**BRITISH COLUMBIA**
**MINISTRY OF WATER, LAND AND AIR PROTECTION - 2002**

# Environmental Indicator: Toxic Releases in British Columbia

**Primary Indicator:** ***Total on-site toxic releases in British Columbia.***

**Selection and Use of Indicator:** The weight of toxic substances released into the environment is a *pressure* indicator; it is a measure of the stress on the environment from human activities. More than 35,000 chemicals are reported to be in use in Canada. Toxic substances enter ecosystems by many pathways, including industrial emissions to air and water and through leaks, spills and accidents. Air and water currents can disperse these contaminants over great distances. The presence of these compounds in the environment may pose a threat to both wildlife and human health. For example, low concentrations of some substances, such as dichlorodiphenyldichloroethane (DDE), polychlorinated biphenyls (PCBs) and some dioxins and furans, may disrupt the endocrine system. This may result in reproductive and immune system dysfunction, neurobehavioral and developmental disorders, and possibly certain forms of cancer (Environment Canada 1996).

Environment Canada has tracked toxic releases since 1993 through the National Pollution Release Inventory (NPRI) for Canada. The NPRI is a federal program that requires polluters that meet specific reporting requirements (reporting thresholds) to report on the contaminants they release. Under the *Canadian Environmental Protection Act* (CEPA), anyone in Canada owning or operating a facility must file a report with Environment Canada if:

- They have 10 or more full-time employees working a total of 20,000 hours or more in the reporting year, and
- The facility manufactures, processes or otherwise uses any of the NPRI-listed substances in concentrations equal to or greater than 1% and in quantities equal to or greater than 10 tonnes.

The report must identify any releases or transfers in waste of the NPRI identified substances to air, water and land, injected underground or transferred off-site for treatment, disposal or recycling. Starting in 2000, facilities used for certain types of incineration and for wood preservation must also report to the NPRI even if they do not meet the 20,000-hr threshold for working hours. Also, starting in 2000, mercury, polycyclic aromatic hydrocarbons (PAHs), dioxins/furans and hexachlorobenzene (HCB) must be reported under different thresholds described below.

This indicator deals with on-site releases reported to NPRI. The NPRI defines an on-site release is an on-site discharge of a pollutant to the environment. This includes emissions (including spill and leaks) to air, discharges to surface waters, on-site releases to land and deep-well underground injection within the boundaries of the facility.

For the purpose of the NPRI, note that:

- Surface water releases do not include discharges to municipal wastewater treatment plants. These are reported as off-site transfers for treatment.
- Landfills are sites in which wastes are buried. For the purposes of the NPRI, on-site land filling is reported as an on-site release. If an NPRI pollutant is transferred to an off-site landfill, it is reported as an off-site transfer for disposal.
- Land treatment, also called application farming, is a disposal method by which a waste containing a listed pollutant is applied or incorporated into soil for biological degradation. For the purposes of the NPRI, on-site land treatment is reported as an on-site release. This type of disposal method is usually approved under provincial jurisdiction.
- Underground injection is another method of waste disposal. Subject to provincial regulation, wastes are injected into known geological formations, generally at great depths.

In 2000, the NPRI list was restructured into four part with the introduction of alternate thresholds for certain substances to the reporting requirements (Schedule 1 of the Canadian Gazette notice http://www.ec.gc.ca/pdb/npri/documents/CG-NPRI-2000.pdf ).

- **Part 1** includes the 248 substances reported at the original 10-tonne and 1% concentration reporting threshold.
- **Part 2** includes mercury (and its compounds). Mercury was on original NRPI substance list, but at the original reporting threshold, which did not capture small amounts. Under the 2000 list, facilities that meet the 20,000-hr reporting threshold, must report releases of mercury (and its compounds) in kilograms if it was manufactured, processed or otherwise used, in a quantity of 5 kg or more.
- **Part 3** substances include 17 polycyclic aromatic hydrocarbons (PAHs). These PAHs are classified as persistent, bio-accumulative and toxic substances by Environment Canada. These are predominantly inadvertently manufactured and released rather than used as commercial chemicals. PAHs are usually released in small amounts and have been missed under the standard reporting thresholds. As of 2000, PAHs must be reported in kilograms at a threshold of 50 kg or and at any threshold if they were released on-site from a wood-preservation process using creosote.
- **Part 4** includes dioxins/furans and hexachlorobenzene (HCB), which are released primarily as by-products of industrial and combustion processes. These substances are reported at non-quantitative, activity-based thresholds. Dioxins and furans are typically reported in units of toxic equivalent (TEQ) to the most toxic congener (member of the same chemical family) of this group, which is 2,3,7,7-tetrachlorodibernzo-p-dioxin. Dioxin/furans are reported together as grams TEQ and include the 17 most toxic dioxin and furan congeners. HCB is reported in grams.

## Data and Sources:

This indicator deals with on-site releases reported to NPRI and includes only Part 1 substances, which are all reported in tonnes. Substances listed in Part 2, 3 and 4 substances are not included in the indicator because they are reported at alternate thresholds (i.e., kilograms, TEQs, etc.).

The data for the indicator showing the total on-site releases of NPRI substances in British Columbia are listed below.

**Table 1. Amount of on-site releases of toxic waste in BC (tonnes).**

| Year | Total On-Site Releases | Air Releases | Water Releases | Land Releases | Underground Releases | # Facilities Reporting |
|---|---|---|---|---|---|---|
| **1993** | 32,079 | 7,223 | 24,442 | 399 | 0 | 111 |
| **1994** | 30,223 | 6,670 | 23191 | 352 | 0 | 118 |
| **1995** | 23,812 | 7,587 | 15,940 | 271 | 2 | 120 |
| **1996** | 9,843 | 7,488 | 1,803 | 534 | 2 | 121 |
| **1997** | 8,448 | 6,600 | 1,420 | 271 | 84 | 128 |
| **1998** | 7,968 | 5,857 | 1,656 | 444 | 82 | 129 |
| **1999** | 111,140 | 9,207 | 2,594 | 557 | 86,631 | 145 |
| **2000** | 122,078 | 10,641 | 10,689 | 729 | 100,004 | 165 |

Source: Environment Canada, 2001. The National Pollutant Release Inventory (NPRI) 2000.
Notes: The most recent information reported by the NPRI is for 2000 and includes data submitted by September 28, 2001. Information in the table includes on-site releases to air, water, land, and underground environmental media. Transfers off-site in waste or recovered, re-used or recycled are not included. Total releases may be greater than the sum of the releases by environmental medium, since releases of less than one tonne could be reported as undifferentiated total releases.

Since the inception of the NPRI in 1993, changes have periodically been made to reporting guidelines and the substance list. The changes are summarized in Table 2. In some cases, these changes result in reported increases in on-site releases even though facilities may not actually be releasing greater amounts of contaminants. For example, the dramatic increase in reported on-site releases between 1998 and 1999 is the result of changes to the substance list. In 1999, 73 new substances were added to the NPRI. One of the new substances, hydrogen sulphide, accounted for approximately 95% (86,809 tonnes) of the increase between 1998 and 1999. Most of this was released by two natural gas companies in Fort St. John. Natural gas companies extract "sour gas" (gas with a high hydrogen sulphide content) from underground. The hydrogen sulphide is corrosive and is removed from the gas to meet pipeline requirements. Most of it is re-injected back underground into reservoirs. It is done under permit under the *Waste Management Act*, with some permits issued under the *Act* by the Oil and Gas Commission and others issued by the Ministry of Water, Land and Air Protection. In 2000, the amount of hydrogen sulphide released in British Columbia was 100,629 tonnes, largely due to increased production by two companies. Together they accounted for 99,894 tonnes of hydrogen sulphide injected underground in 2000.

**Table 2. Number of facilities reporting and changes to the National Pollutant Release Inventory since 1993.**

| Year of change | Changes to reporting requirements | Changes to substance list | # of substances | # of facilities reporting |
|---|---|---|---|---|
| **1993** | | | | 111 |
| **1994** | - | - | - | 118 |
| **1995** | Improved reporting methodology; by-products included | Added nitrate ion in solution; ammonium nitrate & ammonium sulfate now included in ammonium (total) and zinc (fume or dust) now included in zinc (and its compounds). | - | 120 |
| **1996** | N/A | Minimum pH for nitrate ion in solution changed from 6.5 to 6.0 | - | 121 |
| **1997** | N/A | N/A | - | 128 |
| **1998** | N/A | N/A | 172 | 129 |
| **1999** | Improved reporting methodology according to NCASI standards. | Added 73 new substances<br>Removed acetone. combined 3 xylene isomers into xylene (mixed isomers). | 245 | 145 |
| **2000** | Removed 20000–hr employee threshold for some facilities.<br>Alternate thresholds introduced. Mercury exempt from 1% concentration threshold. | Added 4 new substances at standard threshold.<br>Added 19 new substances at alternate thresholds.<br>Changed reporting of mercury to alternate threshold of 5kg. | 268 | 165 |

Source: Environment Canada. 2000. NPRI Highlights and Important Changes from 1995 to 2000.

Not including the 77 Part 1 substances added to the NPRI since 1999, there have been increases in reported toxic waste releases between 1998 (7,968 tonnes) and 2000 (21,419 tonnes). This increase is mostly attributed to increases in reported releases of methanol and ammonia. Almost 50% of the 4200 tonne increase in reported releases between 1998 and 1999 can be attributed to improved reporting methodology for methanol released by the paper and allied products industry. In 1999, the Canadian Pulp and Paper Association and the US National Council for Air and Stream Improvement Inc. developed a manual for reporting to the NPRI, which resulted in facilities from the paper and allied products industry reporting on releases from more sources in 1999 than in the past. Facilities were able to recalculate past releases based on these new emissions factors. The table above incorporates the

new data submitted by this industry for 1994-1998. Recalculating past releases was a voluntary measure therefore the increase in releases for this industry may be a result of the change in reporting requirements and not an actual increase in pollutants. First time reporting of ammonia releases into surface water by the Greater Vancouver Regional District's four wastewater treatment plants accounts for 82% of the 9300 tonne increase that occurred between 1999 and 2000.

Acetone was removed from the NPRI list in 1999 because it was determined that it is not a concern for human health and the environment. Acetone releases from 1983-1998 have not been removed from the data because only limited amounts were reported as released. In 1998, 156 tonnes of acetone were released to the environment and are included in the data.

Between 1993 and 1998 the level of toxins released to the environment in British Columbia decreased by approximately 75% (from 32,079 tonnes down to 7,968 tonnes) despite reporting changes that included more substances and by-products. The main reason for the decrease was the change in releases to water, which decreased from 24,442 tonnes in 1993 to 1,656 tonnes in 1998. In 1994, BHP Minerals Canada Ltd.-Island Copper Mine in Port Hardy and Cominco Ltd.- Trail Operations, had combined releases of 21,304 tonnes (70.6% of provincial releases), 21,056 tonnes of which were to water. Due to the closure of BHP in 1995 and as a result of improved pollution prevention at Cominco, released dropped to only 1,664 tonnes in 1996, with 660 tonnes of that releases to water.

The 1,395 tonne reduction between 1996 and 1997 is largely attributed to three companies. Cominco Ltd. reduced releases to air and water by eliminating a sulfur dioxide treatment process. The temporary shutdown of the Fletcher Challenge Elk Falls mill due to a labour dispute resulted in a 50% reduction of methanol released to air. Placer Dome Canada reduced releases to the air through improved recycling on site.

The slight increase in 1998 (480 tonnes) is due to a number of factors. In 1997, there was a change in reporting technique for electrical utilities that increased reported releases. 1998 was also the first time the Westcoast Energy Inc. McMahon Plant reported releases to the inventory and first time companies reported on the release of nitrate ion.

The top 5 pollutants released on-site in British Columbia in 2000 (see Table 3) were:

- hydrogen sulphide, a flammable poisonous gas that is removed as an impurity by gas extraction facilities and injected underground into reservoirs.,
- ammonia, which is released as a colourless gas to air or in an aqueous solution to water by wastewater treatment facilities and, in lesser amounts, by pulp and paper facilities. Ammonia gas is extremely corrosive and irritating to the skin, eyes, nose, and respiratory tract. Exposure to high concentrations (above approximately 2500 ppm) is life threatening, causing severe damage to the respiratory tract, resulting in bronchitis, chemical pneumonitis, and pulmonary edema, which can be fatal.

- methanol, a flammable poisonous liquid, which is used during processing and manufacturing by the paper and allied products industry. It is also a by-product of this industry, formed during biological decomposition of biological wastes and sludge. Methanol is not known to be carcinogenic but has a number of short and long-term health effects.
- nitrate ion (in solution at pH>6.0), which is largely released as by-products of the paper and allied products industry.
- hydrochloric acid, is a non-flammable corrosive gas, also largely released as by-products of the paper and allied products industry. It has various acute and chronic health effects on humans.

**Table 3. Pollutants released in the largest quantities (tonnes) in BC during 2000**

| | Air | Water | Land | Underground Injection | Total Releases |
|---|---|---|---|---|---|
| **Hydrogen sulphide*** | 759 | 19 | 0 | 99851 | 100,692 |
| **Ammonia (Total)** | 851 | 8671 | 1 | 0 | 9,523 |
| **Methanol** | 5119 | 110 | 4 | 149 | 5,385 |
| **Nitrate ion in solution at pH >6.0** | 0 | 1405 | 3 | 0 | 1407 |
| **Hydrochloric acid** | 1395 | 3 | 0 | 0 | 1398 |
| **Manganese(and its compounds)** | 6 | 370 | 594 | 0 | 970 |
| **Hydrogen fluoride** | 535 | 0 | 0 | 0 | 535 |
| **Styrene** | 352 | 0 | 0 | 0 | 353 |
| **Sulfuric acid** | 337 | 3 | 0 | 0 | 340 |
| **Zinc (and its compounds)** | 146 | 54 | 44 | 0 | 243 |
| **Chlorine dioxide** | 226 | 0 | 0 | 0 | 226 |

*Added to the NPRI in 1999.
Source: Environment Canada, 2001. The National Pollutant Release Inventory 2000. Ottawa: Pollution Data Branch.
Note: Total releases may be greater than the sum of the releases by environmental medium, since releases of less than one tonne could be reported as undifferentiated total releases.

CEPA is the key national legislation for managing toxic substances in Canada. It provides for development of regulations and guidelines to manage substances determined to be toxic under the Act. In 2000, 55 of the 268 pollutants tracked by the NPRI were classified under CEPA as toxic or carcinogenic. Twenty-three pollutants were among the 73 substances added to the NPRI in 1999; all substances added in 2000 at alternate thresholds are included.

In BC in 2000, 39 pollutants classed as toxic or carcinogenic by CEPA were released on-site. Of these, 19 were reported at the '10-tonne' or 'greater than 1% by weight' threshold and accounted for releases totaling 762.10 tonnes. An additional 20 toxic or carcinogenic substances were reported at alternate thresholds in 2000 and accounted for releases of 110,584 kilograms of polycyclic aromatic hydrocarbons (PAHs), 325.08 kilograms of mercury, 855.33 grams of hexachlorobenzene and 68.86 grams TEQ (toxic equivalents) of dioxins/furans. Toxic or carcinogenic pollutants released in the largest quantities (tonnes) in BC during 2000 are as follows:

**Table 4. On-site toxic waste releases (tonnes) of substances classified as toxic under CEPA, reported at the 10 tonne and >1% by weight threshold in 2000.**

| Substance | Year added | Air | Water | Land | Underground Injection | Total Releases |
|---|---|---|---|---|---|---|
| **Hydrogen fluoride** | | 535.33 | 0.00 | 0.00 | 0.00 | 535.33 |
| **Formaldehyde** | | 136.02 | 2.30 | 0.00 | 0.00 | 138.65 |
| **Dichloromethane** | | 51.94 | 0.00 | 0.00 | 0.00 | 52.24 |
| **Lead (and its compounds)** | | 7.95 | 3.59 | 0.00 | 0.00 | 11.94 |
| **Chromium (and its compounds)** | | 0.12 | 0.01 | 7.15 | 0.00 | 7.32 |
| **Benzene** | | 5.44 | 0.00 | 0.00 | 0.00 | 6.05 |
| **Asbestos (friable form)** | | 0.00 | 0.00 | 3.00 | 0.00 | 3.00 |
| **Arsenic (and its compounds)** | | 1.96 | 0.54 | 0.00 | 0.00 | 2.49 |
| **1,2-Dichloroethane** | | 2.35 | 0.06 | 0.00 | 0.00 | 2.41 |
| **Sulfur hexafluoride** | 1999 | 0.66 | 0.00 | 0.00 | 0.00 | 0.66 |
| **Cadmium (and its compounds)** | | 0.29 | 0.29 | 0.00 | 0.00 | 0.58 |
| **CFC-114** | 1999 | 0.14 | 0.41 | 0.00 | 0.00 | 0.54 |
| **CFC-12** | 1999 | 0.26 | 0.00 | 0.00 | 0.00 | 0.26 |
| **HCFC-22** | 1999 | 0.00 | 0.22 | 0.00 | 0.00 | 0.22 |
| **Calcium fluoride** | 1999 | 0.02 | 0.00 | 0.14 | 0.00 | 0.16 |
| **Tetrachloroethylene** | | 0.04 | 0.00 | 0.00 | 0.00 | 0.14 |
| **Acrylamide** | | 0.06 | 0.00 | 0.00 | 0.00 | 0.06 |
| **Nickel (and its compounds)** | | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 |
| **Carbon tetrachloride** | | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 |

Source: Environment Canada, 2001. *The National Pollutant Release Inventory 2000*. Ottawa: Pollution Data Branch.
Note: Total releases may be greater than the sum of the releases by environmental medium, since releases of less than one tonne could be reported as undifferentiated total releases.

**Table 5. On-site toxic waste releases (various units) in BC for substances reported at alternate thresholds.**

| Substance | Units | Air | Water | Land | Underground Injection | Total Releases |
|---|---|---|---|---|---|---|
| **Mercury** | kg | 287.86 | 35.94 | 1.29 | 0.00 | 325.08 |
| Dioxins/Furans | g TEQ | 14.41 | 0.88 | 53.57 | 0.00 | 68.86 |
| Hexachlorobenzene | g | 855.33 | 0.00 | 0.00 | 0.00 | 855.33 |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | |
| PAHs (undifferentiated totals) | kg | 1014.93 | 7.13 | 78.82 | 0.00 | 1100.88 |
| Phenanthrene | kg | 61258.14 | 67.61 | 22.98 | 0.00 | 61348.73 |
| Flouranthene | kg | 19991.30 | 32.57 | 8.15 | 0.00 | 20032.01 |
| Pyrene | kg | 13457.77 | 10.20 | 5,19 | 0.00 | 13473.16 |
| Benzo(b)fluoranthene | kg | 4172.90 | 2.40 | 2.78 | 0.00 | 4178.08 |
| Benzo(a)anthracene | kg | 2839.41 | 5.64 | 2.16 | 0.00 | 2847.21 |
| Benzo(e)pyrene | kg | 2114.71 | 0.00 | 0.50 | 0.00 | 2115.20 |
| Benzo(a)pyrene | kg | 1523.59 | 3.65 | 10.59 | 0.00 | 1537.83 |
| **Polycyclic Aromatic Hydrocarbons (PAHs)** | | | | | | |
| Benzo(k)fluoranthene | kg | 1234.40 | 2.40 | 2.03 | 0.00 | 1238.82 |
| Benzo(g,h,I)perylene | kg | 1006.11 | 6.13 | 2.31 | 0.00 | 1014.56 |
| Indeno(1,2,3-c,d)pyrene | kg | 993.47 | 7.30 | 1.32 | 0.00 | 1002.09 |
| Perylene | kg | 354.81 | 1.66 | 0.01 | 0.00 | 356.48 |
| Dibenzo(a,h)anthracene | kg | 263.98 | 7.3 | 1.90 | 0.00 | 273.18 |
| Benzo(a)phenanthrene | kg | 63.82 | 0.00 | 1.10 | 0.00 | 64.92 |
| Benzo(j)fluoranthene | kg | 0.05 | 0.00 | 0.61 | 0.00 | 0.67 |
| 7H-Dibenzo(c,g)carbazole | kg | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 |
| Dibenzo(a,I)pyrene | kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Dibenz(a,j)acridine | kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total PAHs** | **kg** | **110289** | **153.99** | **135.26** | **0** | **110583.84** |

Source: Environment Canada, 2001. *The National Pollutant Release Inventory 2000*. Ottawa: Pollution Data Branch.
Note: Includes all substances classified under CEPA as toxic or carcinogenic; all substances except mercury were added to the NPRI in 2000.
Total releases may be greater than the sum of the releases by environmental medium, since releases of less than one tonne could be reported as undifferentiated total releases.

**Methodology and Reliability:** A list of 268 substances was used for the 2000 reporting year. These were from the 2000 list of NPRI substances identified in alphabetical order in the *Canada Gazette,* Schedule 1, Part 1-4 (2000). The list was originally developed after a review of the United States' Toxics Release Inventory (TRI) and Canadian industry program lists. Changes to the list are only made after consultations with stakeholders; only minor changes occurred between 1993 to 1998. In 1999, the scope of the inventory changed with the addition of 73 new substances, the de-listing of acetone, and improvements to reporting for the pulp and paper industry. In 2000, 23 new substances were added, 19 of those at alternate reporting thresholds.

The data for the indicator were taken from the NPRI database of on-site releases for facilities in BC. Only substances listed on Schedule 1, Part 1, were used for this indicator. Substances in Parts 2, 3, and 4 were excluded from the indicator because they are reported at alternate thresholds. For 1999, the amount of releases attributed to the changes in reporting techniques was calculated by summing the releases of new substances added to the list in 1999 and subtracting it from the total on-site releases for that year. Similarly in 2000, the amount of releases attributed to the changes in reporting were calculated by subtracting the releases attributed to substances added in 1999 and in 2000.

The quantity of NPRI pollutants released to the environment is not an indicator of all pollutants entering the environment. Other substances, such as greenhouse gases, pesticides and substances scheduled for ban or phase-out (e.g., chlorofluorocarbons and PCBs) are not included on the list.
In addition, not all sources of NPRI pollutants are captured by the inventory. For example, vehicles and vessels are known to be major contributors of hazardous air pollutants on the NPRI list, however, this source is not captured by the NPRI. Long range transboundary air pollution from other countries may also contribute toxic pollutants that are not captured by the inventory.

For example, dry-cleaning operations may collectively release significant amounts of pollutants to the environment, but individual businesses may not meet the reporting requirements. Small facilities that do not meet reporting requirements may collectively account for the majority of releases of some pollutants. This shortcoming has been partially addressed in 2000 by exempting some facilities from the 20,000-hr threshold and by the development of alternate thresholds for some highly toxic substances that are usually released in small quantities. Toxic releases that come directly from mining and petroleum gas extraction are also not included in the inventory because they do not meet the definition of a facility. If further processing occurs at a mine or gas extraction plant, then the resulting releases are included. For example, releases due to gas extraction from wells are not included whereas releases due to the removal of hydrogen sulphide from the gas are included in the inventory.

**References:**

Environment Canada. 1996. *The State of Canada's Environment - 1996*. Ottawa: Environment Canada.

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**Secondary Measure:** ***On-site toxic substance releases in Canada in 2000.***

**Selection of Indicator:** It is important to know how British Columbia compares in the release of toxic contaminants to other provincial and territorial jurisdictions in Canada. In 2000, British Columbia ranked first in total on-site pollutant releases, accounting for about 33% of total Canadian releases.

**Data and Source:**

**Table 6. On-site releases of toxic pollutants in Canada 2000.**

| Jurisdiction | Newly Reportable Substances in 1999 (tonnes) | Newly Reportable Substances in 2000 (tonnes) | Total Releases (tonnes) | % of National Releases |
|---|---|---|---|---|
| **Canada** | **173,231** | **98** | **366,762** | **100.00%** |
| **British Columbia** | 100,660 | 0 | 122,078 | 33.29% |
| **Alberta** | 51,939 | 0 | 107,285 | 29.25% |
| **Ontario** | 6,192 | 24 | 78,716 | 21.46% |
| **Quebec** | 12,921 | 41 | 30,915 | 8.43% |
| **Manitoba** | 466 | 0 | 9,503 | 2.59% |
| **New Brunswick** | 47 | 23 | 7,311 | 1.99% |
| **Nova Scotia** | 67 | 0 | 5,206 | 1.42% |
| **Saskatchewan** | 926 | 10 | 4,572 | 1.25% |
| **Newfoundland** | 13 | 0 | 882 | 0.24% |
| **PEI** | 0 | 0 | 242 | 0.07% |
| **Nunavut** | 0 | 0 | 30 | 0.01% |
| **Northwest Territories** | 1 | 0 | 22 | 0.01% |
| **Yukon** | 0 | 0 | 0.2 | 0.00% |

Source: Environment Canada, 2001. *The National Pollutant Release Inventory 2000*. Ottawa: Pollution Data Branch.
Notes: The most recent information reported by the NPRI is for 2000. Information in the table includes on-site releases to air, water, land, and underground environmental mediums. Transfers off-site in waste and on the "3 Rs" (recovery, re-use, recycling) are not included. Total releases may be greater than the sum of the releases by environmental medium, since releases of less than one tonne could be reported as undifferentiated total releases. Due to rounding, percent of national releases may not equal 100%.

**References:**

Environment Canada 2001. *National Pollutant Release Inventory 2000*. Ottawa: Pollution Data Branch. http://www2.ec.gc.ca/pdb/npri/

**Secondary Measure:** ***On-site toxic substance releases, reported by receiving media, in British Columbia in 2000.***

**Selection of the Indicator:** This indicator shows the amount of on-site toxic waste that was released to air, land, and water or by underground injection in British Columbia in 2000. The toxic impact on ecosystems and human health can vary depending on the media receiving the pollutants.

In 2000, the majority of releases were injected underground, 9% into air, 9% into water and less than 1% was released on land.

In 1999 and 2000, over 80% of on-site toxic waste releases were underground injection (accounting for 100,001 tonnes of hydrogen sulphide in 2000). The releases of hydrogen sulphide are a by-product of natural gas extraction. The hydrogen sulphide is corrosive and is removed from the gas to meet pipeline requirements. Most of it is re-injected back underground into reservoirs. The Province regulates these operations under the *Petroleum and Natural Gas Act*. There are arguments for and against underground injection as a disposal method. Deep well injection is an accepted practice in Alberta and the United States, whereas Ontario is planning to ban the practice, citing it as an out-dated disposal method.

The following are arguments for and against deep well injection as a disposal method for hydrogen sulphide (G. Leu, pers. com.)

**Arguments for deep well injection**

- Some oil and gas reservoirs have been contained in one place over millions of years, therefore, it is possible that the same place can be used to store hazardous waste.
- Once gas wells are exhausted, waste may be disposed there if the geological strata of the area are well understood and suitable for confining waste in the formation.
- Risk of soil and groundwater contamination can be addressed by siting considerations and operational requirements to ensure the integrity of the well.
- Deep well injection may reduce the release of treated effluent to rivers and to air through gas flaring.

**Arguments against deep well injection**

- Potential migration of waste from the confining zone due to a formation rupture or inadequate information regarding the strata.
- Potential operational failure. Pressurized waste fluids could spill along the well bore into groundwater as a result of operational failure.
- Injected fluids may inhibit future mineral exploration/extraction.
- If waste fluids are not confined to the target area, it would be difficult to mitigate impacts to groundwater.
- Deep well injection may increase seismic activities. Fluid injections could cause movement of underground formations into compressed spaces after oil and gas reserves are depleted.
- There are other disposal options available, although at higher costs.

**References:**

*Environment Canada 2001*. National Pollutant Release Inventory 2000. *Ottawa: Pollution Data Branch.* http://www2.ec.gc.ca/pdb/npri/

**Secondary Measure:** ***Amount of adsorbable organic halide (AOX) discharges in pulp and paper effluent.***

**Selection of Indicator:** The total quantity of adsorbable organic halogen (AOX) in pulp and paper mill effluent is a *pressure* indicator and surrogate (stand-in) measure of the chlorinated organic content in the effluent. AOX includes the halogenated (chlorinated) organic compounds that are adsorbable by activated carbon. Adsorption is the accumulation of gases, liquids or solutes on the surface of a solid or liquid.

The total amount of AOX in mill discharges is an overall indicator of potential risk to the environment. British Columbia, like most other jurisdictions, has chosen to monitor and regulate the AOX family of compounds, with the intent of reducing AOX in the environment because:

- some AOX compounds are known to be extremely harmful (e.g., 2,3,7,8-TCDD),
- it is costly and complex to test for individual AOX compounds; and
- not all environmental impacts of AOX are known.

The AOX family includes any compound made up of an organic molecule that is combined with one or more halogen molecules. Organic compounds are mainly compounds that contain the element carbon, such as those released from wood during the pulping process. Halogens are five chemically related elements: fluorine, chlorine, bromine, iodine and astatine. Chlorine, for example, is used for bleaching during the pulp-making process. When organic compounds are exposed to halogens, more than 300 halogenated organic compounds are known to be produced. Of those identified, most belong to the following chemical families: dioxins, furans, chlorophenols and chlorinated fatty and resin acids.

Although many AOX compounds have never been identified, some AOX compounds have been found to be toxic, bio-accumulative (tending to accumulate in the tissues of living organisms) and carcinogenic. Several toxic congeners (related compounds) in two groups of AOX compounds—dioxins and furans—have been found to accumulate in fish near coastal pulp mills; this resulted in fisheries closures in those areas in the 1980s. Scientists have also found that these chemicals have also contaminated fish predators, such as Great Blue Herons and Bald Eagles.

**Data and Source:**

**Table 7. Discharges of Adsorbable Organic Halide from Pulp Mills in British Columbia 1991-1999**.

| Company Name (Location) | Adsorbable Organic Halide Discharges (tonnes/day) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| **Mills Using Chlorine** | | | | | | | | | |
| Avenor (Gold River) | 1.56 | 1.515 | 0.904 | 0.966 | 0.818 | 0.637 | 0.411 | 0.404 | N/A1 |
| Canfor (Prince George) | 2.286 | 1.211 | 0.946 | 0.811 | 0.506 | 0.471 | 0.501 | 0.519 | 0.58 |
| Canfor Northwood (Prince George) 2 | 2.814 | 1.306 | 0.786 | 0.609 | 0.636 | 0.533 | 0.597 | 0.194 | 0.734 |
| Cariboo Pulp and Paper | 3.946 | 1.312 | 0.798 | 0.718 | 0.695 | 0.634 | 0.568 | 0.482 | 0.547 |
| Celgar Pulp (Castlegar) | 1.844 | 1.282 | 0.414 | 0.258 | 0.255 | 0.285 | 0.268 | 0.272 | 0.306 |
| Crestbrook (Skookumchuck) | 0.717 | 0.611 | 0.254 | 0.13 | 0.12 | 0.151 | 0.117 | 0.113 | 0.135 |
| FCC (Campbell River) 3 | 2.406 | 1.615 | 1.377 | 1.004 | 0.4 | 0.489 | 0.459 | 0.506 | 0.418 |
| FCC (Crofton) 3 | 3.05 | 1.09 | 0.99 | 0.719 | 0.786 | 0.677 | 0.565 | 0.478 | 0.45 |
| FCC (Mackenzie) 3 | 0.617 | 0.542 | 0.419 | 0.187 | 0.174 | 0.179 | 0.185 | 0.235 | 0.305 |
| Harmac Pacific (Nanaimo) | 2.282 | 2.272 | 1.307 | 0.968 | 0.952 | 0.432 | 0.465 | 0.433 | 0.376 |
| Howe Sound (Port Mellon) | 0.658 | 0.612 | 0.597 | 0.623 | 0.822 | 0.759 | 0.751 | 0.33 | 0.324 |
| Pacifica (Powell River) 4 | 1.624 | 0.612 | 0.415 | 0.374 | 0.407 | 0.206 | 0.212 | 0.682 | 0.162 |
| Skeena (Prince Rupert) | 2.916 | 2.61 | 2.582 | 1.418 | 1.795 | 1.206 | 1.017 | 0.746 | 0.595 |
| Western Pulp (Port Alice) | 3.465 | 3.35 | 3.372 | 3.03 | 2.453 | 0.337 | 0.242 | 0.227 | 0.38 |
| Western Pulp (Squamish) | 1.36 | 1.33 | 1.021 | 1.24 | 1.043 | 0.793 | 0.714 | 0.428 | 0.396 |
| Weyerhaeuser (Kamloops) | 3.883 | 1.859 | 0.853 | 0.78 | 0.63 | 0.615 | 0.583 | 0.473 | 0.524 |
| **Non-Chlorine Mills** | | | | | | | | | |
| Pacifica (Port Alberni) 4 | 1.183 | 0.5 | 0.221 | N/A | N/A | N/A | N/A | N/A | N/A |
| **TOTAL** | **36.611** | **23.629** | **17.256** | **13.835** | **12.492** | **8.404** | **7.655** | **6.522** | **6.232** |

Source: Pollution Prevention and Remediation Branch, Ministry of Water, Land and Air Protection, 2001.
1 Closed.
2 Formerly Northwood.
3 Name changed in 2000 to Norske Skog Canada.
4 Formerly MB Paper. Name changed in 2000 to Norske Skog Canada.

**Methodology and Reliability:** Most routine AOX discharge data compiled from pulp mills in British Columbia are generated in compliance with permit and regulatory requirements. Pulp mills are required to submit samples of their effluent for analysis by a qualified laboratory, using analytical methods approved by the Ministry of Water, Land and Air Protection. On occasion, the ministry takes audit samples and split samples to check to the validity of the sampling and analytical procedures used by the pulp mills. Potential weaknesses in the data lie in the limited ability of the ministry to document and verify all AOX monitoring data collected by mills. Monitoring records for AOX from British Columbia pulp mills go back to 1988.

**References:**

Ministry of Water, Land and Air Protection. 2000. Pulp and Paper Effluent Discharges (t/dy). http://wlapwww.gov.bc.ca/epd/epdpa/industrial_waste/forestry/papmd.html