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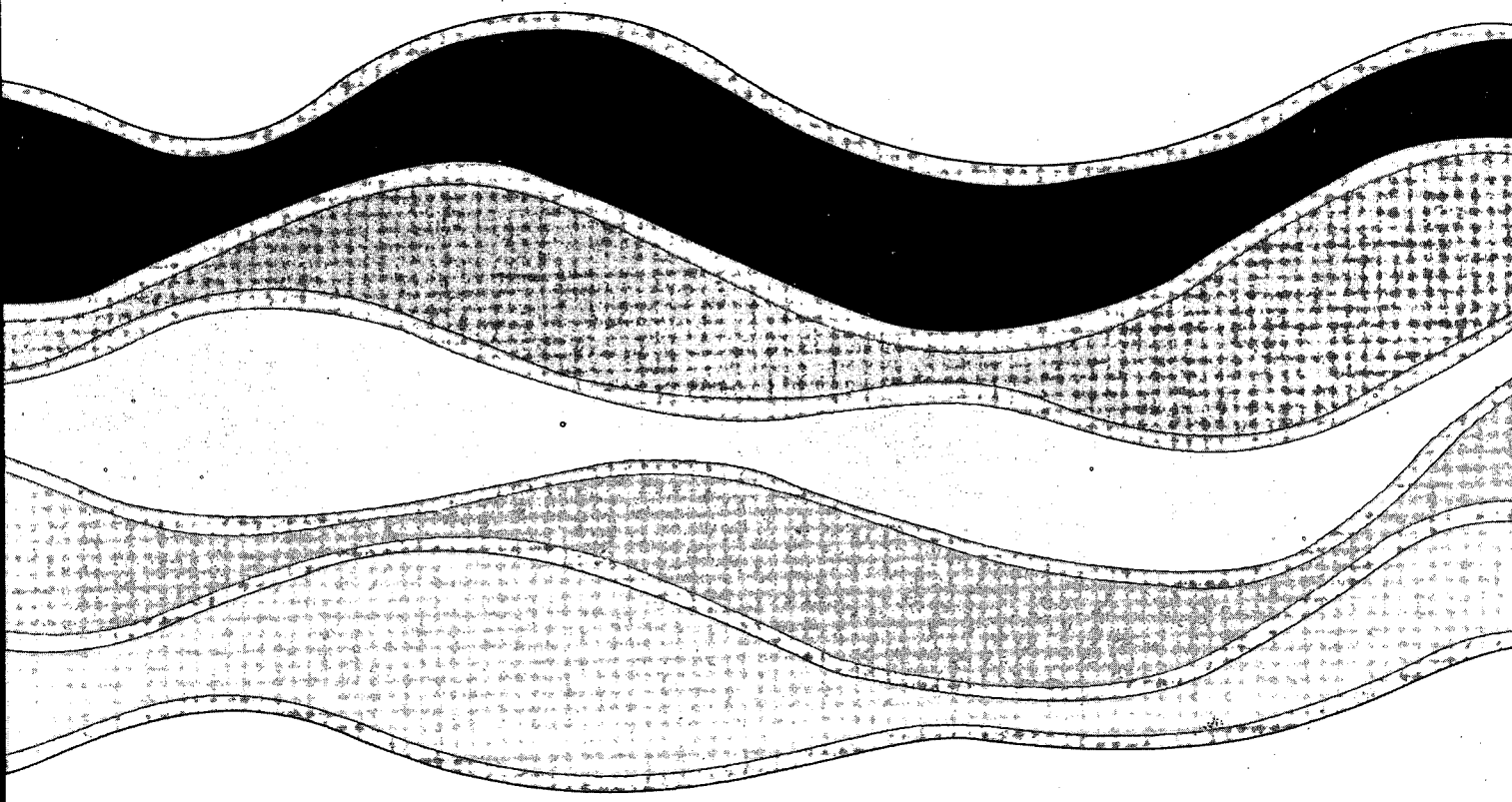





# COMPENDIUM OF RESEARCH NEEDS IDENTIFIED IN PSL ASSESSMENTS

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NWRI Contribution No. 93-81

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## Introduction

The Canadian Environmental Protection Act (CEPA) which became law in 1988, is Canada's primary Act for the nationwide management of toxic substances. CEPA requires the Ministers of the Environment and of National Health & Welfare to prepare and publish a Priority Substances List (PSL) that identifies substances, including chemicals, groups of chemicals, effluents and wastes that may be harmful to the environment or constitute a danger to human health. The Act also requires both federal Ministers to assess these substances and determine whether they are toxic or capable of becoming toxic as interpreted in Section 11 of the Act.

The assessment of whether or not a Priority Substance is toxic as interpreted in CEPA is based on the determination of whether it enters or likely enters the Canadian environment in concentrations or quantities or under conditions that could lead to exposure of humans or other biota at levels that could cause adverse affects. This requires critically reviewing relevant data on sources, use patterns, fate and effects of Priority Substances on the Canadian environment and human health.

In assessing the entry, exposure and effects of Priority Substances on the environment and human health in Canada, a number of data gaps were encountered. In many cases, this information is not considered essential to the assessment of toxicity as defined in Section 11 of CEPA, but would have permitted a more complete evaluation and provided increased confidence in the environmental assessment. However, in some cases the lack of adequate reliable scientific information on the environmental concentrations, bioavailability and effects of exposure in Canada was more serious, and made it impossible to evaluate the ecological significance of the substance in the Canadian environment and to make an assessment of toxicity under CEPA.

In order to focus the attention of the research community on the science needs evolving from the PSL assessment program, this "Compendium of Research Needs Identified in the PSL Assessments" has been compiled. It is intended as a resource document for research managers and scientists for planning future research. The research needs listed in the Compendium have been extracted from the Recommendations section of the assessment reports for the 44 substances on the first Priority Substance List of February 11, 1989, and organized under the headings "Presence and Distribution", "Properties and Behaviour" and "Effects and Toxicity".

Only those research needs which related to the DOE mandate have been included in the Compendium, and those which are currently being addressed have been excluded (i.e. the recommendations in the assessment report for Effluents from Pulp Mills Using Bleaching). The research needs have been prioritized by the DOE Task Group Leads who are listed in the Appendix. Generally, highest priority has been assigned to those needs which were identified as essential to completing an assessment of toxicity under CEPA. The needs which are not considered critical to the assessments but would permit a more thorough evaluation were assigned a lower priority.

# COMPENDIUM OF RESEARCH NEEDS

# IDENTIFIED IN PSL ASSESSMENTS

## 1) PRESENCE AND DISTRIBUTION

**High Priority**

- The monitoring of current concentrations of **bis(2-ethylhexyl)phthalate** in ambient air, surface water, sediments, soil and biota in areas where it is either manufactured or used industrially.

- A determination of current quantities of **bis(2-ethylhexyl)phthalate** released to the atmosphere.

- Additional information to update and complete the inventory of **cadmium** releases from anthropogenic sources in Canada (e.g. incineration facilities, sewage sludge application to soils, and chemical manufacturing) and natural sources.

- Data on levels of **chlorinated paraffins** in the aquatic environment (particularly in biota and sediments) around the manufacturing site.

- Better characterization of the releases of **chlorinated paraffins** to the environment from industrial sources (particularly metalworking).

- Data on current concentrations of **1,2-dichlorobenzene** and **trichlorobenzenes** in sediment near Canadian textile and chemical manufacturing plants.

- Data on current concentrations of **1,4-dichlorobenzene** in sediment near Canadian textile and chemical manufacturing plants, and near effluent outfalls from municipal waste treatment plants.

- The characterization of landfill and waste disposal sites to estimate frequency of occurrence and the potential for **dichloromethane** to migrate into ecosystem compartments.

- Additional monitoring data on concentrations and forms of **nickel** in environmental media in the vicinity of point sources.

- Data on current concentrations of **pentachlorobenzene, tetrachlorobenzenes** and **trichlorobenzenes** in soil and sediment, particularly near point sources.

- The development of analytical methods and additional characterization of concentrations of a broader range of **polycyclic aromatic hydrocarbons** in ambient air and soil.

- A determination of the quantities of **styrene** released to the environment from the production, use and disposal of styrene and styrene-containing materials in Canada.

- Data on current concentrations of **styrene** in terrestrial plants, snow, surface water and aquatic organisms, particularly near industrial sources.

- An expanded and extensive monitoring program for **tetrachloroethylene** concentrations in Canadian surface waters.

- Reliable and representative data on concentrations of **tetrachloroethylene** and **trichloroethylene** in ambient air (especially rural air).

- Data on current concentrations of **trichlorobenzenes** in soils contaminated by spills of PCB-containing dielectric fluids.

- Reliable and representative data on concentrations of **trichloroethylene** in surface water (especially in "pristine" waters and follow-up data after spills), and biota (especially fish and plant levels).

**Medium Priority**

- Information on the levels of **cadmium** in Arctic marine mammals and pelagic seabirds, including the sources of exposure which contribute to the high tissue cadmium burdens in some species (e.g. narwhal).

- A determination of the quantities and fate of **creosote waste products** that are not recycled.

- The monitoring of concentrations of **dibutyl phthalate** (DBP) in air, soil, water, aquatic invertebrates (including benthic invertebrates) and fish in areas of suspected DBP contamination under conditions designed to yield interference-free results, in order to better estimate exposure of fish and wildlife to the substance.

- The monitoring of emissions of **dibutyl phthalate** (DBP) from incinerators, in order to determine the significance of this source of atmospheric DBP.

- Data on current concentrations of **1,2-dichlorobenzene** released to the atmosphere resulting from its use as a carbon remover and metal degreaser in Canada.

- Data on current concentrations of **1,4-dichlorobenzene** released to the atmosphere in Canada, from point sources.

- Data on ambient levels of **dichloromethane** in soil, sediment and biota in the Canadian environment.

- The measurement of the levels of **methylmethacrylate** in air, water, and sediment at sites adjacent to the plant using methylmethacrylate.

- The monitoring of concentrations of **methyl tertiary butyl ether** (MTBE) in air, water, groundwater, soil, and biota in areas adjacent to major sources, including MTBE production and storage facilities, service stations, and areas of high vehicle traffic.

- The monitoring of (i) the largest PVC-fabricating plants in Canada, (ii) sewage treatment plant influents, effluents and sludges, (iii) landfill leachates, and (iv) fresh water, seawater, sediment and aquatic biota to determine environmental trends in concentrations of **non-pesticidal organotin compounds**.

**Low Priority**

- The monitoring of environmental concentrations of **aniline** in areas adjacent to potentially major sources, especially in water.

- The measurement of levels of **bis(2-chloroethyl) ether** (BCEE) in air and water (to characterize the frequency of release and loadings of BCEE in industrial effluents).

- The characterization of the sources of release of **1,2-dichloroethane** to the Canadian ambient air through continued air monitoring, as well as an investigation into the importance of long-range atmospheric transport.

- Data on levels of **dichloromethane** in terrestrial plants so that a scenario can be calculated for a herbivorous mammal.

- Data on current emission rates from Canadian sources utilizing **dichloromethane** and the relationship between such releases and potential contribution to atmospheric effects (e.g. low-level pollution, global warming potential).

- Information on the environmental concentrations of **3,5-dimethylaniline**.

- The monitoring of **di-n-octyl phthalate** in surface water, air, sediment and biota in the proximity of industrial sources.

- Data on the concentrations of man-made vitreous fibres (**mineral fibers**) in Canadian air near point sources, especially production facilities.

- An inventory of decommissioned drycleaning facilities, metal cleaning and degreasing plants, textile manufacturers, waste storage sites and facilities that employ **tetrachloroethylene** (PCE) including: i) location of sites, ii) known and suspected PCE stored, disposed of or use.

- Additional data on concentrations of **toluene** in the vicinity of Canadian point sources such as coke producers and automobile manufacturing plants.

- Additional data on the prevalence and extent of natural contamination of groundwater with **toluene** and **xylenes**.

## 2) PROPERTIES AND BEHAVIOUR

### High Priority

- Additional information on the forms and environmental fate of **chromium** [particularly Cr (III)] being released by key industrial operations, such as leather tanning, metal finishing, cooling towers, steel, stone and clay production, primary and secondary smelters, and chemical and power plants; and a better understanding about the forms and bioavailability of chromium in Canadian air, water, soils and sediments, particularly near industrial sources.

- Additional data on the species of **nickel** present in the general environment of Canada; and additional data on the bioavailability of various nickel compounds in different environmental media.

- Additional data on the physical/chemical properties of **non-pesticidal organotin compounds**, in order to characterize more fully partitioning in the general environment.

### Medium Priority

- Additional information on the amounts, chemical forms and fate of **arsenic** in ores and waste material at Canadian mining and metallurgical operations.

- Data on the chemical forms of **arsenic** and their rates of production and degradation in Canadian water, soil, sediment and biota, particularly in contaminated areas.

- Information on the species of **cadmium** present in the Canadian environment and their bioavailability in different environmental media.

- A determination of the rates of loss, bioavailability and specific components of creosote leached from **creosote waste products** (i.e. rail road ties and marine pilings).

- The full characterization of the forms of **nickel** in slags, as well as the evaluation of the potential for leaching of nickel, with subsequent contamination of ground and surface water.

- Data characterizing the fate, persistence, extent, and movement of **tetrachloroethylene** and **trichloroethylene** in groundwater, with special attention to the effects of subsequent discharge of contaminated groundwater to surface waters in Canada.

- Data on short- and long-term fate and persistence of **trichloroethylene** released into Canadian surface waters after specific spills, with more detailed considerations given to potential exposure levels to aquatic organisms, coupled with on-site impact assessments.

- Data on the fate and persistence of **trichloroethylene** released into Canadian sediments and subsurface soils.

**Low Priority**

- Information on the physical and chemical properties affecting the distribution and fate of **3,5-dimethylaniline** in the environment, including degradation rate constants.

- A modelling and field validation exercise to estimate tissue residue levels of **hexachlorobenzene** at each trophic level in the St. Clair River system.

- A determination of the concentrations and fate of **toluene** and **xylenes** under ice and the potential effects on aquatic biota under such conditions.

## 3) EFFECTS AND TOXICITY
**High Priority**

- Toxicity tests on **bis(2-ethylhexyl)phthalate** (DEHP) and **dibuytl phthalate** (DBP) using benthic organisms representative of those in the Canadian environment to determine the effects of sediment-bound DEHP and DBP.

- Information on the effects of **cadmium** in freshwater sediments on benthic biota.

- A determination of the effects of **chromium** [especially Cr(III)] associated with sediment, on benthic communities in Canada; and a determination of the toxicity of chromium to amphibians and forest communities.

- More extensive monitoring of the concentrations of **chromium** in organisms consumed by wildlife, particularly in areas where sediments contain large amounts of chromium; and studies of the effects on wildlife species in areas where levels of more than 10 $\mu$g/g dw are found in important food sources.

- More information on the carcinogenic action of **chromium** on fish and other organisms in high chromium environments.

- Data on the effects of sediment-bound **1,2-dichlorobenzene** and **1,4-dichlorobenzene** on freshwater and marine benthos.

- Additional data to further elucidate the relationship between levels of gaseous **inorganic fluorides** (especially sulphur hexafluoride) and global climate change potential.

- Toxicity tests (chronic and acute) with benthic organisms representative of those in the Canadian environment, to determine the effects of **pentachlorobenzene** and **tetrachlorobenzenes** associated with sediment.

- A determination of the acute and chronic toxicity of dissolved **styrene** to aquatic organisms (using procedures appropriate for volatile substances), and of atmospheric styrene to terrestrial plants.

- A determination of the potential effects of exposure to **1,1,2,2-tetrachloroethane** on terrestrial biota, including chronic and acute toxicity to terrestrial plants, and oral and inhalation subchronic toxicity to wild mammals and birds.

- Data on the effects of **tetrachloroethylene** on terrestrial organisms including wildlife, invertebrates and plants through the various environmental routes of exposure.

- Data on the effects of atmospheric **tetrachloroethylene** (PCE) and **trichloroethylene** (TCE) on terrestrial plants, especially trees and Canadian commercial crops, and dissolved PCE and TCE on aquatic plants, particularly under typical Canadian conditions of light irradiation.

- Data on the effects of sediment- and soil-bound **trichlorobenzenes** on freshwater benthic organisms and soil microbial processes.

- Data on the effects of sediment- and soil-bound **trichloroethylene** on benthic and soil-dwelling organisms.

- Field toxicity testing and monitoring of air emissions, effluents, and solid wastes released to the environment from **waste crankcase oils** re-refineries.

- Field toxicity testing and monitoring downwind of combustion units using **waste crankcase oils** as a fuel, and toxicity testing and monitoring in areas where unburned residues are disposed.

- Field toxicity testing and monitoring of the constituents of **waste crankcase oils** (WCOs) in nearby streams and fields before and after applications of WCOs to roads for dust suppression.

- Field toxicity testing and monitoring of the constitutents of **waste crankcase oils** (WCOs) in streams and fields adjacent to areas where WCOs are disposed of on land.

**Medium Priority**

- Additional data on the effects of sediment-bound **arsenic** on benthic organisms and the effects of inhaled arsenic on birds.

- Data on the toxicity to wild mammals resulting from chronic oral exposure to **benzene**.

- Information on the dietary **cadmium** intake by wild mammals (particularly cervids) and birds (particularly seabirds), in combination with information on the toxicological effects of this uptake, to complete oral-dose toxicological assessments for wildlife.

- In situ testing and biological surveys downstream of power plant stations and industrial outfalls discharging **chlorinated wastewater effluents** to assess the potential for harmful effects from these sources.

- Bioassay tests on leachate from **creosote waste products** to determine their toxicity to a standard set of bioassay organisms.

- Data on the effects of **dichloromethane** in soil and sediment on organisms within those media.

- Groundwater monitoring at selected sites and determination of the effects of **dichloromethane** in groundwater on biota in contact with this water.

- A determination of the extent of **inorganic fluoride** releases into aquatic environments from the fluoridation of municipal drinking water and the effects on aquatic life.

- Additional toxicological data on the effects of **nickel** on wild mammals (including prey availability studies); and more data on concentrations of nickel in wildlife.

- Additional data on the toxicity of **nickel** in sediments to invertebrates.

- Data on the effects of **polycyclic aromatic hydrocarbons** on biota in the ditches and in receiving waters along railway and utility lines.

- A determination of the chronic effects of **styrene** on birds, preferably through a reproductive/developmental study.

- Information on the effect of **tetrachloroethylene** (PCE) and **trichloroethylene** (TCE) on benthic organisms at high concentration resulting from the puddling phenomenum of PCE or TCE spilled into water.

- Data on the acute and chronic effects of low levels of **trichloroethylene** and its biotic and abiotic transformation products on Canadian aquatic invertebrates, amphibians, and avian and mammalian wildlife.

- Data on the chronic effects of both dietary and atmospheric **trichloroethylene** (separate and combined exposure) on birds, preferably a fish-eating species.

**Low Priority**

- Long-term toxicity tests on **aniline** using aquatic and terrestrial organisms.

- Additional data on the effects of different chemical forms of dissolved **arsenic** on aquatic organisms (particularly amphibians).

- Data on the toxicity to birds resulting from acute or chronic exposure to **benzene**.

- Additional data on the effects of chronic exposure to low concentrations of **benzene, toluene** and **xylenes** on growth, survival, and reproduction of sensitive freshwater fish and invertebrates.

- Toxicity data on **bis(2-chloroethyl) ether** from well designed subchronic and chronic studies, and information on its developmental and reproductive toxicity in mammalian species.

- Relevant data on toxicity of **bis(2-chloroethyl) ether** to aquatic and terrestrial organisms present in the Canadian environment.

- Information regarding the chronic exposure of terrestrial plants to **1,2-dichloroethane.**

- Data on the chronic effects of both dietary and atmospheric **dichloromethane** on birds, preferably a fish-eating species.

- Data on the relationship between the observed inhibitory effects from **dichloromethane** on sludge biota and those microorganisms in the natural environment.

- Toxicological data for **3,5-dimethylaniline** on which exposure and effects assessments are based.

- Chronic toxicity tests on **di-n-octyl phthalate** using selected benthic organisms, algae, and rodents.

- Sediment toxicity bioassays to determine the effects of **hexachlorobenzene** on benthic organisms at environmentally relevant concentrations in sediment.

- Additional data on the relationship between sediment fluoride levels and toxicity to benthic organisms (in areas of Canada where high levels of **inorganic fluorides** in sediments are known or expected to occur).

- Long-term toxicity tests on **methyl tertiary butyl ether** using aquatic and terrestrial organisms.

- Data on the fate and toxicity of **monochlorobenzene** (MCB) in soil as a result of MCB used in pesticides.

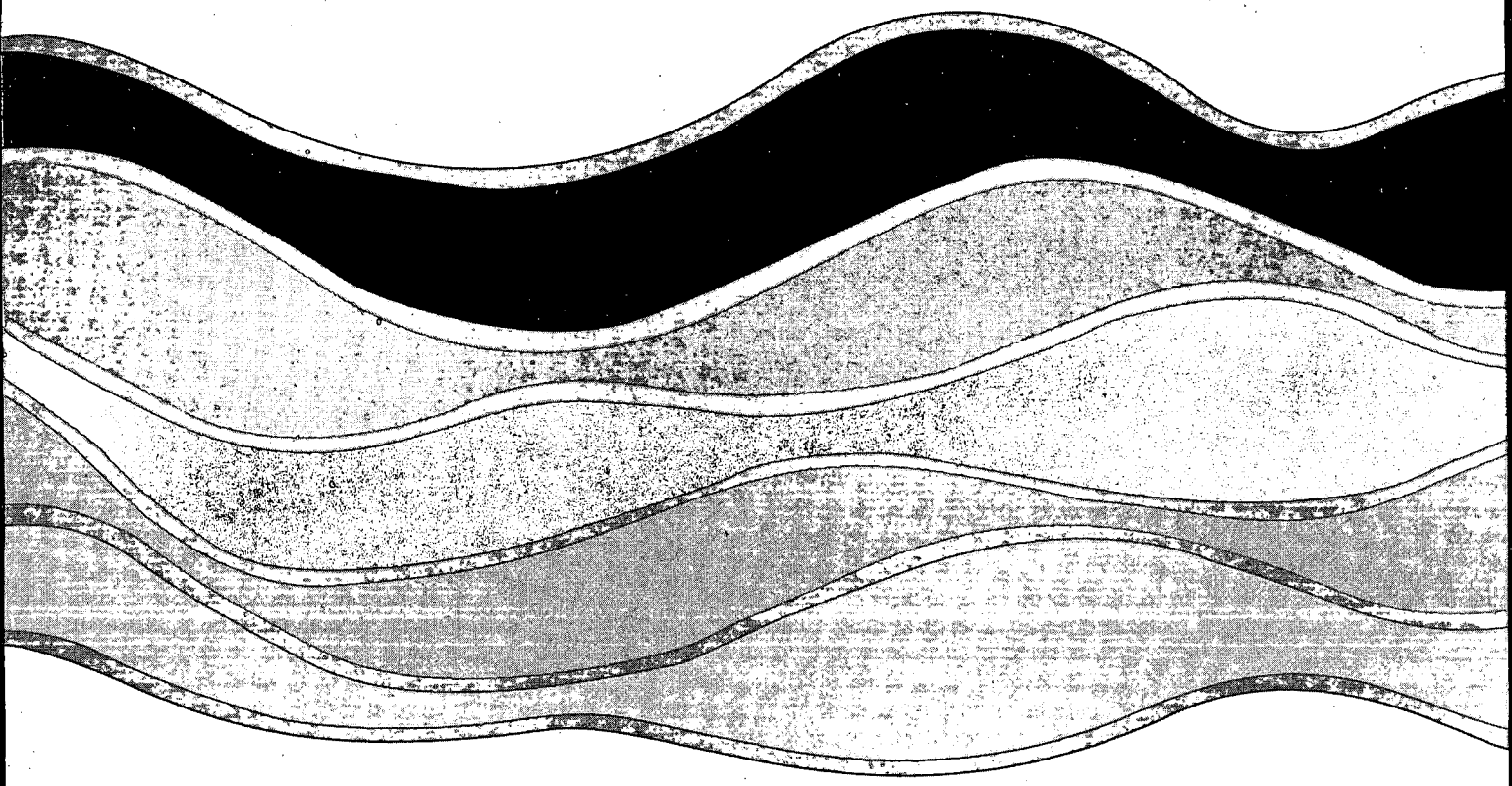
- A determination of the genotoxic and related effects of chronic exposure to **polycyclic aromatic hydrocarbons** (PAHs) on terrestrial organisms, notably mammals, in areas adjacent to major atmospheric sources of PAHs.

- Better characterization of the effects of **polycyclic aromatic hydrocarbons** (PAHs) in sediments on fish using individual sediment-bound PAHs and environmentally relevant exposure protocols.

## APPENDIX

| PRIORITY SUBSTANCE | DOE LEAD | PHONE |
|---|---|---|
| Aniline | Jim Maguire - NWRI | (905) 336-4776 |
| Arsenic | Pat Doyle - CCB | (819) 953-2479 |
| Benzene | Robert Chénier - CCB | (819) 953-1680 |
| Benzidine | Jim Maguire - NWRI | (905) 336-4776 |
| Bis(2-Chloroethyl) Ether | Claude Fortin - CCB | (819) 994-7752 |
| Bis(2-Ethylhexyl) Phthalate | Claude Fortin - CCB | (819) 994-7752 |
| Cadmium | Rob Kent - EIB | (819) 953-1554 |
| Chlorinated Paraffins | Karen Lloyd - CWS | (819) 997-6073 |
| Chlorinated Wastewater Effluents | Dwayne Moore - CCB | (819) 953-1664 |
| Chromium | Jerome Nriagu - NWRI | (313) 764-0523 (Univ. of Michigan) |
| Creosote Impregnated Waste Materials | Barry Munson - P&NR | (403) 468-8034 |
| Dibutyl Phthalate | Claude Fortin - CCB | (819) 994-7752 |
| 1,2-Dichlorobenzene | Claude Fortin - CCB | (819) 994-7752 |
| 1,4-Dichlorobenzene | Claude Fortin - CCB | (819) 994-7752 |
| 3,3'-Dichlorobenzidine | Jim Maguire - NWRI | (905) 336-4776 |
| 1,2-Dichloroethane | Sheila Jones - CCB | (819) 953-3091 |

| | | |
|---|---|---|
| Dichloromethane | Ed Porter - EIB | (819) 953-3118 |
| 3,5-Dimethylaniline | Jim Maguire - NWRI | (905) 336-4776 |
| Di-n-Octyl Phthalate | Claude Fortin - CCB | (819) 994-7752 |
| Hexachlorobenzene | Dwayne Moore - CCB | (819) 953-1664 |
| Inorganic Fluorides | Ed Porter - EIB | (819) 953-3118 |
| Methylmethacrylate | Karen Lloyd - CWS | (819) 997-6073 |
| Methyl Tertiary Butyl Ether | Robert Chénier - CCB | (819) 953-1680 |
| Mineral Fibres | Pat Doyle - CCB | (819) 953-2479 |
| Monochlorobenzene | Claude Fortin - CCB | (819) 994-7752 |
| Nickel | Y.K. Chau - NWRI | (905) 336-4814 |
| Non-Pesticidal Organotin Compounds | Jim Maguire - NWRI | (905) 336-4776 |
| Pentachlorobenzene | Alice Bobra - CCB | (613) 837-2707 |
| Polycyclic Aromatic Hydrocarbons | André Germain - QR | (514) 283-0191 |
| Styrene | Ken Taylor - CCB | (819) 953-3976 |
| Tetrachlorobenzenes | Alice Bobra - CCB | (613) 837-2704 |
| 1,1,2,2-Tetrachloroethane | Sheila Jones - CCB | (819) 953-3091 |
| Tetrachloroethylene | Ed Porter - EIB | (819) 953-3118 |
| Toluene | Robert Chénier - CCB | (819) 953-1680 |
| Trichlorobenzenes | Claude Fortin - CCB | (819) 994-7752 |
| Trichloroethylene | Ed Porter - EIB | (819) 953-3118 |
| Waste Crankcase Oils | Roger Breton - CCB | (819) 953-1650 |
| Xylenes | Robert Chénier - CCB | (819) 953-1680 |



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