NOTICE OF OBJECTION

Sierra Legal is filing this Notice of Objection on behalf of the David Suzuki Foundation, Environmental Defence, and the Canadian Environmental Law Association, pursuant to sections 332(2) and 333 of the *Canadian Environmental Protection Act, 1999* to the Minister of the Environment, the Hon. John Baird, with respect to the proposed *Polybrominated Diphenyl Ethers Regulations.* The proposed regulation was published in Vol. 140, No. 50 of the Canada Gazette Part I on Saturday, 16 December 2006.

Reasons for this Objection

This Notice of Objection underlines significant evidence that hepta through decaBDEs are bioaccumulative and therefore must be added to the list for virtual elimination under subsection 77(4) of the *Canadian Environmental Protection Act, 1999 ("CEPA" or "Canadian Environmental Protection Act").* As such, a main objection is that the scope of the proposed *Polybrominated Diphenyl Ethers Regulations* is too narrow; the use, sale, offer for sale, and import of hepta through decaBDE must also be prohibited.

A second objection is that the section 5(1)(b) exemption for PBDEs and resins, polymers, or mixtures containing such a substance intended for disposal or recycling is inappropriate and uncertain and renders the proposed regulations unenforceable and ineffective.

The key reasons for these Objections are as follows:

1. The criteria in the *Persistence and Bioaccumulation Regulations* are met in relation to the higher congener PBDEs. If neither bioaccumulation nor bioconcentration factors for a substance can be determined, the logarithm of the octanol-water partitioning coefficient (log Kow) is the measure of bioaccumulation. The log Kow for decaBDE exceeds the minimum criteria required for virtual elimination under *CEPA*.

2. The higher-brominated PBDEs such as decaBDE can debrominate and thus transform into the lower-brominated PBDEs, which are bioaccumulative and subject to a ban under the proposed regulation. Given the higher-brominated PBDEs are precursors to the lower-brominated PBDEs, the higher PBDEs should also be subjected to a full ban and virtual elimination, consistent with the Toxic Substances Management Policy, precedence, and the precautionary principle.

3. The evidence presented in Environment Canada's screening assessments for the proposed regulation is now outdated: it included information up until October 2004 only.[1] New evidence shows that decaBDE bioaccumulates in aquatic and terrestrial organisms, including human beings. Recent studies also point to additional evidence of the debromination of decaBDE into lower-brominated congeners. The new evidence points to

[1] Information received between November 2004 and October 2005 was reviewed but not generally added.

threats of serious damage from PBDEs, and application of the precautionary principle requires effective Government action.

4. The Section 5(1)(b) exemption for PBDEs and resins, polymers, or mixtures containing such a substance intended for disposal or recycling is too wide to allow for any ban of PBDEs to be effective, and is also uncertain in meaning and will be difficult to effectively apply so as to limit PBDE emissions.

We urge the Minister to establish a Board of Review to clarify the complex issues that have engulfed Environment Canada regarding PBDEs and to recommend both the updating of the proposed regulation so that it bans the use, sale, offer for sale and import of hepta, octa, nona and decaBDE and the tightening of the "disposal and recycling" exemption**.** Without further review of this topic, the health and environment of Canadians – both of which are priority political issues to Canadians today – may be jeopardized by non-comprehensive regulatory action by the federal government.

This Notice of Objection is set out in four main parts. It commences with an introduction providing background information on Polybrominated Diphenyl Ethers (PBDEs). This is followed by a section on the provisions under the *Canadian Environmental Protection Act* and the *Toxic Substances Management Policy* for the regulation of PBDEs and other toxic substances. Bioaccumulation and debromination issues are addressed in this part, with a focus on new data on decaBDE and other PBDEs. Third, a review of the new evidence of concern on bioaccumulation and debromination is presented**.** Finally a conclusion and summary of remedies that are sought from the Objection is provided.

Two letters from leading experts are attached as annexes to this Notice of Objection, stating their expert opinions on the bioaccumulation and debromination of decaBDE.

I. Introduction

The group of chemicals known as Polybrominated Diphenyl Ethers (PBDEs) are human-produced, persistent, bioaccumulative pollutants that are found throughout the environment. Used as flame retardants in polymer resins and plastics, PBDEs appear in furniture, televisions, stereos, computers, carpets, and curtains, textiles, adhesives, sealants and coatings.[2]

Scientific evidence on PBDEs points to multiple health impacts on hormonal, immune, developmental, including developmental neurotoxicity, and reproductive systems, as well as carcinogenicity. PBDEs are composed of a class of substances consisting of 209 possible congeners with 1 to 10 bromines. Seven PBDE homologues that are on *CEPA's* Domestic Substances List have been assessed. These seven PBDEs (tetraBDE, pentBDE, hexaBDE, heptaBDE, octaBDE, nonaBDE and decaBDE) are found in three commercial mixtures referred to as PentaDBE, OctaBE and DecaBDE.

[2] Environment Canada, *PBDEs,* found at <http://www.ec.gc.ca/CEPARegistry/documents/subs_list/PBDE_draft/PBDEfaq.cfm>.

The DecaBDE commercial mixture is by far the most predominant PBDE mixture in use in North America, as well as Asia and Europe, making up over 80% of the PBDEs used in 2003 according to numbers published by Environment Canada.[3]

DecaBDE mixture is predominately composed of BDE-209 (over 90%) with lower brominated compounds of nona–BDE (BDE 206,207,208) making up the remaining part. One study which looked at two DecaBDE mixtures also found small amounts of three octa-BDEs (BDE-196,-203 and -197).[4] Conclusions below are made in relation to decaBDE because it is the most highly brominated and prevalent PBDE in the environment. Conclusions and actions regarding decaBDE also apply to hepta, octa and nona BDEs as well.

The federal government added PDBEs to the Toxic Substances List in Schedule 1 of *CEPA* in December 2006.[5] On 16 December 2006, the Government proposed to make regulations prohibiting the manufacture of tetraBDEs, pentaBDEs, hexaBDEs, heptaBDEs, octaBDEs, nonaBDEs and decaBDEs in Canada. The proposed regulations also ban the use, sale, offer for sale and import of tetraBDE, pentaBDE, hexaBDE, and mixtures, polymers and resins containing these substances and the manufacture of these mixtures, polymers and resins.

Although PBDEs have been added to the Toxic Substances List because of their immediate and long-term harmful effects on the environment and biological diversity, the fact that PBDEs are bioaccumulating in human beings and are impacting the health of humans should not be ignored. PBDEs are known to be toxic to development, immune, reproductive and hormonal systems. Therefore, findings regarding exposure and uptake of PBDEs, and in particular, decaBDE in human beings are relevant to these submissions.

There is significant concern regarding the impacts of decaBDEs on human beings. There is significant evidence of increasing DecaBDE 209 exposure, uptake and accumulation in human beings, particularly infants, which strongly supports the need for the DecaPBDE mixture and all the higher brominated PBDEs (heptaBDE, octaBDE, nonaBDE and decaBDE) to be banned and virtually eliminated.

Studies have shown very high levels of PBDEs in human breast milk, which are rapidly increasing. In fact, the levels are doubling ever five years according to a Swedish study. Of serious concern is that children – who are the most vulnerable to the adverse effects of PBDEs - have been found to have higher concentrations of decaBDEs than their parents by

[3] Environment Canada. Canadian Environmental Protection Act, 1999 Ecological Screening Assessment Report on Polybrominated Diphenyl Ethers PBDES

[4] Guardia, M.J. et al. 2006. Detailed Polybrominated Diphenyl Ether (PBDE) Congener Composition of the Widely Used Penta-, Octa-, and Deca-PBDE Technical Flame-Retardant Mixtures. Environ. Sci. Technol. 2006, 40, 6247-6254.

[5] Order Adding Toxic Substances to Schedule 1 to the Canadian Environmental Protection Act, 1999 - SOR/2006-333 December 7, 2006, found at <http://www.ec.gc.ca/CEPARegistry/orders/OrderText.cfm?intOrder=306&intDocument=717>.

2 to 5.[6] A study examining occupational exposure confirms the significant uptake of BDE-209 in workers exposed to DecaBDEs. [7]

The food that we eat is likely another considerable source of human exposure. A Spanish study has found a large contribution of the highest brominated BDEs (hepta to deca-BDE), and principally BDE 209 to the total PBDE concentration in many Spanish foods.[8] A similar study of U.S. food found PBD-209 in meat, fish, eggs, dairy products and liver.[9] House dust is thought to also be a major contributor to PBDE exposure in human beings.[10,11]

II. Requirements under the Canadian Environmental Protection Act and the Toxic Substances Management Policy

A. *CEPA* and Bioaccumulation

CEPA defines "virtual elimination" as "the ultimate reduction of the quantity or concentration" of a toxic substance released into the environment as a result of human activity to below a specified level.[12] This level is to be determined by the Ministers of Health and Environment and set out in a Virtual Elimination List.[13] The *Act* states the Ministers of Environment and Health must propose virtual elimination where a toxic substance, such as PBDEs, is listed in the Toxic Substances List and it is found that:

- the substance is persistent and bioaccumulative in accordance with the regulations;
- the presence of the substance in the environment results primarily from human activity; and
- the substance is not a naturally occurring radionuclide or a naturally occurring inorganic substance.[14]

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[6] Fisher, D., et al. 2006. Children Show highest Levels of Polybrominated Diphenyl Ethers in California Family of Four: A Case Study. Environmental Health Perspectives. 114. 10.1581

[7] Thuresson, K. et al. 2005. Occupational Exposure to DCommercial Decabromodiphenyl Ether in Workers Manufacturing or Handling Flame-Retardant Rubber. Enviro. Sci. Technol.30.1980-1986.

[8] Gomara, B., et al., 2006. Survey of Polybrominated Diphenyl Ether Levels in Spanish Commercial Foodstuffs. Environ. Sci. Technol. 40. 7541-7547.

[9] Schecter, A. et al. 2006. Polybrominated Diphenyl Ether (PBDE) Levels in an Expanded Market Basket Survey of U.S. Food Estimated PBDE Dietary Inatke by Age and Sex. Environmental Health Perspectives. 114.1515-1519.

[10] Stapleton HM; Harner T; Shoeib M; Keller JM; Schantz MM: Leigh SD; Determination of polybrominated diphenyl ethers in indoor dust standard reference materials. Analytical Chemistry Division, National Institute of Standards and Technology, Gaithersburg, MD 20899, USA 2007 Jan 6

[11] Butt, C.M., et al. 2004. "Spatial distribution of polybrominated diphenyl ethers in southern Ontario as measured in indoor and outdoor window organic films," *Environ. Sci. Technol.* 38: 724-731.

[12] CEPA, Section 65(1) and (2).

[13] CEPA, Section 65(2).

[14] *CEPA*, section 77(4).

Although there appears to be consensus that heptaBDE, octaBDE, nonaBDE and decaBDE are indeed persistent toxic substances, Environment Canada does not address the bioaccumulation of these PBDEs in the screening assessment. The conclusion in the Screening Assessment at page 14 states only:

> Measured data indicate that tetra-, penta- and hexaBDE are highly bioaccumulative, with bioconcentration factors (BCFs) exceeding 5000 for aquatic species; thus, they satisfy the criteria for bioaccumulation as described in the CEPA *Persistence and Bioaccumulation Regulations.*

There is no indication of an attempt to determine the bioaccumulation or bioconcentration factors (BAF or BCF) of the higher brominated PBDEs, or to resort to the log octanol-water partition coefficient.

The June 2006 Environment Canada Ecological Screening Assessment Report on PBDEs found all PBDEs to be toxic due to their immediate and long-term harmful effects on the environment and biological diversity. Therefore, as noted above, all seven PBDEs that are contained in the three commercial mixtures have been added to the Toxic Substances List in Schedule 1 of *CEPA*.[15]

Prohibitions placed on tetraBDE, pentaBDE and hexaBDE will impact only two of the three commercial mixtures: PentaBDE and OctaBDE. The mixture that makes up 80% or more of the PBDEs in use, namely DecaBDE, will not be impacted by the proposed prohibition of only three of the seven PBDE homologues. Thus the proposed *Polybrominated Diphenyl Ethers Regulation* in prohibiting the manufacture, use, sale, offer for sale or importation of only tetraBDE, pentaBDE and hexaBDE and not the other four PBDEs is not addressing the dangers caused by the most prevalent commercial mixture, DecaBDE.

In response to the comments filed by David Suzuki Foundation concerning the bioaccumulation of decaBDE, Environment Canada replied decaBDE was not found to meet the bioaccumulation requirement of the virtual elimination criteria.[16]

However, it is submitted that the bioaccumulation criteria are met by the higher brominated PBDEs. Section 4 of the *Persistence and Bioaccumulation Regulation* defines bioaccumulation as follows*:*

> 4. A substance is bioaccumulative
>
> (*a*) when its bioaccumulation factor is equal to or greater than 5 000;

[15] Order Adding Toxic Substances to Schedule 1 to the Canadian Environmental Protection Act, 1999. Canada Gazette Vol. 140, No. 26 – July 1, 2006.
[16] Letter dated January 17th, 2007 to Mr. David Hocking, Acting Executive Director of the David Suzuki Foundation from William King, Chief of Staff to Minister Baird.

(*b*) if its bioaccumulation factor cannot be determined in accordance with a method referred to in section 5, when its bioconcentration factor is equal to or greater than 5 000; and

(*c*) if neither its bioaccumulation factor nor its bioconcentration factor can be determined in accordance with a method referred to in section 5, when the logarithm of its octanol-water partition coefficient is equal to or greater than 5.[17]

The regulation also states, in Section 5, that:

> 5. The determination of persistence and bioaccumulation with respect to a substance […] must be made in accordance with generally recognized methods of the Organisation for Economic Co-operation and Development (OECD) or of some other similar organisation or, if no such methods exist, in accordance with generally recognized methods within the scientific community and taking into account the intrinsic properties of the substance, the ecosystem under consideration and the conditions in the environment.[18]

There are no set absolute bioaccumulation or bioconcentration factors for decaBDE. Further, there are concerns with the application to decaBDEs of the generally recognized methods for testing bioaccumulation and bioconcentration that are found in the OECD's Technical Guideline 305 and in the European Commission's Technical Guidance Document. One concern is that the only test in the OECD's and the European Commission's methodologies was developed on the basis of substances in fish under flow-through conditions.[19] However, the low water solubility of decaBDE renders testing for this substance in water difficult and the relevancy of such measurement in water on aquatic species is questionable.[20] In addition, the test is not informative or applicable to terrestrial animals that bioaccumulate PBDEs through their food source.

Further, as the OECD confirms, it is considered that there are two routes of bioaccumulation uptake of a substance: direct bioaccumulation from the ambient medium and indirect bioaccumulation from the food chain. Direct bioaccumulation predominates in the aquatic environment, and indirect bioaccumulation is the dominant mechanism in terrestrial animals.[21] Bioaccumulation of decaBDEs is apparently occurring in animals through the terrestrial web[22] and in environments other than water, as is shown below,

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[17] *Persistence and Bioaccumulation Regulation*, Section 4.
[18] *Persistence and Bioaccumulation Regulation*, Section 5.
[19] OECD Guidelines for Testing of Chemicals: Proposal for Updating Guideline 305 Bioconcentration: Flow-Through Fish Test. Adopted 14.06.96
[20] Per Ola Darnerud,Gunnar S. Eriksen, Torkell Jóhannesson, Poul B. Larsen, and Matti Viluksela. 2001. Polybrominated Diphenyl Ethers: Occurrence, Dietary Exposure, and Toxicology. Environmental Health Perspective Supplement. Vol 109.S1
[21] OECD Guidelines for Testing of Chemicals: Revised Introduction to the OECD Guidelines on Testing of Chemicals, Section 3
[22] Chen D., Mai B., Song J., Sun A., Luo Y., Lou X., Zeng E., Hale, R. Polybrominated Diphenyl Ethers in Birds of Prey from Northern China. Environ Sci. & Technology 2007.

again rendering the OECD test or any test based on aquatic environments problematic in relation to bioaccumulation through terrestrial means. Similarly, the actual definitions of "bioaccumulation factor" and "bioconcentration factor" in the *Persistence and Bioaccumulation Regulation* both compare the ratio of the concentration of a substance in an organism due to the concentration in water.

The OECD itself recognizes the difficulty in Part 2 of the Revised Introduction to the OECD Guidelines for Testing of Chemicals, which deals with bioaccumulation of soil and sediment. It states (at page 14):

> Note: relatively few new or revised OECD guidelines for testing have been issued concerning accumulation and environmental fate in soil and sediment since this annex was originally approved. Nevertheless the text below is currently under revision (and a detailed review paper concerning bioaccumulation is also being drafted for making priorities for future test guideline development).

As noted above, the use of bioaccumulation and bioconcentration factors as a measurement of bioaccumulation as defined in the *Persistence and Bioaccumulation Regulation* and as employed by the OECD is largely inapplicable to terrestrial organism given it is based on a surrounding medium of water. Unlike aquatic organisms, terrestrial organisms are not dependent on exchange with water for their respiratory needs. The following are the definitions of bioaccumulation and bioconcentration factor in the *Persistence and Bioaccumulation Regulation*:

> "bioaccumulation factor" means the ratio of the concentration of a substance in an organism to the concentration in water, based on uptake from the surrounding medium and food. (facteur de bioaccumulation);
>
> "bioconcentration factor" means the ratio of the concentration of a substance in an organism to the concentration in water, based only on uptake from the surrounding medium..

CEPA does not include a definition for bioaccumulation and bioconcentration factors that applies to terrestrial animals. Dr. Stapleton states (see attached letter):

> Generally speaking, the terms bioaccumulations or biomagnifications indicate that the concentration of a chemical is higher in the animal than it is in their food source, or in the cases of aquatic environments, higher than the concentration found in water.

While the inapplicability of bioaccumulation and bioconcentration factors, as defined in the regulation, to terrestrial animals is unfortunate, from our understanding the definitions did not intend to exclude action on chemicals that are found to be bioaccumulative in terrestrial animals.

According to the *Persistence and Bioaccumulation Regulation*, a substance is considered bioaccumulative if its bioaccumulation factors is equal to or greater than 5 000, or in the absence of data on the bioaccumulation factor, the substance is of a bioaccumulative if its bioconcentration factor is equal to or greater than 5000. In the absences of both data on bioaccumulation and bioconcentration factors and the inability to make determinations in relation to terrestrial animals, the substance is bioaccumulative if the logarithm of its octanol-water partition coefficient is equal to or greater than five.

As shown below in the numerous studies reviewed in this submission, decaBDE (BDE 209) is found in a wide range of biota including top predators. The strongest evidence comes from research on top terrestrial predators such as birds of prey and fox. Many of these studies conclude unequivocally that decaBDE bioaccumulates. Thus, there must be BAF and BCF values for decaBDE; but those values cannot presently be determined given the definitions and methods employed under *CEPA*.

Measuring the bioaccumulation factor for decaBDE in terrestrial animals requires the measurement of decaBDE concentrations in the prey and predator which is difficult (see Dr. Stapleton letter). A thorough discussion on these difficulties is offered in a paper on bioaccumulation of brominated flame retardants in a Lake Winnipeg food web.[23]

Similarly, bioconcentration factors are also difficult to determine with substances of low solubility such as decaBDE because measurements of bioconcentration rely on measuring decaBDE in aqueous systems for aquatic organisms and thus are not generally applicable to terrestrial organisms.

Some studies have calculated a biomagnifications factor. Biomagnification factor is not part of the criteria for determination of bioaccumulation under the regulation, but biomagnification shows decaBDE increases in concentration as it moves up the food chain from one tropic level to the next. However, biomagnifications factors vary by up to 10 fold between species, in particular between fish and birds and mammals.[24] Thus using biomagnifications factors in aquatic organisms as a surrogate for bioaccumulation potential can substantially underestimate the extent of chemical biomagnification in birds and mammals.[25]

Without information on or the ability to make a determination on bioaccumulation and bioconcentration factors for decaBDE the regulation requires the use the logarithm of the octane-water partitioning coefficient which is defined in the regulation as follows:

> "octanol-water partition coefficient" means the ratio of the concentration of a substance in an octanol phase to the concentration of the substance in the water phase of an octanol-water mixture.

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[23] Law, Kerri. Et al. 2006. Bioaccumulation and Trophic Transfer of Some Brominated Flame Retardants in a Lake Winnipeg (Canada) Food Web. Environ. Sci. Technol. Vol. 25. 8. 2177-2186.
[24] Kelly, B.C., et al. 2004. Intestinal Absorption and Biomagnification of Organic Contaminants in Fish, Wildlife, and Humans. Environmental Toxicology and Chemistry, Col. 23. 10.2324-2336.
[25] ibid

The estimated log Kow for BDE-209 is in the range of 6.27 to 9.97[26], well in excess of the criteria in the regulation of equal to or greater than five, which classifies decaBDE as bioaccumulative under the *Persistence and Bioaccumulation Regulation* and according to the Organisation for Economic Co-operation and Development (OECD) guidelines (see attached letter from Dr. Stapleton).

Other jurisdictions agree that DecaBDE is bioaccumulative. For example, Washington State in January 2006[27] held that DecaBDE had the potential to bioaccumulate, and states that it is currently on Ecology's Persistent Bioaccumulative and Toxic List (Chapter 173-333 WAC, Persistent Bioaccumulative Toxins). Maine, in a 2005 report, found that decaBDE bioaccumulates and concentrates up the food chain.[28]

Two letters from leading experts, Dr. Stapleton of Duke University and Dr Åke Bergman of Stockholm University are attached as annexes to this Notice of Objection, stating their expert opinions on the bioaccumulation and debromination of decaBDE. Both experts believe, based on years of experience studying PBDEs in the environment, that decaBDE bioaccumulates. Therefore under CEPA decaBDE must be banned.

B. *CEPA* the Toxic Substances Management Policy and Debromination

Debromination is a process by which bromine atoms are removed or cleaved from an organic compound, leaving a smaller lower brominated molecule that is more water soluble. The higher debrominate BDEs into the lower brominated BDEs.

Environment Canada Recognizes Debromination

The Environment Canada *Screening Assessment Report on PBDE*s is clear on the debromination point (at 13):

> Studies have shown the transformation of higher brominated PBDEs (e.g., hepta to decaBDEs) to lower brominated congeners (e.g., tetra to hexaBDEs) which are associated with high levels of bioaccumulation.

The Environment Canada Screening Assessment included information obtained as of October 2004 (although information up to October 2005 was reviewed). More recent studies confirm the debromination point. As detailed in Part III, debromination to lower BDEs has been shown in the metabolization of BDE–209 (commercial product DecaBDE)

[26] Environment Canada. 2006. Canadian Environmental Protection Act, 1999 Ecological Screening Assessment Report on Polybrominated Diphenyl Ethers (PBDEs). p. 5.
[27] Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: Final Plan (Department of Ecology: Olympia, January 10, 2006)
[28] Maine. 2005. Brominated Flame Retardants. A Report to the Joint Standing Committee on Natural Resources, 122nd Maine Legislature. Prepared by Maine Bureau of Health and Maine Department of Environmental Protection, February 2005.

by certain animal species. It has also been shown in the exposure to sunlight of PBDEs found in dust, and in the action of bacteria in sewage on PBDEs in sewage sludge.

Authority, Recognition and Precedent for Regulation

The Toxic Substances Management Policy allows for regulation of a substance if it is a precursor to a substance that is targeted for virtual elimination:

> Where a Track 1 substance results from the degradation or transformation of a parent substance in the environment, the parent substance may also be considered for Track 1.[29]

Environment Canada recognizes this point in particular relation to PBDEs. On the 18th of June 2004 presentation by Environment Canada of the Existing Substance Program to the Great Lake Binational Toxics Strategy Integration Meeting, the following points were made:

> - The tetra-, penta- and hexa- PBDEs satisfy the criteria for virtual elimination in CEPA and should be considered for addition to the Virtual Elimination List
>
> - The hepta- to deca- PBDEs can be transformed to the bioaccumulative forms in the environment, and therefore would be considered as candidates for virtual elimination under the federal Toxic Substances Management Policy

Precedent also exists for regulating precursors in the case of precursors to perflourooctane sulfonate. That the precursors were included is evident from the risk management strategy in relation to these substances, *Perfluoroctane sulfonate (PFOS) its Salts and its Precursors Proposed Risk Management Strategy*, and from the inclusion of the precursors in the regulation.[30]

Precautionary Principle

One of the fundamental principles underlying *CEPA* is the precautionary principle. Section 2(1) of *CEPA* states:

> **2.** (1) In the administration of this Act, the Government of Canada shall, having regard to the Constitution and laws of Canada and subject to subsection (1.1),
>
> (*a*) exercise its powers in a manner that protects the environment and human health, ***applies the precautionary principle that, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation,*** and

[29] Environment Canada, *Toxic Substances Management Policy* (Ottawa: National Library of Canada, 1995) at page 6

[30] Order Adding Toxic Substances to Schedule 1 to the Canadian Environmental Protection Act, 1999 Amendment C.GazVol. 140, No. 26, December 27, 2006

> promotes and reinforces enforceable pollution prevention approaches; [emphasis added]

In practice, this principle has been accepted and applied by the Supreme Court of Canada. In reference to the principle, the Court has stated:

> Canada 'advocated inclusion of the precautionary principle' during the Bergen Conference negotiations (D. Vander Zwaag, CEPA Issue Elaboration Paper No. 18, *CEPA and the Precautionary Principle/Approach* (1995), at p. 8). The principle is codified in several items of domestic legislation: see for example the *Oceans Act*, SC 1996, c. 31, Preamble (para. 6); *Canadian Environmental Protection Act*, 1999, SC 1999, c. 33, s. 2(1)(*a*); *Endangered Species Act*, SNS 1998, c. 11, ss. 2(1)(h) and 11(1).
>
> Scholars have documented the precautionary principle's inclusion 'in virtually every recently adopted treaty and policy document related to the protection and preservation of the environment' (D. Freestone and E. Hey, 'Origins and Development of the Precautionary Principle', in D. Freestone and E. Hey, eds, *The Precautionary Principle and International Law* (1996), at p. 41).[31]

Moreover, DeMarco and Campbell state:

> … at the time that the [Supreme Court of Canada] embraced the precautionary principle in the *Hudson Case*, international acceptance of the concept was well developed, but Canadian domestic implementation of it was relatively limited. Since that decision was released, nearly every new federal law affecting the environment has referred to the principle in some way.[32]

The importance of applying the precautionary principle is heightened when there is evidence that indicates a concern. Section 76.1 of CEPA requires the Minister to apply the precautionary principle when conducting or interpreting the results of a screening assessment. Environment Canada in the Screening Assessment, (which again included information generally up to October 2004 only) points out the debromination concern (at pages 13-14):

> There is a weight of evidence suggesting that highly brominated PBDEs such as decaBDE are precursors of the more toxic, biaccumulative and persistent lower brominated PBDEs. While the degree to which this phenomenon adds to the overall risk presented to organisms from formation of the more toxic and persistent tetra to hexaBDE congeners is not known, <u>there is sufficient evidence to warrant concern</u>. [emphasis added]

[31] 114957 Canada Ltée (Spraytech, Société d'Arrosage) v. Hudson (Town), [2001] 2 SCR 241

[32] See J.V. De Marco and M.L. Campbell, The Supreme Court of Canada's Progressive Use of International Environmental Law and Policy in Interpreting Domestic Legislation' 13:3 *RECIEL* (2004), 320, at 330.

This concern is heightened given the prevalence of PBDEs, particularly decaBDE, in the environment, as is shown below. The ability of the Government of Canada to treat precursors as it treats the substance resulting from the precursor, coupled with concerns surrounding debromination and its effects requires, upon application of the precautionary principle, the ban of higher brominated PBDEs.

Some data of concern is presented below. PBDEs have been found in human beings (as high as 10 parts per million (with a median 4.8 ppb lipid in the dismantlers of electronics) [33] and with up to 230 ppb in rubber workers);[34] the fact that the levels of PBDEs in the environment is doubling every two to five years; the fact that levels of PBDEs in North Americans is approximately 10 times the levels of people in Europe and Japan; the fact that decaBDE has tested positive for carcinogenicity in a rats and mice;[35] the fact there is a correlation between the presence of PBDEs in dust and in human breastmilk;[36] and the fact that infants have been shown to be ingesting 3065 pg/kg-day ww of PBDEs[37] and at levels as high as 230 ppb in an 18-month old from Berkley California.[38] The exposure levels in young children are approaching those that cause neurotoxic and development effects in lab animals.[39]

The higher congener BDEs, particularly decaBDE are prevalent in the environment, particularly the human environment. BDE-209 is found in human food, especially in cheese.[40] Moreover, numerous studies have documented the presence of the PBDEs in various other compartments of the environment. In Illinois, decaBDE has been found in particulates collected in air samples, with samples in Chicago being the highest levels analyzed. DecaBDE has also been found at relatively high levels in sewage sludge and sediments, while much lower levels have been found in most samples of soil and water. Other studies have reported relatively high levels of decaBDE in house dust, with decaBDE usually being the predominant BDE congener detected.

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[33] Sjodin et al., 1999. Flame Retardant Exposure: Polybrominated Diphenyl Ethers in Blood from Swedish Workers. Environemental Health Perspectives.107.8.

[34] Thuresson, K. et al. 2005. Occupational Exposure to Commercial Decabromodiphenyl Ether in Workers Manufacturing or Handling Flame-Retardant Rubber. Enviro. Sci. Technol.30.1980-1986.

[35] International Programme on Chemical Safety**.** Environmental Health Criteria 152.Polybrominated Biphenyls. Available at < http://www.intox.org/databank/documents/chemical/pcbpbb/ehc152.htm#SectionNumber:8.7>

[36] Wu, N. et al. 2007. Human Exposure to PBDEs: Associations of PBDE Body Burdens with Food Consumption and House Dust Concentrations. Environ Science and Technology .Published on web with 01/17/07

[37] Schecter, A. et al. 2006. Polybrominated Diphenyl Ether (PBDE) Levels in an Expanded Market Basket Survey of U.S. Food Estimated PBDE Dietary Inatke by Age and Sex. Environmental Health Perspectives. 114.1515-1519.

[38] Fischer, D.; Hooper, K.; Athanasiadou, M.; Athanassiadis, I.; Bergman, A., Children show highest levels of polybrominated diphenyl ethers in a California family of four: A case study. Environmental Health Perspectives 2006, 114, (10), 1581-1584.

[39] Viberg, H.; Fredriksson, A.; Jakobsson, E.; Orn, U.; Eriksson, P., Neurobehavioral derangements in adult mice receiving decabrominated diphenyl ether (PBDE 209) during a defined period of neonatal brain development. Toxicological Sciences 2003, 76, (1), 112-120

[40] Op cite note 37 (Wu)

DecaBDE has also been detected in samples actually from various organisms, including human beings, with decaBDE being detected in samples of human blood, fat, and breast milk. Low levels have been reported for most fish species sampled, although decaBDE levels in sharks tend to be higher. Birds that feed on terrestrial prey can accumulate decaBDE, and decaBDE can also be passed on to birds' eggs.

Studies have shown that decaBDE levels are increasing over time in sediments, in certain top predators in aquatic and terrestrial environments, and possibly in human blood. Total PBDE concentrations in breast milk were found to have increased 60-fold in Sweden from 1972 levels, although decaBDE was not measured. DecaBDE was detected, however, in a study of PBDEs in Texas mothers' milk."[41]

A ban on DecaBDE in new products such as textiles, upholstery and electrical wiring came into force this year in Sweden. The states of Maine[42] and Illinois[43] are poised to ban DecaBDE once they establish that safer alternatives are available. The state of Washington has begun phasing out all three PBDE mixtures including DecaBDE 005.[44]

Furthermore, legislation[45] is presently before the state legislatures of Minnesota and Hawaii that will prohibit the sale of products containing DecaBDE such as mattresses, furniture, TVs, and computers by mid 2010. Similar legislation banning the use of DecaBDE in mattresses by 1 January 2008 has been introduced in Washington and Montana. Massachusetts has a bill before its legislature requiring the use of safer alternatives to all PBDEs. [46]

III New Evidence on Bioaccumulation and Debromination

As indicated, the Environment Canada Screening Assessment included information up until October 2004 (although information up until October 2005 was reviewed but generally not included). Since such time, there has been an explosion of new studies on PBDEs, with remarkable findings. These show that the higher congener BDEs bioaccumulate, particularly in the terrestrial web, and also show a marked increase of higher congener BDEs in the environment and people. Further studies of bioaccumulation of higher congener BDEs show debromination in dust and uptake by humans from indoor, office and car dust, and also that different species, metabolism and substances have different methods of and products of debromination.

The new evidence points to threats of serious and irreversible damage from the emission, bioaccumulation and debromination of PBDEs, particularly the higher congener PBDEs. The application of the precautionary principle requires that the Government of Canada

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[41] A Report to the General Assembly and the Governor In Response to Public Act 94-100 "*DecaBDE tudy: A Review of Available Scientific Research*" (Illinois Environmental Protection Agency, January 2006)

[42] http://www.ncel.net/articles/ME-LD1790.2004.doc
[43] http://www.ncel.net/articles/IL-GovDecaBDELetter.2006.pdf.
[44] http://www.ncel.net/articles/WA-EXECUTIVE%20ORDER%2004-01.doc
[45] http://www.ncel.net/articles/PBDE.Legislation.Laws.Website.doc
[46] http://www.ncel.net/articles/MA-Safer.Alternatives.bill2007.doc

should exercise its power in a manner that protects the environment and human health and not postpone actions to prevent environmental degradation.

A. Bioaccumulation of decaBDE

i) Evidence of Bioaccumulation in Terrestrial Species

Sound science demonstrates that decaBDE significantly accumulates in human beings and other species and that the levels are increasing. Many of the studies referenced below were not examined as part of the Environment Canada state of the science report and thus represent new evidence of bioaccumulation of decaBDE. One study on the red fox 'confirms unambiguously' that BDE 209 does bioaccumulate in terrestrial top predators.[47] BDE 209 generally dominated the PBDE congener profiles in the red fox samples. In samples containing BDE 209, this congener contributed, on the average, approximately 70% to the total PBDE content.

Studies have found BDE-209 (decaBDE) in top predators such as fox[48] birds of prey[49,50] and grizzly bears.[51] A study on peregrine falcon eggs found significantly higher BDE-209 concentrations in eggs from wild peregrine falcons than captive population feeding on chickens, which the author concludes is evidence that the congener is present in the environment and is bioavailable.[52] A study of peregrine falcon eggs from Greenland also found BDE 209. The study confirms the release into the environment and uptake and bioaccumulation of BDE-209 in biota.[53] Recent research examining the food chain of polar bears also suggests that there is uptake and food web transfer of BDE-209 in Arctic wildlife.[54]

Another recently published paper provides even stronger evidence of bioaccumulation of BDE-209. The study found that Chinese raptors contain BDE-209 at "remarkably" high levels, especially in the tissues of the muscles and liver of common kestrels. All buzzards that were examined in the study contained BDE-209 making up the majority of the PBDEs

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[47] Voorspoels, S. et al 2006. Remarkable Findings Concerning PBDEs in the Terrestrial Top-Predator Red Fox (*VulpesVulpes). Environ. Sci. Tech. 40. 2937-2943*)

[48] Biomagnification of PBDEs in three Small Terrestrial Food Chains. Environmental Science and Technology

[49] Voorspoels, S. et al. 2006 Levels and distribution of polybrominated diphenyl ethers in various tissues of birds of prey. Environ. Pollution. 144, 218-227.

[50] Jaspers, V.L.B. et al. 2006. Brominated flame retardants and organochlorine pollutants in aquatic and terrestrial predatory birds of Belgium. Levels, patterns, tissue distribution and condition factors. Environ Pollution. 139, 340-352

[51] Christensen. J.R., et al. 2005.Persistent Organic Pollutants in British Columbia Grizzly Bear: Consequence of Divergence Diets. Environ Sci. Technol.. Vol 38, No 18, 2005.

[52] Lindberg, P. et al. 2004. Higher Brominated Diphenyl Ethers and hexabromocyclodecane Found in Eggs of Peregrine Falcons .(Falso peregrinus) Breeding in Sweden. 38, 93-96

[53] Vorkamp, K. et al. 2005. Temporal Development of Brominated Flame Retardants in Peregrine Falcon (Falco peregrinus) Eggs from South Greenland (1986-2003).Environ. Sci. Technol. 39, 8199-8206.

[54] Sormo Gravningen, Eugen, et al. 2006.Biomagnification of Polybrominated Dipheyl Ether and Hexabromocyclododecane Flame Retardants in Polar Bear Food Chain in Svalbard, Norway. Environmental Toxicology and Chemistry, Vol, No 9,p. 2509

in the birds. The authors found that the "results reinforce the growing view that significant bioaccumulation of BDE-209 can occur in some terrestrial food chains especially when abundant deca sources are present".[55]

ii) Bioaccumulation in Aquatic Species

There are a few studies which have found that aquatic organisms are capable of accumulating BDE-209 although the evidence is weaker than for terrestrial wildlife; again possibly because of the limitations of testing in water. A study of rainbow trout, which were fed food spiked with DecaBDE commercial mixture, resulted in increases in both decaBDE as well as the lower-brominated PBDEs hexa through nona.[56] A similar study on carp found debrominated metabolites of BDE-209 in carp tissue.[57]

A study of fish in Lake Winnipeg found BDE-209 in Walleye and, based on analysis of the food web, all the brominated flame retardants studied including BDE209 were found to biomagnify to some extent.[58]

iii) Bioaccumulation in Arctic Biota

PBDEs including BDE-209 have been found in Arctic air, sediment and wildlife. The Arctic ecosystem is continually exposed to an influx of organic chemicals from remote places via long distance transport. It has been argued that BDE-209 is highly involatile and therefore unlikely to be subject to air-particle long distance transport like other persistent organic polluants (POPS). Cynthia De Wit *et al.* in 2006 reviewed the scientific literature on brominated flame retardants in the Arctic and concluded that most, if not all, are undergoing long-range transport and have characteristics that qualify them as POPs under the Stockholm Convention.[59]

BDE-209 detected in glaucous gulls and polar bears in Norwegian Arctic "clearly demonstrates that DecaBDE (BDE-209) are bioaccumulative, to a limited extent, in apex marine predators of the Norwegian Arctic", according to the authors of the study.[60] The study is supported by a second study on BDE-209 in polar bears in Norway.[61] Peregrine falcon eggs in South Greenland had levels of BDE 209 high enough to confirm uptake and bioaccumulation according to the authors.[62] One study predicts that at current rates of

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[55] Chen, D. et al. 2007. Polybrominated Diphenyl Ethers in Birds of Prey from Northern China. Environ. Sci. Technol.
[56] Kierkegaard. A., et al. 1999. Dietary Uptake and Biological Effects of Decabromodiphenyl Ether in Rainbow Trout (Oncorhynchus mykiss).Environ Sci. Technol. 33.1612-1617.
[57] Stapleton. H.M., et al. 2004. Debromination of Flame Retardant Decabromodiphenyl Ether by Juvenile Carp.(Cyprinus carpio) following Dietary Exposure..Environ. Sci. Technol.38.112-119.
[58] Law. K. et al. 2006. Bioaccumulation and Tropic transfer of Some Brominated Flame Retardants in A lake Winnipeg (Canada) Food Web. Environmental Toxicology and Chemistry. Vol 25. No. 8.
[59]deWit, Cynthia.A., Alaee, Mehran and Muir, Derek C.G. 2006.Levels and trends of brominated flame retardants in the Arctic. Chemosphere.62, 209-233.
[60] Verreault et al., 2005. Flame Retardants and Methoxylated and Hydroxolated Polybrominated Diphenylethers in two Norwegian Artic Top Predators. Environ Sci. Technol. 39, 6021-6028.
[61] See footnote 26
[62] See footnote 25.

bioaccumulation, PBDEs will exceed PCBs to become the most prevalent organohalogen compound in Arctic ring seals.[63]

B. Debromination of decaBDE

i) Metabolized in Species

Debromination of decaBDE can occur when it is metabolized. There are species specific differences in the biotransformation or debromination of decaBDE in fish and possibly other animals.[64] Debromination to hexaBDE, nona and octa BDE congeners have been shown. A recent study of carp indicates that carp liver micoromes biotransformed up to 65% of BDE-209 primarily down to hexaBDE, and found that penta through nona metabolites were identified both *in vivo and in vitro*. This indicates a metabolic pathway for BDE-209 debromination to the lower congenated hexaBDE.[65] Recent evidence also points to decaBDE debromination in cows[66] with debromination products that include BDE-182. In the second half of 2006, studies on rats[67] and birds have further shown evidence of DecaBDE debromination.[68]

Evidence suggests that DecaPBDE debrominates in human beings as well.[69] A level of almost 300 pmol/g lipid weight (l.w.) was observed in serum from rubber workers manufacturing or handling rubber compounds that were flame retarded with a technical mixture of DecaBDE. Over time, concentrations of decaBDE decreased while hepta and octa increased.

ii) Dust Exposure to Sunlight

DecaBDE absorbs sunlight and is subject to photodegradation, which can occur significantly in debromination. DecaBDE when exposed to sunlight forms debromination products ranging from nona- to tetraBDEs, and also forms some Dibenzofurans and Pentabidenzofuran.

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[63]Ikonomou, Michael. C., Rayne, Sierra and Addison, Richard F. 2002. Exponential Increases of the Brominated Flame Retardants, Polybrominated Diphenyl Ethers, in the Canadian Artic from 1981 to 2000.

[64] Stapleton Heather M., Brominated Flame Retardants: Assessing DecaBDE Debromination in the Environment (EPHA Environment Network, May 2006) at 5.

[65] Stapleton HM, Brazil B, Holbrook RD, Mitchelmore CL, Benedict R, Konstantinov A, Potter D. In Vivo and In Vitro Debromination of Decabromodiphenyl Ether (BDE 209) by Juvenile Rainbow Trout and Common Carp. Environmental Science and Technology 2006 Aug 1: 40(15)

[66] Kierkegaard A., Asplund L., Dewit C., McLachlan M., Garetho T., Sweetman A., Jones K., Fate of Higher Brominated PBDEs in Lactating Cows (Environ. Sci. Technol.2007, 41)417-423

[67] Huwe, J. K. Bioaccumulation of decabromodiphenyl ether (BDE- 209) from the diet into Sprague-Dawley rats. *Organohalogen Compd.* 2005, *67*, 633-635.

Morck, A.; Hakk, H.; Orn, U.; Wehler, E. K. Decabromodiphenyl ether in the rat: absorption, distribution, metabolism, and excretion. *Drug Metab. Dispos.* 2003, *31*, 900-907

[68] Heather Stapleton, Summary of Scientific Studies on Accumulation and Debromination of DecaBDE (Health and Environment Alliance: December 11, 2006)

[69] Thuresson, K.; Bergman, A.; Jakobsson, K. Occupational exposure to commercial decabromodiphenyl ether in workers manufacturing or handling flame-retarded rubber. *Environ. Sci.Technol.* 2005, *39*, 1980-1986.

DecaBDE is found in high levels in office, house and car dust[70]. The National Institute of Standards and Technology in the United States has recently measured PBDEs in house dust in 3 standard reference materials. PentaBDE and DecaBDE were present in all three standard reference materials and were the dominant commercial products, making up approximately 33% and 58% of house dust, respectively. [71]

The average dust concentration of DecaBDE in homes is 1-2 ppm, whereas it is 9.5 ppm in car dust. In a recent study it was found that concentrations of DecaBDE on the windshields of cars was much less than that on indoor windows and in car dust, suggesting that the decaBDE on windshield is exposed more directly to sunlight and therefore debrominates quickly into the lower congener BDEs.[72]

Debromination of OctaBDE (the commercial product that contains 0.5% pentaBDEs and 12% hexaBDEs) in similar environments when exposed to sunlight has been shown.[73]

iii) Bacteria in Sewage

Debromination can also occur because of the presence of bacteria. In sewage, anaerobic bacteria can initiate debromination of BDE-209, albeit at a slower rate than photolytic debromination, but due to the large volumes of DecaBDE in sewage sludge this may be significant.

III Discussion of Exemption

Subsection 5(2)(b) of the Proposed Regulations excepts from the application of Section 5(1) any PBDE "or the following products containing such a substance and intended to be disposed of or recycled".

There are significant concerns with the above wording. First, it is not clear what "such a substance" means; whether it means all PBDEs or only those that are listed on the schedule.

A second concern is that the exemption allows for a very large group of products to continue in circulation and continue emitting PBDEs, which runs counter to banning the substances. There is no practical rationale for allowing any sale or import of the banned substances, and permitting such activities impedes banning the substances. It is submitted

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[70] Stapleton, H. M.; Dodder, N. G.; Offenberg, J. H.; Schantz, M. M.; Wise, S. A., Polybrominated diphenyl ethers in house dust and clothes dryer lint. Environmental Science & Technology 2005, 39, (4), 925-931; Schecter, A.; Papke, O.; Joseph, J. E.; Tung, K. C., Polybrominated diphenyl ethers (PBDEs) in US computers and domestic carpet vacuuming: Possible sources of human exposure. Journal of Toxicology and Environmental Health-Part a-Current Issues 2005, 68, (7), 501-513

[71] Stapleton HM; Harner T; Shoeib M; Keller JM; Schantz MM: Leigh SD; Determination of polybrominated diphenyl ethers in indoor dust standard reference materials. Analytical Chemistry Division, National Institute of Standards and Technology, Gaithersburg, MD 20899, USA 2007 Jan 6

[72] Gearhart, J.; Posselt, H. Toxic at any Speed: Chemicals in Cars and the Need for Safe Alternatives. (Michigan: the Ecology Centre) 2006 at *

[73] Ahn, M. Y.; Filley, T. R.; Jafvert, C. T.; Nies, L.; Hua, I.; Bezares-Cruz, J., Photodegradation of decabromodiphenyl ether adsorbed onto clay minerals, metal oxides, and sediment. Environmental Science & Technology 2006, 40, (1), 215-220

that any exception should apply only to the "use" of the PBDE or product, with this exception being allowed for purposes of practicality only.

Thirdly, there is uncertainty of meaning in the wording in the exemption. The meaning of the word "intended" is unclear. Who is to have the intent? An owner, a user, a manufacturer, any other person? How would such a person evidence such an intent to demonstrate that they fit within the exemption? As well, it is not clear as to what constitutes disposal.

It is submitted that a specific concrete test be regulated instead. The suggested test is that the PBDE or product in use is at the time of coming into force of the Regulations actually scheduled to be disposed of or recycled within a certain set time, to a maximum of one year, at a facility that will destroy the PBDE or completely convert the PBDE to a substance that is not a PBDE. It is suggested that the record of the scheduling be produced and maintained by the facilities. Evidence of the intent would be met with reference to the list. Procedures employed in Europe and elsewhere could be reviewed to ascertain what methods work best.

IV Conclusion and Summary of Recommendations

In relation to bioaccumulation, strong evidence exists that bioaccumulation of the higher congener PBDEs, including decaBDE is occurring. Evidence shows that decaBDE bioaccumulates in, *inter alia,* the terrestrial environment. In this environment, the bioaccumulation factors and bioconcentration factors of decaBDE as defined in the *Persistence and Bioaccumulation Regulation* and as employed by the OECD cannot be conclusively determined given the low water solubility of decaBDE. Accordingly, the *Regulations* dictate that log Kow values are to be used. These are cited from various sources to be higher than 5 and are therefore indicators of bioaccumulation.

In relation to debromination, there is a recognized debromination and transformation of higher congener BDEs into the lower congener BDEs that are targeted for virtual elimination. Authority (the Toxic Substance Management Policy) and precedent (precursors to perflourooctane sulfanate) exist for regulating parent substances. Given the prevalence of the higher congener BDEs in the environment, there is a clear case for adding heptaBDE, octaBDE, nonaBDE and decaBDE as banned substances under the proposed *Polybrominated Diphenyl Ethers Regulation.* Application of the precautionary requires these actions.

In relation to the proposed exemption for products intended to be disposed of or recycled, the exemption is too wide to prove effective because it exempts all products, as opposed to just those in use. Further uncertainty exists in the meaning of the exemption, and therefore difficulties will be encountered in applying it and enforcing it.

We therefore urge the Minister to update the proposed *Polybrominated Diphenyl Ethers Regulations* to:

- prohibit the use, sale, offer for sale and import of hepta-, octa-, nona- and deca-BDEs; and
- tighten the wording of, narrow the application of and provide certainty with respect to the Section 5(2)(b) wording that exempts PBDEs intended for disposal or recycling.

To this end, we request that a board of review be established to examine:

- the basis for Environment Canada's determination that deca-BDE does not meet the criteria for bioaccumulation as set out in Section 4 of the *Persistence and Bioaccumulation Regulations,* in consideration of the evidence presented in the Screening Assessment, the actual tests in the Regulations and the appropriate application of the precautionary principle;

- the intent of the *Persistence and Bioaccumulation Regulations* and the limitations of these regulations in identifying bioaccumulation in the terrestrial food chain and addressing precursors to known bioaccumulative substances, and to make recommendations for updating the regulations;

- new evidence concerning deca-BDE bioaccumulation, and whether measures should be recommended to address timing issues surrounding the issuance of Screening Assessments, the publication of studies, the period for public comment and the use of such Screening Assessments for making determinations under CEPA; and

- the effectiveness of the proposed *Polybrominated Diphenyl Ethers Regulations* in banning persistent, bioaccumulative, and toxic substances (as required by CEPA), in light of the broad Section 5(2)(b) exemption for PBDEs or resins, polymers or mixtures containing such a substance intended for disposal or recycling.