide adequate protection from PBDEs. Because the pollution from the manufacture, import and use of PBDEs and of the use of PBDE-containing products around the basin spreads throughout the basin, there must be powerful controls throughout the entire basin that address all necessary issues.

Recommendation 2: The entire basin should be protected by equally effective restrictions on the manufacture, use and sale of PBDEs and PBDE-containing products. As part of the federal governments' strategy for addressing PBDEs, they should assess the various regulatory and non-regulatory methods that they can use to protect the basin from PBDE-contamination and ensure that equally powerful actions are taken throughout the basin

Addressing PBDE release during recycling and disposal

Although banned, PBDE flame retardants are still present throughout the Great Lakes basin in a vast array of products. A study by the Great Lakes Commission⁵ estimated that the amount of PBDEs contained in products in use in the Great Lakes basin reached a peak of 15,000 tonnes in 2004. Since that time, that number has been decreasing as government restrictions came into effect and as products were taken out of use.

⁵ Abbasi, G., Diamond, M., Soehl, A., & Murray, M., 2014. Great Lakes PBDE reduction project summary paper No. 1: PBDE product inventory. Great Lakes Commission.

PBDEs do not disappear when taken out of use. They may be released when the products they are in are recycled or disposed. This after-use stage presents a threat to the Great Lakes that needs to be addressed. Also, it is important to note that the 15,000 tonnes of PBDEs estimated to be in products in use in 2004 does not account for PBDEs that could be released to the environment as a result of inadequate recycling and disposal practices. Thousands of tonnes of PBDEs had already gone into landfills in the Great Lakes basin as a result of the products that were taken out of use prior to 2004. These PBDEs will not necessarily remain contained in these landfills in the long-term and could migrate to the surrounding environment.⁶

Recommendation 3: The federal governments should develop a plan for reducing and eliminating potential releases of PBDEs in products during the recycling and disposal stages. This plan should be developed in cooperation with a wide range of stakeholders.

Numerous actions have been identified that the governments could include in a strategy.⁷ We place our highest priority on two of these.

Recommendation 3A: The federal governments should develop and promote guidance for industry, municipalities and the public, incorporating best practices, for product end-of life management, such as recycling and disposal, that provides equal protections in all parts of the Great Lakes basin.

This is an action that the governments should be able to carry out in the short-term. In some cases, governments within the Great Lakes basin have already developed such guidance. In other cases, governments elsewhere – especially in Europe – have developed guidance from which the governments here can learn. The U.S. and Canadian governments should work together and with stakeholder groups to assess and determine the most appropriate guidance. Since it is often municipalities that directly deal with recycling and disposal issues, including wastewater treatment and biosolids, the governments should ensure they fully engage municipalities in this guidance development.

To be sure that the guidance has substantial impact on what happens to PBDEs, those who are recycling or disposing the PBDE-containing products should be required to abide by the guidance. In the cases where municipalities have a role in recycling and disposal, the federal and provincial and state governments should

⁶ For a detailed analysis of the potential release of PBDEs during recycling and disposal, see Duncan Bury Consulting. *op. cit.*, Section 3.0

⁷ For a complete list of government strategy actions, see Duncan Bury Consulting. *op. cit.*, Section 5.0

provide municipalities with sufficient resources to carry out these actions. If necessary, the governments should develop the guidance into regulations to ensure adherence.

Recommendation 3B: The responsible governments (federal, provincial and state) should develop and implement Extended Producer Responsibility programs throughout the basin to require industry to be responsible for their products after use and to ensure that they are properly recycled and disposed, to be undertaken in 2 phases:

Phase 1: electronics, appliances, carpets, mattresses, and furniture

Phase 2: construction, renovation and demolition wastes

The producers of PBDE-containing products need to have a more substantial role in ensuring that recycling and disposal problems are avoided. The Organization of Economic Cooperation and Development (OECD) defines Extended Producer Responsibility (EPR) as

... an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. There are two related features of EPR policy: (1) shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities, and 2) to provide incentives to producers to incorporate environmental considerations in the design of their products.⁸

There are jurisdictions in the Great Lakes basin and in places elsewhere in the world, especially Europe, that already have EPR programs for some PBDE-containing products.⁹ Implementing EPR for Phase 1 product categories (electronics, appliances, carpets, mattresses, and furniture) is more easily and quickly achievable since there are programs currently in place in various jurisdictions for some of these products within the basin and/or in other countries, and because of the ease of product source separation. Also, addressing these Phase 1 product categories can have a substantial impact due to the significant presence of PBDEs in the products in these categories.¹⁰ The product categories in Phase 2 (construction, renovation and demolition wastes) are more of a challenge to address but should be pursued in the long-term. Again, we urge full involvement of a range of stakeholders in the development of the EPR programs around the basin.

⁸ OECD, 2001. Extended Producer Responsibility: A Guidance Manual for Governments. p. 9.

⁹ For details on EPR, see Duncan Bury Consulting. *op. cit.* Section 5.1.2.

¹⁰ See Duncan Bury Consulting. *op. cit.* Table 1, pg. 6.

Substitution of PBDEs¹¹

In phasing out PBDEs, it is important to ensure that one hazardous flame retardant is not substituted for another hazardous one, potentially creating a whole new set of environmental and health problems for future generations to deal with. For example, two derivative substances of Tetrabromobisphenol A (an alternative to PBDEs) are now being found to bioaccumulate in the herring gull food chain.¹²

There is a need to look at non-chemical alternatives as methods to address fire concerns. This means designing and building products so that they are inherently less flammable, thus reducing or eliminating the need for chemical flame retardants. For example, studies have shown that increasing foam density in furniture can be sufficient to satisfy fire safety requirements without adding flame retardants to the foam. The U.S. EPA is currently pursuing this type of approach through its “Design for the Environment Alternatives Assessment” program.

Recommendation 4A: Federal, provincial and state governments should develop and distribute guidance for industry on methods to assess PBDE substitutes and encourage use of methods for addressing flammability concerns that are less reliant on chemicals, if at all.

Recommendation 4B: The federal governments should require industry, in advance of making a substitution, to demonstrate the basis for their decision and to obtain government approval for the substitution.

Knowledge gaps

There are many gaps in our knowledge of PBDEs.¹³ The governments should ensure that research is carried out and that systems are created to fill some of the most important knowledge gaps. This is essential to assess progress in addressing the PBDE problem and to determine which actions to take. Some of the major gaps are the limited knowledge with regard to the extent of PBDE presence in products and the release of PBDEs during recycling and disposal. We recommend two knowledge aspects that we consider particularly pressing.

¹¹ For discussion of this issue, see Duncan Bury Consulting. *op. cit.* Section 2.3.

¹² Letcher, R.J. & Chu, S., 2010. High-Sensitivity Method for Determination of tetrabromobisphenol-S and Tetrabromobisphenol-A Derivative Flame retardants in Great Lakes Herring Gull Eggs by Liquid Chromatography-Atmospheric Pressure Photoionization-Tandem Mass Spectrometry. *Environmental Science & Technology*. 44(22), 8615-8621.

¹³ For detailed discussion of this, see Duncan Bury Consulting, *op.cit.*, Sections 2.6 and 6.5

Recommendation 5A: The federal governments should establish a product registry identifying which products contain PBDEs and how much they contain. This will help determine which products need the most control on their disposal, and will help governments, industry and the public make wise, informed choices in their purchasing.

Recommendation 5B: The responsible government jurisdictions (federal, provincial and state) should ensure that research and monitoring is carried out to improve the understanding of the extent to which and how PBDEs are released to the environment in the recycling and disposal stages.

Recommendation 5C: The responsible government jurisdictions (federal, provincial and state) should continue and increase monitoring of PBDEs in environmental media (water, sediment, air, biota [fish, gull eggs, etc.]) in order to assess effectiveness of policies aimed at reducing PBDEs in the environment.

The full range of stakeholders should be involved in helping gather this information, especially industry. The Binational Toxics Strategy under the former GLWQA and the work carried out by the Great Lakes Commission in their PBDE project are excellent examples of the value of this kind of cooperative multi-stakeholder research.

Summary and Conclusions

PBDEs are just one example of a wide array of toxic substances in products broadly available around the basin. The governments should use what is learned through the PBDE experience to deal with other substances in products and how to avoid the creation of these problems in the first place. The recommended strategy components presented in this report, while specific to PBDEs, can be adapted for other substances. As noted throughout the report, it is highly important to engage a variety of stakeholders for the successful development and implementation of a strategy. There are numerous, valuable recommendations in the consultant's report and we urge governments to review each of them as they undertake their process of developing a strategy.

Appendices

The appendices for this report are available online at http://www.ijc.org/en/_pbdes.

Appendix A – Polybrominated Diphenyl Ethers in the Great Lakes Basin Final Report (submitted by Duncan Bury Consulting)

Appendix B – Background Document on Polybrominated Diphenyl Ethers (submitted by Kennan Zhou, IJC Intern)