Taking Stock

North American Pollutant Releases and Transfers

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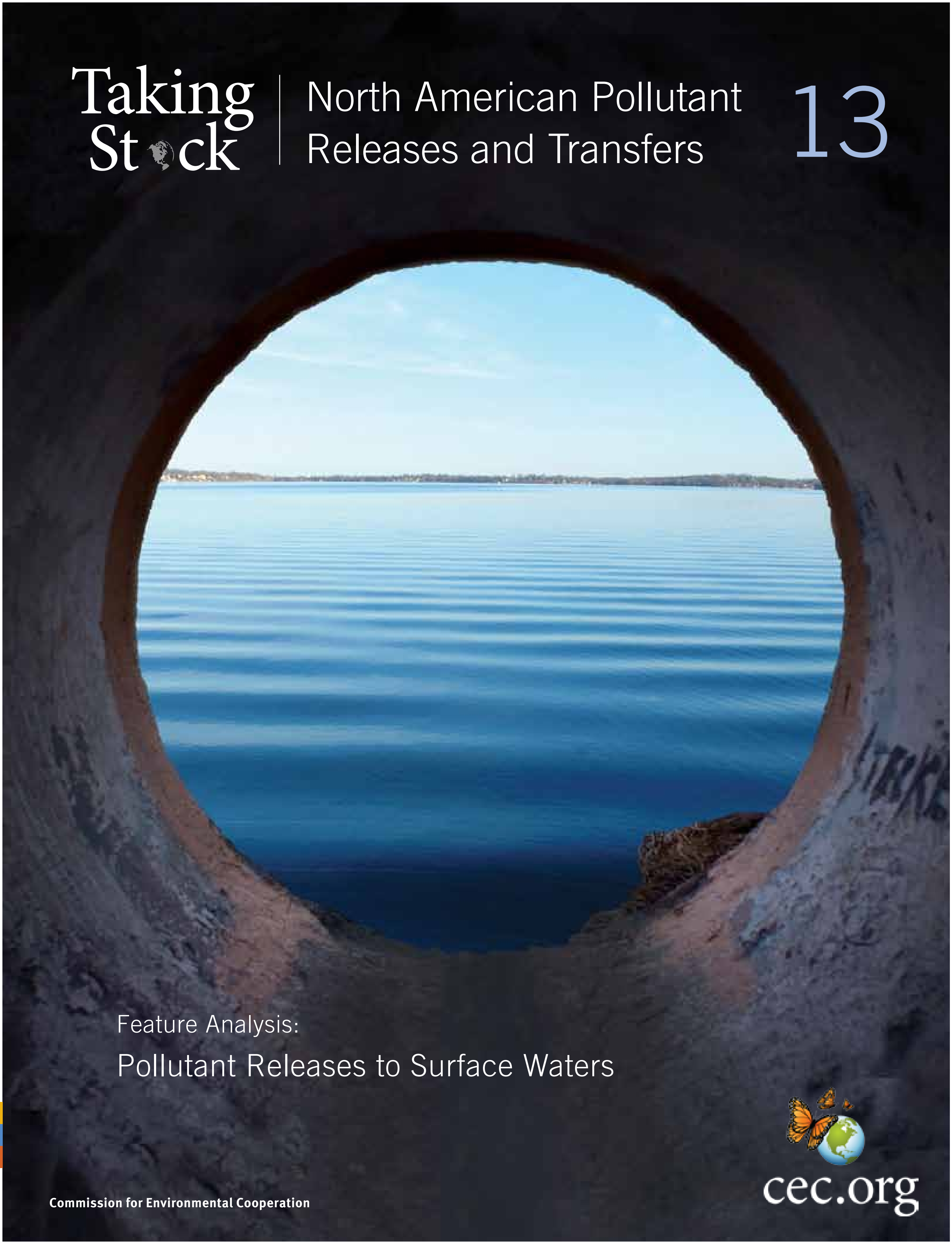

Feature Analysis:

Pollutant Releases to Surface Waters

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Disclaimer

The national PRTR systems are constantly evolving, as facilities revise previous submissions to correct reporting errors or make other changes. For this reason, the three countries 'lock' their data sets on a specific date and use the 'locked' data for annual summary reports. Each year, the countries issue revised databases that cover all reporting years.

The Commission for Environmental Cooperation (CEC) follows a similar process. For the purposes of this report, the NPRI and TRI 2006 data sets of September 2009 and the RETC 2006 data set of January 2010 were used. The CEC is aware that changes have occurred to the data sets subsequent to the official release of the 2006 data that are not reflected in this report. Readers can visit the national PRTR websites to see if any changes to the data have occurred.

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Acronyms

ATSDR	US Agency for Toxic Substances and Disease Registry
BOD	Biological Oxygen Demand
CAC	Criteria Air Contaminant
CAS	Chemical Abstracts Service
CEC	Commission for Environmental Cooperation
GHG	Greenhouse Gas
IARC	World Health Organization's International Agency for Research on Cancer
NAICS	North American Industry Classification System
NEI	US National Emissions Inventory
MNEI	Mexican National Emissions Inventory
NOM	*Norma Oficial Mexicana* (Mexican Official Standard)
NPRI	National Pollutant Release Inventory (Canadian PRTR)
PBT	Persistent, bioaccumulative and toxic substance
POTW	Publicly Owned Treatment Works
Prop 65	California's Office of Environmental Health Hazard Assessment (OEHHA) *Proposition 65* list
PRTR	Pollutant Release and Transfer Register
RETC	*Registro de Emisiones y Transferencia de Contaminantes* (Mexican PRTR)
Semarnat	*Secretaría de Medio Ambiente y Recursos Naturales* (Mexican Secretariat for the Environment and Natural Resources)
TEP	Toxicity Equivalency Potential
TRI	Toxics Release Inventory (US PRTR)
UNITAR	United Nations Institute for Training and Research
US EPA	US Environmental Protection Agency

Like other regions of the world, North Americans are increasingly aware of the challenges facing the sustainability of our most unique and precious natural resource: water. Water is responsible for stabilizing Earth's atmosphere, moving matter throughout the global ecosystem, and providing a unique substance and environmental service that supports the processes of life itself. Increasingly, as our cultures are organized today, this resource is made to yield to the demands of industrial and agricultural production, transportation, recreation, and waste disposal.

This year's *Taking Stock* report, the thirteenth in the CEC's series on pollutant releases and transfers from industrial facilities in North America, features a special analysis of such releases to surface waters. This is based on the most comprehensive, continental-scale data reported by facilities to the pollutant release and transfer registers (PRTRs) of Canada, Mexico and the United States. This analysis also presents releases of pollutants of special interest (such as known or suspected carcinogens and developmental or reproductive toxicants)—with a focus on lead and mercury compounds discharged to two international watersheds, the Columbia River on the Canada-US border, and the Rio Grande/Río Bravo on the US-Mexico border.

As in past reports, *Taking Stock* also provides an overview of releases and transfers reported by facilities across North America for the 2006 reporting year (the most recent data available from all three countries at the time of writing) and detailed data by medium (e.g., releases to air), sector, facility and pollutant. This overview, along with the fully integrated, searchable North American PRTR data, is also available on the *Taking Stock Online* website, www.cec.org/takingstock. The enhanced site features mapping capabilities and allows users to explore different aspects of the reported data.

The purpose of *Taking Stock* is to provide information about the sources, amounts and types of pollutants released and transferred by North American facilities to increase understanding and inform decisions, at all levels, about reducing and preventing pollution. The special analysis of releases to surface waters supports such decisions because it reveals relationships between certain industrial processes and releases of specific pollutants and helps to establish pollution profiles for economic sectors common to our three countries.

This year's *Taking Stock* also demonstrates the gaps in our picture of North American pollution as a consequence of significant differences among national PRTR reporting requirements relative to pollutant and sector coverage. In this way, the data shed light on areas for action relative to increasing comparability among the three PRTR programs—an important step towards improving our understanding about North American industrial pollution and how to address it.

Taking Stock remains a cornerstone of the CEC's efforts to protect human health and enhance environmental sustainability across North America. We continue to work closely with the three governments, environmental organizations, academia, industry and the public to enhance the quality, comparability of and access to PRTR data in support of decision-making. We welcome your suggestions at any time on how *Taking Stock* and the North American PRTR Project can evolve in order to achieve this goal.

Evan Lloyd
Executive Director

This edition of *Taking Stock* presents an overview of the releases and transfers of pollutants from North American industrial sectors in 2006, the most recent data available from all three countries at the time of writing. The report is based primarily on publicly available data reported to the three national pollutant release and transfer registers (PRTRs) in North America:

- *National Pollutant Release Inventory* (NPRI) in Canada;
- *Registro de Emisiones y Transferencia de Contaminantes* (RETC) in Mexico; and
- *Toxics Release Inventory* (TRI) in the United States.

PRTRs gather detailed information on the types, locations and amounts of pollutants released or transferred by industrial facilities. By bringing together data and information from the three national PRTR programs, this publication supports the goal of the Commission for Environmental Cooperation (CEC) to provide information for decision making at all levels of society. Specifically, *Taking Stock* aims to:

- Provide a picture of the industrial releases and transfers of pollutants in North America and serve as an information source for governments, industry and communities in analyzing such data and identifying opportunities to reduce pollution;
- Promote greater comparability of PRTR data among the three countries;
- Raise awareness of the important health and environmental issues associated with industrial releases of toxic substances in North America;
- Increase dialogue and collaboration across borders and industrial sectors; and
- Support integration of PRTR data into an overarching framework for managing pollutants in North America.

What is a Pollutant Release and Transfer Register?

PRTRs provide annual data on the amounts of pollutants released from a facility to the air, water and land and injected underground, as well as transferred off-site for recycling, treatment or disposal. PRTRs are an innovative tool that can be used for a variety of purposes—that is, they track certain chemicals, thereby helping industry, governments and citizens identify ways to reduce the release and transfer of these substances, increase responsibility for chemical use, prevent pollution and cut back on waste generation. Corporations use the data to report on their environmental performance and to identify opportunities for reducing or preventing pollution. Governments use the data to guide program priorities and evaluate results. And communities, nongovernmental organizations and citizens use the data to gain an understanding of the sources and management of pollutants and to support dialogue with facilities and governments.

PRTRs collect data on individual pollutants rather than on the volume of waste streams containing mixtures of substances because this approach allows the tracking of data on releases and transfers of individual substances. *Reporting by facility* is central to locating where releases occur and who or what generated them. Much of the power of a PRTR lies in *public disclosure of the data* and their dissemination to a wide range of users in both raw and summarized form. The public availability of pollutant- and facility-specific data allows interested persons and groups to identify local industrial sources of releases and support regional and other geographically based analyses.

Focus of This Year's Report

This year's report provides an overview of pollutant releases and transfers reported by North American facilities for 2006. It also includes a special feature analysis of releases to surface waters reported that year.

Organization of this Report

Chapter 1 provides the key findings of the 2006 data along with an overview of reporting and details by release medium (e.g., air, water), as well as reported transfers (including pollutants transferred across borders).

Chapter 2 is a special feature analysis of reported pollutant releases to surface waters in 2006 and includes information about national water quality regulations, impacts of specific types of pollutants released to water, and the data on releases reported by North American facilities, including those released to two cross-border river systems.

Chapter 3 provides important information regarding the comparability of North American PRTR reporting, which can be challenging due to differences among the three countries in the years for which data are available, reporting thresholds, pollutants and sectors covered, and so on. These create certain limitations as to the conclusions one can draw on the basis of PRTR data.

Because of the large amount of data involved, readers are encouraged to visit the *Taking Stock Online* integrated North American PRTR database at **www.cec.org/takingstock**, to do specific searches by facility, industry sector, pollutant, or country. Data for all three countries from 2004, 2005 and 2006, as well as additional data going back to 1998 for the United States and Canada, can be explored. The data can also be downloaded for use in spreadsheets or formatted for certain mapping applications. Readers can use the reported data and information about a pollutant's chemical properties as a starting point for learning more about its potential health and environmental impacts. A guide to making queries is provided on the following page.

Appendix 1. Using and Understanding *Taking Stock*
This appendix is intended especially for those readers new to *Taking Stock* or to PRTRs generally. It describes the characteristics of the three national pollutant release and transfer registers and the features that are common or unique to them. It also describes the methodology and terminology used in this report.

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006
The North American PRTRs mandate reporting of only a small fraction of the thousands of chemical substances employed or encountered in the various industrial sectors of the three countries. Some pollutants are common to at least two of the three PRTR programs and in this case, are included in **Appendix 2**, which also provides pollutant CAS numbers and their PRTR reporting thresholds.

Using *Taking Stock Online*

In addition to the analyses found in this printed report, you can use the integrated, North American PRTR database on *Taking Stock Online*, **www.cec.org/takingstock**, to answer your questions about pollutant releases and transfers by year, facility, location, pollutant, or industry sector. For instance:

Do you want to know the total amount of releases and transfers reported by state, province or territory?

Step 1: Under "Report Type," select "state/province/territory"
Step 2: Under "Year," select one or more years
Step 3: Under "Country," select one or more country
Step 4: Click on "Submit"

Note: On this page, you also have the option of selecting a pollutant or category of pollutants, as well as a specific industry sector.

Once on the Results Page, click on the state/province/territory total to get a breakdown of total releases and transfers by facility, industry sector, and pollutant. You have the following options:

- Select the medium of release or transfer type from the media type buttons (the default is "Total Releases and Transfers")
- Check the "NAICS" box to see the facility's industrial code and description
- Sort the data in order of decreasing amounts reported
- View the facility locations on the map inset
- Download the data from this page in an Excel spreadsheet, or as a .kml or .kmz file to be displayed in Google Earth

Do you want to know which pollutants were released to air, water or land, and in what amounts?

Step 1: Under "Report Type," select "pollutant"
Step 2: Under "Year," select one or more years
Step 3: Under "Country," select a country (and one or more state, province or territory, if desired)
Step 4: Click on "Submit"

Note: On this page, you also have the option of selecting a category of pollutant (e.g., "known or suspected carcinogens"), or only those pollutants that are common to the countries selected. You can also select a specific industry sector.

Once on the Results Page, you have the following options:

- Click the media button (e.g., air) to see all pollutants released to that medium
- For releases to air or water only, you can also check the "TEP score" box to obtain calculated risk scores for cancer and non-cancer (e.g., developmental or reproductive toxicity) effects
- Sort the data in order of decreasing amounts reported, or by TEP score
- Click on a pollutant name to get a breakdown of reported releases to that medium by facility, state/province/territory, and industry sector
- View the facility location on the map inset
- Download the data from this page in an Excel spreadsheet, or as a .kml or .kmz file to be displayed in Google Earth

Other sample queries that may be of interest:

- Do a Facility search for one or more countries, then export the query results as kml or kmz file, to map in Google Earth
- Use the "Summary Charts" tab in the left-hand menu to get an overview of reporting in one or more countries by top pollutants or sectors.
- Use the "Cross-border Transfers" tab in the left-hand menu to see details of the pollutant transfers among the three countries.

Overview of Pollutant Releases and Transfers Reported by North American Facilities, 2006

Key Findings

- The integrated North American PRTR data presented in this report constitute the most comprehensive picture of industrial pollution across the region, revealing releases and transfers of 5.7 billion kg of toxic pollutants from industrial facilities in Canada, Mexico and the United States for the 2006 reporting year (the most recent data available from all three countries at the time of writing).
- Of all reporting sectors, eleven accounted for 4.1 billion kg, or about 72%, of the total. They included metal mining and oil and gas extraction activities; fossil-fuel power plants; chemicals manufacturing; and primary metals manufacturing. A total of 26 pollutants reported by these 11 sectors accounted for 63% of all releases and transfers reported by North American facilities that year.
- A look at the reporting profile of each country reveals significant differences in the sources, amounts and types of releases and transfers reported:
    - In Canada, almost 3,200 facilities reported about 2.1 billion kg,[1] with facilities reporting 194 pollutants of the approximately 350 subject to NPRI reporting. Of the total amount reported, 55% were transfers to recycling.
    - In Mexico, almost 1,900 facilities reported a total of about 28 million kg.[2] These facilities reported 69 of the 104 pollutants subject to RETC reporting. Of the total amount of releases and transfers reported, 70% were releases to air.
    - In the United States, more than 23,000 facilities reported approximately 3.5 billion kg, with releases to land and transfers to recycling together comprising about 52% of the total. Facilities reported 491 pollutants of the approximately 600 substances subject to TRI reporting.

1. This number excludes reporting from over 5,500 Canadian facilities that reported releases of criteria air contaminants, exclusively.
2. This number excludes reporting from 873 Mexican facilities that reported releases of greenhouse gases, exclusively.

Key Findings (continued)

- The feature analysis of pollutant releases to water shows that almost 5,000 North American facilities, most of them in Canada and the United States, reported releases to surface waters of about 228.5 million kg in 2006. The public wastewater treatment sector accounted for 44% of the total releases to water that year—with almost all of the data for this sector from Canada, since public wastewater treatment facilities are exempt from US TRI reporting and in Mexico, very few wastewater treatment plants reported in 2006.
- Of the 256 pollutants released to water, just two—nitrate compounds and ammonia—comprised 90% of the total. These pollutants can contribute to nutrient loadings in lakes and rivers, leading to problems such as eutrophication. In Mexico, fossil fuel-powered electric utilities reported almost 50% of the country's total releases to water, including heavy metals and their compounds such as nickel, lead, and chromium. When released to water, these pollutants have the potential to be extremely toxic to human health and the aquatic environment.
- North American facilities also transferred approximately 234 million kg of pollutants across national borders in 2006. More than 170 million kg (or almost 73% of all cross-border transfers) were sent from Canadian facilities to the United States, much of it sulfuric acid sent for recycling by the petroleum and coal products manufacturing sector.
- US primary metals manufacturers accounted for the majority of the 45.5 million kg of pollutants transferred to Mexico, with over 80% consisting of zinc compounds destined for recycling, mainly at one Mexican facility. However, because some pollutants such as zinc are not subject to Mexican RETC reporting, once they are transferred across the border they can no longer be tracked.
- The North American data reflect differences among the three countries' PRTR programs in terms of sector and pollutant coverage and incomplete reporting. For instance, oil and gas extraction activities accounted for more than half of Canada's total releases and transfers in 2006. However, this sector and the top reported pollutant, hydrogen sulfide, are exempt from reporting under the US Toxics Release Inventory. In Mexico, the oil and gas extraction sector reported zero hydrogen sulfide emissions in 2006.
- This report also demonstrates how PRTR data can be used to improve our understanding of industrial pollution and the opportunities for pollution prevention and reduction: The data establish associations between releases of certain pollutants and specific industrial activities and thus provide a basis for the development of pollutant profiles for sectors common to the three countries; and details about releases of pollutants of special interest, such as carcinogens, can highlight issues for priority consideration relative to human and environmental health across the region.

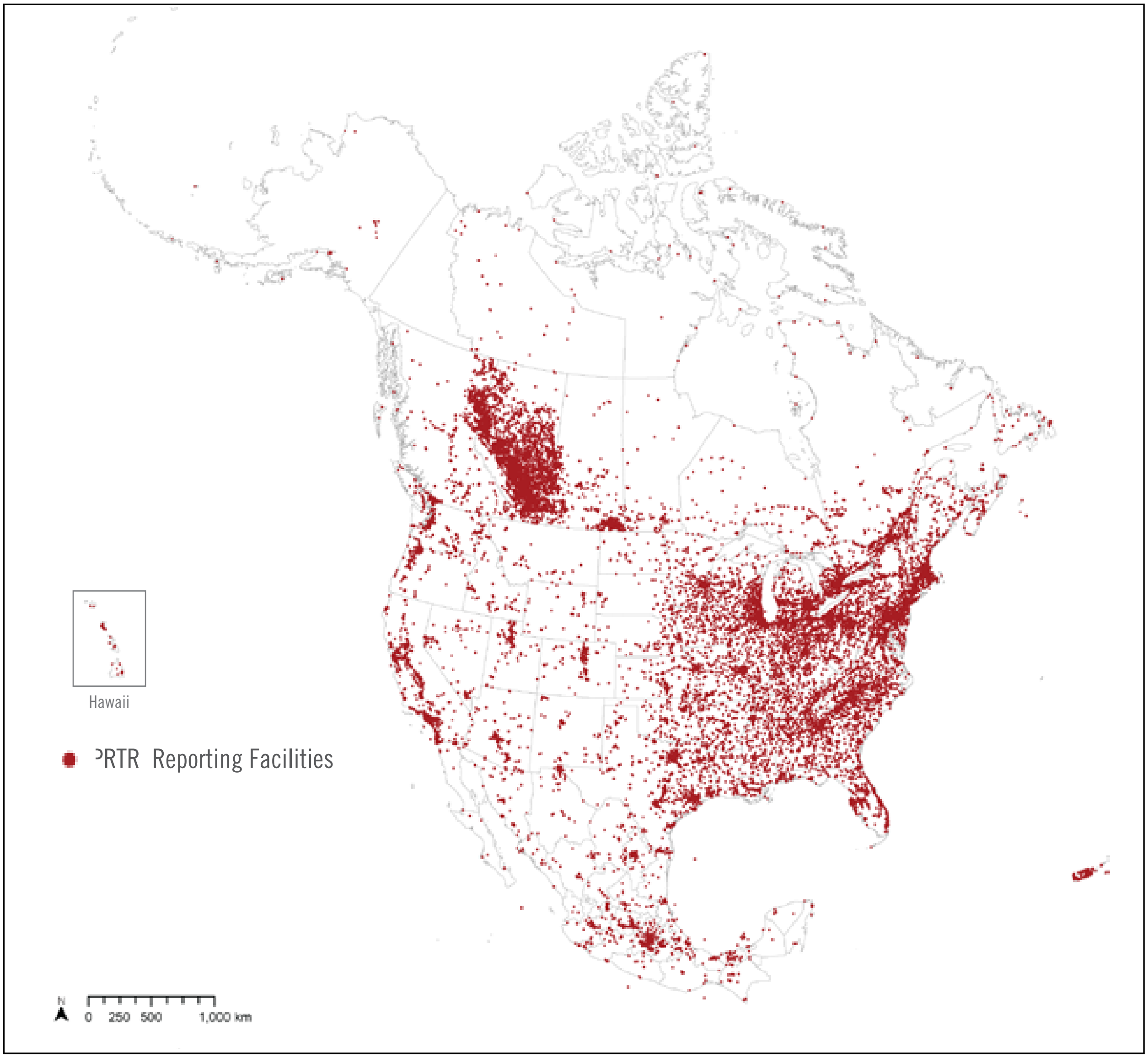
Comparing PRTR data from Canada, the United States and Mexico

Taking Stock presents PRTR data from Canada, Mexico and the United States, thereby providing the most complete picture currently available of industrial releases and transfers of pollutants in North America. This picture includes data that might be reported differently in each country because of national reporting requirements. The features unique to each PRTR are described in **Appendix 1 (Table A-1)** to provide the context needed for a better understanding of the pollutant releases and transfers in the three countries.

Map 1 shows the locations of the approximately 35,000 facilities that reported to the North American PRTRs in 2006. In the United States, 23,449 facilities reported to the TRI program. In Canada, 8,860 facilities reported to the NPRI, with 5,668 of them reporting exclusively releases of criteria air contaminants (CACs). In Mexico, 2,736 facilities reported to the RETC, with 873 of them reporting exclusively releases of greenhouse gases (GHGs).[3] Thus, of the total facilities reporting in those two countries, 3,192 Canadian facilities and 1,863 Mexican facilities are included in this report. In total, 28,504 facilities across North America are included in the *Taking Stock* report and online database.

3. Some CACs are subject to NPRI reporting, and certain GHGs are subject to RETC reporting, but these substances are not reported under the US TRI. In each country, other programs (e.g., national emissions inventories, greenhouse gas registers) collect data on these particular groups of substances (though not necessarily at the facility level). Because of these important differences, CACs and GHGs are excluded from *Taking Stock* at this time. For more information, see *Taking Stock* Scope and Methodology in **Appendix 1**.

Map 1. Distribution of PRTR Reporting Facilities in North America, 2006



Note: **Almost 7,000 of the facilities shown on this map (in Canada and Mexico) reported exclusively criteria air contaminants or greenhouse gases.** Readers are reminded that each country has specific reporting requirements for sectors, facilities and pollutants that affect the North American picture of industrial pollution.

Table 1. Total Releases and Transfers in North America, by Country, 2006

PRTR Program	Number of Facilities Reporting	Substances Reported	Total, excluding CACs and GHGs (kg)
Canada NPRI	**3,192** (excluding 5,668 reporting only CACs)	194	2,165,320,683
Mexico RETC	**1,863** (excluding 873 reporting only GHGs)	69	27,969,765
US TRI	23,449	491	3,518,657,632
North American Total	**28,504** (of 35,045 total, including those reporting only CACs and GHGs)	**539** (44 pollutants common to the three countries)	**5,711,948,081**

Please note that due to rounding, totals might differ slightly.

Figure 1. Total Releases and Transfers by Medium, North America, 2006

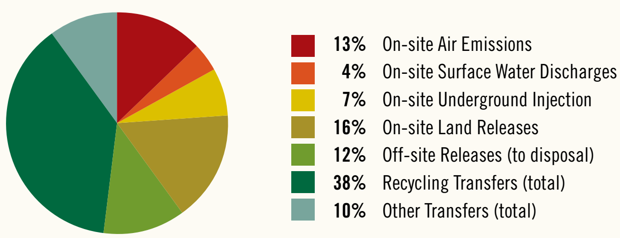
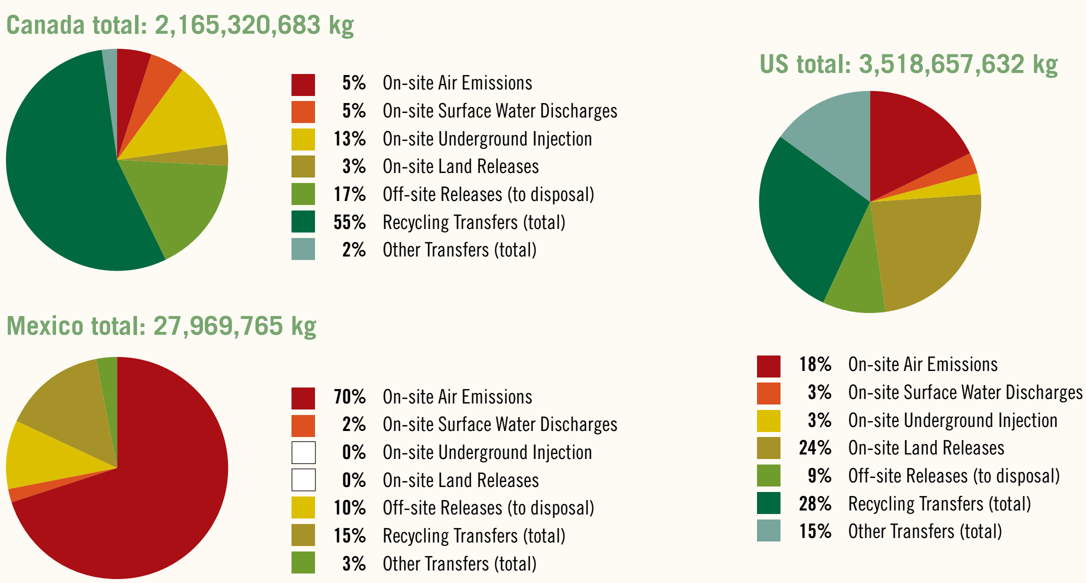


Figure 2. Releases and Transfers, 2006: Country Profiles



Readers are reminded that each country has specific reporting requirements for sectors, facilities, and pollutants that affect the North American picture of industrial pollution.

Table 1 shows that of the pollutants subject to reporting under each PRTR program in 2006 (other than CACs and GHGs), Canadian facilities reported on 194, Mexican facilities reported on 69, and US facilities reported on 491. These include certain pollutants that have been grouped in *Taking Stock* for purposes of comparability among the countries (e.g., arsenic and its compounds, xylene isomers).

North American facilities reported more than 5.7 billion kg in releases and transfers of toxic pollutants. **Figure 1** provides a breakdown of this North American total by medium, while **Figure 2** shows how these releases and transfers were distributed in each of the three countries.

Table 2 provides the amounts of releases and transfers reported to each country's PRTR in 2006.

In Canada, transfers to recycling (mainly of non-metals) accounted for 55% of the total, followed by 16% released to disposal and 13% released to underground injection.

In Mexico, 70% of the reported total consisted of releases to air, with another 15% comprised of transfers (mostly of metals) to recycling.

In the United States, 25% of the reported total consisted of land releases, 18% were releases to air, and 28% involved transfers (mainly of metals) to recycling.

This table reveals great variations among the three countries in the number of facilities reporting to their respective PRTRs, as well as in the amounts and types of releases and transfers reported in each country. This is due in part to national differences in PRTR reporting requirements for sectors and pollutants, incomplete reporting, as well as the industrial make-up of each country.

Table 2. Summary of Total Reported Releases and Transfers in Canada, Mexico and the United States, 2006

	Canadian NPRI (kg)*	% of National Total	Mexican RETC (kg)*	% of National Total	United States TRI (kg)	% of National Total
On-site Releases	565,535,127	26%	20,145,057	72%	1,714,906,407	49%
Air	110,209,028	5%	19,637,734	70%	639,682,800	18%
Surface Water	114,702,329	5%	442,353	2%	113,330,201	3%
Underground Injection	275,639,414	13%	NA	NA	99,711,525	3%
Land	64,984,356	3%	64,970	0%	862,181,881	25%
Off-site Releases	370,011,629	17%	2,632,269	9%	299,686,275	9%
Transfers to Disposal (except metals)	342,241,671	16%	540,820	2%	30,377,514	1%
Transfers of Metals	27,769,958	1%	2,091,450	7%	269,308,761	8%
Total On- and Off-site Releases	**935,546,755**	**43%**	**22,777,326**	**81%**	**2,014,592,682**	**57%**
Off-site Transfers to Recycling	1,180,674,304	55%	4,301,382	15%	988,318,913	28%
Transfers to Recycling of Metals	184,755,335	9%	3,533,050	13%	872,824,685	25%
Transfers to Recycling (except metals)	995,918,969	46%	768,331	3%	115,494,228	3%
Off-site Transfers for Further Management	49,099,623	2%	891,057	3%	515,746,037	15%
Energy Recovery (except metals)	12,182,266	1%	817,184	3%	251,691,713	7%
Treatment (except metals)	23,836,878	1%	73,366	0%	146,465,274	4%
Sewage (except metals)	13,080,479	1%	507	0%	117,589,051	3%
Total Transfers	**1,229,773,927**	**57%**	**5,192,439**	**18%**	**1,504,064,950**	**43%**
National Totals	**2,165,320,683**	**100%**	**27,969,765**	**100%**	**3,518,657,632**	**100%**
Total Number of Facilities	3,192 (of 8,860)		1,863 (of 2,736)		23,449	
Number of Pollutants Reported (no CACs/GHGs)	194		69		491	

Please note that due to rounding, totals might differ slightly.
* These totals do not include releases of criteria air contaminants (CACs) reported to Canada's NPRI and releases of greenhouse gases (GHGs) reported to Mexico's RETC. At present, CAC and GHG data are not included in the *Taking Stock Online* database, but for more information, consult **Appendix 1**. As also noted there, readers are reminded that each country has specific reporting requirements for sectors, facilities and pollutants that affect the North American picture of industrial pollution.

Releases to Air: 769,529,563 kg

Almost 770 million kg of releases to air were reported across North America. Coal- and oil-fired power plants contributed 43 percent of the total.

North American facilities reported releases of 453 pollutants to air in 2006. Five of these pollutants (the top five shown in **Figure 3**) accounted for more than one-third of the total. Many facilities also released criteria air contaminants and greenhouse gases (See **Appendix 1**).

In both the United States and Mexico, releases to air were dominated by facilities from the electricity generation sector (coal- and oil-fired power plants, see **Table 3**), but the top pollutants reported in each country differed: hydrochloric acid, sulfuric acid and hydrogen fluoride in the United States; and mainly hydrogen sulfide in Mexico.

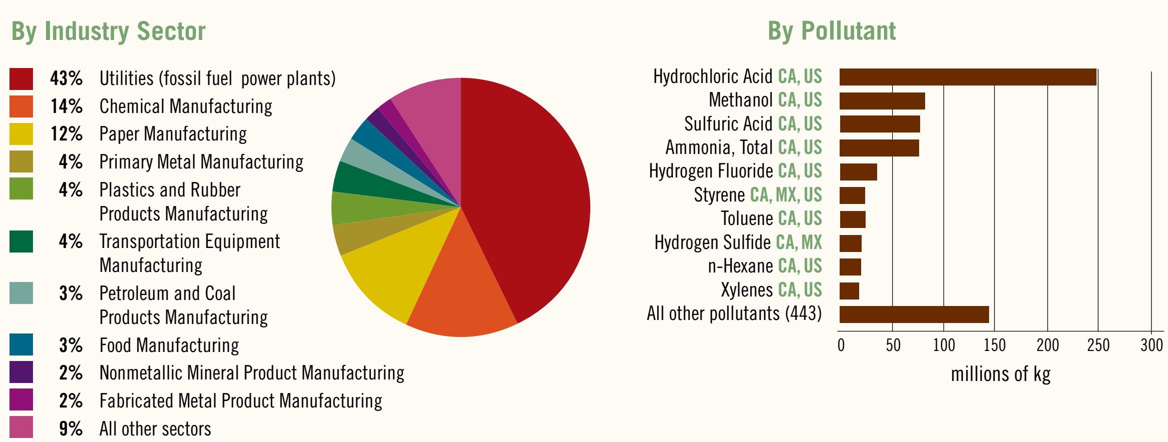
National PRTR reporting requirements can partly explain these discrepancies: the top three pollutants reported by US power plants are not subject to reporting in Mexico, while reporting of hydrogen sulfide is not mandatory in the United States. Other factors contributing to these reporting differences include operational parameters and the types of fuels used by the power plants in each country: about half of the electricity produced in the United States comes from coal-fired generation, while half of Mexico's is derived from the combustion of petroleum (in Canada, about 60% is from hydroelectric power plants).

The top sectors contributing to air releases in Canada included chemicals manufacturing and paper manufacturing, together reporting 34% of the country's total. Pollutants such as methanol and ammonia dominated releases by these two sectors. However, individual facilities involved in mining and oil and gas extraction, as well as utilities (including electricity generation and wastewater treatment), accounted for some of the largest releases to air (**Table 3**).

Pollutants such as sulfuric acid, released to air through the burning of fossil fuels, can react in the atmosphere to create acid rain. Air releases of pollutants including methanol, styrene and others can contribute to the formation of smog, cause respiratory problems, or be otherwise toxic.

> Approximately 600 US power plants released 304 million kg to air, or almost 48% of the United States' total reported air emissions in 2006. In Mexico, just three power plants released 17.8 million kg, or 91% of Mexico's total reported air emissions in 2006 (see **Table 3**).

Figure 3. Reported Releases to Air in North America, 2006



Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.

Table 3. Top Facilities Reporting Releases to Air in North America, by Country, 2006

Facility Name	PRTR ID	City	State, Province or Territory	On-site Air Emissions (kg)
Canada (top 10 = 21% of total air releases in Canada)				
Vale Inco - Copper Cliff Smelter Complex	444	Copper Cliff	Ontario	4,105,178
Syncrude Canada - Mildred Lake Plant Site	2274	Fort McMurray	Alberta	3,886,112
Agrium - Redwater Fertilizer Operations	2134	Redwater	Alberta	2,664,730
Koch Fertilizer Canada, Ltd.	2515	Brandon	Manitoba	2,504,088
Canadian Fertilizers Limited	3821	Medicine Hat	Alberta	2,479,814
Ontario Power Generation - Nanticoke Generating Stn	1861	Nanticoke	Ontario	2,427,293
Agrium - Carseland Nitrogen Operations	3269	Calgary	Alberta	1,831,458
City of Hamilton - Woodward Avenue Wastewater Treatment	5970	Hamilton	Ontario	1,532,791
Suncor Energy - Suncor Energy Inc. Oil Sands	2230	Fort McMurray	Alberta	1,423,123
Spectra Energy Transmission - Pine River Gas Plant	4306	Chetwynd	British Columbia	1,111,360
Mexico (top 10 = 95% of total air releases in Mexico)				
Comisión Federal de Electricidad, Campo y Central	CFELS0200211	Mexicali	Baja California	10,875,000
Comisión Federal de Electricidad, Campo y Central	CFELS1603411	Ciudad Hidalgo	Michoacán	4,916,000
Comisión Federal de Eléctricidad, Central Geotermoeléctrica	CFELS2105411	Maztaloya	Puebla	2,019,000
Continental Structural Plastics de Tijuana	CSP520200411	Tijuana	Baja California	399,062
Altos Hornos de México, S.A. de C.V.	AHM7F0501811	Monclova	Coahuila	187,700
Productos y Diseños de Mármol, S.A. de C.V.	PDM9D0200412	Tijuana	Baja California	91,336
Teepak de México, S. de R.L. de C.V.	TMEN31610711	Zacapu	Michoacán	75,400
Industrias Polyrey, S.A. de C.V.	IPO6M1403911	Guadalajara	Jalisco	54,329
3m México, S.A. de C.V.	TMM5X2402811	San Luis Potosí	San Luis Potosí	53,678
Fersinsa Gb, S.A. de C.V. - Planta Síntesis	FGB5M0502721	Ramos Aizpe	Coahuila	50,140
United States (top 10 = 10% of total air releases in US)				
Bowen Steam Electric Generating Plant	30120BWNST317CO	Cartersville	Georgia	9,263,344
American Electric Power Amos Plant	25213JHNMS1530W	Winfield	West Virginia	8,682,994
Reliant Energy Keystone Power Plant	15774KYSTNRTE21	Shelocta	Pennsylvania	7,397,184
Duke Energy Corp - Belews Creek Steam Stn	27052DKNRGPINEH	Belews Creek	North Carolina	6,654,491
American Electric Power Kammer/Mitchell Plants	26041KMMRPRTE2	Moundsville	West Virginia	5,592,225
Carolina Power & Light Co. - Roxboro Steam Electric	27343RXBRS1700D	Semora	North Carolina	5,586,733
Progress Energy Inc. - Florida Power Crystal River	34428FLRDP15760	Crystal River	Florida	5,422,714
Georgie Power Wansley Steam Electric Generating	30170WNSLYGEORG	Roopville	Georgia	5,199,429
Branch Steam Electric Generating Plant	31061BRNCHUSHWY	Milledgeville	Georgia	5,150,398
Marshall Steam Station	28682DKNRG8320E	Terrell	North Carolina	5,150,050

Please note that due to rounding, totals might differ slightly.

Pollutants released to air or discharged to water have the potential to negatively impact human health and the environment. However, the magnitude of a release is not the only factor to consider, since some substances can be highly toxic even when released in very small quantities. In order to help users better understand the potential for harm to human health or the environment, *Taking Stock* provides Toxicity Equivalency Potentials (TEPs) for many pollutants released to air or discharged to water. See **Appendix 1** for the risk scores associated with the top pollutants released to air or water in 2006 and for other sources of human health and environmental effects information. For a sample query go to *Taking Stock Online*, **http://goo.gl/R4WH5**. To see the TEP scores for pollutants released to air or discharged to water, select a Pollutant report (for one or more countries). On the Query Results page, click on "Air Releases" or "Surface Water Discharges" and "TEP Score."

Releases to Water: 228,474,882 kg

Facilities reported releases of more than 228 million kg of pollutants to water. Public wastewater treatment plants contributed 44% of the total.

North American facilities reported releases of 257 pollutants to water in 2006. Just two of these, nitrate compounds and ammonia, comprised 90% of the total.

Public wastewater treatment plants, which receive wastewater from a variety of sources, were top contributors to the total amount released to water in 2006, with this sector reporting 84% of Canada's total water discharges (**Figure 4**). Public wastewater treatment facilities (or publicly-owned treatment works—POTWs) are not required to report to the US TRI; and while facilities discharging to national water bodies in Mexico are subject to RETC reporting, very few wastewater treatment plants reported in 2006.

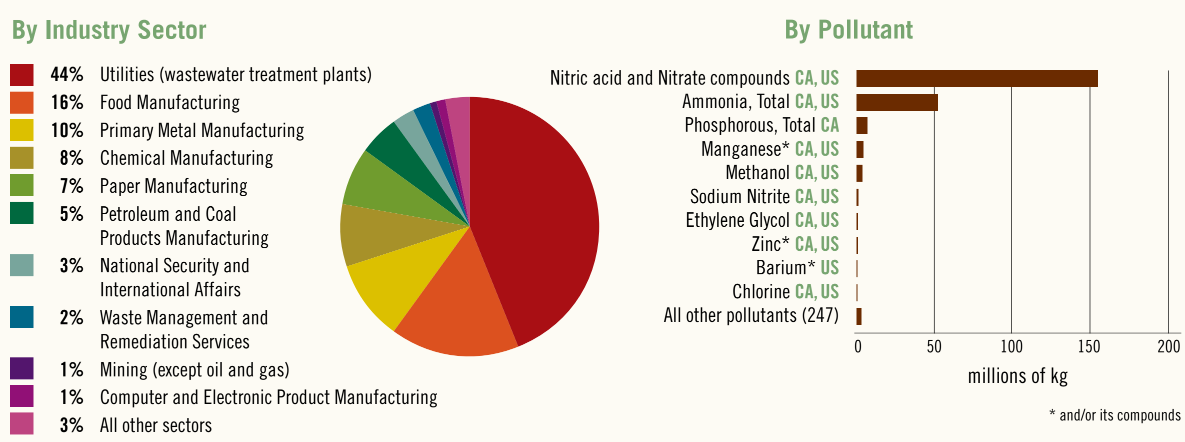
For the United States, **Table 4** shows that one steel manufacturing facility reported the largest releases to water in that country. However, combined releases by US food manufacturing facilities made that sector the top-ranking industry for releases to water in 2006. The top pollutant released by this sector was nitrate compounds, followed by ammonia.

Although dwarfed by Canadian and US facilities in terms of the amounts discharged, Mexican power plants reported almost 50% of the country's total releases to water, including heavy metals such as nickel, lead, and chromium, as well as arsenic and cyanide compounds. Metals present in the fuels used in power plants can be captured and removed as a sludge from the stacks or during cleaning of the boilers.

Public wastewater treatment plants, a sector reporting almost exclusively in Canada, released to water over 90 million kg of such pollutants as ammonia and nitrates—pollutants that can have potentially negative impacts on the aquatic environment. North American facilities in a variety of sectors, including pulp and paper, chemicals, and utilities, also reported metals such as lead, cadmium, and mercury compounds. These pollutants, released to water in relatively small quantities, may have even greater impacts. See **Appendix 1** for the TEP risk scores associated with the top pollutants released to water in 2006, and for other sources of human health and environmental effects information.

Heavy metals and their compounds, when released to water, have the potential to be extremely toxic to human health and the aquatic environment. Other pollutants, such as nitrate compounds and phosphorous, can contribute to nutrient loading in lakes and rivers, leading to problems like eutrophication. See the next chapter for a special analysis of releases to surface waters, as well as **Appendix 1** for sources of human health and environmental effects information.

Figure 4. Reported Releases to Surface Water in North America, 2006



Note: "CA" and "US" designate the countries in which the pollutant is subject to PRTR reporting.

Table 4. Top Facilities Reporting Releases to Surface Water in North America, by Country, 2006

Facility Name	PRTR ID	City	State, Province or Territory	On-site Surface Water Discharges (kg)
Canada (top 10 = 48% of total water releases in Canada)				
City of Toronto - Ashbridges Bay Treatment Plant	2240	Toronto	Ontario	13,679,710
City of Calgary - Bonnybrook Wastewater Treatment	5308	Calgary	Alberta	9,344,624
City of Ottawa - Robert O. Pickard Environmental Ctr	770	Gloucester	Ontario	5,260,625
Greater Vancouver Regional District - Annacis Island	1338	Delta	British Columbia	4,836,140
Ville de Montréal - Station d'épuration des eaux usées	3571	Montréal	Québec	4,800,901
City of Toronto - Highland Creek Treatment Plant	4435	Toronto	Ontario	4,765,634
Regional Municipality of Halton - Skyway Waste Water	4771	Burlington	Ontario	3,878,724
Greater Vancouver Regional District - Iona Island	5189	Richmond	British Columbia	3,246,525
City of Edmonton - Gold Bar Wastewater Treatment	5390	Edmonton	Alberta	3,144,753
City of Toronto - Humber Treatment Plant	2238	Toronto	Ontario	2,636,142
Mexico (top 10 = 74% of total water releases in Mexico)				
Comisión Federal de Electricidad, C. T. Juan	CFEAD2500111	Topolobampo	Sinaloa	114,844
Ciba Especialidades Químicas de México, S.A. de C.V.	CEQ5J1404411	Atotonilquillo	Jalisco	77,652
Electricidad Águila de Tuxpan, S. de R.L. de C.V.	EATAD3018911	Comunidad Chile Frío	Veracruz	29,735
Iberdrola Energía Altamira, S.A. de C.V.	IEAMI2800311	Altamira	Tamaulipas	26,230
Junta Municipal de Agua Potable y Alcantarillado	JIAUB2500611	Culiacancito	Sinaloa	20,076
Electricidad Sol de Tuxpan, S. de R.L. de C.V.	ESTUB3018911	Comunidad Chile Frío	Veracruz	19,779
Manufacturas Pegaso, S.A. de C.V.	MPE520900711	Granjas San Antonio	Distrito Federal	13,200
Recubrimientos Industriales Fronterizos, S. de R.L.D.	RIF8A2802211	Matamoros	Tamaulipas	11,690
Productos Farmacéuticos, S.A. de C.V.	PFA5T0100711	Pabellón de Hidalgo	Aguascalientes	8,134
Industria del Alcali, S.A. de C.V.	IAL5I1901811	García	Nuevo León	6,345
United States (top 10 = 30% of total water releases in US)				
AK Steel Corp. (Rockport Works)	47635KSTLC6500N	Rockport	Indiana	11,941,973
U.S. Army Radford Army Ammunition Plant	24141SDDSRPOBOX	Radford	Virginia	6,122,497
Tyson Fresh Meats Inc. Wastewater Treatment Plant	68731BPNCWGST	Dakota City	Nebraska	3,540,580
Cargill Meat Solutions Corp.	68661XCLCRWESTH	Schuyler	Nebraska	2,169,576
Smithfield Packing Co. Inc. Tar Heel Div.	28392CRLNFHWY87	Tar Heel	North Carolina	2,082,479
Tyson Fresh Meats Inc.	68850BPNC 1500S	Lexington	Nebraska	1,950,227
AK Steel Corp. Coshocton Works	43812CSHCTSTATE	Choshocton	Ohio	1,814,849
ExxonMobil Refining & Supply Baton Rouge Refinery	70805XXNBT4050S	Baton Rouge	Louisiana	1,636,160
Dupont Chambers Works	08023DPNTCRT130	Deepwater	New Jersey	1,567,002
DSM Chemicals North America Inc.	30903DSMCHNO1CO	Augusta	Georgia	1,555,243

Please note that due to rounding, totals might differ slightly.

Releases to Land: 927,231,207 kg

North American facilities reported releases to land of more than 927 million kg of pollutants. Metal mining activities accounted for 63% of the total.

North American facilities reported releases to land of 235 pollutants in 2006. Metals and their compounds accounted for about 90% of the total reported amounts (**Figure 5**).

Activities dominating releases to land included US metal mining, which contributed about 65% of that country's land releases, particularly of zinc and lead compounds. (See **Table 5** for top releasers from each country.) One Canadian diamond mine also reported the top releases to land in 2006, with nitrate compounds accounting for a majority of these releases, followed by ammonia.

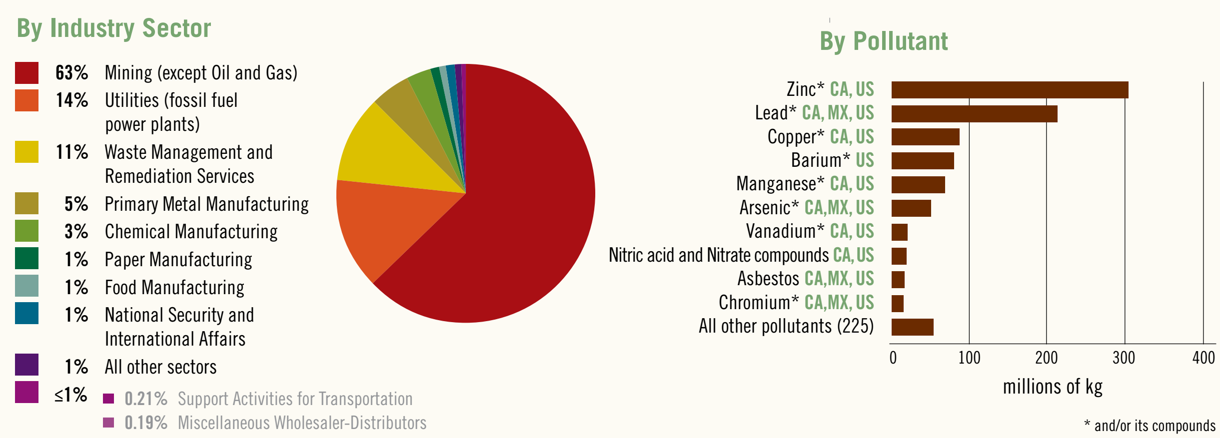
US power plants ranked second for land releases, reporting barium and other metals. In both Canada and the United States, the waste management and remediation sector (primarily treatment and disposal) also reported large proportions of land releases, mainly of nitrate compounds.

Mexican facilities in the fabricated metals (particularly coating, engraving and heat treating activities) and miscellaneous manufacturing sectors reported 75% of the country's total land releases, including metals such as chromium, lead, nickel and mercury compounds, along with cyanides and asbestos.

Industrial releases to land can involve disposal in landfills or holding ponds, where the pollutants settle over time; as well as "land treatment" or "application farming," where pollutants are incorporated into the soil. Pollutants handled in this way have the potential for negatively impacting human health and the environment; this is especially true of heavy metals, due to their inherent toxicity and tendency to persist in the environment. See **Appendix 1** for sources of human health and environmental effects information.

> US metal mining companies in Alaska, Utah, Arizona, Nevada, and other states released almost 190 million kg of lead compounds and 2 million kg of mercury compounds to land in 2006. In Mexico, reported releases and transfers from metal mines decreased dramatically from 2005 to 2006 (from over 43 million kg to just over 10,000 kg). We can expect to see an increase in PRTR reporting next year from mines in Canada, due to the removal of the NPRI exemption for mine tailings and waste rock.

Figure 5. Reported Releases to Land in North America, 2006



Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.

Table 5. Top Facilities Reporting Releases to Land in North America, by Country, 2006

Facility Name	PRTR ID	City	State, Province or Territory	On-site Land Releases (kg)
Canada (top 10 = 70% of total land releases in Canada)				
Tahera Diamond Corporation - Jericho Diamond Mine	21864	N/A	Nunavut	18,658,084
Stablex Canada - Blainville	5491	Blainville	Québec	7,302,314
Clean Harbors Canada - Lambton Facility	2537	Corunna	Ontario	4,874,210
BFI Usine de Triage Lachenaie - Usine de triage	6370	Terrebonne	Québec	2,872,380
Waste Management of Canada - Petrolia Landfill	10801	Petrolia	Ontario	2,655,000
Gerdau AmeriSteel - Whitby	3824	Whitby	Ontario	2,125,149
BFI Canada - Ridge Landfill	7396	Blenheim	Ontario	1,866,160
ArcelorMittal Montréal Inc. - ArcelorMittal Contre	2986	Contrecoeur	Québec	1,865,555
Gerdau Ameristeel - Gerdau Ameristeel Manitoba Met	5246	RM of St. Andrews	Manitoba	1,732,641
ArcelorMittal Montréal Inc. - Aciérie - ArcelorMit	3649	Contrecoeur	Québec	1,721,106
Mexico (top 10 = 97% of total land releases in Mexico)				
Hylsa, S.A. de C.V. - Planta R	HYL8A1904611	San Nicolás de los Garza	Nuevo León	27,260
Manufacturas Pegaso, S.A. de C.V.	MPE520900711	Granjas San Antonio	Distrito Federal	13,200
Yamaver, S.A. de C.V.	YAM8S1407011	El Salto	Jalisco	5,142
Iluminaciones Cooper de Las Californias, S. de R.L.	ICC930200211	Mexicali	Baja California	4,803
Electrónica Brk de México, S.A. de C.V.	EBMAZ0803711	Ciudad Juárez	Chihuahua	4,674
Zacapu Power, S. de R.L. de C.V.	ZPOAD1610711	Zacapu	Michoacán	3,600
Cromo Duro, S.A. de C.V.	CDU8A0900211	Azcapotzalco	Distrito Federal	3,200
Honeywell Aerospace de México, S.A. de C.V.	HAM9S0200211	Mexicali	Baja California	388
Maquiladora San Diego, S.A. de C.V.	MSD7T0200211	Mexicali	Baja California	329
Panasonic Electric Works Mexicana, S.A. de C.V.	PEW910200211	Mexicali	Baja California	270
United States (top 10 = 57% of total land releases in US)				
Red Dog Operations	99752RDDGP90MIL	Kotzebue	Alaska	278,928,549
Kennecott Utah Copper Mine Concentrators and Power	84006KNNCT12300	Copperton	Utah	67,013,373
Phelps Dodge Miami Inc.	85532NSPRTPOBOX	Claypool	Arizona	25,933,016
Newmont Mining Corp. Twin Creeks Mine	89414NWMNT35MIL	Golconda	Nevada	25,765,705
Envirosafe Services of Ohio Inc.	43616NVRSF8760T	Oregon	Ohio	24,180,668
Barrick Goldstrike Mines Inc.	89803BRRCK27MIL	Elko	Nevada	22,037,370
US Ecology Idaho Inc.	83624NVRSF1012M	Grand View	Idaho	14,206,114
Newmont Mining Corp. Carlin South Area	89822NWMNT6MAIL	Carlin	Nevada	12,866,753
Buick Mine/Mill	65440BCKMNHWYKK	Boss	Missouri	12,193,395
Newmont Mining Corp. Lone Tree Mine	89438NWMNTSTONE	Valmy	Nevada	11,249,020

Please note that due to rounding, totals might differ slightly.

To learn more about the types of pollutants (e.g., metals, carcinogens, etc.) released to land by metal mining facilities, go to **http://goo.gl/xoJkJ**, select a Pollutant report, then under Industry, select "NAICS 4" and "Metal Ore Mining." On the Query Results page, click on "Land Releases." If the pollutant is categorized in one or more of the four *Taking Stock* categories, there will be a letter next to it (e.g., "C" for "Known or Suspected Carcinogen"). Place your mouse over the letter to reveal the category name.

Releases to Underground Injection: 375,350,939 kg

Facilities released more than 375 million kg to underground injection, a practice reported only in Canada and the United States.

Underground injection is a waste management method practiced by certain industrial sectors in western Canada and parts of the United States. In 2006, facilities reported a total of 163 pollutants (with about 68% of the total consisting of hydrogen sulfide) (**Figure 6**). This method is not reported under Mexico's PRTR program.

Oil and gas extraction facilities involved in gas processing in the provinces of Alberta and British Columbia contributed 99% of Canada's total releases to underground injection, reporting mainly hydrogen sulfide, along with some methanol and ammonia (see **Table 6**). The oil and gas extraction sector is not required to report to the US TRI. Moreover, hydrogen sulfide, the top-reported pollutant in North America for underground injection, is also not subject to US reporting.

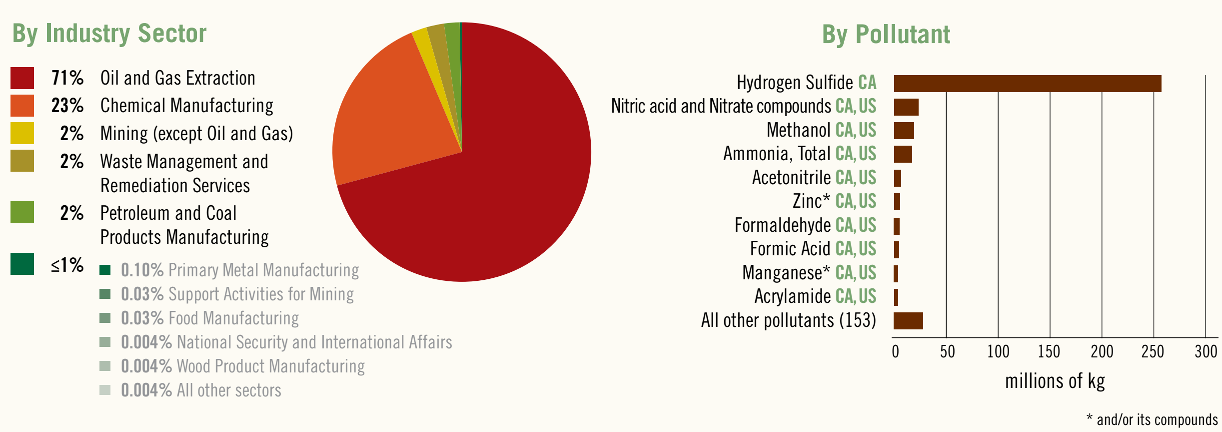
The chemicals manufacturing sector dominated releases to underground injection in the United States, reporting releases of nitrates and ammonia and smaller proportions of methanol, acetonitrile, formaldehyde and other substances.

The Canadian oil and gas extraction sector reported almost three-quarters of the total releases to underground injection reported in 2006, mainly of hydrogen sulfide. Neither the oil and gas extraction sector nor the top reported pollutant, hydrogen sulfide, is subject to reporting in the United States.

If undertaken safely, injection of metals and other waste from industrial activities into deep wells below fresh water aquifers can prevent the contaminants from leaking or migrating upward into the fresh water; otherwise, private and municipal water wells can be contaminated. The practice of underground injection is not accepted in all jurisdictions.

See **Appendix 1** for sources of human health and environmental effects information.

Figure 6. Reported Releases to Underground Injection in Canada and United States§, 2006



§ Underground injection is not reported under Mexico's PRTR program.

Note: "CA" and "US" designate the countries in which the pollutant is subject to PRTR reporting.

Table 6. Top Facilities Reporting On-site Releases to Underground Injection in Canada and the United States*, 2006

Facility Name	PRTR ID	City	State, Province or Territory	On-site Underground Injection (kg)
Canada (top 10 = 91% of underground injection in Canada)				
Keyera Energy Ltd. - Brazeau River Gas Plant	1362	Drayton Valley	Alberta	61,220,560
Husky Energy - Rainbow Lake Processing Plant	1439	Rainbow Lake	Alberta	51,051,049
Canadian Natural Resources Limited - West Stoddart	5286	Charlie Lake	British Columbia	44,272,676
Conoco Phillips Canada - Wembley Gas Plant	536	N/A	Alberta	29,158,209
Apache Canada - Zama Gas Processing Complex	5285	Zama	Alberta	23,376,280
Spectra Energy Midstream Corporation - Gordondale	5247	Spirit River	Alberta	13,364,000
Keyera Energy Ltd. - Bigoray Gas Plant	16152	Drayton Valley	Alberta	11,875,170
Spectra Energy Midstream Corporation - Pouce Coupe	16491	Spirit River	Alberta	7,003,900
Keyera Energy Ltd. - West Pembina Sour Gas Plant	689	Drayton Valley	Alberta	4,634,010
Paramount Resources Ltd. - Bistcho Lake Plant	17420	N/A	Alberta	4,628,925
United States (top 10 = 72% of underground injection in US)				
Solutia Inc.	32533MNSNT3000O	Cantonment	Florida	13,809,706
Solutia Chocolate Bayou	77511SLTNCFM291	Alvin	Texas	10,382,935
Kennecott Greens Creek Mining Co.	99801KNNCT13401	Juneau	Alaska	8,989,221
Ineos USA LLC Green Lake Plant	77979BPCHMTEXAS	Port Lavaca	Texas	7,228,149
Monsanto Luling	70070MNSNTRIVER	Luling	Louisiana	6,578,190
Ineos USA LLC	45805BPCHMFORTA	Lima	Ohio	5,366,137
Dupont Delisle Plant	39571DPNTD7685K	Pass Christian	Mississippi	5,034,005
Vickery Environmental Inc.	43464WSTMN3956S	Vickery	Ohio	4,837,547
Cytec Industries Inc. Fortier Plant	70094MRCNC10800	Westwego	Louisiana	4,803,153
Dupont Beaumont Plant	77704DPNTBSTATE	Beaumont	Texas	4,742,717

* Underground injection is not reported under Mexico's PRTR program.
Please note that due to rounding, totals might differ slightly.

To learn more about Canadian and US facilities releasing pollutants to underground injection, go to **http://goo.gl/7kjrw**, select a Facility report for Canada and the United States. On the Query Results page, click on "Underground Injection."

Off-site Releases to Disposal: 672,330,173 kg

In 2006, facilities reported off-site releases to disposal of over 672 million kg, with support activities for mining accounting for 43% of the total, followed by primary metals manufacturing with 29%.

In all, facilities reported off-site releases of 351 pollutants in 2006, with the top ten substances, mainly hydrogen sulfide and metals, accounting for 607 million kg (or 90% of the total) (**Figure 7**).

Some of these pollutants were also transferred across-borders (see next section, "Off-site Transfers" and **Map 2** showing cross-border transfers data).

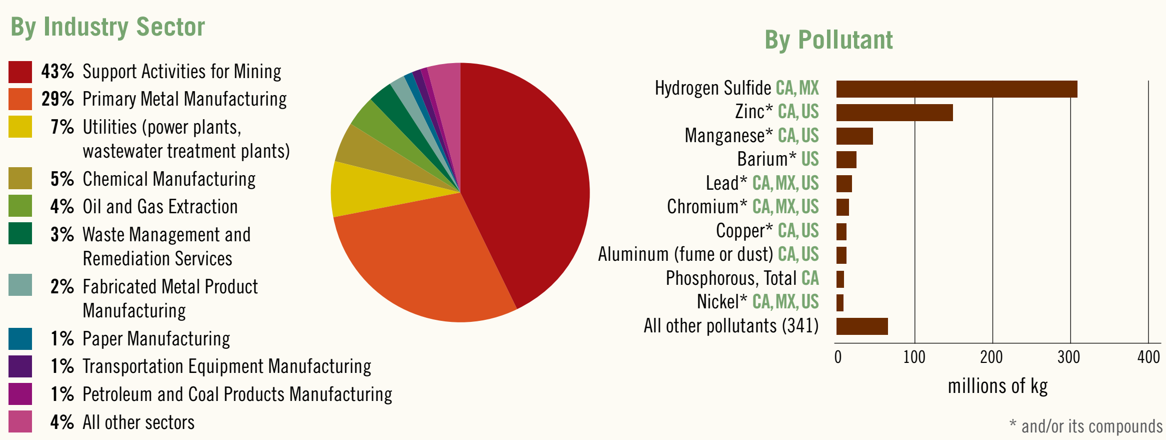
Facilities providing support to the oil and gas extraction sector, and particularly, gas processing plants in the Canadian province of British Columbia, reported almost all of the hydrogen sulfide released off-site to disposal in North America. (See **Table 7**.) These facilities also reported releases to disposal of methanol and other substances such as benzene, toluene and xylenes.

Metals (and their compounds) such as zinc made up most of the remaining pollutants released off-site. They were reported by the US primary metals manufacturing sector, which includes iron and steel mills; and power plants, which reported releases of barium compounds. Mexican electrical equipment manufacturing facilities released almost 1 million kg of lead compounds off-site to disposal, with the fabricated metals sector also releasing lead, nickel and other metal compounds.

> As with other data associated with oil and gas extraction and support activities for that sector, releases of hydrogen sulfide dominated off-site releases to disposal. These data were reported only by Canadian facilities, illustrating major gaps in our picture of industrial pollution in North America due to differences in national reporting requirements, as well as incomplete reporting.

The "Off-site releases" category used in *Taking Stock* describes pollutants transferred off site for disposal, including to land, landfills or underground injection. For purposes of PRTR reporting comparability, metals sent off-site for treatment, sewage or energy recovery are also included in the off-site releases category. See the section on **Terminology** in **Appendix 1** or ***Taking Stock Online***.

Figure 7. Reported Releases Off-site to Disposal in North America, 2006



Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.

Table 7. Top Facilities Reporting Off-site Releases to Disposal in North America, by Country, 2006

Facility Name	PRTR ID	City	State, Province or Territory	Off-site Releases to Disposal (kg)
Canada (top 10 = 88% of off-site releases to disposal in Canada)				
Spectra Energy Transmission - Kwoen Gas Plant	7718	Chetwynd	British Columbia	257,000,997
Spectra Energy Midstream Corporation - Jedney Gas	5125	Fort St. John	British Columbia	31,447,200
Canadian Natural Resources Limited - West Stoddart	5286	Charlie Lake	British Columbia	19,395,428
Evraz Inc. NA Canada - Regina Plant Site	2740	Regina	Saskatchewan	4,367,075
Ethyl Canada Inc. - Corunna Site	2734	Corunna	Ontario	3,606,760
ArcelorMittal-Dofasco Inc. - Dofasco Hamilton	3713	Hamilton	Ontario	2,709,520
Rio-Tinto-Alcan Métal primaire - Usine Shawinigan	3057	Shawinigan	Québec	2,214,911
Ville de Montréal - Station d'épuration des eaux usées	3571	Montréal	Québec	1,526,448
Gerdau Ameristeel - Gerdau Ameristeel Manitoba	1651	R.M of St. Andrews	Manitoba	1,490,950
City of Toronto - Ashbridges Bay Treatment Plant	2240	Toronto	Ontario	1,445,440
Mexico (top 10 = 72% of off-site releases to disposal in Mexico)				
Enersys de México, S.A. de C.V.	EME8Z1904611	Casa Blanca	Nuevo León	660,309
Ideal Standard	IST8A1901211	Ciénega de Flores	Nuevo León	456,697
Empresas Ca-Le de Tlaxcala, S.A. de C.V.	ECL8Z2903111	Tetla	Tlaxcala	234,200
Solvay Fluor México, S.A. de C.V.	SFM5I0803711	Ciudad Juárez	Chihuahua	107,282
Cobre de México, S.A. de C.V.	CME7N0900211	Azcapotzalco	Distrito Federal	96,880
Dupek, S. de R.L. de C.V.	DUP5S1901911	San Pedro Garza García	Nuevo León	80,821
Cloro de Tehuantepec, S.A. de C.V.	CTE5I3003911	Coatzacoalcos	Veracruz	68,210
Industrias Negromex, S.A. de C.V.	INE5R2800311	Altamira	Tamaulipas	65,846
Power Sonic, S.A. de C.V.	PSO8Z0200411	Tijuana	Baja California	62,114
Acabados de Calidad Tecate, S.A. de C.V.	ACT7X0200311	Tecate	Baja California	52,740
United States (top 10 = 26% of off-site releases to disposal in US)				
Nucor Steel	47933NCRST400SO	Crawfordsville	Indiana	15,232,075
Mittal Steel USA Inc. Indiana Harbor East	46312NLNDS3210W	East Chicago	Indiana	11,444,874
Steel Dynamics Inc.	46721STLDY4500C	Butler	Indiana	10,590,880
Horsehead Corp. Monaca Smelter	15061ZNCCR300FR	Monaca	Pennsylvania	8,347,581
Wheeling-Pittsburgh Steel Corp. Mingo Junction	43952WHLNGMCLIS	Mingo Junction	Ohio	7,165,697
Ipsco Steel (Alabama) Inc.	36505PSCST12400	Axis	Alabama	5,444,291
Alumitech of West Virginia	26146LMTCH3816S	Friendly	West Virginia	5,005,193
Nucor Steel Nebraska	68701NCRSTRURAL	Norfolk	Nebraska	4,792,219
Nucor Steel Hertford County	27922NCRST1505R	Cofield	North Carolina	4,505,044
Miittal Steel USA Inc. Indiana Harbor West	46312LTVST3001D	East Chicago	Indiana	4,139,631

Please note that due to rounding, totals might differ slightly.

Off-site Transfers: 2,739,031,317 kg

North American facilities transferred more than 2.7 billion kg of pollutants off-site, with almost 80% of the total transferred to recycling.

In 2006, North American facilities transferred more than 2.7 billion kg of pollutants off-site, with transfers to recycling accounting for the majority (**Table 8**). Of the 192 pollutants transferred to recycling by facilities in a variety of industrial sectors, just five of these pollutants made up about 85% of the total (see **Figure 8**). Some of these pollutants were also transferred across borders (see **Map 2**).

Hydrogen sulfide, the top pollutant transferred to recycling, was reported by Canadian facilities providing support for mining activities and in particular, gas processing plants for the oil and gas extraction sector. Three of these facilities are featured in **Table 9**. The Canadian petroleum and coal products manufacturing sector also reported transfers to recycling, mainly of sulfuric acid.

Metals and their compounds (e.g., copper, lead, zinc, manganese, chromium) were sent to recycling in large proportions, particularly by the primary metals, and electrical equipment manufacturing sectors. In the United States, these two sectors are well represented among the top 10 facilities reporting transfers to recycling (**Table 9**).

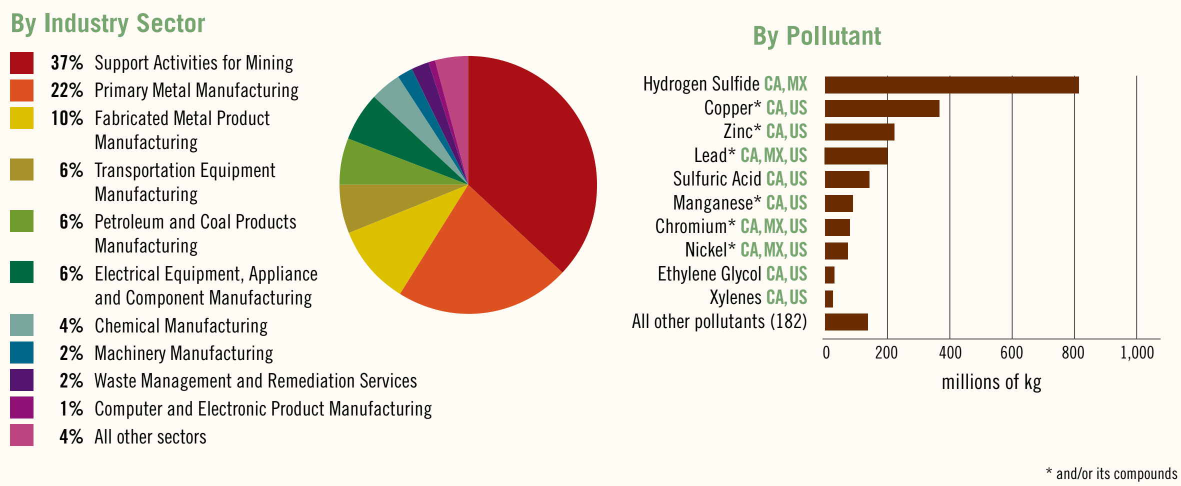
In Mexico, facilities involved in electrical equipment/components manufacturing and computer products manufacturing are featured among the top facilities reporting transfers to recycling. These sectors reported transfers of

Table 8. Reported Off-site Transfers in North America, by Country, 2006

	Canadian NPRI (kg)	Mexican RETC (kg)	US TRI (kg)	Total, North America (kg)
Transfers to Recycling	1,180,674,304	4,301,382	988,318,913	2,173,294,599
Other Transfers (except metals)	49,099,623	891,057	515,746,037	565,736,718
• Energy recovery	12,182,266	817,184	251,691,713	264,691,163
• Treatment	23,836,878	73,366	146,465,274	170,375,518
• Sewage	13,080,479	507	117,589,051	130,670,037
Totals	**1,229,773,928**	**5,192,439**	**1,504,064,950**	**2,739,031,317**

Please note that due to rounding, totals might differ slightly.

Figure 8. Reported Off-site Transfers to Recycling in North America, 2006



Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.

large proportions of metals and their compounds, including lead, chromium and nickel. Half of the top reporting facilities featured in **Table 9** together reported transfers to recycling of more than 1.5 million kg of lead compounds.

Chemical manufacturing facilities reported transfers to recycling of a total of 158 pollutants, with sulfuric acid, dichloromethane, xylenes, ethylene glycol, and toluene among the top reported substances. Many of these pollutants, along with those reported by other industrial sectors in all three countries, are considered to be pollutants of special interest, such as known or suspected carcinogens and developmental or reproductive toxicants.

Table 9. Top Facilities Reporting Off-site Transfers to Recycling in North America, by Country, 2006

Facility Name	PRTR ID	City	State, Province or Territory	Transfers to Recycling (kg)
Canada (top 10 = 85% of total transfers to recycling, Canada)				
Spectra Energy Transmission - Pine River Gas Plant	4306	Chetwynd	British Columbia	585,061,100
Spectra Energy Transmission - McMahon Gas Plant	4305	Taylor	British Columbia	132,530,686
Spectra Energy Transmission - Fort Nelson Gas Plant	4304	Ft. Nelson	British Columbia	94,229,120
Irving Oil Refining G.P. - Refining Div.	4101	Saint John	New Brunswick	56,633,918
K.C. Recycling	7830	Trail	British Columbia	49,400,000
Imperial Oil - Nanticoke Refinery	3701	Nanticoke	Ontario	33,130,841
Petro-Canada - Raffinerie de Montréal	3897	Montreal	Québec	17,488,475
Xstrata Canada Corporation - Xstrata Copper Canada	2815	Timmins/District of Cochrane	Ontario	11,896,530
Karmax Heavy Stamping	3949	Milton	Ontario	11,708,970
Chevron Canada Limited - Burnaby Refinery	2776	Burnaby	British Columbia	9,165,960
Mexico (top 10 = 84% of total transfers to recycling, Mexico)				
Power Sonic, S.A. de C.V.	PS08Z0200411	Tijuana	Baja California	1,442,820
GE Electrical Distribution Equipment	GED910502721	Ramos Arizpe	Coahuila	884,921
Industrias Químicas Falcón de México, S.A. de C.V.	IQF5M1701111	Jiutepec	Morelos	389,790
Signa, S.A. de C.V.	SIG5M1510611	Toluca	Estado de México	271,527
Met Mex Peñoles, S.A. de C.V - Unidad Bermejillo	MMP7L1001311	Mapimí	Durango	243,086
Hylsa, S.A. de C.V., Planta Norte	HYL7I1904612	San Nicolás de los Garza	Nuevo León	157,000
Sanmina - Sci System Services de México	SSM8S1409712	Zapote del Valle	Jalisco	79,519
Delphi Delco Electronics de México, S.A. de C.V. (Operaciones 1-4)	DDE912803211	Reynosa	Tamaulipas	61,626
Delphi Delco Electronics de México, S.A. de C.V. (Operaciones 5-6)	DDE912803221	Reynosa	Tamaulipas	54,415
Fisher Controles de México, S.A. de C.V.	FCMLK1510611	Toluca	Estado de México	48,593
United States (top 10 = 12% of total transfers to recycling, US)				
Exide Technologies	37620XDCRP364EX	Bristol	Tennessee	21,606,616
Kinbursky Brothers Supply Inc.	92801KNSBR1314N	Anaheim	California	16,150,592
Mueller Copper Tube Products Inc.	72396HLSTDHWY1N	Wynne	Arkansas	10,942,104
Nucor Steel - Berkeley	29450NCRST1455H	Huger	South Carolina	10,045,712
Cerro Flow Products Inc.	62202CRRCPHWY3A	Sauget	Illinois	9,862,709
Indalex Inc.	27215NDLXN1507I	Burlington	North Carolina	9,835,379
Nucor Steel - Arkansas	72315NCRST7301E	Blytheville	Arkansas	9,571,845
Toyota Motor Manufacturing Indiana Inc.	47670TYTMT4000T	Princeton	Indiana	8,731,134
Revere Smelting and Refining Corp.	10940RVRSMRD2BA	Middletown	New York	8,644,263
Toxco Inc.	43130TXCNC265QU	Lancaster	Ohio	8,586,600

Please note that due to rounding, totals might differ slightly.

Table 10. Pollutants (Excluding Metals) Transferred to Treatment, Sewage, and Energy Recovery, North America, 2006

Transfers to Treatment (except Metals) (kg)		Transfers to Sewage/POTWs (except Metals) (kg)		Transfers to Energy Recovery (except Metals) (kg)	
Methanol (CA, US)	1,180,674,304	Nitric acid and Nitrate compounds (CA, US)	65,202,766	Methanol (CA, US)	53,387,962
Nitric acid and Nitrate compounds (CA, US)	49,099,623	Methanol (CA, US)	26,135,944	Toluene (CA, US)	48,042,332
Toluene (CA, US)	21,731,312	Ethylene Glycol (CA, US)	10,561,768	Xylenes (CA, US)	43,762,132
Ethylene (CA, US)	17,226,957	Ammonia, Total (CA, US)	8,338,329	Ethylene (CA, US)	9,512,233
Dichloromethane (CA, MX, US)	13,826,082	N,N-Dimethyl formamide (CA, US)	3,968,379	n-Hexane (CA, US)	9,227,358
Xylenes (CA, US)	10,248,578	Certain Glycol Ethers (CA, US)	2,071,167	Certain Glycol Ethers (US)	8,374,878
Formic Acid (CA, US)	8,429,968	Formaldehyde (CA, MX, US)	2,003,981	Styrene (CA, MX, US)	7,769,133
Hydrochloric Acid (CA, US)	7,312,186	Acrylic Acid (CA, US)	1,224,956	Ethylene Glycol (CA, US)	6,240,100
n-Hexane (CA, US)	6,252,081	Sodium Nitrite (CA, US)	1,035,521	Ethylbenzene (CA, US)	6,097,979
Sodium Nitrite (CA, US)	5,337,372	Phenol (CA, MX, US)	1,016,309	Methyl Isobutyl Ketone (CA, US)	5,993,968
Acetonitrile (CA, US)	4,602,468	Acetaldehyde (CA, MX, US)	951,675	n-Butyl alcohol (CA, US)	5,761,784
Ethylene Glycol (CA, US)	3,704,650	N-Methyl-2-pyrrolidone (CA, US)	917,627	Dichloromethane (CA, MX, US)	5,232,216
Ammonia, Total (CA, US)	3,446,921	Phosphorous, Total (CA)	883,079	Tert-Butyl alcohol (CA, US)	4,115,970
Vinyl Acetate (CA, US)	3,207,134	n-Butyl alcohol (CA, US)	838,983	N-Methyl-2-pyrrolidone (CA, US)	3,564,046
Diaminotoluene (Mixed Isomers) (US)	2,891,195	Diethanolamine (CA, US)	744,696	Phenol (CA, MX, US)	3,380,651
All other pollutants (388)	56,864,609	All other pollutants (197)	4,774,858	All other pollutants (247)	44,228,421
Total	170,375,518	Total	130,670,037	Total	264,691,163

Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.
Please note that due to rounding, totals might differ slightly.

North American facilities also transferred over 565 million kg to **treatment, sewage and energy recovery**. **Table 10** shows the pollutants reported as transferred for other treatment in largest proportions in 2006.

The chemicals manufacturing sector accounted for over 70% of all transfers to treatment, followed by waste management and remediation services. A total of 403 pollutants was transferred, with methanol and nitrate compounds ranking first and second, respectively. These pollutants were reported only by Canadian and US facilities, as they are not subject to Mexican RETC reporting. In Mexico, the waste management and remediation sector ranked first, reporting large proportions of PCBs. Chemicals manufacturing facilities reported large transfers of phenol.

The Canadian and US chemicals manufacturing and waste management remediation sectors also accounted for over 88% of all transfers to energy recovery, with three pollutants, methanol, toluene and xylenes, representing over half of the total (**Table 10**). These pollutants are not subject to RETC reporting in Mexico. In that country, the chemicals manufacturing (and specifically, resins and synthetic rubber and fibers), along with the plastic and rubber products manufacturing sectors, accounted for almost all transfers to energy recovery.

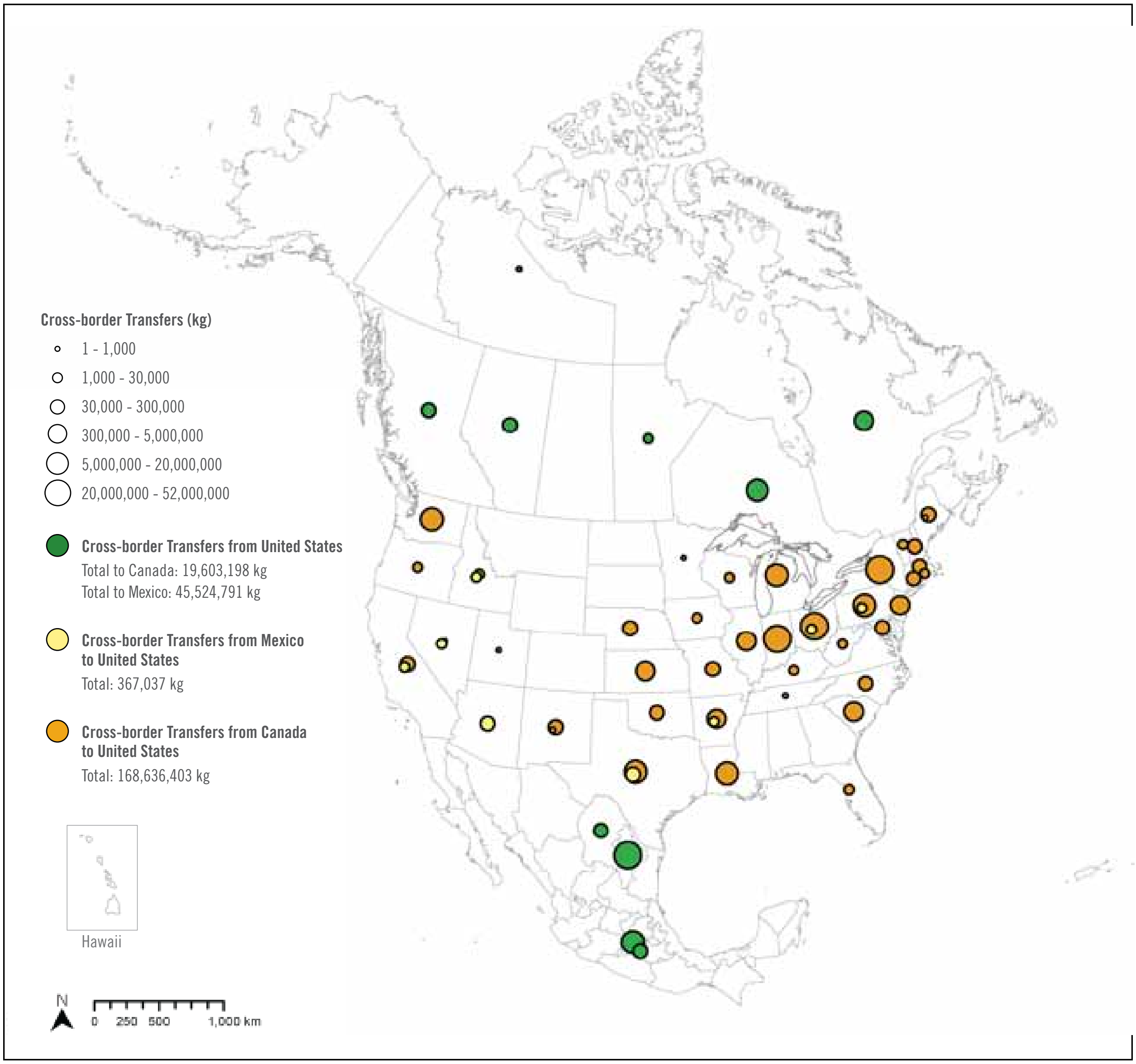
Canadian and US chemicals, food and paper manufacturing facilities reported transfers of a large variety of pollutants to sewage, with nitrate compounds and methanol reported in largest proportions, followed by ethylene glycol. Together, these three pollutants accounted for over 77% of the total. In Mexico, approximately 500 kg comprising mainly formaldehyde and phenol were reported transferred to sewage, mainly by the chemicals manufacturing sector.

Cross-border transfers: Of the 2.7 billion kg transferred off-site by North American facilities, over 234 million kg were transferred across national borders. **Map 2** shows the recipient states and provinces.

More than 170 million kg, or almost 73% of all cross-border transfers, were sent from Canadian facilities to the United States. Much of this amount consisted of sulfuric acid, which was sent for recycling by the Canadian petroleum and coal products manufacturing sector.

US primary metals manufacturers accounted for the majority of the 45.5 million kg of pollutants transferred from that country to Mexico. More than 80% of this amount consisted of zinc compounds destined for recycling, much of it at one facility in the Mexican state of Nuevo León. However, because some pollutants (such as zinc and its compounds) are not subject to RETC reporting, once they are transferred across the border, they can no longer be tracked.

Map 2. Sites Receiving Cross-border Transfers in North America



Zinc and its compounds accounted for 38 million kg, or 83%, of all transfers from the United States to Mexico. Most of it went to one facility in the state of Nuevo León. However, zinc and its compounds are not subject to reporting under Mexico's PRTR program, which means there is no way of knowing if the substance is being properly managed. To learn more about Cross-border Transfers within North America, go to **http://goo.gl/kz1av** for *Taking Stock Online* and click on the Cross-border Transfers tab in the left-hand menu of the main page of the *Taking Stock* database query tool.


“We forget that the water cycle and the life cycle are one.” Jacques-Yves Cousteau

Feature Analysis: North American Pollutant Releases to Surface Waters

Introduction

It is difficult to overstate the importance of water to humans and to all other forms of life on the planet. Water is responsible for stabilizing Earth's atmosphere, moving matter throughout the global ecosystem, and providing a unique substance that supports the processes of life. Humans have long gravitated to rivers, lakes and ocean shores to satisfy our requirements for sustenance, manufacturing, transportation, recreation, waste disposal and other needs. This attraction to water and the pathway it takes—from the sky to earth to sea—continues to this day and reflects our ongoing ties to this precious natural resource.

The growing economic and social interdependency of Canada, Mexico, and the United States brings with it the need to manage water resources at multinational scales. Restoring and maintaining clean water and healthy freshwater and marine habitats poses a challenge for all three countries as national and international demand places more pressure on already stressed aquatic resources. Where waterways serve as international boundaries, cross national borders, or discharge to international waters, conflicts over water quality and quantity take on added importance. Understanding and managing the threats facing North America's surface water resources requires a continental-scale approach that recognizes the unique economic, socio-political, health, environmental and ecological considerations of each country while providing comparable data for analysis and decision-making.

This *Taking Stock* analysis presents the most comprehensive continental-scale data on releases of toxic pollutants directly to North American surface waters by facilities reporting to the pollutant release and transfer registers (PRTRs) of Canada, Mexico and the United States. The purpose of this analysis is to provide information about the sources, amounts and types of pollutants released to water in North America in order to inform decisions relative to pollution prevention and reduction.

> ***"Releases to Surface Waters"*** refer to direct discharges, spills or leaks from a facility into surface waters including streams, rivers, lakes, oceans and other water bodies. Releases to groundwater are not included in this category.

Information about releases to water is an important part of planning and managing the environmental compatibility of facility siting and the regulating of industry, business, and household discharges. Because the amount of freshwater directly available for use by living organisms is limited, understanding the impacts of our activities on this important natural resource is an essential step towards managing it in a sustainable manner. As such, PRTR data are valuable because:

- They reveal releases and transfers of pollutants at the level of individual facility, industry sector and geographic region.
- They provide information for the tracking of individual pollutants, in addition to giving insight into mixed waste streams.
- They can help identify trends and overall progress in reducing pollutant releases and transfers.

This examination of pollutant releases to water by facilities in North America reveals that certain activities, including wastewater treatment, food and chemicals manufacturing, and electricity generation, dominated reported releases to water in 2006. Associations between releases of certain pollutants and common North American sectors have been established—information that can contribute to the development of sector pollutant profiles, and inform decisions relative to pollution prevention and reduction.

In addition, examination of releases of pollutants of special interest—including metals, carcinogens, and others—according to their potential toxicity in water provides information that can highlight areas for priority consideration relative to the long-term human and environmental health needs in the region, and for ensuring the sustainability of this precious resource.

However, while this examination brings together the most complete available PRTR dataset for North America, the picture of releases to water remains incomplete, with only a portion of the total being captured through PRTR reporting. Differences among the three countries' programs create significant gaps, which are well illustrated by data from the public wastewater treatment sector. This sector, which accounted for significant releases to water in Canada in 2006, is not subject to TRI reporting in the United States; and in Mexico, while releases to national water bodies are subject to reporting under RETC, only a handful of wastewater treatment facilities did so.

Thus, assessing and understanding release data for the region remains challenging due to national differences in pollutant coverage, reporting thresholds, compliance rates for reporting, and exemptions allowed for industrial sectors or activities. For managing and planning purposes, comparability and quality of North American PRTR data are essential. Not only are the countries linked politically and economically, but also in the common resources shared along borders and in the surrounding waters. To fully realize the capacity to plan and sustain shared water resources, and to avoid potential future conflicts, Canada, Mexico and the United States need to find common ground relative to their approach and application of PRTR reporting requirements.

Scope and Methodology of this Analysis

This analysis examines data on pollutant releases to surface waters, as reported in 2006 by North American facilities to the three PRTR programs: Canada's National Pollutant Release Inventory (NPRI); Mexico's *Registro de Emisiones y Transferencia*

> ### About the Data Used in this Analysis
>
> The PRTR data used in this analysis were obtained from the Canadian NPRI, Mexican RETC, and the US TRI and are for the 2006 reporting year (the latest data available for all three countries at the time of writing).
>
> Readers can explore the data using the web-based query and data display tools available through *Taking Stock Online* (www.cec.org/takingstock), including summary charts and downloadable Excel files and .kml exports for mapping with Google Earth.
>
> Each PRTR program has unique reporting requirements for sectors, facilities and pollutants. In the context of this analysis of releases to water, some of these differences can be significant and therefore, they are highlighted in the tables and figures presented in this analysis, in order to help readers better understand and interpret the data. Readers are also encouraged to consult the section of this report or the online information entitled **Using and Understanding *Taking Stock.***

de Contaminantes (RETC); and the US Toxics Release Inventory (TRI). The data presented are the latest available for the three countries at the time of writing. They have been compiled into an integrated, North American PRTR dataset and analyzed in order to determine the amounts, types, and sources of pollutants released into North American surface waters.

The data also include reporting from private and municipal wastewater treatment plants. These facilities are not necessarily the initial generators of pollutants, but receive and treat releases from a wide range of industrial, residential, commercial and non-point (e.g., agricultural and stormwater run-off) sources. The complex nature and large volumes of the wastewater requiring treatment at these facilities present significant challenges for managing pollutant releases to surface waters.

Transfers of pollutants by facilities to sewage and/or wastewater treatment are also presented very briefly in this analysis. Because these data do not provide information about the type (or even existence) of wastewater treatment facilities at the receiving end, there is no way to know the ultimate fate of the pollutants. These transfers can result in direct discharges to surface waters, although pollutants transferred to wastewater treatment may pass through several additional steps before being released.

Each PRTR program has unique reporting requirements for sectors, facilities and pollutants. In the context of this analysis of releases to water, some of these differences can be significant and therefore, they are highlighted in the tables and figures presented in this analysis, in order to help readers better understand and interpret the data. Readers are also encouraged to consult **Using and Understanding *Taking Stock*** (**Appendix 1** or online).

The facilities included in this analysis were identified by their North American Industrial Classification System (NAICS) codes. Facilities with similar industrial activities can report under different, and in some cases, multiple NAICS codes. Of relevance for this analysis of releases to water are the NAICS codes under which wastewater treatment plants reported. Most were Canadian public or municipal facilities (often referred to in this report as Publicly Owned Treatment Works, or POTWs). The majority of wastewater treatment facilities reported under NAICS code 2213 (Water, Sewage and Other Systems); however, a small number also reported under Waste Management and Remediation (NAICS codes 5621, 5622, and 5629), and in Mexico, they reported under NAICS code 2221 (Water Collection, Treatment and Supply).

For the case studies of the Columbia and Rio Grande/Río Bravo river basins, locational data for facilities on either side of the borders in question were mapped against the CEC's Atlas Watershed Map layers. This exercise provided additional insights into the sources and types of cross-border pollutant releases potentially impacting these two important watersheds.

In order to provide an indication of the potential toxicity of the substances released to water, *Taking Stock* uses Toxicity Equivalency Potentials (TEPs) to calculate cancer and non-cancer risk scores. TEPs indicate the relative human health risk associated with the release of one unit of a pollutant, compared to the risk posed by the release of one unit of a reference substance. The release amount is multiplied by the pollutant's assigned toxicity weight to give an indication of the potential toxicity of the substance in water.

Additional information on national legal and regulatory aspects, the impacts of substances, and localized issues was obtained from:

- the US Environmental Protection Agency (EPA), Agency for Toxic Substances and Disease Registry;
- Environment Canada and Health Canada;
- Mexico's Secretary of the Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales*—Semarnat), the National Water Commission (*Comisión Nacional de Agua*—Conagua), and the Mexican Institute of Water Technology (*Instituto Mexicano de Tecnología del Agua*—IMTA);
- and the World Health Organization, Food and Agriculture Organization, World Bank, United Nations Environment Program, and the United Nations Institute for Training and Research (UNITAR).

Structure of this Analysis

Pollutants and the Aquatic Environment presents the current issues and challenges facing North American management of water resources.

Wastewater Treatment: Challenges and Processes provides an overview of wastewater treatment issues and processes.

Regulating Water Quality in North America briefly describes the development of Canadian, Mexican and US policies and regulations relative to water pollution.

Releases to Water Reported by North American Facilities presents data reported by facilities, along with information about the potential impacts of releases of pollutants of special interest. Reported data on transfers to sewage and/or wastewater treatment are also presented.

Cross-border Case Studies: the Columbia and Rio Grande/Río Bravo River Basins presents reported releases of pollutants into these two watersheds, both of which cross international borders.

Pollutants and the Aquatic Environment

Despite water's central role in creating and maintaining a suitable environment for life on Earth to evolve and persevere, the total amount of freshwater accessible directly for use by most living organisms is limited. And like any natural resource of value to people, conflicts over its use and management are common and likely to increase as demand increases.

Life on Earth evolved in water and the majority of current life forms continue to rely on water for a wide range of essential functions. These functions have evolved in response to one or more of the unique chemical and physical properties of water. Water is one of the few inorganic liquids occurring in nature and the only substance that occurs as a solid, liquid, and gas. Water's unequalled capacity to store heat makes it an excellent buffer against rapid temperature changes which, in turn, provided conditions suitable for life to evolve. The high transparency of water allows sunlight—the energy source for living systems—to penetrate the water column and reach the organisms that begin the process of converting that energy into usable forms for other organisms in the aquatic food web.

Water has the capacity to buffer the environment from impacts of toxic releases, but this service is limited in function and varies with relationships to other physical or chemical aspects of the water. In combination with climatic conditions and seasonal variations, wastewater from industries, households, agricultural and other non-point sources has characteristics that influence its toxicity and the resulting impact on the receiving environment. Facility managers and operators must consider ambient water chemistry, other sources in the same airshed or watershed, and the character of individual point and non-point sources in order to allow for sufficient safety margins to protect receiving waters and associated ecosystem services.

Water pollution results from the introduction of substances, organisms, or chemicals into a body of water, which deleteriously affect the water and aquatic habitats, leading to undesirable impacts on water users, including other organisms as well as humans. Water pollutants can include sediments; oils and greases; litter; excessive algal, fungal and bacterial growth; nutrients; altered temperature; altered chemistry; and toxic chemicals, including substances like radionuclides. Toxic pollutants include those substances that have an immediate or long-term harmful effect on the environment or the organisms (including humans) that depend on it. When toxic substances come into contact with living tissues, they can trigger biochemical responses ranging from cancer, reproductive impairment and organ damage, to issues such as altered behavior in both humans and wildlife.

Physical or structural damage to aquatic habitats can occur directly when soils, dusts, and other solid materials enter lakes, rivers, and wetlands. And while physical pollutants such as sediments can be directly lethal to aquatic organisms (for example when fish eggs cannot exchange

Worldwide Distribution of Water

The world's water supply is approximately 1.39 billion cubic kilometers, or 330 million cubic miles. However, more than 96 percent is saline or salt water and not directly usable for human consumption or agriculture. Of the remaining available freshwater, most is contained in ice caps, glaciers, permanent snow fields, and groundwater formations (or aquifers). Water in rivers, freshwater lakes, and wetlands—the most accessible sources of freshwater for humans and most other life forms—comprises only 0.296 percent of all freshwater on the planet.

North America is relatively rich in the quantity, quality, and diversity of freshwater resources, but uneven distribution of those resources across the continent alters its relative presence. Local precipitation rates vary widely across the continent—ranging from an average of 650 cm (256 in) at Henderson Lake, British Columbia, to 3.0 cm (1.2 in) at Batagues, La Paz, Baja California Sur, Mexico. In general, freshwater resources (and often quality) decline as one moves westward from relative abundance on the eastern half of the continent. A similar pattern occurs as one moves south from Canada and through the United States into Mexico, until precipitation once again begins to increase south of Mexico City. This uneven distribution of precipitation across the continent results in uneven distribution of lakes, rivers, and wetlands, which in turn influences the abundance and productivity of shallow aquifers.

A substance is toxic if it enters the environment in a quantity or concentration or under conditions that potentially have an immediate or long-term harmful effect on the environment; or that potentially constitute a danger to the environment on which life depends; or to human life or health.

Toxic substances discharged to surface waters can enter the body in several ways, including ingestion via foodstuffs and water; inhalation of air and particulates in lungs and sinuses; and dermal contact.

- Acute Toxicity: When a single dose produces immediate symptoms of toxicity.
- Chronic Toxicity: A result of exposure to repeated, non-lethal doses, causing damage over a long period of time.

Compounds accumulate in living things when they are taken up and stored faster than they are broken down (metabolized) or excreted.

- Bioaccumulation: The net accumulation of the chemical in the tissue or the whole organism that results from all environmental exposure media including air, water, solid phases (i.e., soil, sediment), and diet, and that represents a net mass balance between uptake and elimination of the chemical.
- Bioconcentration: Total net accumulation of a chemical in an organism resulting from direct uptake from water, such as through gill membranes
- Biomagnification: Total accumulated from food chain buildup from concentration in water to concentration in top predators.

oxygen with the surrounding water), they are not considered toxic pollutants.[4]

Ionic strength of a solution (reflecting the concentrations of major ionic components) can affect the behavior of pollutants in surface water, including important characteristics such as aqueous solubility and persistence.

Water hardness (dissolved minerals) varies with the substance involved. Water hardness affects the transport and toxicity of many inorganic chemicals, including copper and zinc, but has little effect on organic chemicals.

Thermal pollution of waterways can occur where wastes are discharged from wastewater treatment plants, industrial and commercial processes and electricity generating facilities. These facilities can release heated water to rivers, lakes and estuaries at rates that create stress on aquatic organisms, reduce dissolved oxygen levels, and provide a habitat for pests and pathogens. In most cases, heat has negative impacts on the local system until sufficiently dissipated into the surrounding waters and/or the air above. For most chemicals, acute toxicity to aquatic organisms increases as temperature increases.

Bioavailability of synthetic organic chemicals (i.e., the extent to which they can be taken up by an organism) can be altered by the presence of particles. Synthetic organic chemicals tend to form complexes with particulate matter too large to pass through membranes, such as gills, skin or digestive tracts. Since amounts of particulate matter vary greatly from one water body to the next, the bioavailability and toxicity of a pollutant can differ widely based on water characteristics.

The use of salt for melting ice and snow on roads increases mobility of metals in chlorine-laden runoff from urban areas in northern latitudes, resulting in high levels of toxicity in winter runoff. Infrequent rainfall events of higher intensity are more effective at flushing contaminants from streets, so longer intervals between storms in arid regions leaves more time for contaminants to accumulate and impact ecosystems when washed into them.

Both the volume and flow of receiving waters influence their capacity to dilute or assimilate pollutants and attenuate their potential adverse effects. Dilution capacity of a receiving water body varies with seasonal hydrological events and depends on the volume of the discharge and the flow of the receiving water at the point of discharge. Precipitation, surface runoff, groundwater discharge, and the drainage area, slope, soils, and vegetation patterns of the drainage basin determine receiving water flow. In some situations, tidal patterns can influence the capacity of estuarine and marine receiving waters to assimilate or dilute pollutants.

Another factor to consider relative to discharges into lakes and reservoirs is "residence time" (how long water remains in the system). Unlike rivers and streams which have relatively short residence times, water remains in lakes and reservoirs for longer periods. For some large lakes, residence times for water can be very long (100+ years) with corresponding implications for pollutant loadings and movement through the system.

4 See, among others: Newcombe, C.P. and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems, *North American Journal of Fisheries Management* 11(1): 72-82. Henley, W., M.A. Patterson, R.J. Neves, and A.D. Lemly. 2000. Effects of sedimentation and turbidity on lotic food webs: A concise review for natural resource managers. *Reviews in Fisheries Science* 8(2): 125-139. Available at: http://www.informaworld.com/10.1080/10641260091129198. Latif, M. and E. Licek. 2004. Toxicity assessment of wastewaters, river waters, and sediments in Austria using cost-effective microbiotests. *Environmental Toxicology* 19(4): 302-309.

Fate and Transport of Pollutants in the Aquatic Environment

When pollutants get released into the environment, their movement, how long they last in their original form, and their ultimate fate in the global ecosystem are influenced by a variety of biological, chemical, and physical processes. These processes can affect the toxicity of a substance as well as the risk that substance poses once released to the environment.

I. Chemical characteristics

While chemicals move within the aquatic ecosystem, a variety of processes also affects their environmental behavior and their potential risk or benefit to living organisms. The degree to which a chemical is affected by such processes is influenced by characteristics of the chemical itself, including its ability to dissolve in water (solubility), susceptibility to oxidation and reduction reactions, reactivity with water (hydrolysis), and reactivity to sunlight (photolysis). Chemical reactions can alter the molecular structure which, in turn, affects a chemical's inherent toxicity, persistence in the environment, tendency to accumulate in living organisms, and susceptibility to degradation.

II. Physical processes

Physical processes affect the fate of pollutants in the aquatic ecosystem; they include sorption (attachment to solid particles), volatilization (movement from water to air), diffusion (movement of molecules within water, or mixing), and advection (horizontal flow). Together, these processes determine the rate and patterns of pollutant mixing within water and the flux or movement of pollutants between water and the atmosphere and/or sediments. Physical processes in surface waters are taken into account when determining water quality limits for discharge of wastes.

III. Biological processes

Biological chemical processes mediated by living organisms fall into two general categories: processes involving enzyme-catalyzed transformation of chemicals, and processes resulting in accumulation of chemicals within organisms (bioaccumulation) and/or the build-up of chemicals in the food web (biomagnification). In water and soils, microbial biotransformation can play a significant role in influencing the transport and fate of chemicals.

Nutrient enhancement in surface waters from carbon, phosphorous and nitrogen in wastewater can occur and in some cases, can be a primary cause of excessive eutrophication (the natural aging of aquatic systems). In freshwater systems, phosphorus is most often the limiting nutrient (or the factor controlling plant growth), while nitrogen is limiting in marine systems. As a result, when these nutrients are discharged to waterways, they stimulate higher levels of primary production (plant growth) which often takes the form of excessive algal blooms and nuisance plant growth. Moreover, when plants die, bacterial processes begin to break down organic matter using oxygen in the process and in some cases, depleting oxygen concentrations in water to levels that kill fish and other aquatic organisms. In marine systems, biological oxygen demand (BOD) creates areas of depleted oxygen called "dead zones" which have been documented in coastal areas worldwide. Oxygen depletion also occurs in freshwater ecosystems, particularly in systems with limited mixing, such as lakes.

Dissolution of nutrients into waters affects levels of productivity and biomass. Increases in biomass due to increased dissolved nutrients do not always equate to beneficial or even ecologically-balanced production. Movement of productivity from primary producers (plants) to primary consumers (herbivores) and then upper level consumers (predators) through the ecosystem affects all levels of the food web. If the balance between these is upset, the system becomes degraded and efficiency is lost. The system can become unsuitable to aquatic life as oxygen depletion, reductions in water clarity, and increases in potentially toxic algae (including blue-green algae and red tides) and bacteria (including e coli) all increase due to nutrient enrichment.[5] When introduced nutrient levels significantly exceed those limiting

5 Naganuma, T. and H. Seki. 1993. Abundance and productivity of bacterioplankton in a eutrophication gradient of Shimoda Bay, *J. Oceanography* 49: 657-665. Also Krstulovi, N. and M. Solic. 1990. Long-term study of heterotrophic bacteria as indicators of eutrophication of the open middle Adriatic Sea. Estuarine, Coastal and Shelf. *Science* 30(6): 611-617.

plant growth, hyper-eutrophication occurs (i.e., when eutrophication, or aging, accelerates beyond naturally-occurring levels). This increased plant growth can strongly affect BOD.

Estuarine and coastal waters are perhaps the best indicators of the scope and magnitude of nutrient pollution impacts. Eutrophication affects most estuaries located in US coastal areas, where nearly 65 percent of assessed systems show moderate to high-level problems, with conditions expected to worsen in nearly two-thirds of those systems.[6] Hundreds of "dead zones" now occur each year worldwide as a result of nutrient pollution, with the majority of these (including one of the largest in the Gulf of Mexico at the mouth of the Mississippi River) forming in European and US coastal waters. According to the Woods Hole Oceanographic Institute,[7] harmful algal blooms capable of producing toxins that can kill fish, shellfish, and mammals have been reported in almost every coastal state in the United States.

Non-Point or Diffuse Sources of Water Pollution

Direct releases to surface waters are not the only source of water pollution. Pollutants can shift readily from one location or medium to another. Groundwater can move pollutants effectively. Withdrawals, hydraulic gradients (where water is drawn or pushed due to the presence or absence of waters in pore spaces) and other physical forces on the movement of groundwater can compound issues related to water contamination. Examples include withdrawals for irrigation and drinking water supply.

Runoff from non-point or diffuse sources, such as agricultural fields for animal or crop production, urban and suburban homes, lawns and streets, and businesses, can contribute large quantities of pollutants to the water system. Storm and drainage waters coming from diffuse sources can contain significant quantities of pollutants potentially affecting the health of local residents and the ecosystem. Settling basins and ponds can hold stormwater and release it slowly to a drainage system, allowing for the removal of suspended materials and potential temperature adjustment, and slowing the flow that enters streams and lakes.

These systems can get overwhelmed as well, and release waters to the system prior to "treatment." Adding to the complexity of managing wastewater to protect resources, accidents can happen, even when everything operates as it should. For example, between June 18 and June 19, 2006, an 8-inch (20 cm) rainfall flooded parts of a refinery in Lake Charles, Louisiana, resulting in the release of a total of 365,000 pounds (164,400 kg) of pollutants, including sulfur dioxide, benzene, ethyl benzene, xylenes and toluene.[8]

Direct and indirect atmospheric deposition can also add pollutants or affect water chemistry through the physicochemical characteristics of the precipitation. Atmospheric pollution can contain aerosols of mixtures with persistent, bioaccumulative and toxic (PBT) pollutants like mercury and volatile organic compounds like benzene. Atmospheric influences can also affect pH (the measure of acidity or basicity of a solution) and nitrogen levels. The pH of precipitation is greatly affected by air pollutants—the best example of this would be acid rain.

Some chemicals (such as PBTs) can move long distances by volatilizing and depositing numerous times during their lifecycle (the "grasshopper effect") and affecting local ecosystems—most notably water resources. The discovery by the Arctic Monitoring and Assessment Program (AMAP) about the prevalence and magnitude of known PBTs in areas far from any known sources has been verified by other programs and research.[9] These pollutants have been documented in the Great Lakes.[10] The greatest impacts occur in the aquatic ecosystems where they deposit and become part of the food chain (see Great Lakes text box).

Wastewater Treatment: Challenges and Processes

As populated areas and industrial development have grown, not only have communities seen their need for wastewater management increase, but also the treatment levels necessary to protect the public health and the health of their local natural resources and the services they provide. The increasing complexity of the issue involves more than capacity: governments must consider the many challenges of emerging pollutants and chemicals of concern in waters discharged for treatment and their eventual effect on receiving waters and the involved ecosystems.

Wastewater treatment is intended to enhance the breakdown of biological and chemical pollutants prior to release. The degree to which individual pollutants break down, get controlled during wastewater treatment and are potentially released to the environment in other ways depends upon the characteristics of the pollutant itself, the efficacy of any treatment, and the effectiveness of final disposal alternatives for sequestering the pollutants. Ultimately, pollutants and/or

6 Bricker, S.B., et al. 2008. Effects of nutrient enrichment in the nation's estuaries: A decade of change. *Harmful Algae* 8(1): 21-32.

7 Anderson, D.M. 2004. The growing problem of harmful algae, *Oceanus Magazine* 43(1). Woods Hole Oceanographic Institute.

8 Louisiana Department of Environmental Quality Incident Report 88679. See: Louisiana Bucket Brigade report on Citgo Petroleum spill: http://farm.ewg.org/sites/labb/incident.php?serno=546.

9 Hung, H., et al. 2010. AMAP Assessment 2009: Atmospheric monitoring of organic pollutants in the Arctic. Arctic Monitoring and Assessment Programme. *Science of the Total Environment* 408: 2851-3051. Elsevier.

10 Cohen, M. 1999. Tracking sources of atmospheric pollution to the Great Lakes. Presented to International Air Quality Advisory Board (IAQB), International Joint Commission, Biennial Forum, Milwaukee WI. Available: http://www.ijc.org/rel/milwaukee/transcript/cohen/milwmark.html.

their breakdown products that do not degrade quickly can end up transferring between media (air, land and water).

Historically, wastewater disposal was often nothing more than direct discharge to a waterway. As long as population densities remained low, this method was probably sufficient to allow for natural processes to treat wastes. However, expanding populations, industrial activities, and availability of consumer goods resulted in a much greater volume and diversity of wastes discharged to the environment. Many continued to believe dilution and natural processes would be sufficient for waste treatment, and the results have been similar to the events leading up to the US Clean Water Act, where rivers caught fire, fish kills were regular events, disease and pest problems increased, and waters were characterized by excessive chemical and nutrient pollution. In response, most urban and near-urban pollution releases are now piped to a central treatment plant, whose basic function is to enhance natural processes that purify water prior to discharging it back to local surface waters.

Ideally, industries, homes and businesses would reduce or manage wastes at the source. When they send contaminants not normally found in aquatic systems or local waters to treatment facilities, the complexity associated with treating these wastes increases. Treatment is also complicated by the introduction of synthetic chemicals and pharmaceutical and personal care products to the waste stream, particularly when those materials resist conventional treatment. Wastewaters from homes or businesses can contain mixtures of detergents, surfactants, disinfectants, pharmaceuticals, food additives, pesticides, herbicides, industrial chemicals, heavy metals, and other synthetic materials or suspended solids. Chemicals in industrial wastewater are usually found at much higher concentrations, but likely have less complexity and variability than the effluent discharged from smaller sources to public treatment systems. Unfortunately, conventional treatment facilities have been designed to treat conventional pollutants such as organic materials and solids; their ability to remove toxic contaminants and other modern chemicals is limited for many substances and nonexistent for others.

Wastewater treatment now requires a more sophisticated approach and advanced technology to address nutrients, innovations in chemistry, changes in land-use, shifts in consumption, and the complexity of multiple problems needing solutions. All of these factors result in an increased demand for the development of new, cost-effective means for treating wastewaters.

Wastewater Treatment Processes

Depending on the source of the wastewater, existing regulations, and the existence of adequate treatment technologies, wastewater can be discharged directly to surface waters, undergo industrial pre-treatment prior to discharge, or be piped directly to a public wastewater treatment plant. In the latter case, fees for the treatment of industrial wastewater can be imposed in order to meet water quality guidelines. In general, municipal wastewater treatment plants are designed to handle conventional pollutants, while industrial treatment is designed to handle pollutants specific to the process in question. Both industrial and municipal treatment can include multiple stages of treatment using similar approaches, including pre-treatment and tertiary treatment for non-conventional pollutants.

Industrial Wastewater Treatment

Industrial wastewater can be very different from sewage processed at public or municipal wastewater treatment plants, and often contains higher concentrations of toxic substances. Sources of industrial wastewater can include a wide variety of manufacturing operations from food to chemicals production; petroleum refining; commercial establishments; mining sites; and many other activities. Depending on the nature of the sector and process, industrial wastewater can contain high levels of suspended solids, nutrients, organic and inorganic compounds, surfactants and pesticides, and/or heavy metals.[11]

Thus, an essential element in any industrial wastewater treatment process is proper characterization of the effluent, through a series of manual, physical and chemical tests. Many jurisdictions have strict effluent limitations for industry and, as part of the permitting process, require the implementation of wastewater monitoring and pre-treatment programs aimed at reducing pollutant loadings to surface waters.

Pre-treatment occurs upstream in the wastewater system and focuses on identifying and pre-treating pollutants of concern. This is done through changes in handling, use and disposal methods that reduce the magnitude or even likelihood of the pollutant being present. In addition to substituting less toxic chemicals, pre-treatment shifts pollutants to another management method such as recovery for reuse, recycling, or other method. It should be noted that these alternative methods may not eliminate water impacts. Some processes also feature closed-loop recycling, meaning that wastewater is re-used in the industrial process rather than being discharged.

A number of industrial effluent treatment options exist, including:

- Mechanical or physical processes such as: filtering, oil-water separation, sedimentation, and flotation;
- Chemical processes including precipitation and physico-chemical treatment;
- Biological processes including aerobic (using air) and anaerobic treatment

11 *Industrial Wastewater Management, Treatment, and Disposal.* 3rd Edition, Manual of Practice No. FD-3. Water Environment Federation (WEF) Press, 2008.

- Sludge management: stabilization, de-watering, re-use, incineration, or disposal.

Wastewater treatment within industrial facilities can use a combination of these methods, as well as processes similar to those used for domestic wastewater treatment. A study from the United Arab Emirates of wastewater treatment options involving eight very diverse industrial sectors—including manufacturing of food, pharmaceuticals, paints, and fertilizers, along with iron and steel processing—indicates that relatively simple and cost-effective methods such as soil filtration can result in the significant removal of heavy metals from wastewater. The achieved removal efficiency was sufficient to bring concentrations well below maximum allowable limits.[12]

Municipal Wastewater Treatment

Whether pre-treated or not, industrial wastewater may be sent to public or municipal wastewater treatment plants (where these exist), which often impose fees on facilities to monitor and/or treat their effluent in order to meet water quality guidelines. As with industrial treatment processes, public facilities often utilize a suite of applications in varying configurations to remove pollutants from wastewater before it is discharged back to the environment. These wastewater treatment processes can be divided into primary, secondary, and tertiary segments, each with increasing levels of treatment.[13]

Sewage (and in some cases, stormwater) conveyance systems transport wastewater to centralized locations where it undergoes a series of treatment steps beginning with primary treatment. Application of primary treatment to municipal wastewater protects the quality of receiving waters, particularly in areas with raw wastewater discharges, but does not address dissolved materials including nutrients. Primary treatment removes large and medium-size solids, including litter, coarse organic matter, and other materials from the waste stream using screening devices. Sediment chambers are then used to allow sand, grit, and other suspended materials to settle. This can be an important step, as stormwater and wastewater can contain metals and other pollutants attached to or contained in solids suspended in the waters. Finer particles and suspended materials are then aggregated and removed as primary sludge, which must be disposed of in a separate process.

Secondary treatment consists of steps designed to hasten removal and/or biological conversion of dissolved nutrients to forms that can be removed from waste waters. Secondary treatment systems speed up biological processing of nutrients by providing oxygen-rich environments that support beneficial bacteria and reduce pests and odors. Most municipal wastewater treatment systems in North America now use some type of secondary treatment process prior to discharging wastewater, although the efficacy of these systems may vary. Tertiary treatment allows for additional removal of problem contaminants, whether biological or chemical in nature. Many large public and private systems implement approaches that include tertiary treatment (including wastewater disinfection).

Residual solids from primary and secondary wastewater treatment processes must ultimately be managed to reduce environmental risk and increase their benefit. Current strategies include incineration, disposal or reuse. A major consideration during management is the amount of toxic materials, including PBTs and pathogens that may be present. Currently, more than half of the biosolids in the United States are applied to land as a soil conditioner. Canada has been utilizing almost half of its available biosolids for land application. Mexico has now begun a similar program in areas near the US border.

Often, even after secondary treatment, wastewater releases contain high concentrations of soluble carbon, nitrogen and phosphorous, the major nutrients essential to plant growth. Waters enriched with nitrogen and phosphorous will tend to have accelerated eutrophication, the natural aging of aquatic systems. The release of these nutrients enhances bacteria, algae and aquatic plant growth in receiving waters. Conventional secondary treatment cannot remove all nitrogen and phosphorous. In fact, these nutrients can be converted into more biologically useable forms during treatment.

Further wastewater treatment plant operations (tertiary treatment) can enhance nutrient removal. Biological Nutrient Removal (BNR) utilizes nitrifying bacteria to convert ammonia to non-toxic nitrate that may also incorporate some portion of the phosphorous present. Chemically-induced coagulation and sedimentation can also be implemented to remove phosphorous. When removing nutrients from potential release into waters, there remains a cost for disposal. This process has been widely used for treating industrial wastewater, but has not been universally adopted for use in municipal systems due to concerns about that cost.

Tertiary treatment intended to remove greater amounts of nutrients and other pollutants from the waste stream can include use of natural systems. Use of wetlands, lagoons or designated land treatment can bring water to a finished state where it can be returned to receiving waters, minimizing adverse impacts but not necessarily eliminating them. Very simply, these tertiary systems retain water and help remove nutrients and other pollutants by sequestering them into the resident plant life or allowing further environmental processing through the soils present. These forms of tertiary treatment differ from other forms that rely upon either chemical or physical mechanisms, including disinfection.

12 Industrial wastewater treatment using local natural soil in Abu Dhabi, U.A.E., http://www.scipub.org/fulltext/ajes/ajes13190-193.pdf.

13 See US EPA. 2004. Primer for Municipal Wastewater Treatment Systems, EPA 832-R-04-001, September, http://www.epa.gov/OWM/primer.pdf. Environment Canada. Wastewater management, http://www.ec.gc.ca/eu-ww/default.asp?lang=En&n=0FB32EFD-1.

Land treatment includes overland flow and rapid and slow-rate infiltration. These processes allow for polishing or a finishing treatment of the waters using one or more layer(s) of soil as a filtration medium. Overland flow allows for the water to run across a field before entering a waterway. Engineered soil beds can be created to further enhance the infiltration rates and natural processes. This increases the surface area for beneficial natural processes to enhance removal of pollutants. Lands used for such treatment should not be employed for growing food for human consumption, and might also impose issues that would make it unwise to allow animals to consume forage grown there.

If not properly monitored and maintained, any wastewater treatment system can become compromised by the creation of a toxic growing environment or system failure. Partial or total loss of treatment can occur once the system becomes upset. In more advanced systems, a vigorous pretreatment effort must be in place in order to reduce this potential.

Pathogens, including disease-causing bacteria, viruses, and protozoa, inhabit all wastewater. Modern disinfection techniques used post-treatment and prior to discharge at wastewater treatment plants and for treating drinking water supplies prior to distribution have greatly reduced the public threat from pathogens. To increase the disinfection provided by sunlight, chlorine (or other chemicals), ozone, or ultra-violet (UV) radiation may be used. In treatment plants in North America, chlorine is the most widely-used disinfectant. However, the use of halogens (such as chlorine and bromine or their derivatives[14]) to treat water can result in the formation of disinfection byproducts designated as halogenated organics. These create additional secondary toxicity concerns in managing wastewater discharges.

Further efforts to address potentially harmful and significant trace amounts of synthetic organic chemicals and metals that resist treatment can be undertaken post-treatment, through filtering or treatment with activated carbon or similar materials.

If released to the environment, many of these pollutants can cause direct human health issues, become the basis for fish and wildlife consumption advisories, and induce foaming in water. They can even upset the local ecosystem by slowly eliminating species through chronic exposure or create an acute exposure that results in the rapid elimination of one or more aspects of the local food web, including potential keystone species (species that play a unique role in the health of the food chain or ecosystem and are critical to the overall health of the system).

14 Coulliette, A.D., et al. Evaluation of a new disinfection approach: Efficacy of chlorine and bromine halogenated contact disinfection for reduction of viruses and microcystin toxin, in: *Am. J. Trop. Med. Hyg.*, 82(2), 2010, pp. 279-288, http://www.ajtmh.org/cgi/content/abstract/82/2/279.

Regulating Water Quality In North America

Canada

In Canada, the various levels of government have different jurisdictional roles related to water management, with provinces and one territory having primary jurisdiction over most areas of water management and protection. Under federal jurisdiction are the conservation and protection of oceans and their resources; fisheries; and responsibilities related to the management of boundary waters shared with the United States. International agreements and treaties for shared waters go back to the 1909 Boundary Waters Treaty between Canada and the United States, and have led to improvements in the protection of water resources, such as the Great Lakes Water Quality Agreement.

The Federal Water Policy addresses Canadian water resource management. Its main objective is to encourage the use of freshwater in an efficient and equitable manner, while taking into account social, economic and environmental considerations of present and future generations. The two main goals of the Federal Water Policy are:

- to protect and enhance the quality of the water resource and
- to promote the wise and efficient management and use of water.[15]

The *Canadian Water Act* (1970), the *Canadian Environmental Protection Act* (CEPA 1999—entered into force in March 2000), the *Fisheries Act* (revised in 1985), and the *Canadian Environmental Assessment Act* (1992) are the foundation of Canadian federal water legislation and regulation.

The regulatory framework with the greatest potential for protecting the aquatic environment is the Fisheries Act. The Act prohibits persons from depositing, or permitting the deposit of, deleterious substances into waters frequented by fish, unless the deposits are of the type, quantity, or concentration authorized by regulation. Deleterious substances, as defined under the Act, are any substances, that if added to water, would degrade or alter the quality of the water, rendering it either deleterious to fish or fish habitat, or to the use by humans or fish that frequent the water. Since the Act's inception, regulations for effluent from certain industrial sectors such as pulp and paper mills, petroleum refineries, chlor-alkali plants, and metal mining operations have been developed. These regulations designate a number of substances released by these industrial activities as deleterious substances for which there are effluent control limits established by the regulations.

15 Environment Canada. Water legislation, http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=E05A7F81-1#Section1.

Regulations under the Fisheries Act are typical of an industry sector-specific control regime. Because regulations are specific to releases defined by substance, industrial sector, or medium (e.g., water), situations not covered by the regulations fall under the general prohibition provision of the Act. Deposit or releases of deleterious substances by these sectors would be contrary to the Act's general prohibition of depositing such substances into waters frequented by fish, thereby constituting a violation of the Act.

The majority of Canadian public wastewater treatment facilities are owned and operated by municipalities, with others owned or operated by provinces, territories, federal departments, and other entities. This shared jurisdiction has resulted in different regulatory requirements and varying levels of treatment across the country. In order to address these varying levels of wastewater management and after much consultation, the Canadian Council of Ministers of the Environment (CCME) in 2009 endorsed a Canada-wide Strategy for the Management of Municipal Wastewater Effluent. The CCME Strategy established national effluent quality standards requiring a secondary level of wastewater treatment or equivalent. Very recently, the federal Department of the Environment (Environment Canada) published proposed Wastewater Systems Effluent Regulations under the Fisheries Act using the national effluent quality standards established in the CCME Strategy.[16]

The objective of the proposed regulations is to reduce the risks to ecosystem health, fisheries resources and human health by decreasing the level of harmful substances deposited to Canadian surface waters from wastewater effluent. The proposed regulations specify the conditions that must be met for depositing effluent containing specified deleterious substances including biochemical oxygen demanding (BOD) matter, suspended solids, total residual chlorine and un-ionized ammonia.

The proposed regulations would also set requirements for the monitoring and reporting of substances, with reports and supporting documents submitted on a quarterly basis to Environment Canada. The regulations would apply to any wastewater system that has a capacity to deposit a daily volume of effluent of 10 m^3 or more from its final discharge point, and that deposits a deleterious substance to surface water (with exceptions for areas north of the 54th parallel, pending further research on the standards appropriate for climatic conditions found in those areas). They would not apply to on-site wastewater systems for industrial, commercial or institutional facilities if 25% or less of the volume of the effluent is blackwater (wastewater containing fecal matter and organic material).

16 Environment Canada. Wastewater Systems Effluent Regulations, http://www.gazette.gc.ca/rp-pr/p1/2010/2010-03-20/html/reg1-eng.html.

Provinces are free to establish more stringent regulatory regimes to address the sources and problems associated with water pollution, and have instituted regulations relating to drinking water protections, process effluent restrictions, and management of contaminated sites and hazardous waste.

Mexico

In Mexico, responsibility for developing and implementing environmental legislation lies with the federal Secretariat of Environment and Natural Resources (*Secretaría de Medio Ambiente y Recursos Naturales*—Semarnat). The overarching framework for Mexico's environmental legislation is the National Development Plan (*Plan Nacional de Desarrollo*—PND), the highest instrument of the federal public administration. This plan states that the country's economic development must take place in a sustainable manner—that is, based on the preservation and rational use of natural resources (with a particular focus on water, forests and biodiversity) so as to ensure the quality of life of current generations, without jeopardizing that of future generations.

In 1989, the National Water Commission (*Comisión Nacional de Agua*—Conagua) was created with the mission of coordinating with federal, state and municipal levels of government to manage and preserve Mexico's water in a sustainable manner. In 1992, Mexico established a National Water Law, the legal framework for water management in Mexico. Conagua allocates the water-related budget for the 32 Mexican states, which accounts for approximately 60% of the total environmental budget for the country.[17]

Within this legislative framework, Semarnat has implemented an environmental protection program called the National Program for the Environment and Natural Resources (*Programa Nacional de Medio Ambiente y Recursos Naturales*—PNMARN). Implementation of this program is through a series of multi-year sectoral plans (*Programa Sectorial de Medio Ambiente y Recursos Naturales*—PSMAyRN), with the most recent being for the 2007–2012 period. Among other strategies to preserve ecosystems and biodiversity is the National Water Program (*Programa nacional hídrico*), which is developed and overseen by Conagua. The objectives of this program relate to the prevention of water pollution, the protection of natural water resources, and the improvement of water infrastructure, including the achievement of 100 percent coverage of wastewater treatment by 2030.

The legal protection of water resources is based on the General Law of Ecological Equilibrium and Environmental Protection *(Ley General de Equilibrio Ecológico y la Protección al*

17 Semarnat. The Conagua in Action, http://www.conagua.gob.mx/english07/publications/Conagua%20in%20action%20carta%20cor.pdf.

18 Semarnat. 2008. *Programa Sectorial del Medio Ambiente y Recursos Naturales*, 2007–2012, http://www.ordenjuridico.gob.mx/Federal/PE/APF/APC/SEMARNAT/Programas/2008/21012008(1).pdf.

Ambiente—LGEEPA). Article 109 bis of the LGEEPA provides for the development of a PRTR program (*Registro de Emisiones y Transferencia de Contaminantes*—RETC) at national, state and municipal levels. Conagua, in coordination with a few other key agencies such as the National Forest Commission, oversees the implementation of various regulations or official norms (*Norma Oficial Mexicana*—NOM) under the LGEEPA, including:

- NOM-001-Semarnat-1996: regulates persons or facilities discharging listed pollutants into national water bodies[19] (seas, lakes, rivers and tributaries), and establishes maximum allowable limits for a number of parameters (e.g., BOD, suspended solids, temperature, pathogens)
- NOM-002-Semarnat-1996: regulates municipal water discharges and sets maximum allowable limits for pollutants discharged to urban or municipal wastewater treatment facilities
- NOM-003-Semarnat-1997: establishes maximum limits of contaminants in wastewater that is treated for reuse
- NOM-014-Conagua-2003: establishes water quality parameters applicable to water used for artificial well recharge
- NOM-127-SSA1-1994: establishes maximum limits for parameters relative to water used for human consumption
- NOM-004-Semarnat-2001: regulates the byproducts generated by wastewater treatment
- NMX-AA-118-SCFI-2001: lists the substances subject to reporting under the RETC program.

Because almost all water bodies are under federal jurisdiction, most releases to water are subject to reporting under the federal RETC, while releases to sewage or wastewater treatment are in most cases under municipal jurisdiction. The relatively recent decentralization of authority from the federal to state/municipal levels allows for greater local control over reporting of releases. Nevertheless, facilities (including wastewater treatment plants) report on a quarterly or semiannual basis to Conagua, in order to comply with the combination of regulations (NOM-014-Conagua-2003, NOM-127-SSA1-1994, and NMX-AA-118-SCFI-2001) targeting water for human consumption and releases from wastewater treatment plants.

United States

In 1948, the Federal Water Pollution Control Act became the first major federal law addressing water pollution in the United States. Following amendments in 1972 and 1977, the law became known as the Clean Water Act (CWA). The law required the US EPA to develop and implement water quality standards that would restore and protect water quality and aquatic habitats across the country. Through a variety of regulatory and non-regulatory tools, the goal of the CWA is to sharply reduce the direct release of pollutants into waterways. Through a basic structure of regulations, the law prohibits an unpermitted direct release of pollutants by a point source (discreet conveyances such as pipes or ditches) into navigable waters.

National effluent guidelines typically specify the maximum allowable levels of pollutants that may be discharged by facilities within an industrial category or subcategory ranging from activities such as petroleum refining to centralized waste treatment facilities. These regulations apply to between 35,000 and 45,000 facilities that discharge directly to US waters, as well as another 12,000 facilities that discharge into wastewater treatment plants, commonly referred to as publicly owned treatment works (POTWs).[20]

These effluent guidelines are based on the performance of specific pollution control technologies. These are identified through EPA assessments of the best technologies or pollution prevention practices available, and the economic achievability of that technology in consideration of costs, benefits, and affordability. Industrial facilities are not required to use these technologies, but can use any effective alternative to meet pollutant discharge limits.

The nature of the technology required by regulation varies in part according to whether a facility discharges directly to surface waters or is an indirect discharger (i.e., discharging to a POTW), and if the facility is an existing or new source. By regulation, POTWs must achieve technology-based effluent limits; other permitted sources must achieve practically-demonstrated achievable effluent limit guidelines for a water body—or in the absence of such guidelines, the permit writer determines through use of Best Professional Judgment, the criteria necessary for water treatment and pollution control(s) on a release from a facility.

These permits make up part of the National Pollutant Discharge Elimination System (NPDES), which is now commonly delegated to states to implement. The states are nevertheless held accountable to fulfilling the regulatory requirements of the federal program. State NPDES permits regulate the majority of treatment facilities, making them subject to national technology-based "secondary treatment" limits on Biological Oxygen Demand (BOD), Total Suspended Solids, and alkalinity/acidity (pH). They also must comply with other applicable federal and state water quality standards.

19 The waters owned by the Nation in terms of the fifth paragraph of Article 27 of the Constitution of the United Mexican States. See also Article 3 of the National Water Act.

20 US EPA. Laws and regulatory development (The Clean Water Act), http://water.epa.gov/scitech/wastetech/guide/laws.cfm.

An Example of Cross-Border Collaboration: The Great Lakes

The Great Lakes ecosystem is home to approximately 20 percent of the world's freshwater and 84 percent of the North American surface waters. Retention time varies from under three years (Lake Erie) to almost 200 (Lake Superior). Only about one percent of the water in the system is replaced annually.[21] The region is home to 24 million Americans and 8 million Canadians. In 2006, an estimated 847 billion gallons (3,206 billion liters) per day of water were withdrawn from the lakes. Of this, 0.7 percent (roughly 6 billion gallons, or 22.5 billion liters per day) was used solely for drinking water.[22]

Industrialization and urbanization followed exploitation of the timber resource and the development of agriculture in the Great Lakes region. Use of the lakes for disposal led to outbreaks of waterborne disease in the communities along the shorelines of the tributaries and the lakes themselves. With the intensification of industry and the continued belief that these water bodies were an almost inexhaustible resource, synthetic fertilizers, chemicals, and nutrients ended up in the lakes. In the 1960s Lake Erie was declared "dead" from hyper-eutrophication, and industrial releases and debris clogging rivers resulted in events like the infamous Cuyahoga River fire.

The International Joint Commission (IJC) was created by the 1909 Boundary Waters Treaty between the United States and Canada for the purpose of assisting the governments in addressing boundary water issues. The IJC publishes reports and studies on the progress made and the challenges that remain in restoring and protecting these boundary waters; it is also currently studying the impacts of chemicals of emerging concern on water quality in the Great Lakes.

The Great Lakes Water Quality Agreement (GLWQA), first signed by Canada and the United States in 1972, is the cornerstone policy with regards to the environmental management of the Great Lakes basin. Its goal is the restoration and maintenance of the chemical, physical and biological integrity of the waters of the Great Lakes ecosystem, and includes a number of objectives and guidelines to achieve this goal.

Under the GLWQA, the two countries have identified Areas of Concern (AOC): historically impacted ecosystems at the mouths of tributaries or in the nearshore waters of the Great Lakes, where beneficial use of the waters has been adversely affected. A major impairment common in most AOCs is from the residual chemical contamination (especially from PBTs) that continues to affect the local ecosystem or limit human activity or ability to utilize the resource. Recent research has identified emerging pollutants with persistent and bioaccumulative properties of concern to communities on the Great Lakes. A total of 101 chemical compounds were identified and measured in the Great Lakes, 47 of which are subject to monitoring programs.

As a complement to these national efforts, the two countries established the Great Lakes Binational Toxics Strategy (GLBTS) in 1997, bringing together representatives from federal, provincial and state levels, industry, academia, Tribes and First Nations, to develop voluntary initiatives for reducing pollution in the Great Lakes basin. Progress is being made toward GLBTS goals and there has been a continued decline in the use and emissions of toxic substances targeted by the Strategy. The GLWQA also prescribes specific principles and procedures for addressing open-water critical pollutants through the development and implementation of Lakewide Management Plans (LaMPs) for each of the Great Lakes. LaMPs for lakes Erie, Ontario and Superior have been developed. A Lake Huron Binational Partnership has also been established, and addresses the same issues as a LaMP, albeit under a different name. The scope of these plans has since expanded to address various ecosystem threats.

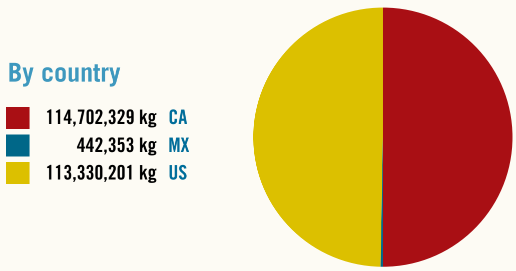
As a result of Great Lakes research, efforts were undertaken in areas like the Arctic and industrialized European communities to assess pollutant reporting and monitoring inventories, which led to international negotiations on Persistent Organic Pollutants (POPs). The resulting Stockholm Convention under UNEP has been signed by 152 countries.[23] The initial "Dirty Dozen" POPs identified have a common ancestry to the chemicals of concern identified in the Great Lakes. More recently, additional chemicals (now known as PBTs) have been identified that have similar modes of toxicity, but are not synthetically-produced organic pollutants. Efforts are now underway to address metals (e.g., lead, mercury and cadmium) and other elements and compounds released in greater quantities due to human activities.

21 US EPA. 2008. Great Lakes basic information http://epa.gov/greatlakes/basicinfo.html.
22 Great Lakes Commission. 2009. Annual Report of the Great Lakes Regional Water Use Database Repository. October. http://glc.org/wateruse/database/pdf/2006%20Water%20Use%20Report.pdf.
23 Stockholm Convention on Persistent Organic Pollutants. 2008. Status of Ratifications. http://chm.pops.int/Countries/StatusofRatification/tabid/252/language/en-US/Default.aspx.

Releases to Water Reported by North American Facilities

Of the 5.7 billion kg released or transferred by North American facilities in 2006, 228,474,883 kg (or 4%) were releases to surface waters (see **Figure 1**, **Chapter 1**). **Figure 9** below shows that reported amounts released to water varied greatly among the three countries, with Canadian and US facilities reporting 99.8% of the total.

Figure 9. Reported Releases to North American Surface Waters, 2006



Across North America, 4,997 facilities reported releases of a total of 256 pollutants.[24] In Canada, 485 facilities (of a total of 3,192 facilities reporting to the NPRI in 2006) reported releases to water of 114,702,329 kg of 86 pollutants. In the United States, 3,281 facilities (of a total of 23,449 reporting to the TRI that year) reported releases to water of 113,330,201 kg of 228 pollutants. Reported releases of 19 pollutants to surface waters from 1,231 Mexican facilities (of a total of 1,863 facilities reporting to RETC in 2006) accounted for 442,353 kg, or just over 0.2 percent of the North American total.

The great variation in the numbers of reporting facilities and amounts reported across the region is in part a reflection of differences among national PRTR reporting requirements for industrial sectors or activities.

Reporting Sectors

Each country's PRTR program requires reporting by facilities in specific industrial sectors or undertaking specific industrial activities. PRTR reporting requirements are based in part on the industrial activity undertaken by a facility; therefore, not all facilities within a given sector might have to report (for example, within the mining sector, processing of extracted material is generally subject to PRTR reporting, while initial extraction and crushing activities might be exempt).

Some of the key differences in national PRTR requirements for sectors and/or activities include:

- In Canada, all facilities that meet reporting thresholds and requirements must report to the NPRI. With the exception of reporting on criteria air contaminants from stationary combustion equipment, facilities engaged in oil and gas exploration are exempt from reporting. There are also exclusions for certain activities such as research and testing.
- In Mexico, eleven (11) industrial sectors regulated under federal law are required to report to the RETC, along with facilities in other sectors that engage in activities subject to federal regulation—including facilities that use boilers and transfer hazardous waste. All facilities that discharge into national water bodies must also report to RETC (most water bodies in Mexico are under national jurisdiction).
- In the United States, TRI requires reporting by most manufacturing facilities and the industries that service them (e.g., electric utilities and hazardous waste management facilities). Certain resource-based activities, including those involved in oil and gas extraction and exploration, as well as public wastewater treatment facilities (or publicly-owned treatment works—POTWs), are not subject to TRI reporting.

In addition to differences in the industry sectors and activities subject to PRTR reporting in each country, both Canada's NPRI and the US TRI have an employee threshold, generally corresponding to the equivalent of 10 full-time employees (or 20,000 hours/year). In Canada, there are certain exceptions to this threshold—for example, municipal wastewater treatment operations;[25] wood preservation activities; and certain types of incineration. Mexico's RETC does not have an employee threshold.

For additional details about national PRTR reporting requirements for industrial sectors and activities, please consult **Using and Understanding *Taking Stock*.**

Figure 4 in **Chapter 1** shows the main sectors reporting releases to water across North America, as well as the top pollutants released, by volume. Three sectors, wastewater collection and treatment, food manufacturing, and primary metal manufacturing, accounted for more than 70% of all reported releases to surface water in 2006.

The following tables present the profile of reported releases to water for each of the North American countries—

24 For comparability among the three countries, certain pollutants are grouped (e.g., lead and/or its compounds). See **Appendix 1: Using and Understanding *Taking Stock.***

25 In Canada, municipal wastewater treatment plants that discharge treated or untreated wastewaters into surface waters with an annual average flow rate of 10 000 cubic meters or more per day are required to report to NPRI. See *NPRI Guidance Manual for the Wastewater Sector* at http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=86E3D932-1&offset=2&toc=show.

Canada

Table 11. Releases to Surface Waters, by Top Reporting Industry Sectors, NPRI, 2006

NAICS Code	Sector	No. of Facilities Reporting Releases to Water*	Releases to Water (kg)
2213	Water, Sewage and Other Systems	156/162	96,553,345
3221	Pulp, Paper, and Paperboard Mills	84/95	6,891,634
5622	Waste Treatment and Disposal	7/82	3,647,782
3116	Animal Slaughtering and Processing	4/19	1,642,208
2122	Metal Ore Mining	48/65	1,638,853
2111	Oil and Gas Extraction	8/138	1,587,779
3241	Petroleum and Coal Products Manufacturing	16/37	501,070
3251	Basic Chemical Manufacturing	22/83	446,474
5621	Waste Collection	3/13	434,490
3314	Nonferrous Metal (except Aluminum) Prod/Processing	7/27	269,565
Subtotal		355	113,613,200
Total, All Sectors		485	114,702,329

* Facilities reporting releases to water out of all reporting facilities in that sector.

Table 12. Releases to Surface Waters, by Top Reporting Facilities, NPRI, 2006

Facility Name	City, Province/Territory	NAICS	Sector	Releases to Water (kg)	% of Total Releases to Water
City of Toronto - Ashbridges Bay Treatment Plant	Toronto, Ontario	2213	Water, Sewage, & Other Systems	13,679,710	11.93
City of Calgary - Bonnybrook Wastewater Treatment	Calgary, Alberta	2213	Water, Sewage, & Other Systems	9,344,624	8.15
City of Ottawa - Robert O. Pickard Environmental Ctr	Gloucester, Ontario	2213	Water, Sewage, & Other Systems	5,260,625	4.59
Greater Vancouver Regional District - Annacis Island	Delta, British Columbia	2213	Water, Sewage, & Other Systems	4,836,140	4.22
Ville de Montréal - Station d'épuration des eaux usées	Montréal, Québec	2213	Water, Sewage, & Other Systems	4,800,901	4.19
City of Toronto - Highland Creek Treatment Plant	Toronto, Ontario	2213	Water, Sewage, & Other Systems	4,765,634	4.15
Regional Municipality of Halton - Skyway Wastewater	Burlington, Ontario	2213	Water, Sewage, & Other Systems	3,878,724	3.38
Greater Vancouver Regional District - Iona Island	Richmond, British Columbia	2213	Water, Sewage, & Other Systems	3,246,525	2.83
City of Edmonton - Gold Bar Wastewater Treatment Plant	Edmonton, Alberta	2213	Water, Sewage, & Other Systems	3,144,753	2.74
City of Toronto - Humber Treatment Plant	Toronto, Ontario	2213	Water, Sewage, & Other Systems	2,636,142	2.30
City of Winnipeg - North End Water Pollution Control	Winnipeg, Manitoba	2213	Water, Sewage, & Other Systems	2,493,128	2.17
City of Hamilton - Woodward Avenue Wastewater Treatmt	Hamilton, Ontario	2213	Water, Sewage, & Other Systems	2,101,209	1.83
City of Guelph - City of Guelph Wastewater Treatmt	Guelph, Ontario	5622	Waste Management/ Remediation	1,842,476	1.61
City of Regina - Wastewater Facility	N/A, Saskatchewan	2213	Water, Sewage, & Other Systems	1,710,559	1.49
Cargill Foods - Cargill High River Plant	High River, Alberta	3116	Animal Slaughtering/Processing	1,619,365	1.41
Ontario Clean Water Agency - G.E. Booth (Lakeview)	Mississauga, Ontario	2213	Water, Sewage, & Other Systems	1,562,370	1.36
City of Barrie - Barrie Water Pollution Control Ctr	Barrie, Ontario	2213	Water, Sewage, & Other Systems	1,517,578	1.32
Regional Municipality of Halton - Mid-Halton Waste	Oakville, Ontario	2213	Water, Sewage, & Other Systems	1,445,199	1.26
Ville de Longueuil - Centre d'épuration Rive-Sud	Longueuil, Québec	2213	Water, Sewage, & Other Systems	1,251,400	1.09
Ontario Clean Water Agency - Clarkson Wastewater Trtmt	Mississauga, Ontario	2213	Water, Sewage, & Other Systems	1,146,540	1.00
Subtotal, top 20 facilities				72,283,602	63.02
All other (462*) facilities				42,418,727	36.98
Total, all facilities				114,702,329	100.00

* Number of facilities = those that reported amounts greater than 0 kg.

Mexico

Table 13. Releases to Surface Waters, by Top Reporting Industry Sector, RETC, 2006

NAICS Code	Sector	No. of Facilities Reporting Releases to Water*	Releases to Water (kg)
2211	Electric Power Generation, Transmission & Distribution	50/65	196,338
3251	Basic Chemical Manufacturing	52/72	90,018
2221	Water Collection, Treatment and Supply	10/10	30,320
3328	Coating, Engraving, Heat Treating, and Allied Activities	39/69	16,061
3399	Other Miscellaneous Manufacturing	13/20	13,258
3254	Pharmaceutical and Medicine Manufacturing	59/81	10,342
3121	Beverage Manufacturing	29/41	9,009
3221	Pulp, Paper, and Paperboard Mills	29/34	7,043
3315	Foundries	45/60	6,342
3259	Other Chemical Product and Preparation Manufacturing	43/58	6,232
Subtotal		369	384,963
Total, All Sectors		1,231	442,353

* Facilities reporting releases to water out of all reporting facilities in that sector

Table 14. Releases to Surface Waters, by Top Reporting Facilities, RETC, 2006

Facility Name	City, State	NAICS	Sector	Releases to Water (kg)	% of Total Releases to Water
Comisión Federal de Electricidad, C. T. Juan de Dios	Topolobampo, Sinaloa	2211	Electric Utilities	114,844	25.96
Ciba Especialidades Químicas de México, S.A de C.V	Atotonilquillo, Jalisco	3251	Basic Chemical Manufacturing	77,652	17.55
Electricidad Águila de Tuxpan, S. de R.L. de C.V.	Comunidad Chile Frío, Veracruz	2211	Electric Utilities	29,735	6.72
Iberdrola Energía Altamira, S.A. de C.V.	Altamira, Tamaulipas	2211	Electric Utilities	26,230	5.93
Junta Municipal de Agua Potable y Alcantarillado	Culiacancito, Sinaloa	2221	Water Collection, Treatment/Supply	20,076	4.54
Electricidad Sol de Tuxpan, S. de R.L. de C.V.	Comunidad Chile Frío, Veracruz	2211	Electric Utilities	19,779	4.47
Manufacturas Pegaso, S.A. de C.V.	Granjas San Antonio, Distrito Federal	3399	Miscellaneous Manufacturing	13,200	2.98
Recubrimientos Industriales Fronterizos, S. de R.L.D.	Matamoros, Tamaulipas	3328	Coating, Engraving, Heat Treat.	11,690	2.64
Productos Farmacéuticos, S.A. de C.V.	Pabellón de Hidalgo, Aguascalientes	3254	Pharmaceutical/Medicine Mfg	8,134	1.84
Industria del Álcali, S.A. de C.V.	García, Nuevo León	3251	Basic Chemical Manufacturing	6,345	1.43
Terminal de LNG de Altamira, S. de R.L. de C.V.	Altamira, Tamaulipas	4862	Natural Gas Pipeline Transport	6,171	1.40
Cerraduras y Candados Phillips, S.A. de C.V.	Gustavo A. Madero, Distrito Federal	3315	Foundries	4,953	1.12
Cervecería Cuauhtémoc Moctezuma, S.A. de C.V.	Toluca, Estado de México	3121	Beverage Manufacturing	4,216	0.95
Sigma Alimentos Centro, S.A. de C.V.	Atitalaquia, Hidalgo	3116	Animal Slaughtering/Processing	4,077	0.92
Petroquímica Morelos, S.A. de C.V.	Coatzacoalcos, Veracruz	3251	Basic Chemical Manufacturing	3,914	0.88
Innophos Fosfatados de México, S. de R.L. de C.V.	Coatzacoalcos, Veracruz	3259	Other Chemical Product Mfg	3,766	0.85
Antonio Briseño León	Guadalajara, Jalisco	3328	Coating, Engraving, Heat Treat.	3,500	0.79
Sistema Ambiental Industrial, S.A. de C.V.	Del Prado, Nuevo León	2221	Water Collection, Treatment/Supply	3,370	0.76
Degremont, S.A. de C.V.	Delegación Villa de Pozos, San Luis Potosí	2221	Water Collection, Treatment/Supply	2,896	0.65
Compañía Minera Nukay, S.A. de C.V.	Eduardo Neri, Guerrero	2122	Metal Ore Mining	2,869	0.65
Subtotal, top 20 facilities				367,417	83.06
All other (1211*) facilities				74,935	16.94
Total, all facilities				442,353	100.00

* Number of facilities = those that reported amounts greater than 0 kg.

United States

Table 15. Releases to Surface Waters, by Top Reporting Industry Sector, US TRI, 2006

NAICS Code	Sector	No. of Facilities Reporting Releases to Water*	Releases to Water (kg)
3116	Animal Slaughtering and Processing	105/259	29,339,431
3311	Iron & Steel Mills & Ferroalloy Manufacturing	99/140	14,624,265
3241	Petroleum and Coal Products Manufacturing	142/644	10,470,223
3251	Basic Chemical Manufacturing	266/1079	9,656,984
3221	Pulp, Paper, and Paperboard Mills	187/298	8,776,526
9281	National Security and International Affairs	43/188	7,196,574
3312	Steel Product Manufacturing from Purchased Steel	76/254	5,717,874
2213	Water, Sewage and Other Systems	5/12	3,542,699
3253	Pesticide, Fertilizer, & Other Agricultural Chemical Mfg	82/234	3,378,865
3314	Nonferrous Metal (except Aluminum) Prod/Processing	130/386	2,326,270
Subtotal		1,135	95,029,711
Total, All Sectors		3,281	113,330,201

* Facilities reporting releases to water out of all reporting facilities in that sector.

Table 16. Releases to Surface Waters, by Top Reporting Facilities, US TRI, 2006

Facility Name	City, State	NAICS	Sector	Releases to Water (kg)	% of Total Releases to Water
AK Steel Corp (Rockport Works)	Rockport, Indiana	3311	Iron & Steel Mills & Ferroalloy Mfg	11,941,973	10.54
U.S. Army Radford Army Ammunition Plant	Radford, Virginia	9281	National Security and International Affairs	6,122,497	5.40
Tyson Fresh Meats Inc. Wastewater Treatment Plant	Dakota City, Nebraska	2213	Water, Sewage & other systems	3,540,580	3.12
Cargill Meat Solutions Corp	Schuyler, Nebrasca	3116	Animal Slaughtering/Processing	2,169,576	1.91
Smithfield Packing Co. Inc. - Tar Heel Div.	Tar Heel, North Carolina	3116	Animal Slaughtering/Processing	2,082,479	1.84
Tyson Fresh Meats Inc.	Lexington, Nebraska	3116	Animal Slaughtering/Processing	1,950,227	1.72
AK Steel Corp (Coshocton Works)	Coshocton, Ohio	3312	Steel Prod. Mfg from Purchased Steel	1,814,849	1.60
ExxonMobil Refining & Supply – Baton Rouge Refinery	Baton Rouge, Louisiana	3241	Petroleum and Coal Products Manufacturing	1,636,160	1.44
Dupont Chambers Works	Deepwater, New Jersey	3251	Basic Chemical Manufacturing	1,567,002	1.38
DSM Chemicals North America Inc.	Augusta, Georgia	3251	Basic Chemical Manufacturing	1,555,243	1.37
North American Stainless	Ghent, Kentucky	3312	Steel Prod. Mfg from Purchased Steel	1,531,879	1.35
Cargill Meat Solutions Corp	Beardstown, Illinois	3116	Animal Slaughtering/Processing	1,529,725	1.35
McCain Foods USA - Burley	Burley, Idaho	4244	Grocery/Related Prod. Merchant Wholesale	1,400,600	1.24
River Valley Animal Foods	Scranton, Arkansas	3116	Animal Slaughtering/Processing	1,370,170	1.21
USS – Clairton Works	Clairton, Pennsylvania	3312	Steel Prod. Mfg from Purchased Steel	1,323,950	1.17
Premcor Refining Group Inc.	Delaware City, Delaware	3241	Petroleum and Coal Products Manufacturing	1,304,463	1.15
John Morrell & Co.	Sioux Falls, South Dakota	3116	Animal Slaughtering/Processing	1,284,246	1.13
IBM Corp.	Hopewell Junction, New York	3344	Semiconductor/Other Electronic Component Mfg.	1,151,106	1.02
Cargill Meat Solutions Corp	Fort Morgan, Colorado	3116	Animal Slaughtering/Processing	1,128,220	1.00
Tyson Fresh Meats Inc. - Joslin	Hillsdale, Illinois	3116	Animal Slaughtering/Processing	1,117,828	0.99
Subtotal, top 20 facilities				47,522,774	41.93
All other (3008*) facilities				65,807,426	58.07
Total, all facilities				113,330,201	100.00

* Number of facilities = those that reported amounts greater than 0 kg.

with one table showing the breakdown by top reporting sectors in the country and the number of facilities reporting in each, and a second table listing the top reporting facilities by releases to water.

These tables reveal that a relatively small number of reporting facilities accounted for a substantial proportion of the national totals. In Canada, with the exception of one food manufacturing plant, the top reporting facilities were public wastewater treatment plants (**Table 12**). In Mexico, the top facility, an electric utility, accounted for 26% of the total reported releases to water in that country. Altogether, four electric utilities accounted for 43% of all releases to water reported in Mexico in 2006 (**Table 14**). In the United States, while combined reporting by food manufacturing facilities made that sector the top reporting industry, one steel manufacturer accounted for about 10% of total releases to water, followed by a federal military complex with 5% of the total (**Table 16**).

The data reveal certain commonalities in terms of the top reporting sectors in each country, including the basic chemical manufacturing sector, pulp and paper mills, sewage/wastewater and water collection activities, and facilities involved in metals manufacturing. However, the data also reveal important gaps due in part to differences in national PRTR reporting requirements and inadequacy of reporting. An example is the municipal wastewater treatment sector (NAICS code 2213), the dominant reporter in Canada, where wastewater treatment plants discharging a minimum average of 10,000 cubic meters per day are subject to NPRI reporting. These wastewater treatment plants serve large metropolitan areas across Canada and treat the largest volumes of wastewater. Together with 10 wastewater treatment facilities reporting under NAICS codes 5621 or 5622, a total of 166 such facilities (of the 3,700 existing in the country[26]) accounted for approximately 100 million kg, or more than 87% of all reported releases to water in 2006 (**Tables 11 and 12**).

In Mexico, any facility discharging to national water bodies is required to report to the RETC. In 2006, 10 wastewater treatment facilities, most of them private, reported releases to surface waters (**Table 13**). Of the three municipal plants that reported, one located in the state of Sinaloa accounted for 20,000 kg, or 66% of the total reported by this sector (**Table 14**). According to Mexico's National Water Commission (Conagua), there were almost 1,600 public wastewater treatment facilities across the country at the end of 2006.[27]

In the United States, with the exception of federal facilities, public wastewater treatment plants (or Publicly Owned Treatment Works—POTWs) are exempt from TRI reporting. Private and federal wastewater treatment facilities in that country reported more than 3.5 million kg in releases to water in 2006 (**Table 15**). About 3.54 million kg, or 99%, of this amount was reported by one facility, a wastewater treatment plant for a food manufacturing facility. The remaining amount was reported by a few US Army facilities, with about 33 kg also reported by a water purification plant in Milwaukee, Wisconsin (**Table 16**). There are an estimated 16,000 POTWs in the United States.[28] Given the large volumes and complex composition of the effluent treated at public wastewater treatment plants, and considering the data reported by these facilities in Canada, requiring reporting by this sector across North America would likely result in a substantial increase in reporting of releases to water.

Other examples of the impacts of differences in national PRTR reporting requirements include the food manufacturing and the oil and gas extraction sectors. The former is not subject to Mexican RETC reporting because it is not federally-regulated (although releases to water are subject to reporting—with 53 facilities in Mexico's food manufacturing sector reporting releases to water in 2006). In the United States, the food manufacturing sector was among the top sectors reporting releases to surface waters that year. In the case of oil and gas extraction activities, this sector is not subject to US TRI reporting; therefore, it is difficult to estimate the amount of releases to water not being reported by the hundreds of thousands of oil and gas wells currently in operation in that country.[29] Requiring reporting by oil and gas exploration facilities in all three countries would likely result in a substantial increase in release and transfer data.

An examination of the various factors potentially contributing to these differences would likely yield additional insights into their impacts on reporting. For example, what explains the fact that Mexican power plants were responsible for almost 45% of all releases to water reported in that country in 2006? Possible hypotheses include differences among the three countries in terms of the waste management methods used by these facilities, and a lack of reporting from other Mexican sectors, resulting in electric utilities being ranked first among Mexico's sectors.

Employee thresholds are another factor that could potentially affect reporting, particularly in Canada and the United States. With certain exceptions (see **Using and Understanding *Taking Stock***), there is a reporting threshold of 10 full-time employees (or equivalent) for facilities in these two countries (in Mexico, there are no employee thresholds).

26 Environment Canada (NPRI). 2007. Wastewater Systems Effluent Regulations. *Municipal Water Use Report*. http://www.gazette.gc.ca/rp-pr/p1/2010/2010-03-20/html/reg1-eng.html.

27 *Inventario Nacional de Plantas Municipales de Potabilización y de Tratamiento de Aguas Residuales en Operación*. 2007, December. See www.conagua.gob.mx.

28 US EPA. 2007. CHP opportunities at wastewater treatment plants. Opportunities for and Benefits of Combined Heat and Power at Wastewater Treatment Facilities. Combined Heat and Power Partnership. April, http://www.epa.gov/chp/documents/wwtf_opportunities.pdf.

29 US EPA. *2008 Sector Performance Report: Oil and Gas At a Glance 1996–2005*, http://www.epa.gov/sectors/pdf/2008/oil_gas.pdf.

Reported Pollutants

In addition to specific reporting requirements for industrial sectors or activities, each country's PRTR program has its own list of pollutants subject to reporting, along with pollutant-specific reporting requirements including "activity" and/or "release" thresholds:

- Canada's NPRI: 321 pollutants or pollutant groups subject to reporting. "Activity" thresholds of 10,000 kg for most chemicals. Lower thresholds for certain PBTs, metals, polycyclic aromatic hydrocarbons (PAHs), dioxins and furans, and criteria air contaminants (CAC)
- Mexico's RETC: 104 pollutants subject to reporting. "Release" and "activity" thresholds for each pollutant (a facility must report if it meets or exceeds either threshold). In general, "release" thresholds range from 1 kg to 1,000 kg. "Activity" thresholds range from 5 kg to 5,000 kg. Any release of polychlorinated biphenyls (PCBs) and sulfur hexafluoride, and any release or activity involving dioxins and furans, is reportable.
- US TRI: 581 individual pollutants and 30 pollutant categories subject to reporting. "Activity" thresholds of about 11,340 kg (with an "otherwise use" threshold of about 5,000 kg); lower thresholds for certain pollutants (e.g., persistent, bioaccumulative, and toxic (PBT) chemicals; dioxins and furans)

Readers should remember that facilities in all three countries can report their releases using a variety of methods, including direct measurement, estimation, observation, or using emissions factors—with each method involving different assumptions, degrees of accuracy, and uncertainty. In addition, certain pollutants, such as dioxins and furans and hexachlorobenzene, are reported in different units of measure in the three countries (e.g., grams-TEQ versus grams). Please see **Appendix 2, Pollutants Common to at Least Two of the Three North American PRTRs**. Also, for additional details about national PRTR reporting requirements for pollutants, please consult **Appendix 1, Using and Understanding *Taking Stock***.

Figure 4 in **Chapter 1** also shows the top 10 pollutants released by facilities to water in North America, as reported to the PRTR programs. These accounted for more than 98 percent of the total reported. Nitric acid and nitrate compounds were released at the highest rates, and together with ammonia, made up nearly 91 percent of the total reported by North American facilities in 2006. This figure also reveals that all but two of the pollutants (barium and its compounds and total phosphorous) are subject to reporting under both Canada's NPRI and the US TRI, while none of them is subject to reporting under the Mexican RETC.

Tables 17, **18**, and **19** present the top pollutants reported released to water in each country and the sector(s) accounting for the majority of these releases.

Canada

Table 17. Releases to Surface Waters, by Pollutant, NPRI, 2006

Pollutant	Pollutant Subject to Reporting in	Releases to Water (kg)	Top Sector(s) Reporting (% Contribution)
Nitric acid and Nitrate compounds	CA, US	53,503,872	2213: Water, sewage other systems (85%)
Ammonia, Total	CA, US	49,942,947	2213: Water, sewage other systems (91%)
Phosphorous, Total	CA	6,800,981	2213: Water, sewage other systems (69%)
Manganese (and/or its compounds)	CA, US	1,385,155	3221: Pulp, paper, paperboard mills (87%)
Methanol	CA, US	1,150,629	2111: oil and gas extraction (60%) and 3221: Pulp, paper, paperboard mills (37%)
Ethylene glycol	CA, US	519,809	2111: oil and gas extraction (88%)
Zinc (and/or its compounds)	CA, US	298,222	2213: Water, sewage other systems (54%) and 3221: Pulp, paper, paperboard mills (18%)
Chlorine	CA, US	220,295	2213: Water, sewage other systems (89%)
Benzene	CA, MX, US	101,662	2111: oil and gas extraction (99%)
Copper (and/or its compounds)	CA, US	99,951	2213: Water, sewage other systems (65%) and 2122: Metal ore mining (20%)
Subtotal		114,023,523	
All Other Reported Pollutants (76)		678,806	
Total, All Sectors		114,702,329	

Mexico

Table 18. Releases to Surface Waters, by Pollutant, RETC, 2006

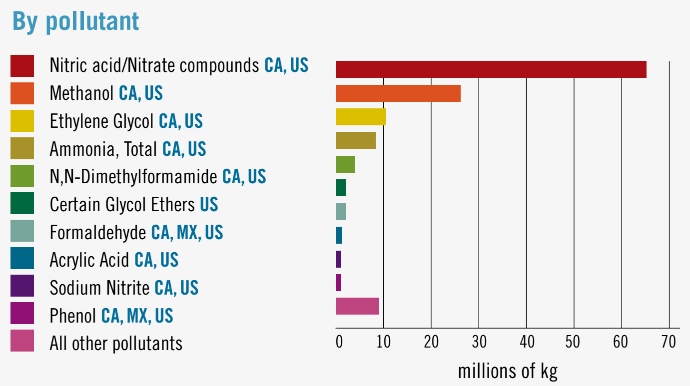
Pollutant	Pollutant Subject to Reporting in	Releases to Water (kg)	Top Sector(s) Reporting (% Contribution)
Nickel (and/or its compounds)	CA, MX, US	141,047	2211: Electric power generation, transmission, distrib'n (43%) and 3251: Basic chemical mfg (33%)
Lead (and/or its compounds)	CA, MX, US	121,079	2211: Electric power generation, transmission, distrib'n (43%) and 3399: Other miscellaneous mfg (11%)
Chromium (and/or its compounds)	CA, MX, US	84,365	2211: Electric power generation, transmission, distrib'n (58%)
Cadmium (and/or its compounds)	CA, MX, US	36,330	2211: Electric power generation, transmission, distrib'n (40%) and 3251: Basic chemical mfg (32%)
Arsenic (and/or its compounds)	CA, MX, US	21,656	2211: Electric power generation, transmission, distrib'n (38%) and 3116: Animal slaughtering/processing (19%)
Cyanides	CA, MX, US	21,413	2211: Electric power generation, transmission, distrib'n (49%) and 3251: Basic chemical mfg(12%)
1,2-Dichloroethane	CA, MX, US	8,125	3254: Pharmaceutical/medicine mfg (100%)
Mercury (and/or its compounds)	CA, MX, US	5,170	3259: Other chemical product & preparation mfg (32%), 3315: Foundries (20%), 3254: Pharmaceutical/medicine mfg (18%), and 2211: Electric power generation, transmission, distrib'n (16%)
Hydrogen sulfide	CA, MX	1,471	3221: Pulp, paper, paperboard mills (99%)
Trichloroethylene	CA, MX, US	473	3254: Pharmaceutical/medicine mfg (100%)
Subtotal		441,130	
All Other Reported Pollutants (9)		1,222	
Total		442,353	

United States

Table 19. Releases to Surface Waters, by Pollutant, TRI, 2006

Pollutant	Pollutant Subject to Reporting in	Releases to Water (kg)	Top Sector(s) Reporting (% Contribution)
Nitric acid and Nitrate compounds	CA, US	101,514,858	3116: Animal slaughtering/processing (29%); 3311: Iron/steel mills and ferroalloy mfg (14%) and 3251: Basic chemical mfg (8%)
Manganese (and/or its compounds)	CA, US	2,851,784	3221: Pulp, paper, paperboard mills (71%)
Methanol	CA, US	2,567,719	3221: Pulp, paper, paperboard mills (91%)
Ammonia, Total	CA, US	2,338,819	3221: Pulp, paper, paperboard mills (34%); 3251: Basic chemical mfg (16%), and 3112: Grain and oilseed milling (8%)
Sodium nitrite	CA, US	1,002,904	3311: Iron/steel mills and ferroalloy mfg (52%) and 3251: Basic chemical mfg (19%)
Barium (and/or its compounds)	US	490,180	2211: Electric power generation, transmission, distrib'n (67%)
Zinc (and/or its compounds)	CA, US	422,467	3221: Pulp, paper, paperboard mills (39%) and 2211: Electric power generation, transmission, distrib'n (27%)
Ethylene glycol	CA, US	224,130	3252: Resin, synthetic rubber/filaments mfg (48%) and 9281: National security/international affairs (17%)
Formic acid	CA, US	216,748	3221: Pulp, paper, paperboard mills (73%)
Vanadium (and/or its compounds)	CA, US	190,305	2122: Metal ore mining (29%), 3251: Basic chemical mfg (21%), 2211: Electric power generation, transmission, distrib'n (17%)
Subtotal		111,819,915	
All Other Reported Pollutants (218)		1,510,286	
Total		113,330,201	

Figure 10. Reported Transfers of Non-metals to Sewage/POTWs, North America, 2006



Readers are reminded that each country has specific reporting requirements for sectors, facilities, and pollutants that affect the North American picture of industrial pollution. Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.

Many of the top substances reported released to water were common to the United States and Canada. In fact, of the top ranked pollutants in these two countries, only benzene is also subject to RETC reporting; this is most likely the reason that **Table 18** portrays a very different set of pollutants released to water by Mexican facilities in 2006.

The data also demonstrate a relationship between reporting sectors and the pollutants they released: the nature of the materials they use, the industrial processes undertaken, and the means used to facilitate those processes. For instance, nitrates are associated with processes such as meat packing in the food manufacturing sector, with meat preparation activities being the top reporting sector in the United States (**Table 19**). Releases of nitrates from public wastewater treatment plants are also common, often as a result of the presence of organic matter, agricultural fertilizers, and other pollutants in the waste stream.

Pulp, paper, and paperboard mills (NAICS code 3221) are an example of a sector reporting releases to water in all three countries. In Canada and the United States, this sector reported many of the same pollutants, including additives used in the Kraft pulping process, such as manganese, methanol and zinc (and their compounds), and ammonia. However, the top pollutant (total phosphorous) reported by this sector in Canada (**Table 17**) was not reported by US mills. Under the US TRI, only the yellow or white form of phosphorous is subject to reporting. Total phosphorus, a measure of all forms of phosphorus found in a water sample, leaches from the raw materials (wood) processed by this sector.[30]

None of the substances reported by Canadian and US mills is subject to reporting under Mexico's RETC. In that country, the pulp, paper and paperboard sector reported mainly releases to water of chromium, lead, and nickel and their compounds, as well as hydrogen sulfide (**Table 18**).

As these tables indicate, data reported by common sectors can potentially be useful in the development of industrial pollutant profiles. However, this analysis also demonstrates how gaps created by national differences in PRTR reporting requirements for pollutants can hinder such efforts.

30 World Bank Group. 1998. Pulp and paper mills. *Pollution Prevention and Abatement Handbook*, July, http://www.ifc.org/ifcext/enviro.nsf/attachmentsbytitle/gui_pulp_wb/$file/pulp_ppah.pdf.

Transfers to Sewage/Wastewater Treatment

Along with direct releases to surface waters, North American facilities transferred substantial quantities of pollutants to sewage or wastewater treatment plants. Approximately ten percent of all reporting North American facilities in 2006 reported transfers of a total of 133,458,993 kg of pollutants to sewage and/or wastewater treatment facilities. In Canada, 183 facilities reported transfers of 63 pollutants; in Mexico, 13 facilities reported transfers of 3 pollutants; and in the United States, 2,717 facilities reported 198 pollutants transferred to sewage and/or wastewater treatment (or POTWs).

In terms of volumes reported, non-metals, including nitric acid and nitrates, methanol, ethylene glycol, ammonia and others, made up the bulk (130,670,036 kg) of the total transferred to sewage and/or wastewater treatment (**Figure 10**). Of the total number of pollutants reported, 17 were metals and their compounds (including cadmium, lead, chromium and others), for a total of 2,795,287 kg (**Figure 11**).

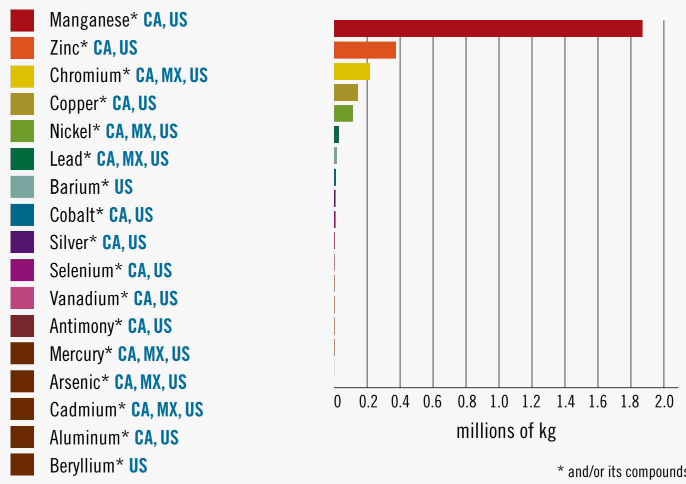
As mentioned earlier, pollutants transferred to sewage and/or wastewater treatment can be eventually released to surface waters, whether in their original form or converted into other compounds. With little information available through PRTR data about the type of treatment (or for that matter, whether a treatment facility exists) at the receiving end of these transfers, it is difficult to know the ultimate fate of these pollutants.

Depending on the type of treatment available, metals can be collected and removed for disposal via settling and other methods; however, this is not always the case. Data from public wastewater treatment plants reporting in 2006 (most of them Canadian facilities, due to the lack of data from Mexican and US facilities for this sector) show that the following pollutants were released to water in 2006:

- Metals (and their compounds), including: aluminum, lead, chromium, arsenic, cadmium, mercury, zinc, manganese, and copper
- Ammonia
- Nitric acid and Nitrate compounds
- Phosphorous, Total
- Chlorine
- Ethylene glycol
- Nonylphenol and its ethoxylates

Figure 11. Reported Transfers of Metals to Sewage/POTWs, North America, 2006

By pollutant



Readers are reminded that each country has specific reporting requirements for sectors, facilities, and pollutants that affect the North American picture of industrial pollution. Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.

Releases to Water of Pollutants of Special Interest

Substances released to water have physical and chemical characteristics that influence their ultimate disposition and consequences for human and ecological health. However, it is important to keep in mind that PRTR data do not provide all information necessary for determining the impacts of reported releases, such as the environmental fate of, or risks from, the pollutants and the levels of exposure of human or ecological populations to the substances. This analysis provides information about some of the problems that can arise from the presence of certain substances in surface waters. A number of the pollutants released by North American facilities can be classified as:

- Known or suspected carcinogens, based on the World Health Organization's International Agency for Research on Cancer (IARC)[31] and California's Office of Environmental Health Hazard Assessment (OEHHA) Proposition 65.[32]
- Developmental or reproductive toxicants, based on California's Proposition 65 list. These substances adversely affect reproductive capabilities and/or the development of the fetus. Metals, solvents, and pesticides have been widely implicated in reproductive and/or developmental impacts. New classes of endocrine disruptors have also been added to this category.
- Persistent, bioaccumulative and toxic (PBT) substances, which exhibit some combination of three critical properties when released to the environment: *persistence* (the amount of time PBTs exist in the environment); *bioaccumulation* (their ability to be taken up and stored in the tissues of living organisms, often to be passed up the food web from lower to higher organisms through predation or other means); *inherent toxicity* (their negative effects on living organisms, which can be maintained over a long period due to their persistence in the environment). Because of their unique behavior in the environment and within living organisms, PBTs pose a substantial short and long-term risk to humans and wildlife.[33] The substances designated as PBTs differ somewhat among the three countries.[34]
- Metals, which occur naturally, but human activities such as mining and smelting enlarge their concentrations in the environment. The toxicity of certain metals and their compounds can depend on the forms they take in the environment.

31 International Agency for Research on Cancer (IARC), http://www.iarc.fr/.
32 Proposition 65, the Safe Drinking Water and Toxic Enforcement Act of 1986, http://www.oehha.org/prop65.html
33 See, for instance, Mergler, D., H.A. Anderson, L.H. Chan, K.R. Mahaffey, M. Murray, M. Sakamoto, A.H. Stern. 2007. Methylmercury exposure and health effects in humans: A worldwide concern. *Ambio* 36(1): 3-11; Bernanke, J. and H.R. Kohler. 2009. The impact of environmental chemicals on wildlife vertebrates. *Reviews in Environmental Contamination and Toxicology* 198: 1-47; Hotchkiss, A.K., C.V. Rider, C.R., Blystone, V.S. Wilson, P.C. Hartig, G.T. Ankley, P.M. Foster, C.L. Gray and L.E. Gray. 2008. Fifteen years after "Wingspread"—environmental endocrine disrupters and human and wildlife health: where we are today and where we need to go. 2008. *Toxicology Science* 105(2): 225-259.
34 US EPA. TRI PBT chemical list, http://www.epa.gov/tri/trichemicals/pbt%20chemicals/pbt_chem_list.htm.

Toxic Equivalency Potentials (TEPs) indicate the relative human health risk associated with the release of one unit of a pollutant, compared to the risk posed by the release of one unit of a reference substance. The reference chemical for carcinogens is benzene and the reference chemical for pollutants that produce non-cancerous health effects (e.g., developmental or reproductive toxicants) is toluene.

TEPs provide a chemical ranking system that takes into account both a chemical's toxicity and its potential for human exposure. However, this analysis is limited in that a release does not directly correlate to actual exposures nor to levels of risk. In addition, TEPs are only available for air and water releases, and not all of the chemicals have an assigned TEP (information on their toxicity or exposure potential may be missing). While these chemicals are not ranked by TEP, they should not be assumed to be without risk.

The TEPs used in *Taking Stock* are one of many different screening tools, each of which is based on a series of assumptions and, therefore, can yield different results. *Taking Stock* provides TEPs for air and surface water releases of known or suspected carcinogens and for other substances with potential non-cancerous health effects. The TEP is multiplied by the amount of release and the result is used to rank the pollutants. For details, see **Using and Understanding *Taking Stock***, or visit the Scorecard website at: www.scorecard.org.

Data for these categories of pollutants can also be explored via the *Taking Stock Online* integrated database, at: www.cec.org/takingstock.

Taking Stock incorporates information on the potential toxicity of PRTR substances, through the use of Toxicity Equivalency Potentials (TEPs).[35] This chemical ranking system takes into account both a chemical's toxicity and its potential for human exposure (see text box above).

Of the total number of pollutants (256) reported released to surface waters in 2006, 135 of them are potentially of special interest—i.e., known or suspected carcinogens, developmental or reproductive toxicants, PBTs, metals, or some combination thereof. **Table 20** presents the top 25 pollutants released to water, according to their cancer and/or non-cancer risk (TEP) scores.[36] It reveals that regardless of the relatively small reported release amounts, the potential toxicity of these substances in water can be significant.

An example is dioxins and dioxin-like compounds.[37] Known carcinogens that persist in the environment, dioxins can be important when considering local health and diet and the potential for bioaccumulation in fish. These substances are not created intentionally, but are byproducts of the manufacturing of herbicides and other products, or the bleaching of wood pulp for the paper industry. They can also be created when materials are incinerated. In 2006, a total of 1.32 kg of dioxins and dioxin-like compounds was reported released to surface water by 16 US facilities mainly involved in three activities: sawmills and wood preservation, pulp, paper and paperboard mills, and basic chemicals manufacturing.

A total of 15 metals and their compounds are also among the 25 substances with highest TEP scores for cancer and/or non-cancer risk in water. Six of them—mercury, lead, cadmium, arsenic, chromium and nickel—are subject to RETC reporting in Mexico, while the other nine are not. Two metals, barium and thallium (and their compounds), are not subject to reporting under Canada's NPRI.

Mercury, a known PBT associated with developmental or reproductive toxicity, transforms into an organic form, methylmercury, and is of special concern in water. In natural settings, this organic mercury bioaccumulates in fish and wildlife, potentially affecting the reproductive and developmental capacity of humans and wildlife that feed on them. A total of 972 facilities in North America reported releases of 6,624 kg of mercury and/or its compounds directly to surface waters in 2006. Over half of this amount was reported by three industrial sectors: chemical products manufacturing, coal- and oil-fired electric utilities, and foundries.

Lead is a naturally occurring metal which does not break down, but can be transformed by sunlight, air and water. Human activities such as the burning of fossil fuels, mining and manufacturing result in lead's increased presence as an environmental pollutant. Inorganic lead is considered a probable carcinogen and developmental or reproductive toxicant, and exposure to even small amounts of this metal can affect almost every organ in the body, especially the nervous system. In 2006, 2,454 North American facilities from a very wide range of industrial sectors reported releases to water of lead and its compounds, in the amount of 189,763 kg.

35 See **Using and Understanding *Taking Stock***, or visit the Scorecard website: www.scorecard.org.\

36 To obtain the TEP score, the release amount is multiplied by a pollutant's assigned toxicity weight to give an indication of the potential toxicity of the substance in water.

37 Dioxins and dioxin-like compounds are reported differently among the three countries. For more info, please see **Using and Understanding *Taking Stock***

Table 20. Releases to Water of Pollutants of Special Interest, by Cancer and Non-Cancer Risk Scores, North America, 2006

Pollutant	Surface Water Releases (kg)	Cancer Risk Score for Water (TEP)	Non-cancer Risk Score for Water (TEP)	Known or Suspected Carcinogen	Developmental or Reproductive Toxicant	Persistent, Bioaccumulative and Toxic (PBT)*	Metal
Dioxin and dioxin-like compounds CA, MX, US	1.32	907,840,549	644,698,360,651	X	X	X *	
Mercury (and/or its compounds) CA, MX, US	6,624	–	86,115,783,751	X	X	X *	X
Lead (and/or its compounds) CA, MX, US	189,763	379,527	7,970,061,772	X	X	X *	X
Cadmium (and/or its compounds) CA, MX, US	40,607	77,153,574	5,685,000,181	X	X	X	X
Copper (and/or its compounds) CA, US	276,967	–	3,323,598,121			X	X
Arsenic (and/or its compounds) CA, MX, US	104,568	418,273,112	2,091,365,562	X	X	X	X
Thallium (and/or its compounds) US	720	–	1,943,387,755				X
Vanadium (and/or its compounds) CA, US	191,342	–	135,853,150	X			X
Chromium (and/or its compounds) CA, MX, US	148,189	–	65,203,188	X	X	X	X
Antimony (and/or its compounds) CA, US	42,715	–	64,072,890	X		X	X
Selenium (and/or its compounds) CA, US	15,665	–	25,064,125	X		X	X
Barium (and/or its compounds) US	490,180	–	23,528,622				X
Manganese (and/or its compounds) CA, US	4,236,939	–	14,829,287				X
Zinc (and/or its compounds) CA, US	720,689	–	10,089,651			X	X
Nickel (and/or its compounds) CA, MX, US	274,368	–	7,133,572	X	X	X	X
Cobalt (and/or its compounds) CA, US	79,148	–	5,144,634	X			X
1,2-Dibromoethane US	2,990	35,886	3,887,619	X	X		
Epichlorohydrin CA, US	16,455	7,405	1,365,752	X	X		
Hexachlorobenzene CA, MX, US	32.19	109,443	1,062,244	X	X	X *	
Benzene CA, MX, US	106,312	80,797	1,063,123	X	X		
Acetaldehyde CA, MX, US	187,130	1,179	954,363	X			
Carbon Tetrachloride CA, MX, US	246	64,071	566,781	X			
1,2-Dichloropropane CA, US	2,162	1,795	562,237	X			
Silver (and/or its compounds) CA, US	1,101	–	506,489				X
Hydrazine CA, MX, US	1,873	4,495	262,179	X			

Note: "CA", "MX", and "US" designate the countries in which the pollutant is subject to PRTR reporting.
"–" indicates no TEP available for that pollutant.
* substance designated a PBT by the US EPA

Arsenic, a naturally-occurring element, enters surface waters through natural erosion and leaching, as well as from wastewater and industrial and agricultural releases (as a result of its use in pesticides, wood preservatives, etc.). Chronic exposure to arsenic in drinking water is associated with increased risks of bladder and other cancers,[38] along with heart disease and other problems in humans. In 2006, 958 North American facilities, including metal ore mines, coal- and oil-fired electric utilities, and pulp, paper and paperboard mills, among others, reported releases to water of arsenic and its compounds.

Non-metals are also listed among the pollutants with highest cancer and/or non-cancer risk scores in water, including 1,2-dibromoethane and epichlorohydrin. These chemicals are associated with cancer, damage of the central nervous system, and kidney and liver function problems in humans. The former is used as a solvent, pesticide and gasoline additive. Ingestion of contaminated drinking water is a likely route of exposure and because 1,2-dibromoethane can migrate through soil and enter groundwater, individuals living near hazardous waste sites contaminated with this substance can also be exposed.

Epichlorohydrin is used mainly in the production of glycerol and epoxy resins, plastics and adhesives. This substance can enter water through industrial discharges. A possible route of human exposure is through drinking water, since epichlorohydrin is also used as a clarifier during water treatment. When added to water, it coagulates and traps suspended solids, allowing them to be more easily removed.

In 2006, a total of five US facilities reported releases to water of 1,2-dibromoethane and epichlorohydrin. Two of these facilities, a resins and synthetic rubber manufacturer and basic chemicals manufacturer, accounted for almost 100% of the total. The chemical 1,2-dibromoethane is not subject to PRTR reporting in Canada and Mexico.

Nutrients Released To Water: Nitrogen And Phosphorous

Nutrients, including nitrate compounds and phosphorous, are also considered to be pollutants of special interest for the present analysis, because of their potential impacts on the aquatic environment. The spreading environmental degradation associated with anthropogenically-induced levels of nitrogen and phosphorous in continental waters has been studied and extensively documented. Impacts due to nutrient-related pollution occur in all categories of waters—rivers, streams, lakes, reservoirs, estuaries and coastal areas—affecting drinking water supplies, aquatic life and recreational water quality to considerable degrees.

Over the past decade, phosphorous levels in the lower Great Lakes, where the population pressures are greatest, may be on the rise again. In addition, invasive *Dreissenid* (zebra and quagga) mussels are changing the way nutrients are cycled in the lakes. They filter large volumes of water, and in doing so they decrease the concentration of total phosphorus through the removal of particles, but they excrete soluble (i.e., dissolved) phosphorus, thereby increasing the availability of phosphorus that can be readily utilized by nuisance algae. In this way, previously acceptable concentrations of nutrients may now be promoting excessive algae growth. Direct inputs from nutrient sources are also contributing to excessive weed and algae growth and resulting in impacts to the ecosystem, recreation and the economy.

As shown in **Tables 17** and **19**, nitrates and phosphorous were among the top reported releases to water in Canada and the United States. In 2006, releases to water of 155,018,730 kg of nitric acid and nitrate compounds were reported by approximately 800 Canadian and US facilities (mainly US food manufacturers and Canadian public wastewater treatment plants), with another 6.8 million kg in releases of total phosphorous reported by just over 200 Canadian facilities (mainly from the wastewater treatment sector). These two sectors accounted for approximately 52% of reported nitric acid and nitrate compound releases and almost 70% of the reported phosphorous releases. Both nitrate compounds and phosphorous are not subject to PRTR reporting in Mexico, while only the yellow (or white) form of phosphorous is subject to US TRI reporting.

According to the US EPA, current efforts to control nutrients have been inadequate at both statewide and national scales. "Continuing the status quo at the national, state and local levels and relying upon our current practices and control strategies will not support a positive public health and environmental outcome."[39] Some of the potential solutions to elevated nutrients and their associated issues proposed by EPA include:

- *Agricultural waste composting.* Unused portions of harvested crops, manure, and other organic forms of agricultural wastes are composted and recycled for their nutrient and soil additive value.
- *Corporate stewardship program.* Provides corporations, such as food services, with an opportunity to actively participate in conservation activities by establishing continuous improvement programs to reduce nutrient pollution at all levels of the food production process (farms, processors, etc.).
- *Green labeling.* Labeling of products from farms that are certified in the implementation of nutrient reduction practices (e.g., organic and sustainable farming practices).

38 Health Canada. 2006. Arsenic (Environmental and Workplace Health), http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/arsenic/index-eng.php.

39 US EPA. 2009. *An Urgent Call to Action.* Report of the State-EPA Nutrient Innovations Task Group, August, http://www.epa.gov/waterscience/criteria/nutrient/nitgreport.pdf.

Japan's Experience: Using PRTR Data to Understand and Reduce Risks from Water Pollutants

A recent study from Japan explores the use of PRTR data in combination with other information to reduce the potential risks from pollutant releases to surface waters.[40] The use of PRTR data in the analysis of discharges to water includes potential exposure scenarios for local residents and the local environment. The concerns identified include timing and duration of releases, the duration and toxicity of exposures, and sufficiency of monitoring.

This review of releases reported to the Japanese PRTR program reveals that substances subject to monitoring by regulatory agencies in Japan cover only a fraction of the total pollutants released to surface waters. The study shows how environmental monitoring can be improved with the use of publicly available PRTR data.

The study also found that in addition to health and environmental assessments, the use of PRTR information can be of value to land-use and emergency planners. Facility location and other information were found to be useful in efforts to characterize the potential hazard, posed by a catastrophic event at a single facility, to public health and safety and to the safety of foods harvested from local water bodies and agricultural lands.

- *Market-based nutrient reduction land-use incentives.* Programs that encourage and reward effective manure management and nutrient reduction practices on farms and urban landscapes.
- *Nutrient bioharvesting.* Harvesting nutrients in the form of algae or other aquatic plants for use in animal feed or biofuels.

This analysis of top reported pollutant releases to water—whether ranked by volume or toxicity potential—reveals that certain pollutants are not tracked in all three countries, resulting in gaps in our picture of North American industrial pollution. In fact, of the 539 pollutants reported overall by facilities in 2006, 44 (including groupings of compounds) are common to all three PRTR programs. In order to narrow these gaps, substances could be added to a country's PRTR list if they are regularly reported to the other PRTR programs by sectors that are common to all three countries.

The use of TEP scores to evaluate releases to water of pollutants of special interest yields additional information that can help identify priority substances for PRTR reporting—such as metals and their compounds and other substances important for their potential toxicity in water. Standardizing the way substances are categorized and making additions to the lists of required substances on this basis would also advance North American PRTR comparability efforts. Recommendations relative to the addition of substances or other actions aimed at increasing the comparability of North American PRTR data are provided in an Action Plan developed by the CEC and the three Parties.[41]

As pointed out in a 2001 report by the National Water Research Institute called *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada*, wastewater effluents from industrial, commercial and residential sources are a complex mixture of endocrine disrupting substances, pharmaceutical and personal care products, and other contaminants.[42] The report examines releases from specific industrial point sources such as pulp and paper mills, which generate millions of litres of effluent per day that pose the threat of chronic toxicity to aquatic organisms and eutrophication. Little is known about the impacts of these pollutants combined with releases from other sources; therefore, the report argues for cumulative effects assessments and an integrated watershed management approach.

40 Hartmann, J., N. Okada, J. Levy, 2005. Using PRTR database for the assessment of surface water risk and improvement of monitoring in Japan. *International Journal of Critical Infrastructures* 1(2–3): 155–69.

41 CEC. 2005. Action Plan to Enhance the Comparability of Pollutant Release and Transfer Registers in North America.

42 Environment Canada. 2008. Threats to sources of drinking water and aquatic ecosystem health in Canada, http://ec.gc.ca/inre-nwri/default.asp?lang=En&n=235D11EB-1&offset=1&toc=show.

Cross-Border Case Studies: The Columbia and Rio Grande/Río Bravo River Basins

Watersheds or catchments have been proposed as a means of ecological subdivision for both monitoring and management of water quality, quantity and a variety of other natural resources. Watersheds are real and observable features within a landscape and they fundamentally affect the characteristics of rivers and streams that drain them. They also offer unique opportunities for integrated monitoring of environmental conditions within their boundaries primarily because the effects of human activities on land often show up as damage to rivers, streams, wetland habitats and deterioration in water quality.

Two North American river basins, the Rio Grande/Río Bravo and Columbia, were selected for examination of releases of selected pollutants to surface waters in North America. Both of the rivers cross international borders and serve as the receiving waters for pollutant releases from a variety of sources in each country. Both rivers are also contaminated with a variety of toxic substances, many of which are included in the integrated *Taking Stock* North American PRTR database. Each major basin also encompasses multiple sub-basins or sub-watersheds that are entirely within the borders of each nation.

A review of current information on the pollutants found in each of the major river basins revealed a wide range of toxic and conventional pollutants in sediments and/or in water considered to be hazardous to humans and/or wildlife. Both the Columbia and the Rio Grande/Río Bravo are contaminated by both toxic and non-toxic pollutants released historically, and in some cases, on an ongoing basis. We selected mercury (Hg) and lead (Pb) for closer examination of releases to surface waters at the river basin scale for several reasons. First, both substances are highly toxic to living organisms, including humans, and both are released directly to surface waters in the two river basins. Like other metals, these substances accumulate in the environment and build up in aquatic food webs. Similarly, they pose long-term hazards to humans and biota in the two river basins with historic releases already limiting water quality in selected portions of each river.

The Rio Grande/ Río Bravo River Basin

The Rio Grande River, known in Mexico as the Río Bravo del Norte, is the twenty-second longest river in the world and the fifth-longest river in North America, draining portions of both Mexico and the United States. The source of the Rio Grande is found in the alpine regions of southern Colorado's San Juan Mountains. From its headwaters, the river follows a 1,885-mile (3,034 km) course before it empties into the Gulf of Mexico. From its alpine sources, the Rio Grande's path to the ocean runs southward through Colorado (175 mi/280 km) and New Mexico (470 mi./756 km) before turning east, where it becomes an international waterway separating Mexico and the United States. Then, from the Cuidad Juárez/El Paso metropolitan area the river makes its way 1,250 miles (2,012 km) to its mouth at the Gulf of Mexico.

The river and its tributaries drain an 868,945 km^2 (335,500 mi^2) land area or *watershed* in the United States (Colorado, New Mexico and Texas), and Mexico (Chihuahua, Coahuila, Durango, Nuevo León and Tamaulipas). However, only part of the basin drains to the Rio Grande; half of the total watershed area lies within closed basins in a generally arid part of the continent, where water either evaporates or soaks into the ground before it can flow to the river channel. The portion of the watershed of the Rio Grande/Río Bravo that contributes surface runoff is 471,937 km^2 (182,215 mi^2). Approximately half of its length is in the United States and the remaining half is in Mexico.[43] Because much of this basin does not directly drain to the river itself, the average flow is much less than similarly-sized rivers draining other areas of North America.

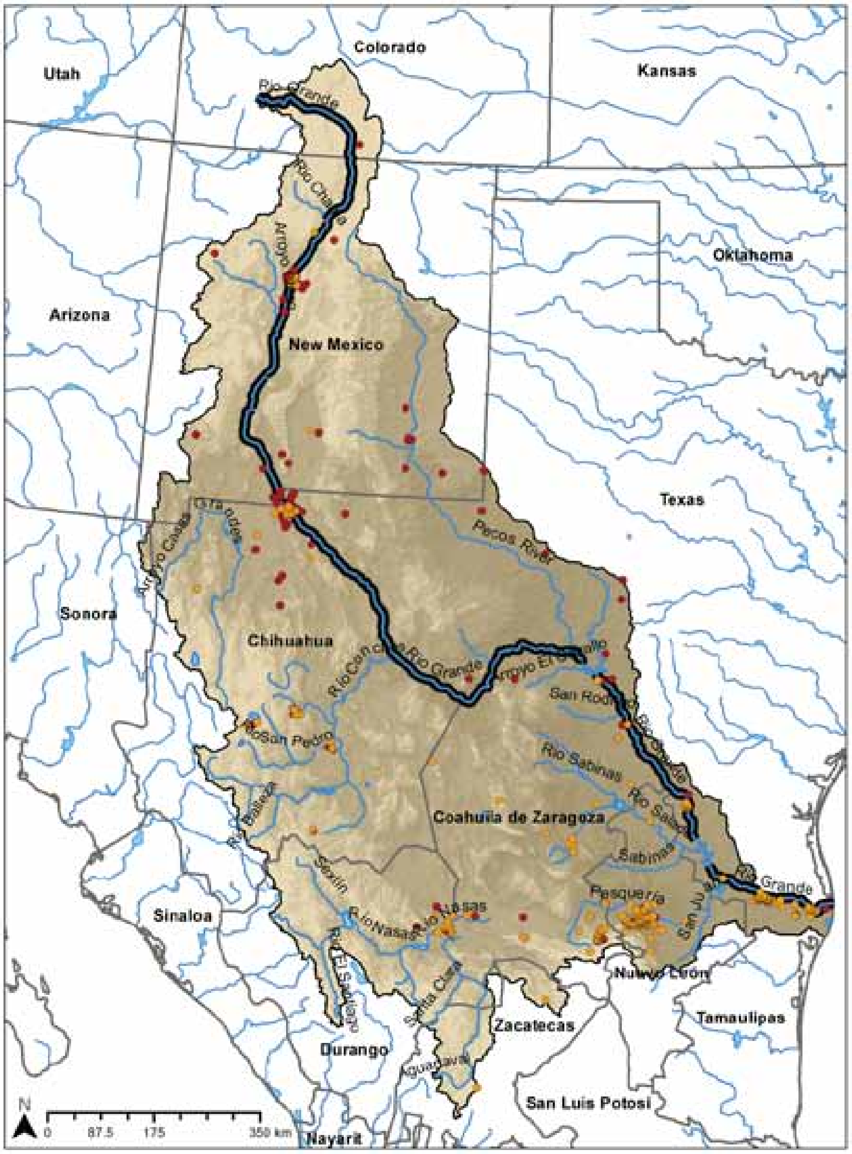
The Rio Grande/Río Bravo's watershed encompasses a variety of landscapes and regional ecosystems including alpine mountain ranges, forests, grasslands and deserts. The basin supports a variety of native plant and animal communities and more than 10 million people, with the majority residing in Mexico. The river's location within an arid environment characterized in part by low precipitation and limited surface water resources makes it a critically important resource for industry, agriculture, domestic water supply, recreation, as well as much of the region's native plant and animal communities.

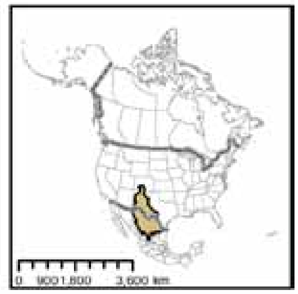
From Laredo/Nuevo Laredo to the Gulf of Mexico, the Rio Grande/Río Bravo is the primary drinking water source for over 90 percent of the population along the border in both countries. The river's major tributaries, including the Pecos, Devils, Chamas and Puerco rivers in the United States and the Río Concho in Mexico, as well as several minor tributaries in both countries, are also of significance to the overall flow and ecology of the Rio Grande. The United States recognized the unique value of the Rio Grande when approximately 200 miles of the river's length, including 111 miles of the river flowing within Big Bend National Park, was designated a National Wild and Scenic River.

The pace of both industrial expansion and population growth in the Rio Grande basin has put increasing stress on the natural communities dependent upon freshwater flows. From 1980 to 1990, populations in the Texas portion of the basin grew by more than 25 percent, with similar increases on the Mexican side of the basin. This growth has been spurred, in part, by the maquiladora program of industrial development which began in 1965. Predictions of future growth point to new and expanded demands on the Rio Grande/Río Bravo basin.

43 Miymamoto, S., L.B. Fenn, and D. Swietlik. 1995. Flow, Salts and Trace Elements in the Rio Grande. Texas Water Resources Inst. Report MP 1764/TR-169.

Map 3. Reporting Facilities in the Rio Grande/Río Bravo Watershed, 2006





● **Reporting Facilities**
Total Number of Facilities: 577
Total Annual Release and Transfers: 12,393,735 kg
* Facilities reporting releases and transfers greater than 0.

● **Facilities Reporting Releases to Surface Waters**
Total Number of Facilities Releasing to Water: 335
Total Annual On-site Surface Water Releases: 58,072 kg
* Facilities reporting releases and transfers greater than 0.

Rio Grande Watershed
Rivers
Rio Grande / Río Bravo channel
Lakes and large rivers

Binational management of transboundary water resources of the Rio Grande River has been governed by a 1944 treaty, "Utilization of Waters of Colorado and Tijuana Rivers and of the Rio Grande," which also renamed the International Boundary and Water Commission (IBWC) and designated it as the supervising body for matters stemming from the treaty. In 1992, the United States and Mexico issued the Integrated Environmental Plan for the Mexican–US Border Area, which called for the two countries to work together to identify and address environmental challenges, particularly those related to transboundary water contamination. At the same time, the IBWC, working with a range of state and federal agencies from both countries, developed a comprehensive study to investigate water quality in the river and its tributaries. Ratification of the North American Free Trade Agreement (NAFTA) gave added emphasis to transboundary environmental issues resulting in increased international cooperation and creation of the Border Environment Cooperation Commission (BECC) and the North American Development Bank (NAD Bank) to finance infrastructure improvements in the region.

Despite numerous national and binational efforts, continued growth and increasing development in the Rio Grande/Río Bravo basin brings added stress to the river system. The adverse impacts of past activities and recent industrial development and population growth have

Table 21. Reported Releases to the Rio Grande/Río Bravo, by Pollutant, TRI and RETC, 2006

Pollutant	Mexico (kg)	United States (kg)	Total (kg)
Antimony (and/or its compounds)	N/S	0.91	0.91
Arsenic (and/or its compounds)	569.04	0	569.04
Cadmium (and/or its compounds)	1,353.53	0	1,353.53
Chromium (and/or its compounds)	15,857.46	0	15,857.46
Copper (and/or its compounds)	N/S	2.23	2.23
Cyanides	1,350.77	0	1,350.77
Hydrogen sulfide	10.00	N/S	10.00
Lead (and/or its compounds)	5,360.56	22.49	5,383.05
Mercury (and/or its compounds)	2,035.23	0	2,035.23
Nickel (and/or its compounds)	9,419.79	2.27	9,422.06
Nitric acid and Nitrate compounds	N/S	22,076.64	22,076.64
Phenol	4.53	0	4.53
Silver (and/or its compounds)	N/S	2.05	2.05
Zinc (and/or its compounds)	N/S	4.54	4.54
Grand Total	**35,960.91**	**22,111.13**	**58,072.04**

N/S = pollutant not subject to PRTR reporting in that country.

degraded water and habitat quality along much of the river corridor and its tributaries. Environmental monitoring within the basin continues to document historical and current releases of toxic pollutants to the river as well as their effects on humans, wildlife, and other organisms that come in contact with them.[44]

Pollutant Releases to the Rio Grande/Río Bravo

The Rio Grande/Río Bravo is a unique natural resource whose importance to both Mexico and the United States is growing. Unfortunately, the river and the landscape that it drains have been degraded by a variety of human activities, including direct releases of pollutants to the river and the tributaries that feed it.

In 2006, 577 facilities (83 in the United States and 494 in Mexico) located within the Rio Grande Basin reported releases and transfers of pollutants (**Map 3**). Three hundred thirty-five (335) of those facilities (7 in the United States and 328 in Mexico) reported direct releases of 14 pollutants, totaling 58,072 kg, to the river or its tributaries (**Table 21**). The top ten direct releasers to the Rio Grande (one in the United States and nine in Mexico) accounted for 51,757 kg, or 89 percent of all releases to the river reported that year. These facilities were from ten industrial sectors including Coating, Engraving, Heat Treating, and Allied Activities (11,690 kg), Basic Chemical Manufacturing (6345 kg), Water Collection, Treatment, and Supply (3370 kg), and others.

Reporting facilities in the United States accounted for 22,111 kg, or approximately 38 percent, of the total direct releases to the river in 2006, with 99.8 percent made up of nitric acid and nitrate compounds released by a single US facility in New Mexico. This federal governmental facility reported the largest quantity of direct releases to the Rio Grande of all facilities in the basin. These substances are not reportable under Mexico's RETC program.

In Mexico, 328 facilities accounted for the remaining 39,955 kg, or 62 percent, of total reported releases to the river in 2006. Mexican facilities released a wider range of pollutants in significantly greater amounts to the river than did their US counterparts in 2006. For example, all reported direct releases of arsenic (564 kg), cadmium (1,354 kg), chromium (15,857 kg), cyanide (1,351 kg), and mercury (2,035 kg) (and their compounds) to the river were from Mexican facilities. Discharging facilities in Mexico were clustered around major manufacturing centers in and around the cities of Monterrey in the state of Nuevo León, Reynosa and Matamoros in the state of Tamaulipas, and Ciudad Juárez in the state of Chihuahua.

44 See: International Boundary and Water Commission (2004). *Third Phase of the Binational Study Regarding the Presence of Toxic Substances in the Upper Portion of the Rio Grande/Río Bravo Between the United States and Mexico.* Final Report, June; Mendoza, J., et. al. 2004. Microbial contamination and chemical toxicity of the Rio Grande. *BMC Microbiology* (4)17: 16 p.; New Mexico Environment Department. *Water Quality Monitoring of the Middle Rio Grande: Annual Baseline Condition and Trends of Key Water Quality Parameters: October 2006–July 2008.* Final Report. 63 p.; Schmitt, C.J., G.M. Dethloff, J.E. Hinck, T.M. Bartish, V.S. Blazer, J.J. Coyle, N.D. Denslow, and D.E. Tillitt. 2004. *Biomonitoring of Environmental Status and Trends (BEST) Program: Environmental Contaminants and Their Effects on Fish in the Rio Grande Basin.* US Geological Survey. Scientific investigation report 2004-5108. 117 p.

Mercury and Lead (and Their Compounds) Released to the Rio Grande/Río Bravo

Together with other toxic pollutants released into the Rio Grande, mercury and lead releases pose an ongoing threat to the ecology of the river itself as well as to people that may be exposed to these toxic substances directly or from consuming contaminated fish or drinking water from the river. Hundreds of facilities reported releases of mercury and/or lead (and their compounds) to the river and its tributaries in 2006, with very few of these facilities responsible for large portions of the total (see **Table 22**).

A total of 170 individual facilities, all of them located in Mexico, reported direct releases of 2,035 kg of mercury to the Rio Grande/Río Bravo. Two facilities, representing the Foundry and Pharmaceutical and Medical Manufacturing sectors, accounted for 94 percent (1,910 kg) of this total.

Of the total amount of lead (and/or its compounds) released to the river in 2006, nearly 80 percent came from the top ten reporters. A total of 268 facilities (four in the United States and 264 in Mexico) reported 5,383 kg of releases of lead to surface waters of the Rio Grande/Río Bravo River and/or its tributaries in 2006, with Mexican facilities accounting for 99 percent of this amount. Two facilities, from the Basic Chemical Manufacturing and the Motor Vehicle Parts Manufacturing sectors, accounted for approximately 63 percent (3,380 kg) of the total. Other top releasers of lead (>100 kg) to the Rio Grande/Río Bravo include facilities from the Foundry, Water Collection, Treatment and Supply, and Computer and Peripheral Equipment Manufacturing sectors.

Table 22. Releases of Lead and Mercury (and Their Compounds) to the Rio Grande/Río Bravo, by Top Reporting Sector, TRI and RETC, 2006

Industry	Data	Lead (and its compounds)	Mercury (and its compounds)	Grand Total* (kg)
Basic Chemical Manufacturing (3251)	Number of reporting facilities	7	7	
	Amount released (kg)	1,869.30	19.46	1,888.76
Motor Vehicle Parts Manufacturing (3363)	Number of reporting facilities	47	36	
	Amount released (kg)	1,736.96	18.13	1,755.09
Foundries (3315)	Number of reporting facilities	8	3	
	Amount released (kg)	224.75	997.18	1,221.93
Pharmaceutical and Medicine Manufacturing (3254)	Number of reporting facilities	2	2	
	Amount released (kg)	42.03	912.77	954.80
Electric Power Generation, Transmission and Distribution (2211)	Number of reporting facilities	6	4	
	Amount released (kg)	328.34	2.95	331.28
Water Collection, Treatment, and Supply (2221)†	Number of reporting facilities	1	1	
	Amount released (kg)	208.00	27.44	235.44
Computer and Peripheral Equipment Manufacturing (3341)	Number of reporting facilities	1	2	
	Amount released (kg)	135.43	14.01	149.44
Beverage Manufacturing (3121)	Number of reporting facilities	17	11	
	Amount released (kg)	96.01	3.85	99.86
Other Electrical Equipment and Component Manufacturing (3359)	Number of reporting facilities	6	4	
	Amount released (kg)	79.62	0.66	80.28
Pulp, Paper, and Paperboard Mills (3221)	Number of reporting facilities	6	4	
	Amount released (kg)	79.62	0.66	80.28
Subtotal, Top 10 industry sectors	Amount released (kg)	4,825.44	1,997.18	6,822.62
Total, All sectors	Amount released (kg)	5,383.00	2,035.08	7,418.07

* Note: Some facilities reported both lead and mercury (and their compounds).
† Wastewater Treatment (sector 2213 in Canada and the United States) corresponds to 2221 in Mexico (Water Collection, Treatment, and Supply).

The Columbia River Basin

The Columbia River, the largest North American river draining to the Pacific Ocean, is one of the world's most important rivers. Beginning in the remote alpine watersheds of British Columbia, the Columbia flows for 1,243 miles (2,000 km) before reaching the Pacific Ocean near Astoria, Oregon. At that point, the Columbia has become the United States' twelfth-longest river, draining the sixth-largest watershed in the nation.

The Columbia River basin encompasses a range of landscapes containing globally-significant mountain, desert, forest and grassland ecosystems that supply water, raw materials, energy, recreational opportunities and other natural resources to millions of residents in Canada and the United States. The river's watershed extends over 260,000 square miles (673,400 km^2) of land, covering portions of seven US States (Montana, Idaho, Washington, Oregon, Wyoming, Nevada, and California) and the province of British Columbia, Canada. Just over 85 percent of the watershed (219,400 mi^2/568,243 km^2) is within the United States, with the remaining 39,500 square miles (102,304 km^2) in Canada.

Canadian segments of the Columbia account for nearly 500 miles (801 km) of the river's length, making it the 23rd-longest river draining the 13th-largest watershed in Canada. However, the Canadian segment of the watershed, while only 15 percent of the river basin, contributes nearly 40 percent of the Columbia's average annual flow. Major tributaries to the Columbia include the Snake, Willamette, Spokane, Okanogan, Flathead, Kootenay, Grande Ronde, Lewis, Salmon, and Klickitat Rivers. The Snake River is the largest tributary, with a drainage area of 108,500 mi^2 (281,013 km^2), or 49 percent of the US portion of the watershed, while the Kootenay River drains approximately half (50,300 km^2) of the entire Canadian portion of the Columbia watershed.

The rugged topography of the mountainous landscapes drained by the river creates a wide range of ecological conditions, including some of North America's wettest and driest areas. This extreme variability in water availability across the Columbia basin, along with steep topography and changes in elevation, have spurred development of one of the world's most extensive hydropower and irrigation systems. There are more than 370 major dams on the river's main channel and tributaries that generate tens of thousands of megawatts of electricity, provide agricultural irrigation water for hundreds of thousands of acres of arid land, and allow the passage of barge traffic thousands of miles from the ocean.

Construction and operation of these dams continue and have caused serious environmental damage to the Columbia River's ecology and to the fish and wildlife species that rely on the river.[45] Populations of salmon using the Columbia River for reproduction were severely reduced and/or eliminated when dams that blocked upstream movement of salmon were constructed on the Columbia and its tributaries. Dams on the river have altered flow patterns, erosion rates, groundwater movement, and the fate and transport of contaminants that enter the system. The effects of accelerated logging and other forms of resource extraction in the river's watershed, along with fast-growing human populations, have added to the threats facing the Columbia River.

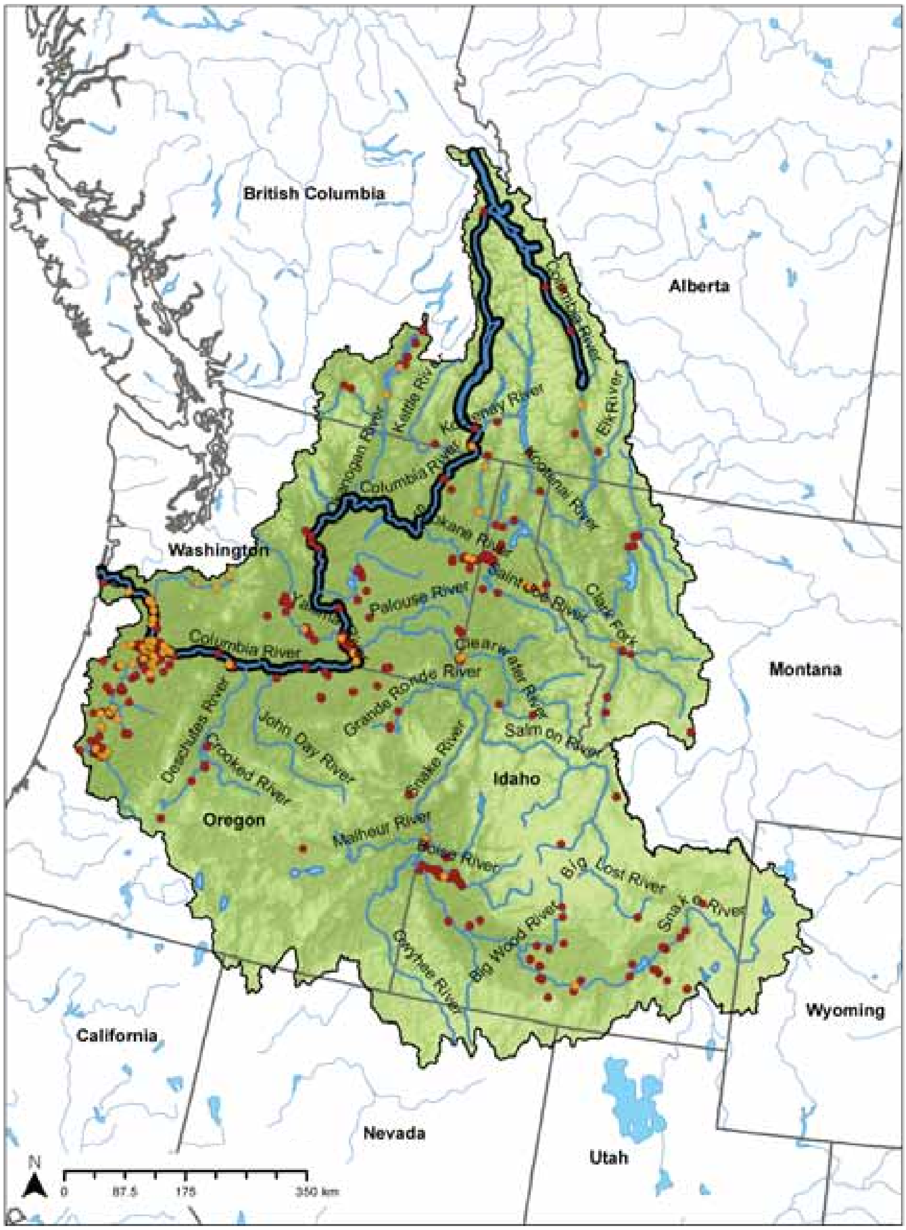
Adding to these threats is the continuing contamination of the river and its watershed by toxic chemicals, many of which are included in the *Taking Stock* database. Ongoing research on the Columbia and its tributaries has shown contamination of river water, sediments, and biota that may threaten the health of humans and the river ecosystem. In 2002, the US EPA completed the Columbia River Basin Fish Contaminant Survey, which found residues of 92 priority pollutants in fish that are eaten by people and wildlife.[46] Of particular concern are several persistent, bioaccumulative, and toxic (PBT) pollutants, including heavy metals like arsenic (As), lead (Pb), and mercury (Hg), as well as industrial chemicals and wastes such as chlorinated dioxins and furans, halogenated ethers, polychlorinated biphenyls (PCBs), byproducts of burning (polycyclic aromatic hydrocarbons—PAH), chlorinated hydrocarbon pesticides, modern pesticides, and others.

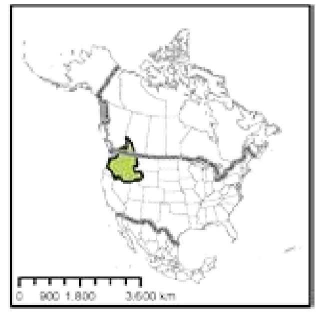
The Columbia's transboundary flow path and the relative contribution to its flow from each country's portion of the watershed make the river a potential focus of controversy and conflict, necessitating a binational approach to management. Early cooperation began with the Boundary Waters Treaty of 1909 and, in 1961, the two countries signed the Columbia River Treaty, which has guided management of the river since then. The Treaty called for a joint US-Canadian Entities to oversee implementation of the treaty within each nation. The US Entity consists of the Administrator of the Bonneville Power Administration (BPA) and the Northwestern Division Engineer of the US Army Corps of Engineers (ACOE). The Canadian Entity is the British Columbia Hydro and Power Authority (BC Hydro). Implementation of the Treaty has included construction of major dams in both countries, cross-boundary electric transmission lines, and additional agreements covering flow management and other issues.

45 See: Kareiva, P., M. Marvier, and M. McClure. 2000. Recovery and management options for spring/summer Chinook salmon in the Columbia River Basin. *Science* 290(5493): 977–979; US EPA. 2009. *Columbia River Basin: State of the River Report for Toxics*. Region 10: the Pacific Northwest, January, http://yosemite.epa.gov/r10/ecocomm.nsf/Columbia/SoRR/; US EPA and Columbia River Inter-tribal Fish Commission. n.d. *Columbia River Basin Fish Contaminant Survey: 1996–1998*. Region 10: the Pacific Northwest, EPA 910-R-02-006, http://yosemite.epa.gov/r10/OEA.NSF/webpage/Columbia+River+Basin+Fish+Contaminant+Survey; Lower Columbia River Estuary Partnership. 2010. Report on the Estuary, http://www.lcrep.org/sites/default/files/pdfs/Estuary%20Partnership%20State%20of%20the%20Estuary%20Report%202010.pdf.

46 US EPA and Columbia River Inter-tribal Fish Commission. n.d. Columbia River Basin Fish Contaminant Survey: 1996–1998. Region 10: the Pacific Northwest, EPA 910-R-02-006, <http://yosemite.epa.gov/r10/OEA.NSF/webpage/Columbia+River+Basin+Fish+Contaminant+Survey>.

Map 4. Reporting Facilities in the Columbia River Watershed, 2006





Pollutant Releases to the Columbia River

In 2006, 479 facilities (449 in the United States and 30 in Canada) located within the Columbia River watershed reported releases and transfers in the amount of 121,682,701 kg (**Map 4**). Of these, 83 facilities (78 in the United States and five in Canada) reported direct releases to the Columbia River or its tributaries. These facilities, representing 28 industry sectors at the NAICS-4 level, reported total releases to water in the amount of 3,367,476 kg. Reported releases comprised one or more of 47 pollutants– including carcinogens such as chromium and its compounds (334 kg), arsenic and its compounds (1,091 kg), and benzene (8 kg) as well as 0.01 kg of dioxin and dioxin-like compounds and 40 kg of polycyclic aromatic hydrocarbons (PAH). These are shown in **Table 23**.

Many of the pollutants released are persistent in the environment and can accumulate in animals and the food web. Highly toxic substances such as dioxins, furans, heavy metals, and others are already responsible for contaminating human food webs and other portions of the Columbia

Table 23. Reported Releases to the Columbia River, by Pollutant, NPRI and TRI, 2006

Pollutant	Canada (kg)	US (kg)	Total (kg)
1,2,4-Trimethylbenzene	0	0.45	0.45
Acetaldehyde	0	21,117.01	21,117.01
Ammonia, Total	122,626.00	49,400.10	172,026.10
Antimony (and/or its compounds)	4,400.00	40.36	4,440.36
Arsenic (and/or its compounds)	1,088.74	1.81	1,090.55
Barium (and/or its compounds)	N/S	1,789.57	1,789.57
Benzene	0	7.71	7.71
Benzo(G,H,I)perylene	0	4.76	4.76
Cadmium (and/or its compounds)	191.84	2.27	194.11
Carbon disulfide	0	0.27	0.27
Catechol	0	208.30	208.30
Chlorine	0	7,939.23	7,939.23
Chloroform	0	4,090.70	4,090.70
Chromium (and/or its compounds)	9.62	324.26	333.88
Cobalt (and/or its compounds)	0	10.68	10.68
Copper (and/or its compounds)	490.00	1,568.78	2,058.78
Cresols	0	109.75	109.75
Cyclohexane	0	54.88	54.88
Dazomet	N/S	58.96	58.96
Dimethylamine	0	0.50	0.50
Dioxin and dioxin-like compounds	0	0.01	0.01
Ethylbenzene	0	0.45	0.45
Ethylene glycol	0	2.27	2.27
Formaldehyde	0	9,111.69	9,111.69
Formic acid	0	3,268.91	3,268.91
Hydrogen sulfide	1,660.00	N/S	1,660.00
Lead (and/or its compounds)	1,594.35	1,175.06	2,769.41
Manganese (and/or its compounds)	9,010.00	217,485.80	226,495.80
Mercury (and/or its compounds)	31.41	3.73	35.14
Methanol	2,900.00	141,664.20	144,564.20
Methyl isobutyl ketone	0	3,424.04	3,424.04
Naphthalene	0	2.72	2.72
N-Butyl alcohol	0	1,011.34	1,011.34
n-Hexane	0	111.56	111.56
Nickel (and/or its compounds)	0	279.82	279.82
Nitric acid and Nitrate compounds	78,044.00	2,649,533.19	2,727,577.19
Pentachlorophenol	0	0.45	0.45
Phenol	0	856.80	856.80
Phosphorous, Total	5,715.00	N/S	5,715.00
Polycyclic aromatic compounds	0	40.09	40.09
Sodium Dimethyldithiocarbamate	N/S	0.54	0.54
Styrene	0	18.14	18.14
Toluene	0	16.33	16.33
Trichloroethylene	0	0.41	0.41
Triethylamine	0	0.03	0.03
Xylenes	0	809.98	809.98
Zinc (and/or its compounds)	8,520.00	15,647.55	24,167.55
Grand Total	236,280.96	3,131,195.48	3,367,476.44

N/S = pollutant not subject to PRTR reporting in that country.

River ecosystem. In 2010, US EPA characterized as "unacceptable" the risks posed to fish, wildlife, and people by chemical contamination in the Columbia River basin. This high level of risk comes from historic releases to the river, releases that continue to move through the system and are combined with current releases to the river from permitted sources.

Nitric acid and nitrate compounds (2,727,577 kg) were the top reported pollutants released to the Columbia River in 2006. Together with manganese (226,496 kg), ammonia (172,026 kg), methanol (144,564 kg), and zinc (24,168 kg), these five pollutants accounted for more than 98 percent of the total releases to the river and its tributaries reported in both Canada and the United States.

Facilities associated with Non-Ferrous Metal (except aluminum) Production and Processing (732,753 kg), Pulp, Paper, and Paperboard Mills (656,594 kg), Semiconductor and Other Electronic Component Manufacturing (313,371 kg), Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing (86,083 kg), and Water, Sewage and Other Systems (73,062 kg) made up the top five industrial sectors discharging to the river in 2006.

Facilities within the Grocery and Related Product Merchant Wholesaler category reported the largest volume of pollutants released to the river (1,400,600 kg), with the majority made up of nitrogen-containing compounds. These compounds, including ammonia (172,026 kg), can be directly toxic to aquatic life and contribute to algal blooms in marine and estuarine systems.

Mercury and Lead (and Their Compounds) Released to the Columbia River

Mercury was identified as one of four toxic contaminants posing the greatest risk to humans and wildlife within the river basin and/or consuming fish caught from the river. Lead is a persistent and bioaccumulative pollutant with a wide range of adverse effects in humans and wildlife. Hazardous concentrations of lead have been found in many sections of the Columbia River and continued releases add to the river's long-term toxic burden. Releases of these two pollutants (and/or their compounds) are shown in **Table 24**.

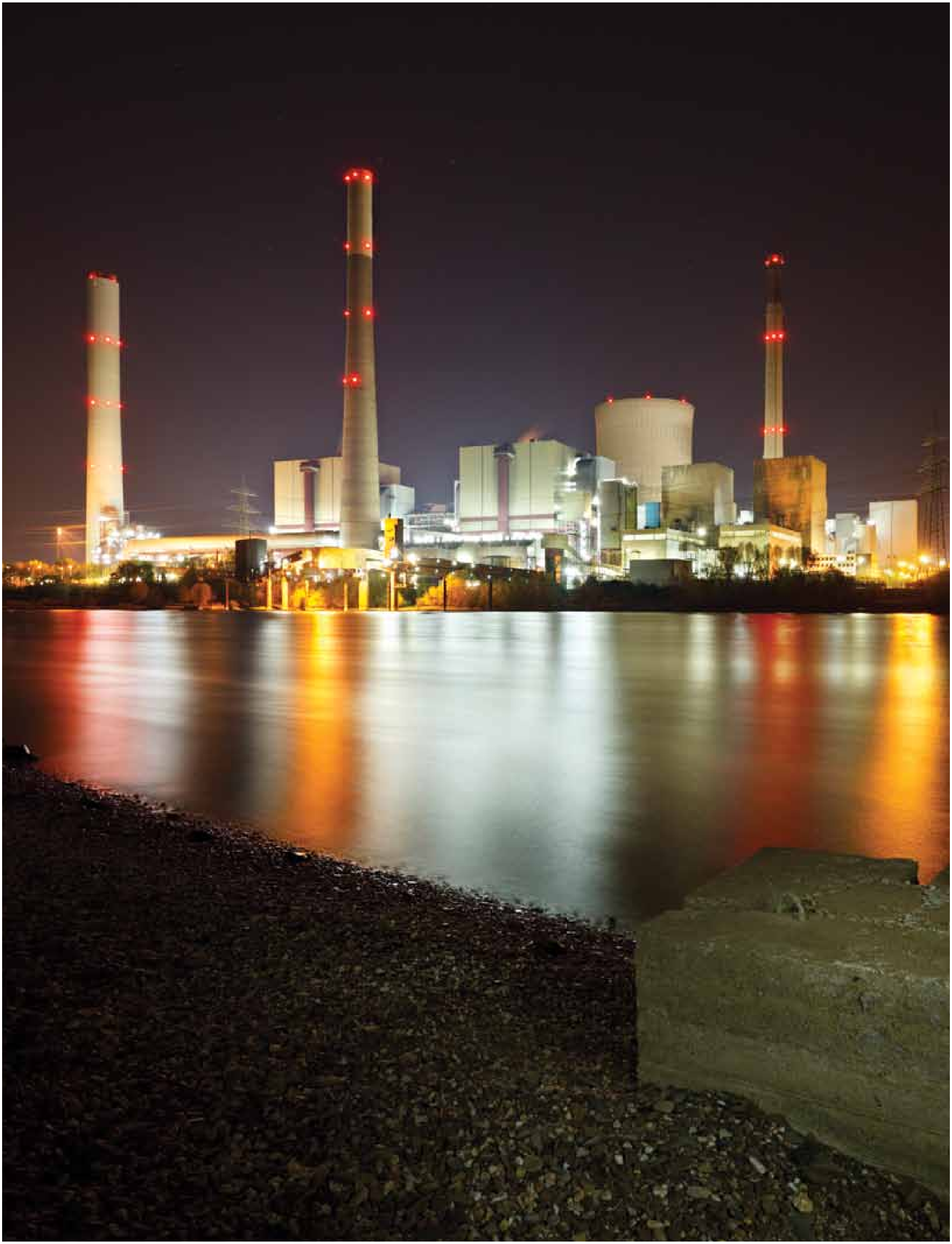
In 2006, seven facilities (six in the United States and one in Canada) reported releases of 35 kg of mercury (and/or its compounds) into surface waters of the Columbia River or its tributaries. The Canadian facility, located in British Columbia and classified within the Nonferrous Metal (except Aluminum) Production and Processing sector, was responsible for 31 kg, or 90 percent of total reported mercury releases within the basin. The remaining six US facilities reporting releases of the pollutant to the river are in the Pulp, Paper, and Paperboard sector.

Forty-three (43) facilities (41 of them located in the United States and two in Canada) reported direct releases of 2,769 kg of lead (and its compounds) to surface waters and/or tributaries of the Columbia River in 2006. The top ten facilities, located in the US, were responsible for 2,573 kg or 93 percent of this total. Seven of the top ten facilities are in the Pulp, Paper, and Paperboard industry sector and one facility is a hazardous waste site. The two top releasers are in the Metal Ore Mining sector; their releases accounted for approximately 65 percent of the total reported releases of lead or its compounds.

Table 24. Releases of Lead and Mercury (and Their Compounds) to the Columbia River, by Top Reporting Sector, NPRI and TRI, 2006

Industry	Data	Lead (and its compounds)	Mercury (and its compounds)	Grand Total* (kg)
Nonferrous Metal (except Aluminum) Production and Processing (3314)	Number of reporting facilities	2	1	
	Amount released (kg)	1,589.49	31.41	1,620.90
Pulp, Paper, and Paperboard Mills (3221)	Number of reporting facilities	17	6	
	Amount released (kg)	760.08	3.73	763.81
Metal Ore Mining (2122)	Number of reporting facilities	3	0	
	Amount released (kg)	235.77	0	235.77
Administration of Environmental Quality Programs (9241)	Number of reporting facilities	1	0	
	Amount released (kg)	136.51	0	136.51
Iron and Steel Mills and Ferroalloy Manufacturing (3311)	Number of reporting facilities	2	0	
	Amount released (kg)	16.78	0	16.78
Other Fabricated Metal Product Manufacturing (3329)	Number of reporting facilities	2	0	
	Amount released (kg)	14.06	0	14.06
Basic Chemical Manufacturing (3251)	Number of reporting facilities	1	0	
	Amount released (kg)	7.48	0	7.48
Ship and Boat Building (3366)	Number of reporting facilities	1	0	
	Amount released (kg)	3.63	0	3.63
Navigational, Measuring, Electromedical, and Control Instruments Mfg (3345)	Number of reporting facilities	1	0	
	Amount released (kg)	1.60	0	1.60
Coating, Engraving, Heat Treating, & Allied Activ. (3328)	Number of reporting facilities	2	0	
	Amount released (kg)	1.16	0	1.16
Subtotal, Top 10 industry sectors	Amount released (kg)	2,766.56	35.14	2,801.70
Total, All sectors	Amount released (kg)	2,769.40	35.14	2,804.54

*Note: Some facilities reported both lead and mercury (and their compounds).

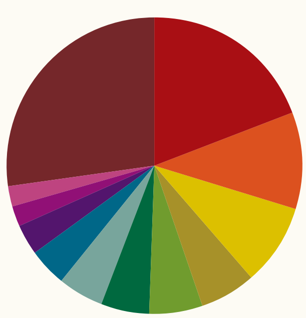


Comparability of North American Pollutant Release and Transfer Data

The integrated, North American PRTR data presented in this report constitute the most comprehensive picture of industrial pollution across North America, revealing releases and transfers of 5.7 billion kilograms of toxic pollutants in 2006 from industrial facilities in Canada, Mexico and the United States. As shown in **Figure 12**, 11 industrial sectors accounted for 4.1 billion kg, or about 72%, of the total releases and transfers reported across the region in 2006. They included metal mining and activities related to the oil and gas extraction sector; fossil-fuel power plants; chemicals manufacturing; and primary metals manufacturing.

This North American picture is incomplete, however, as a combination of national reporting exemptions for certain sectors and pollutants, along with incomplete reporting by some facilities, results in significant gaps in the portrait of how much pollution is generated and managed by North American industry. As explained in **Using and Understanding *Taking Stock*** (**Appendix 1**), there are differences among the three countries in PRTR reporting requirements relative to sector and pollutant coverage, numbers of pollutants subject to reporting, and reporting thresholds. An understanding of these differences is important in order to interpret and compare data across the region.

Figure 12. Top Reporting Sectors, North America, 2006*



(kg)	
1,102,965,072	Support Activities - Mining & Oil/Gas Extraction (2131)
601,566,575	Metal Ore Mining (2122)
505,531,393	Electric Power Generation/Transmission/Distrib. (2211)
357,308,792	Basic Chemical Manufacturing (3251)
323,137,267	Iron & Steel Mills & Ferroalloy Manuf. (3311)
310,624,245	Oil & Gas Extraction (2111)
281,543,211	Nonferrous Metal (except Alum.) Production/Processing (3314)
240,086,148	Waste Management & Remediation Services (562)
182,079,274	Petroleum & Coal Products Manufacturing (3241)
137,708,761	Pulp, Paper, & Paperboard Mills (3221)
122,939,901	Water, Sewage & Other Systems (2213, 2221)†
1,546,457,442	All other Sectors

* Note: These top sectors represented 73% of all reported releases and transfers in North America for 2006.
† Wastewater Treatment (sector 2213 in Canada and the United States) corresponds to 2221 in Mexico (Water Collection, Treatment, and Supply).

Sector and Pollutant Coverage of PRTR Programs

For instance, **Table 25** shows that of the 539 pollutants reported overall in 2006, a total of 26 pollutants (or pollutant groups) reported among the top eleven sectors represented 63% of the total for the region. However, certain industrial activities and/or pollutants are not subject to reporting in one or more of the countries, making the task of comparing them difficult. In fact, of all substances subject to reporting under any of the North American PRTR programs, approximately 60 pollutants (or pollutant groups) are common to all three, with 44 of these reported by facilities in 2006.

Key examples of how comparability is hindered include oil and gas extraction activities, an important industrial sector in North America. There are over 200,000 oil- and gas-producing wells in Canada.[47] In 2006, facilities involved in oil and gas extraction and support activities accounted for approximately 1.4 billion kg, or more than half of all releases and transfers reported in that country.[48] Of this total, hydrogen sulfide accounted for more than 90%. In the United States, both the oil and gas extraction sector and hydrogen sulfide are exempt from reporting under the TRI. It is therefore difficult to know the magnitude of releases of hydrogen sulfide, as well as other pollutants, released or transferred by this US sector. However, an industry report shows almost 900,000 oil and gas wells in operation in that country.[49]

In Mexico, where this sector is subject to the RETC (and the reporting threshold for hydrogen sulfide is lower than in Canada), zero hydrogen sulfide emissions were reported by Mexican oil and gas extraction facilities in 2006. In fact, while there were approximately 6,300 producing wells in that country,[50] very little was reported to the RETC by facilities in this sector (i.e., about 10,000 kg in total releases and transfers, reported by 29 facilities).

Table 25 also shows that a number of the top pollutants reported in 2006 are not subject to reporting under Mexico's RETC, although the sectors reporting them in Canada and the United States are also common to Mexico. They include many pollutants released to air in largest proportions by fossil fuel-powered electric utilities in both Canada and the United States—such as hydrochloric acid, sulfuric acid, manganese and vanadium compounds, and hydrogen fluoride. In Mexico, oil and coal-fired electric utilities were among the top reporting industries in 2006, but the pollutants reported in largest proportions by these facilities (e.g., hydrogen sulfide and formaldehyde) differed from Canada and the United States. A likely reason is the absence of substances such as hydrochloric acid and sulfuric acid from the RETC list.

Table 25 gives information about the 26 pollutants, out of a total of 539, reported in largest proportions in 2006. You can also find out more about other substances of special interest (e.g., known or suspected carcinogens) reported in much smaller proportions, but with potentially greater impacts on human health and the environment, at www.cec.org/takingstock.

This year's special feature analysis of pollutant releases to water illustrates very clearly the impacts of differing reporting requirements and incomplete reporting on North American PRTR data. Releases to water were dominated by certain industrial activities—including public wastewater treatment plants, fossil-fuel power plants, and the food and chemicals manufacturing sectors. However, while the public wastewater treatment sector accounted for about 98 million kg (or 84%) of all reported Canadian discharges to water in 2006, data are almost non-existent for this sector in Mexico and the United States.

The reason for this is that publicly owned treatment works (POTWs) are exempt from the US TRI; and in Mexico, while facilities discharging to national water bodies are required to report to RETC, very few wastewater treatment plants did so in 2006. There are an estimated 16,000 POTWs in the United States,[51] and almost 1,600 public wastewater treatment facilities in Mexico.[52] Given the data reported by this sector in Canada, it is likely that we would see a substantial increase in reporting, particularly of releases to water, by similar facilities in the United States and Mexico.

Another example of gaps in sector and pollutant coverage highlighted in the special feature analysis is that of nitric acid and nitrate compounds. These pollutants accounted for the largest proportions discharged to water in both Canada and the United States, but are not subject to Mexico's RETC. As explained in this report, releases of nitrates can contribute significantly to the degradation of water quality. Since they were reported by Canadian and US facilities involved in food manufacturing, pulp and paper, and wastewater treatment, sectors common to Mexico, one would also expect to see releases to water of nitrates in that country.

47 Canadian Association of Petroleum Producers. 2010. *Statistical Handbook for Canada's Upstream Petroleum Industry.* November. Tables 3.17 and 3.18, http://www.capp.ca/library/statistics/handbook/pages/statisticalTables.aspx?sectionNo=1#7p1LJs204ZSQ. The CAPP figures are only for the Western provinces of Alberta, British Columbia, and Saskatchewan and also omit offshore drilling.

48 In 2005 almost 3,600 oil and gas production facilities reported to NPRI (see *Taking Stock 2005*, p. 67), but the majority of these facilities reported releases of criteria air contaminants only, which are not included in this report.

49 US EPA. 2008 Sector Performance Report, pp. 78–89: Oil & Gas, http://www.epa.gov/sectors/pdf/2008/oil_gas.pdf.

50 Pemex. 2007. Exploration and Production (cover), http://www.pemex.com/files/content/2_Exploration_08.pdf.

51 US EPA. 2007. *Opportunities for and Benefits of Combined Heat and Power at Water Treatment Facilities.* April. http://www.epa.gov/chp/documents/wwtf_opportunities.pdf.

52 Conagua. 2007. *Inventario nacional de plantas municipales de potabilización y de tratamiento de aguas residuales en operación* (December). www.conagua.gob.mx.

Table 25. **Comparing North American Releases and Transfers, Top Pollutants and Top Sectors, 2006**

Sector/Pollutant	Canada (kg)	Mexico (kg)	United States (kg)	North America (kg)
Support Activities for Mining and Oil and Gas Extraction (2131)*				
Hydrogen Sulfide	1,100,322,051	0	N/S	1,100,322,051
Carbon Disulfide	1,144,730	N/S	0	1,144,730
Methanol	318,082	N/S	0	318,082
n-Hexane	237,336	N/S	0	237,336
1,2,4-Trimethylbenzene	211,585	N/S	0	211,585
Subtotal, Top Pollutants	**1,102,233,784**	**0**	**0**	**1,102,233,784**
Metal Ore Mining (2122)				
Zinc (and its compounds)	1,033,538	N/S	229,663,480	230,697,018
Lead (and its compounds)	8,585,595	1,250	194,040,814	202,627,659
Copper (and its compounds)	1,990,402	N/S	76,239,466	78,229,868
Arsenic (and its compounds)	191,732	135	45,733,569	45,925,436
Manganese (and its compounds)	184,653	N/S	13,818,292	14,002,945
Subtotal, Top Pollutants	**11,985,920**	**1,385**	**559,495,621**	**571,482,926**
Electric Power Generation, Transmission and Distribution (2211)				
Hydrochloric Acid	4,142,371	N/S	216,542,605	220,684,976
Barium (and its compounds)	N/S	N/S	93,914,861	93,914,861
Sulfuric Acid	2,063,452	N/S	55,610,024	57,673,476
Hydrogen Fluoride	1,504,516	N/S	27,054,872	28,559,388
Manganese (and its compounds)	2,468,906	N/S	16,692,023	19,160,929
Subtotal, Top Pollutants	**10,179,245**	**0**	**409,814,385**	**419,993,630**
Basic Chemical Manufacturing (3251)				
Methanol	3,073,201	N/S	42,083,857	45,157,058
Nitric acid and Nitrate compounds	2,631,092	N/S	41,595,177	44,226,269
Manganese (and its compounds)	24,976	N/S	24,858,848	24,883,824
Ammonia, Total	425,950	N/S	18,666,836	19,092,786
Ethylene	857,081	N/S	16,635,893	17,492,974
Subtotal, Top Pollutants	**7,012,300**	**0**	**143,840,611**	**150,852,911**
Iron and Steel Mills and Ferroalloy Manufacturing (3311)				
Zinc (and its compounds)	16,716,372	N/S	209,358,009	226,074,381
Manganese (and its compounds)	4,161,774	N/S	42,789,825	46,951,599
Nitric acid and Nitrate compounds	21,793	N/S	14,601,743	14,623,536
Lead (and its compounds)	1,752,402	207,367	12,132,343	14,092,112
Chromium (and its compounds)	335,265	10,082	7,123,760	7,469,107
Subtotal, Top Pollutants	**22,987,606**	**217,449**	**286,005,680**	**309,210,735**
Oil and Gas Extraction (2111)*				
Hydrogen Sulfide	278,067,161	0	N/S	278,067,161
Methanol	13,547,418	N/S	0	13,547,418
Ammonia, Total	2,257,951	N/S	0	2,257,951
Carbonyl Sulfide	1,772,597	N/S	0	1,772,597
Carbon Disulfide	1,451,699	N/S	0	1,451,699
Subtotal, Top Pollutants	**297,096,826**	**0**	**0**	**297,096,826**

Table 25. Comparing North American Releases and Transfers, Top Pollutants and Top Sectors, 2006 (cont')

Sector/Pollutant	Canada (kg)	Mexico (kg)	United States (kg)	North America (kg)
Nonferrous Metal (except Aluminum) Production and Processing (3314)				
Copper (and its compounds)	8,069,198	N/S	125,868,877	133,938,075
Lead (and its compounds)	42,968,731	171,931	24,865,754	68,006,416
Zinc (and its compounds)	2,422,410	N/S	25,282,266	27,704,676
Sulfuric Acid	15,494,959	N/S	236,698	15,731,657
Nickel (and its compounds)	468,323	3,938	6,903,687	7,375,948
Subtotal, Top Pollutants	**69,423,621**	**175,869**	**183,157,282**	**252,756,772**
Waste Management and Remediation Services (562)				
Zinc (and its compounds)	7,874,118	N/S	42,441,396	50,315,514
Lead (and its compounds)	4,506,280	60	32,651,862	37,158,202
Toluene	3,945,845	N/S	17,807,539	21,753,384
Xylenes	3,765,304	N/S	14,721,201	18,486,505
Asbestos	11,785,618	0	4,219,493	16,005,111
Subtotal, Top Pollutants	**31,877,165**	**60**	**111,841,491**	**143,718,716**
Petroleum and Coal Products Manufacturing (3241)				
Sulfuric Acid	116,409,168	N/S	3,611,222	120,020,390
Nitric acid and Nitrate compounds	323,950	N/S	10,245,343	10,569,293
Ammonia, Total	4,431,619	N/S	4,858,812	9,290,431
Ethylene Glycol	223,282	N/S	8,041,229	8,264,511
Toluene	495,273	N/S	2,380,330	2,875,603
Subtotal, Top Pollutants	**121,883,292**	**0**	**29,136,936**	**151,020,228**
Pulp, Paper, and Paperboard Mills (3221)				
Methanol	11,677,807	N/S	62,795,882	74,473,689
Manganese (and its compounds)	4,328,261	N/S	8,196,455	12,524,716
Ammonia, Total	3,790,597	N/S	8,168,282	11,958,879
Hydrochloric Acid	2,001,131	N/S	6,981,155	8,982,286
Phosphorous, Total	4,552,058	N/S	N/S	4,552,058
Subtotal, Top Pollutants	**26,349,854**	**0**	**86,141,774**	**112,491,628**
Water, Sewage and Other Systems (2213)†§				
Ammonia, Total	56,859,946	N/S	13,082	56,873,028
Nitric acid and Nitrate compounds	45,590,565	N/S	3,539,267	49,129,832
Phosphorous, Total	15,221,677	N/S	N/S	15,221,677
Chlorine	321,557	N/S	36,567	358,124
Zinc (and its compounds)	356,427	N/S	0	356,427
Subtotal, Top Pollutants	**118,350,172**	**0**	**3,588,916**	**121,939,088**
Total, 26 Top Pollutants	**1,819,379,785**	**394,763**	**1,813,022,696**	**3,632,797,244**

N/S = the pollutant is not subject to reporting under that country's PRTR. 0 kg = the pollutant is subject to reporting, but no amounts were reported.

* In the United States, activities related to oil and gas extraction are exempt from reporting; this applies to establishments in sectors 2111 (oil and gas extraction) and 2131 (facilities providing support services required for the mining and quarrying of minerals and for the extraction of oil and gas)

† In the United States, publicly-owned treatment works (POTWs) are exempt from reporting (the US data shown are from private or federal facilities).

§ Wastewater Treatment (sector 2213 in Canada and the United States) corresponds to 2221 in Mexico (Water Collection, Treatment, and Supply).

Readers are reminded that in addition to the exemptions indicated above, each country has specific reporting requirements for sectors (e.g., specific activities exemptions for the mining and waste management sectors), as well as specific thresholds or other requirements relative to facilities and pollutants. See: **Using and Understanding *Taking Stock***.

Reported cross-border transfers also reflect the challenge of comparing incomplete and very different North American pollutant data. Some of the toxic substances reported transferred across national borders in the greatest volume in Canada and the United States, such as carbon disulfide, zinc compounds, methanol, and hydrochloric acid, are exempt from the Mexican RETC program. As a result, once these pollutants are transferred across the border—for example, when zinc is transferred from the United States to Mexico for disposal or recycling—they cannot be tracked.

PRTR Reporting Thresholds

In addition to gaps in PRTR pollutant and sector coverage, a factor that potentially affects our understanding of North American industrial pollution is that of reporting thresholds. In Canada and the United States, only facilities with at least 10 full-time employees (or the equivalent) are required to report to the PRTR programs, with some exceptions. There is no employee threshold in Mexico. It would be interesting to explore, with the help of available employment statistics, the possible impact on PRTR reporting of the Canadian and US employee threshold.

In all three countries, there are also reporting thresholds for substances. For certain pollutants known to pose serious risks to human health and the environment (e.g., lead, mercury, dioxins and furans), the governments have set lower reporting thresholds; however, the standard "activity" (manufacture, process or otherwise use) threshold in Canada and the United States is approximately 10,000 kg. In Mexico, the standard "release" threshold is 1,000 kg, with an "activity" threshold of 5,000 kg (see **Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006**).

These reporting thresholds likely mask the real magnitude of North American industrial releases and transfers and might not be adequate to assess exposure and environmental risk. To illustrate this point: among Mexican facilities reporting to the RETC in 2006, only about 6% reported releases and transfers of more than 10,000 kg—suggesting that if the RETC reporting threshold were the same as the Canadian NPRI and US TRI, only a small proportion of all releases and transfers in Mexico would be reported.

Subnational efforts have been undertaken with the intention of capturing data from a wide range of facilities whose typical releases do not meet national reporting thresholds. Examples include the *Massachussetts Toxics Use Reduction Act* (TURA) and the *City of Toronto's Chemicals in Toronto: Reduction and Awareness in our Community* (ChemTRAC) program (see text box on this page). These initiatives establish lists of priority substances and lower (or no) reporting thresholds for specific pollutants of concern (e.g., carcinogens). They recognize that concentrations of small- and medium-size facilities potentially pose important health and environmental risks through their use and release of substances of concern. Data obtained through these efforts can shed light on the gaps created by national reporting thresholds and provide insight about the true magnitude of industrial releases and transfers.

Notwithstanding the difficulty involved in comparing North American PRTR reporting, the data compiled and analyzed in this report are useful in that they reveal associations between releases of certain pollutants and specific industrial sectors and activities—as indicated by the data for fossil fuel power plants, pulp and paper mills, and other sectors. Analyses of PRTR data can thus provide a basis for the development of pollutant profiles for sectors common to the region.

Similarly, the analysis of releases of pollutants of special interest, such as developmental or reproductive toxicants, PBTs, and carcinogens—particularly when reported consistently over time—can highlight areas for priority consideration relative to human and environmental health. A great deal of information exists on the inherent toxicity and potential risk of these pollutants, which have been identified by all three governments as important enough to warrant reporting at very low thresholds.

Thus, North American PRTR data can provide information for decision-making relative to the prevention and reduction of industrial pollution. With this objective, the CEC continues to work with the PRTR programs of the three countries to improve the overall quality and comparability of North American PRTR data. As part of this effort, the CEC and the three Parties developed the *Action Plan to Enhance the Comparability of Pollutant Release and Transfer Registers in North America*, which outlines specific reporting issues to address in the three countries and recommendations relative to increasing PRTR data comparability (see the following text box).

The City of Toronto's ChemTRAC Program

In Toronto, a few hundred large facilities report their emissions through Canada's National Pollutant Release Inventory; however, the city estimates that 80% of emissions from small and medium-size facilities go unreported each year. Toronto has identified 25 "priority contaminants" released to air by such facilities that pose the greatest potential risk to public health. The goal of the ChemTRAC Program is to encourage businesses to voluntarily reduce their emissions by requiring them to calculate and publicly report them. The ChemTRAC Program also includes a set of tools to assist businesses with reporting. For more information, see http://www.toronto.ca/chemtrac/chemicals.htm

Ongoing Activities of the CEC's North American PRTR Project

In an effort to improve the overall quality and comparability of North American PRTR data, the CEC continues to work with the PRTR programs of the three countries.

As part of this effort, the CEC and the three Parties developed the *Action Plan to Enhance the Comparability of Pollutant Release and Transfer Registers in North America*, which outlines specific reporting issues to address in the three countries and recommendations on how to do so. Planned initiatives include the development of sector-based work that would facilitate the identification of specific data quality issues and allow for increased collaboration among North American industry sectors.

An essential component of the North American PRTR project is stakeholder involvement. Every year, the CEC convenes the public meeting of the North American PRTR project, to bring together government officials, nongovernmental organizations, industry representatives, academics, and citizens. This meeting represents an opportunity for all stakeholders to exchange information and provide input regarding the direction of the project and the *Taking Stock* report. The meeting summary and all comments and suggestions received are compiled and made public on the CEC website.

The CEC is also involved with other international PRTR efforts, including the PRTR Task Force of the Organization for Economic Co-operation and Development (OECD), and PRTR activities under the United Nations Institute for Training and Research (UNITAR).

Using and Understanding *Taking Stock*

For those new to pollutant release and transfer registers or to *Taking Stock*, this section describes the characteristics of the three national PRTRs, including the features that are unique to the system of each country. It also describes the scope and methodology and terminology used in this report.

Features of the Three North American PRTRs

Taking Stock is based on information provided by North America's three national PRTR programs:

- Canada's NPRI (http://www.ec.gc.ca/pdb/npri/npri_online_data_e.cfm)
- The US TRI (http://www.epa.gov/triexplorer)
- Mexico's RETC (http://app1.semarnat.gob.mx/retc/index.php).

Each country's PRTR has evolved with its own list of pollutants, sector coverage, and reporting requirements. **Table A-1** compares features of the three PRTRs, as of the 2006 reporting year.

Table A-1. Features of the Three North American PRTRs

Feature	Canadian National Pollutant Release Inventory (NPRI)	Mexican *Registro de Emisiones y Transferencia de Contaminantes* (RETC)	US Toxics Release Inventory (TRI)
First mandatory reporting year	1993	2004	1987
Industrial activities or sectors covered	Any facility manufacturing or using a listed chemical, except for exempted activities such as research, repair, retail sale, agriculture and forestry	Facilities under federal jurisdiction: petroleum, chemical/petrochemical, paints/ inks, metallurgy (iron/steel), automobile manufacture, cellulose/ paper, cement/ limestone, asbestos, glass, electric utilities and hazardous waste management; and facilities with specific activities subject to federal jurisdiction, such as the transfer of hazardous wastes or discharges to national water bodies	Manufacturing and federal facilities, electric utilities (oil- and coal-fired), coal and metal mines, hazardous waste management and solvent recovery facilities, chemical wholesalers and petroleum bulk terminals
Number of pollutants subject to reporting	321 pollutants or pollutant groups	104 pollutants	581 individual pollutants and 30 pollutant categories
Employee threshold	Generally 10 employees or more. For certain activities, such as waste incineration and wastewater treatment, the 10-employee threshold does not apply	No employee thresholds	10 or more full-time employees (or equivalent number of hours)
Substance "activity" (manufacture, process or otherwise use) thresholds, or "release" thresholds	"Activity" thresholds of 10,000 kg for most chemicals. Lower thresholds for certain PBTs, metals, polycyclic aromatic hydrocarbons, dioxins and furans, and criteria air contaminants	"Release" and "activity" thresholds for each pollutant (a facility must report if it meets or exceeds either threshold). Except for greenhouse gases, "release" thresholds range from 1 kg to 1,000 kg. "Activity" thresholds range from 5 kg to 5,000 kg. Any release of polychlorinated biphenyls (PCBs) and sulfur hexafluoride, and any release or activity involving dioxins and furans, is reportable	"Activity" thresholds of about 11,340 kg (with an "otherwise use" threshold of about 5,000 kg); lower thresholds for certain pollutants (e.g., persistent bioaccumulative and toxic (PBT) chemicals and dioxins and furans)
Types of releases and transfers covered	On-site releases to air, water, land, and disposal, including underground injection; transfers off-site for disposal; treatment prior to final disposal (including sewage); recycling and energy recovery	On-site releases to air, water and land; transfers off-site for disposal, recycling, reutilization, energy recovery, treatment, co-processing (input from another production process) and sewage	On-site releases to air, water, land, and underground injection; transfers off-site to disposal; recycling, energy recovery, treatment and sewage

Overview of PRTR Reporting Requirements

Which Pollutants Must Be Reported?

The pollutants subject to national PRTR reporting requirements are listed because they meet certain criteria for chemical toxicity and the potential for risk to human health and the environment. Each PRTR system covers a specific list of substances: NPRI spans over 300 pollutants, TRI approximately 600, and RETC 104.

As of April 2006, the Chemical Abstracts Service (CAS) listed more than 27 million chemical substances and identified more than 239,000 of them as regulated or covered by chemical inventories worldwide.

Facilities report the amounts of each pollutant they have released to the environment at their own location (on site). They also report how much of the substance was sent off-site for disposal, or transferred for recycling or other waste management. Pollutant-based reporting thresholds exist, and certain pollutants have lower reporting thresholds due to their greater potential for risk to human health and the environment. In general, the PRTR pollutant thresholds are as follows:

- For Canada's NPRI and the US TRI, a facility must report if it manufactures, processes, or otherwise uses (e.g., in cleaning industrial equipment) 10,000 kilograms (NPRI) or 11,340 kilograms (TRI) of a listed pollutant.

- Mexico's RETC has both an "activity" threshold and a "release" threshold. A facility must report if it meets or exceeds either threshold. The RETC "activity" threshold is typically either 2,500 kilograms or 5,000 kilograms, depending on the substance; the typical "release" threshold is 1,000 kilograms.

For more information, see **Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006**.

In order to provide more information about PRTR pollutants, the *Taking Stock* report and online database also categorize them as follows:

- Known or suspected carcinogens, based on the World Health Organization's International Agency for Research on Cancer (IARC) and California's Office of Environmental Health Hazard Assessment (OEHHA) *Proposition 65* list
- Developmental or reproductive toxicants, based on California's *Proposition 65* list
- Persistent, bioaccumulative and toxic (PBT) substances, which have properties that render them a long-term environmental and health threat, even in small quantities
- Metals: Metals occur naturally, but their exposure, liberation, or transformation in such processes as mining, coal combustion and smelting enlarge their proportional effects in the environment. In addition, the toxicity of certain metals and their compounds can depend on the forms they take in the environment. Many metals are also considered to be PBT substances.

Ranking Pollutants by Toxic Equivalency Potential (TEP)

To put pollutant releases into context, *Taking Stock* includes a chemical ranking system that takes into account both a pollutant's toxicity and its potential for human exposure, using toxic equivalency potentials (TEPs). TEPs indicate the relative human health risk associated with a release of one unit of a pollutant, compared to the risk posed by the release of one unit of a reference substance. TEP weights are calculated using the CalTOX model developed by California regulatory agencies. TEPs are one of many different screening tools, each of which is based on a series of assumptions, thus yielding different results.

Readers should note that the TEP analysis is limited, in that a release does not directly correlate to actual exposures or levels of risk. In addition, not all of the substances have an assigned TEP (information on their toxicity or exposure potential may be missing). However, these pollutants should not be assumed to be without risk. Also, TEPs are available only for air and water releases and it should not be assumed that other types of pollutant releases (e.g., to land) present no risk.

Reporting of Criteria Air Contaminants and Greenhouse Gases

Currently, data for releases of **Criteria Air Contaminants** (CACs) and **Greenhouse Gases** (GHGs) are not included in *Taking Stock*, but will be in future editions. CACs—including carbon monoxide, nitrogen oxides, particulate matter, sulfur oxides and volatile organic compounds—are a group of chemicals associated with environmental effects such as smog, acid rain and regional haze, and health effects such as respiratory illnesses. Major sources of CACs are the burning of fossil fuels, as well as natural resource extraction and a variety of manufacturing activities. GHGs contribute to climate change by trapping heat within the earth's atmosphere. They are the subject of the international Kyoto Protocol, which came into force in 2005. The major GHGs include carbon dioxide, methane, nitrous oxide and three groups of fluorinated gases. Some of the main anthropogenic sources of GHGs are the burning of fossil fuels, deforestation and agricultural activities.

CACs are reported to Canada's NPRI and GHGs are reported to Mexico's RETC, but these pollutants are not subject to US TRI reporting. However, there are other sources of information on emissions of these pollutants in all three countries:

CAC:

- Canadian NPRI facility-specific CAC data, available on the NPRI website
- US National Emissions Inventory (www.epa.gov/air/data/neidb.html)
- Mexico National Emissions Inventory (Inventario nacional de emisiones de México), at: www.ine.gob.mx/dica/547-calaire-inem

GHG:

- Canadian GHG Inventory and Reporting Program (www.ec.gc.ca/ges-ghg/default.asp?lang=En&n=1357A041-1)
- US GHG Inventory (www.epa.gov/climatechange/emissions/)
- US GHG power plant emissions (eGRID, 2005 data), available at: www.epa.gov/cleanenergy/energy-resources/egrid/index.html
- Mexican RETC facility-specific GHG data, available at the RETC website.

Table A-2. Top Pollutant Releases to Air and Water in North America*, by TEP, 2006

Pollutant	Releases to Air (kg)	Non-Cancer† Risk Score (air)
Hydrochloric Acid	246,842,049	2,962,104,590
Hydrogen Sulfide	20,710,311	704,150,585
Ammonia, Total	76,227,739	289,665,407
Hydrogen Fluoride	35,525,713	127,892,565
Toluene	24,465,003	24,465,003
Methanol	81,801,255	7,362,113
Xylenes	18,512,929	4,998,491
Styrene	24,874,701	1,989,976
n-Hexane	20,305,817	609,175
Sulfuric Acid	76,786,919	–

Pollutant	Releases to Water (kg)	Non-Cancer† Risk Score (water)
Barium (and/or its compounds)	490,180	23,528,622
Manganese (and/or its compounds)	4,236,939	14,829,287
Zinc (and/or its compounds)	720,689	10,089,651
Ammonia, Total	52,281,766	522,818
Methanol	3,718,348	37,183
Ethylene Glycol	743,939	3,125
Nitric acid and Nitrate compounds	155,018,730	–
Phosphorous, Total	6,798,701	–
Sodium Nitrite	1,004,143	–
Chlorine	334,272	–

* as shown in **Figures 3** and **4** (see **Chapter 1**);
† "Non-Cancer" refers to potential health impacts other than cancer, such as developmental/reproductive, acute respiratory, or other effects. Not all pollutants have been evaluated and assigned TEP weights, but readers should not necessarily assume that these pollutants have no potential for toxicity (for example, nitrate compounds are associated with nutrient loading and negative impacts on aquatic ecosystems). "–" indicates no TEP available for that pollutant.

The TEP reference chemical for carcinogens is benzene and the reference chemical for non-carcinogens is toluene. The TEP weights used in the *Taking Stock* report and online database have been taken from the Scorecard website (www.scorecard.org), Sept. 2009. The TEP weight is multiplied by the amount of release to provide a score for each pollutant.

The top 10 pollutants released to air and water by North American facilities, as shown in **Figures 3** and **4** of this report (**Chapter 1**), have been ranked by their TEP scores in **Table A-2**. All of the associated risk scores (for those pollutants for which TEP weights are available) relate to non-cancer effects. Ranking releases according to their potential toxicity highlights the fact that volume is not always the most important consideration relative to releases to the environment.

Which Industries Report?

Each country requires PRTR reporting by facilities in specific industrial sectors or undertaking specific industrial activities.

- In Canada, all facilities that meet reporting thresholds and requirements report to the NPRI, with the exception of a few resource-based sectors and certain activities such as research laboratories.
- In Mexico, all industrial sectors regulated under federal law are required to report to the RETC, along with facilities in other sectors that engage in activities subject to federal regulation. These include facilities that use boilers, transfer hazardous wastes, or discharge into national water bodies.
- In the United States, TRI requires reporting by federal facilities, most manufacturing facilities and industries that service manufacturing facilities (e.g., electric utilities and hazardous waste management facilities). A few resource-based sectors, such as oil and gas extraction, are exempt from reporting

North American Industry Classification System

Canada, Mexico and the United States have adopted the North American Industry Classification System (NAICS), whose codes are used to categorize the industrial activities of a facility. NAICS codes were established in 1997 and since 2006 they have been incorporated into PRTR reporting to replace the standard industrial classification (SIC) codes used by each country. Although there is some variation among the three countries in the subsector categorizations and codes used, the breakdown of industrial sectors into general categories is the same (see the following text box). For more information about the implementation of the NAICS system in each country, see:

North American Industry Classification System

NAICS code	Industry
11	Agriculture, Forestry, Fishing and Hunting
21	Mining, Quarrying and Oil and Gas Extraction
22	Utilities (Electricity, Water and Gas Distribution)
23	Construction
31/32/33	Manufacturing
41/42/43	Wholesale Trade
44/45/46	Retail Trade
48/49	Transportation and Warehousing
51	Information and Cultural Industries
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific and Technical Services
55	Management of Companies and Enterprises
56	Administrative and Support, Waste Management and Remediation Services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment and Recreation
72	Accommodation and Food Services
81	Other Services (except Public Administration)
91/92/93	Public Administration

- Canada: http://www.statcan.gc.ca/subjects-sujets/standard-norme/naics-scian/2007/list-liste-eng.htm
- Mexico: http://www.inegi.org.mx/est/contenidos/espanol/metodologias/censos/scian2007_1.pdf
- United States: http://www.census.gov/cgi-bin/sssd/naics/naicsrch?chart=2007

PRTR reporting requirements are based in part on the industrial activity undertaken within a facility, and not only the industry code assigned to that facility. Therefore, not all facilities within a given sector might have to report. For example, within the economic sector that includes dry-cleaning only those facilities undertaking the actual dry-cleaning process, and not clothing drop-off points, might be required to report. Another example is a food processing plant that is required to report because it has its own power plant to generate electricity.

Employee Thresholds

Both NPRI and TRI have an employee threshold, generally corresponding to the equivalent of 10 full-time employees (with some exceptions for pollutants or certain types of facilities). Mexico's RETC does not have an employee threshold. More information on reporting instructions is available on the NPRI, RETC and TRI websites:

- NPRI guidance documents: http://www.ec.gc.ca/inrp-npri/default.asp?lang=En&n=9BAE017F-1
- RETC reporting instructions: http://app1.semarnat.gob.mx/retc/contact/index.html
- TRI reporting materials and guidance: http://www.epa.gov/triinter/report/index.htm

Taking Stock Terminology

Taking Stock uses the following categories for presenting information on pollutant releases and transfers (see **Figure A-1**).

Releases

- ***On-site releases*** describes releases that occur at a facility-that is, pollutants that are released into the air or water, injected into underground wells, or put in landfills "inside the fence line."
- ***Off-site releases*** describes pollutants sent off-site for disposal. Waste sent off-site to another facility for disposal may be disposed of on land, in landfills or by underground injection. These methods are the same as on-site releases, but they occur at locations other than at the originating facility.

Transfers

- ***Transfers to recycling*** describes substances sent off-site for recycling.
- ***Transfers for further management*** includes pollutants (other than metals*) sent off-site for treatment, energy recovery, or to sewage.

***A note about metals**: Metals sent off-site for disposal, sewage, treatment or energy recovery are included in the *off-site releases* category. This mirrors the US TRI practice of classifying all transfers of metals as "transfers to disposal," because metals sent to energy recovery, treatment or sewage treatment may be captured and removed from waste and disposed of in landfills or by other disposal methods. This approach recognizes the physical nature of metals, and acknowledges that metals sent to disposal, sewage, treatment or energy recovery are not likely to be destroyed, and therefore they may eventually enter the environment.

Because this terminology is specific to *Taking Stock*, the terms *release* and *transfer* as defined here may differ from their use in NPRI, RETC and TRI.

Taking Stock Scope and Methodology

Data from the three countries' PRTRs were obtained by the CEC from the three governments or retrieved from their publicly accessible websites. The CEC received the data for this year's edition of *Taking Stock* from Canada and the United States in September 2009, and from Mexico in January 2010.[53]

With the exception of criteria air contaminants (CACs) and greenhouse gases (GHGs), all reported data from the three countries are accessible through the *Taking Stock Online* integrated North American PRTR database.

The methodology used in preparation of the annual *Taking Stock* report and online database includes the following:

- The PRTR data from each country are compiled for the *Taking Stock* integrated, North American PRTR database. This involves standardizing data fields used in the three countries—for example, aggregating reported off-site transfers to disposal (NPRI) into an "off-site releases" category (see *Taking Stock* Terminology, above or online).
- Certain individual reported substances, including many metals, are aggregated into pollutant groups or categories (e.g., lead and its compounds, xylene isomers). In these cases, no specific CAS number for the pollutant group is assigned.
- The data are submitted to a general review in order to identify inconsistencies or possible errors, which are then communicated to the national PRTR programs. Although the CEC cannot be responsible for erroneous reporting by facilities, the goal of the North American PRTR project is to use the best data possible.
- Data for each reporting year (going back to 1998) are refreshed at least annually—a fact readers are urged to remember, particularly when they attempt to use the data to analyze time trends. Users can visit the national websites to view changes to the data.
- The methodology for the feature analysis on releases to water (**Chapter 2**) is described in that section of the report.

Limitations of PRTR Data

Because of national PRTR reporting requirements, including thresholds for pollutants and facilities, only a portion of all industrial pollution is being captured. Also, industrial facilities are not the only sources of pollution in North America. North American PRTR data do not provide information on:

- *All potentially harmful substances.* The data provide information only on the pollutants reported to each country's PRTR.
- *All sources of contaminants.* The report includes only those facilities in the countries' industrial sectors, or undertaking specific industrial activities, that are subject to reporting to each national PRTR program. The North American PRTRs do not include emissions from automobiles or other mobile sources, from natural sources such as forest fires or from agricultural sources. For some pollutants, these mobile, natural and agricultural sources can be large contributors to the overall amounts.
- *Releases and transfers of all pollutants from a facility.* Only those pollutants for which reporting thresholds are met are included.
- *All facilities within required reporting sectors.* In Canada and the United States, only facilities with the equivalent of 10 full-time employees must report (with certain exceptions). Mexico has no employee threshold.
- *Environmental fate of or risks* from the pollutants released or transferred.
- *Levels of exposure* of human or ecological populations to the pollutants.
- *Legal limits* of a pollutant from a facility. The data do not indicate whether a facility is in compliance with permits and other regulations.

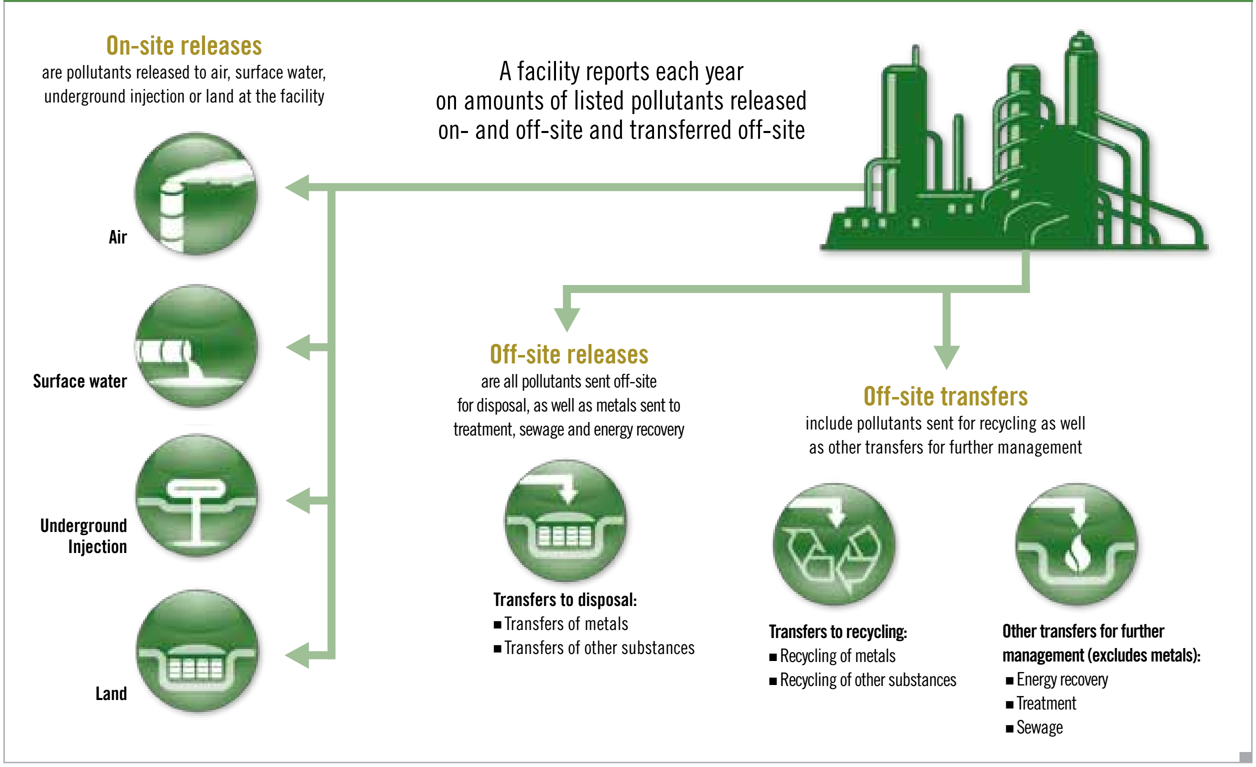
Substances released or transferred by industrial facilities have physical and chemical characteristics that influence their ultimate disposition and consequences for human and ecological health. Assessing the potential harm from particular releases of a pollutant to the environment is a complex task because the potential of a substance to cause harm arises from various factors, including its inherent toxicity and the nature of the exposure to the substance (e.g., the potential risk posed by asbestos sent to a secure landfill is considered to be much lower than the risk posed by asbestos released to air).

PRTR data alone cannot provide enough information to assess the potential harm from a pollutant; however, the data in combination with other information about a pollutant can serve as a starting point for learning more about its potential impacts. Readers may with to other sources for more information, including:

- ToxFAQs, US Agency for Toxic Substances and Disease Registry: http://www.atsdr.cdc.gov/toxfaqs/index.asp
- State of New Jersey, Department of Health, Right-to-Know Hazardous Substance Fact Sheets (information also available in Spanish): http://web.doh.state.nj.us/rtkhsfs/indexFs.aspx.

53 The data sets of the national PRTR systems are constantly evolving as facilities revise previous submissions to correct reporting errors or make other changes. To get the most recent data for specific facilities of interest, readers are encouraged to consult the national PRTR websites.

Figure A-1. Pollutant Releases and Transfers in North America



Pollutants Common to at Least Two of the Three North American PRTRs, 2006

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006

English	Français	Español	CAS Number	NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
				M/P/U§	M/P/U§	Emissions level	M/P/U§	Can	Mex	US
1,1,1,2-Tetrachloroethane	1,1,1,2-Tétrachloroéthane	1,1,1,2-Tetracloroetano	630-20-6	10,000			11,340	x		x
1,1,1-Trichloroethane	1,1,1-Trichloroéthane	1,1,1-Tricloroetano	71-55-6		2,500	1,000	11,340		x	x
1,1,2,2-Tetrachloroethane	1,1,2,2-Tétrachloroéthane	1,1,2,2-Tetracloroetano	79-34-5	10,000	5,000	1,000	11,340	x	x	x
1,1,2-Trichloroethane	1,1,2-Trichloroéthane	1,1,2-Tricloroetano	79-00-5	10,000	5,000	1,000	11,340	x	x	x
1,1,2-Trichlorotrifluoroethane (CFC-113)	1,1,2-Trichloro-1,2,2-trifluoroéthane (CFC-113)	CFC-113	76-13-1		2,500	1,000	11,340		x	x
1,1-Dichloro-1-fluoroethane (HCFC-141b)	1,1-Dichloro-1-fluoroéthane (HCFC-141b)	1,1-Dicloro-1-fluoroetano (HCFC-141b)	1717-00-6	10,000	5,000	1,000	11,340	x	x	x
1,1-Methylenebis (4-isocyanatocyclohexane)	1,1'-Méthylènebis (4-isocyanatocyclohexane)	1,1- Metilenobis (4-isocianato ciclohexano)	5124-30-1	10,000			11,340	x		x
1,2,4-Trichlorobenzene	1,2,4-Trichlorobenzène	1,2,4-Triclorobenceno	120-82-1	10,000	5,000	1,000	11,340	x	x	x
1,2,4-Trimethylbenzene	1,2,4-Triméthylbenzène	1,2,4-Trimetilbenceno	95-63-6	10,000			11,340	x		x
1,2-Butylene oxide	1,2-Époxybutane	Óxido de 1,2-butileno	106-88-7	10,000			11,340	x		x
1,2-Dichlorobenzene	o-Dichlorobenzène	1,2-Diclorobenceno	95-50-1	10,000	5,000	1,000	11,340	x	x	x
1,2-Dichloroethane	1,2-Dichloroéthane	1,2-Dicloroetano	107-06-2	10,000	5,000	1,000	11,340	x	x	x
1,2-Dichloropropane	1,2-Dichloropropane	1,2-Dicloropropano	78-87-5	10,000			11,340	x		x
1,3-Butadiene	Buta-1,3-diène	1,3-Butadieno	106-99-0	10,000	5,000	100	11,340	x	x	x
1,3-Dichloro-1,2,2,3,3-Pentafluoropropane (HCFC-225cb)	1,3-Dichloro-1,2,2,3,3-pentafluoropropane (HCFC-225cb)	HCFC-225cb	507-55-1		2,500	1,000	11,340		x	x
1,4-Dichlorobenzene	p-Dichlorobenzène	1,4-Diclorobenceno	106-46-7	10,000	5,000	1,000	11,340	x	x	x
1,4-Dioxane	1,4-Dioxane	1,4-Dioxano	123-91-1	10,000	5,000	100	11,340	x	x	x
1-Chloro-1,1-difluoroethane (HCFC-142b)	1-Chloro-1,1-difluoroéthane (HCFC-142b)	1-Cloro-1,1-difluoroetano (HCFC-142b)	75-68-3	10,000	5,000	1,000	11,340	x	x	x

§ Manufacture/Process/Otherwise Used

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006 (continued)

English	Français	Español	CAS Number	NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
				M/P/U§	M/P/U§	Emissions level	M/P/U§	Can	Mex	US
2,2,4-Trimethylhexamethylene diisocyanate	Diisocyanate de 2,2,4-triméthylhexamethylène	Diisocianato de 2,2,4-trimetilhexametileno	16938-22-0	10,000			11,340	x		x
2,4,4-Trimethylhexamethylene diisocyanate	Diisocyanate de 2,4,4-triméthylhexamethylène	Diisocianato de 2,4,4-trimetilhexametileno	15646-96-5	10,000			11,340	x		x
2,4,5-Trichlorophenol	Trichloro-2,4,5 phénol	2,4,5-Triclorofenol	95-95-4		2,500	1,000	11,340		x	x
2,4,6-Trichlorophenol	Trichloro-2,4,6 phénol	2,4,6-Triclorofenol	88-06-2		2,500	1,000	11,340		x	x
2,4-Diaminotoluene	2,4-Diaminotoluène	2,4-Diaminotolueno	95-80-7	10,000			11,340	x		x
2,4-Dichlorophenol	2,4-Dichlorophénol	2,4-Diclorofenol	120-83-2	10,000			11,340	x		x
2,4-Dichlorophenoxyacetic acid	Acide dichloro-2,4 phénoxyacétique	Acido 2,4-diclorofenoxiacético	94-75-7		2,500	100	11,340		x	x
2,4-Dinitrotoluene	2,4-Dinitrotoluène	2,4-Dinitrotolueno	121-14-2	10,000	5,000	1,000	11,340	x	x	x
2,6-Dinitrotoluene	2,6-Dinitrotoluène	2,6-Dinitrotolueno	606-20-2	10,000			11,340	x		x
2-Ethoxyethanol	2-Éthoxyéthanol	2-Etoxietanol	110-80-5	10,000	2,500	100	11,340	x	x	x
2-Mercaptobenzothiazole	Benzothiazole-2-thiol	2-Mercaptobenzotiazol	149-30-4	10,000			11,340	x		x
2-Methoxyethanol	2-Méthoxyéthanol	2-Metoxietanol	109-86-4	10,000			11,340	x		x
2-Methylpyridine	2-Méthylpyridine	2-Metilpiridina	109-06-8	10,000			11,340	x		x
2-Naphthylamine	bêta-Naphthylamine	Beta-naftalina	91-59-8		50	100	11,340		x	x
2-Nitropropane	2-Nitropropane	2-Nitropropano	79-46-9	10,000	2,500	100	11,340	x	x	x
2-Phenylphenol	o-Phénylphénol	2-Fenilfenol	90-43-7	10,000			11,340	x		x
3,3-Dichloro-1,1,1,2,2-pentafluoropropane (HCFC-225ca)	Dichloro-3,3 pentafluoro -1,1,1,2,2 propane (HCFC-225ca)	HCFC-225ca	422-56-0		2,500	1,000	11,340		x	x
3,3'-Dichlorobenzidine dihydrochloride	Dichlorhydrate de 3,3'-dichlorobenzidine	Dihidrocloruro de 3,3'-diclorobencidina	612-83-9	10,000			11,340	x		x
3-Chloro-2-methyl-1-propene	3-Chloro-2-méthylpropène	3-Cloro-2-metil-1-propeno	563-47-3	10,000			11,340	x		x
3-Chloropropionitrile	3-Chloropropionitrile	3-Cloropropionitrilo	542-76-7	10,000			11,340	x		x
4,4'-Isopropylidenediphenol	p,p'-Isopropylidènediphénol	4,4'-Isopropilidenodifenol	80-05-7	10,000			11,340	x		x
4,4'-Methylenebis (2-chloroaniline)	p,p'-Méthylènebis (2-chloroaniline)	4,4'-Metilenobis (2-cloroanilina)	101-14-4	10,000			11,340	x		x
4,4'-Methylenedianiline	p,p'-Méthylènedianiline	4,4'-Metilenodianilina	101-77-9	10,000			11,340	x		x
4,6-Dinitro-o-cresol	4,6-Dinitro-o-crésol	4,6-Dinitro-o-cresol	534-52-1	10,000	2,500	100	11,340	x	x	x
4-Aminobiphenyl	Amino-4 diphényle	4-Amino Difenilo	92-67-1		2,500	1,000	11,340		x	x
4-Nitrophenol	p-Nitrophénol	4-Nitrofenol	100-02-7	10,000			11,340	x		x
7H-Dibenzo(c,g)carbazole	7H-Dibenzo(c,g)carbazole	7H-Dibenzo(c,g)carbazol	194-59-2	50 **			45 **	x		x
Acetaldehyde	Acétaldéhyde	Acetaldehído	75-07-0	10,000	2,500	100	11,340	x	x	x
Acetonitrile	Acétonitrile	Acetonitrilo	75-05-8	10,000			11,340	x		x
Acetophenone	Acétophénone	Acetofenona	98-86-2	10,000			11,340	x		x
Acrolein	Acroléine	Acroleína	107-02-8	10,000	2,500	100	11,340	x	x	x
Acrylamide	Acrylamide	Acrilamida	79-06-1	10,000	2,500	100	11,340	x	x	x
Acrylic acid	Acide acrylique	Ácido acrílico	79-10-7	10,000			11,340	x		x

§ Manufacture/Process/Otherwise Used

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006 (continued)

				NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
English	Français	Español	CAS Number	M/P/U§	M/P/U§	Emissions level	M/P/U§	Can	Mex	US
Acrylonitrile	Acrylonitrile	Acrilonitrilo	107-13-1	10,000	2,500	100	11,340	x	x	x
Aldrin	Aldrine	Aldrin	309-00-2		50	100	45		x	x
Allyl alcohol	Alcool allylique	Alcohol alílico	107-18-6	10,000			11,340	x		x
Allyl chloride	Chlorure d'allyle	Cloruro de alilo	107-05-1	10,000			11,340	x		x
Aluminum (fume or dust)	Aluminium (fumée ou poussière)	Aluminio (humo o polvo)	7429-90-5	10,000			11,340	x		x
Aluminum oxide (fibrous forms)	Oxyde d'aluminium (formes fibreuses)	Óxido de aluminio (formas fibrosas)	1344-28-1	10,000			11,340	x		x
Ammonia	Ammoniac	Amoniaco	--	10,000			11,340	x		x
Aniline	Aniline	Anilina	62-53-3	10,000	5,000	1,000	11,340	x	x	x
Anthracene	Anthracène	Antraceno	120-12-7	10,000			11,340	x		x
Antimony (and its compounds)	Antimoine (et ses composés)	Antimonio y compuestos	--	10,000			11,340	x		x
Arsenic (and its compounds)	Arsenic (et ses composés)	Arsénico (y compuestos)	--	50	5	1	11,340	x	x	x
Asbestos (friable form)	Amiante (forme friable)	Asbestos (friables)	1332-21-4	10,000	5	1	11,340	x	x	x
Benzene	Benzène	Benceno	71-43-2	10,000	5,000	1,000	11,340	x	x	x
Benzidine	Benzidine	Bencidina	92-87-5		5,000	1,000	11,340		x	x
Benzo(a)anthracene	Benzo(a)anthracène	Benzo(a)antraceno	56-55-3	50 **			45 **	x		x
Benzo(a)phenanthrene	Benzo(a)phénanthrène	Benzo(a)fenantreno	218-01-9	50 **			45 **	x		x
Benzo(a)pyrene	Benzo(a)pyrène	Benzo(a)pireno	50-32-8	50 **			45 **	x		x
Benzo(b)fluoranthene	Benzo(b)fluoranthène	Benzo(b)fluoranteno	205-99-2	50 **			45 **	x		x
Benzo(g,h,i)perylene	Benzo(g,h,i)pérylène	Benzo(g,h,i)perileno	191-24-2	50 **			4.5 **	x		x
Benzo(j)fluoranthene	Benzo(j)fluoranthène	Benzo(j)fluoranteno	205-82-3	50 **			45 **	x		x
Benzo(k)fluoranthene	Benzo(k)fluoranthène	Benzo(k)fluoranteno	207-08-9	50 **			45 **	x		x
Benzoyl chloride	Chlorure de benzoyle	Cloruro de benzoilo	98-88-4	10,000			11,340	x		x
Benzoyl peroxide	Peroxyde de benzoyle	Peróxido de benzoilo	94-36-0	10,000			11,340	x		x
Benzyl chloride	Chlorure de benzyle	Cloruro de bencilo	100-44-7	10,000			11,340	x		x
Biphenyl	Biphényle	Bifenilo	92-52-4	10,000	5,000	1,000	11,340	x	x	x
Bis (Chloromethyl) **Ether**	Éther de bis (chlorométhyle)	Eter bis-cloro metílico	542-88-1		2,500	1,000	11,340		x	x
Boron trifluoride	Trifluorure de bore	Trifluoruro de boro	7637-07-2	10,000			11,340	x		x
Bromine	Brome	Bromo	7726-95-6	10,000			11,340	x		x
Bromochlorodifluoromethane (Halon 1211)	Bromochlorodifluorométhane (Halon 1211)	Bromoclorodifluorometano (Halon 1211)	353-59-3	10,000	5,000	1,000	11,340	x	x	x
Bromoform	Bromoforme	Bromoformo	75-25-2		2,500	1,000	11,340		x	x
Bromomethane	Bromométhane	Bromometano	74-83-9	10,000	5,000	1,000	11,340	x	x	x
Bromotrifluoromethane (Halon 1301)	Bromotrifluorométhane (Halon 1301)	Bromotrifluorometano (Halon 1301)	75-63-8	10,000	5,000	1,000	11,340	x	x	x
Butyl acrylate	Acrylate de butyle	Acrilato de butilo	141-32-2	10,000			11,340	x		x
Butyraldehyde	Butyraldéhyde	Butiraldehído	123-72-8	10,000			11,340	x		x
C.I. Acid Green 3	Indice de couleur Vert acide 3	Verde 3 ácido	4680-78-8	10,000			11,340	x		x
C.I. Basic Green 4	Indice de couleur Vert de base 4	Verde 4 básico	569-64-2	10,000			11,340	x		x

§ Manufacture/Process/Otherwise Used

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006 (continued)

English	Français	Español	CAS Number	NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
				M/P/U§	M/P/U§	Emissions level	M/P/U§	Can	Mex	US
C.I. Basic Red 1	Indice de couleur Rouge de base 1	Rojo 1 básico	989-38-8	10,000			11,340	x		x
C.I. Direct Blue 218	Indice de couleur Bleu direct 218	Índice de color Azul directo 218	28407-37-6	10,000			11,340	x		x
C.I. Disperse Yellow 3	Indice de couleur Jaune de dispersion 3	Amarillo 3 disperso	2832-40-8	10,000			11,340	x		x
C.I. Food Red 15	Indice de couleur Rouge alimentaire 15	Rojo 15 alimenticio	81-88-9	10,000			11,340	x		x
C.I. Solvent Orange 7	Indice de couleur Orange de solvant 7	Naranja 7 solvente	3118-97-6	10,000			11,340	x		x
C.I. Solvent Yellow 14	Indice de couleur Jaune de solvant 14	Amarillo solvente 14	842-07-9	10,000			11,340	x		x
Cadmium (and its compounds)	Cadmium (et ses composés)	Cadmio (y compuestos)	--	5	5	1	11,340	x	x	x
Calcium cyanamide	Cyanamide calcique	Cianamida de calcio	156-62-7	10,000			11,340	x		x
Carbon disulfide	Disulfure de carbone	Disulfuro de carbono	75-15-0	10,000			11,340	x		x
Carbon tetrachloride	Tétrachlorure de carbone	Tetracloruro de carbono	56-23-5	10,000	5,000	1,000	11,340	x	x	x
Carbonyl sulfide	Sulfure de carbonyle	Sulfuro de carbonilo	463-58-1	10,000			11,340	x		x
Catechol	Catéchol	Catecol	120-80-9	10,000			11,340	x		x
Chlordane	Chlordane	Clordano	57-74-9		5	100	4.5		x	x
Chlorendic acid	Acide chlorendique	Ácido cloréndico	115-28-6	10,000			11,340	x		x
Chlorine	Chlore	Cloro	7782-50-5	10,000			11,340	x		x
Chlorine dioxide	Dioxyde de chlore	Dióxido de cloro	10049-04-4	10,000	5,000	100	11,340	x	x	x
Chloroacetic acid	Acide chloroacétique	Ácido cloroacético	79-11-8	10,000			11,340	x		x
Chlorobenzene	Chlorobenzène	Clorobenceno	108-90-7	10,000	5,000	1,000	11,340	x	x	x
Chlorodifluoromethane (HCFC-22)	Chlorodifluorométhane (HCFC-22)	Clorodifluorometano (HCFC-22)	75-45-6	10,000	5,000	1,000	11,340	x	x	x
Chloroethane	Chloroéthane	Cloroetano	75-00-3	10,000			11,340	x		x
Chloroform	Chloroforme	Cloroformo	67-66-3	10,000	5,000	1,000	11,340	x	x	x
Chloromethane	Chlorométhane	Clorometano	74-87-3	10,000	5,000	1,000	11,340	x	x	x
Chlorotrifluoromethane (CFC-13)	Chlorotrifluorométhane (CFC-13)	Clorotrifluorometano (CFC-13)	75-72-9	10,000	5,000	1,000	11,340	x	x	x
Chromium (and its compounds)	Chrome (et ses composés) *	Cromo y compuestos *	--	10,000 *	5	1	11,340	x	x	x
Cobalt (and its compounds)	Cobalt (et ses composés)	Cobalto y compuestos	--	10,000			11,340	x		x
Copper (and its compounds)	Cuivre (et ses composés)	Cobre y compuestos	--	10,000			11,340	x		x
Creosote	Créosote	Creosota	8001-58-9	10,000			11,340	x		x
Cresol (all isomers and their salts)	Crésol (mélange d'isomères)	Cresol (mezcla de isómeros)	--	10,000			11,340	x		x
Crotonaldehyde	Crotonaldéhyde	Crotonaldehído	4170-30-3	10,000			11,340	x		x
Cumene	Cumène	Cumeno	98-82-8	10,000			11,340	x		x
Cumene hydroperoxide	Hydroperoxyde de cumène	Cumeno hidroperóxido	80-15-9	10,000			11,340	x		x
Cyanides	Cyanures	Cianuros	--	10,000	5,000	100	11,340	x	x	x
Cyclohexane	Cyclohexane	Ciclohexano	110-82-7	10,000			11,340	x		x
Cyclohexanol	Cyclohexanol	Ciclohexanol	108-93-0	10,000			11,340	x		x

§ Manufacture/Process/Otherwise Used

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006 (continued)

English	Français	Español	CAS Number	NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
				M/P/U§	M/P/U§	Emissions level	M/P/U§	Can	Mex	US
Decabromodiphenyl oxide	Oxyde de décabromodiphényle	Óxido de decabromodifenilo	1163-19-5	10,000			11,340	x		x
Di(2-ethylhexyl) phthalate	Phtalate de bis(2-éthylhexyle)	Di(2-etilhexil) ftalato	117-81-7	10,000			11,340	x		x
Dibenz(a,j)acridine	Dibenz(a,j)acridine	Dibenzo(a,j)acridina	224-42-0	50 **			45 **	x		x
Dibenzo(a,h)anthracene	Dibenzo(a,h)anthracène	Dibenzo(a,h)antraceno	53-70-3	50 **			45 **	x		x
Dibenzo(a,i)pyrene	Dibenzo(a,i)pyrène	Dibenzo(a,i)pireno	189-55-9	50 **			45 **	x		x
Dibutyl phthalate	Phtalate de dibutyle	Dibutil ftalato	84-74-2	10,000	5,000	100	11,340	x	x	x
Dichlorodifluoromethane (CFC-12)	Dichlorodifluorométhane (CFC-12)	Diclorodifluorometano (CFC-12)	75-71-8	10,000	5,000	1,000	11,340	x	x	x
Dichloromethane	Dichlorométhane	Diclorometano	75-09-2	10,000	5,000	1,000	11,340	x	x	x
Dichlorotetrafluoroethane (CFC-114)	Dichlorotétrafluoroéthane (CFC-114)	Diclorotetrafluoroetano (CFC-114)	76-14-2	10,000	5,000	1,000	11,340	x	x	x
Dicyclopentadiene	Dicyclopentadiène	Dicloropentadieno	77-73-6	10,000			11,340	x		x
Diethanolamine	Diéthanolamine	Dietanolamina	111-42-2	10,000			11,340	x		x
Diethyl sulfate	Sulfate de diéthyle	Sulfato de dietilo	64-67-5	10,000			11,340	x		x
Dimethyl phthalate	Phtalate de diméthyle	Dimetil ftalato	131-11-3	10,000			11,340	x		x
Dimethyl sulfate	Sulfate de diméthyle	Sulfato de dimetilo	77-78-1	10,000			11,340	x		x
Dimethylamine	Diméthylamine	Dimetilamina	124-40-3	10,000			11,340	x		x
Dinitrotoluene (mixed isomers)	Dinitrotoluène (mélange d'isomères)	Dinitrotolueno (mezcla de isómeros)	25321-14-6	10,000			11,340	x		x
Dioxins and furans	Dioxines et furanes	Dioxinas y furanos	--	***	***	***	***	x	x	x
Diphenylamine	Dianiline	Difenilamina	122-39-4	10,000			11,340	x		x
Epichlorohydrin	Épichlorohydrine	Epiclorohidrina	106-89-8	10,000	5,000	1,000	11,340	x	x	x
Ethyl acrylate	Acrylate d'éthyle	Acrilato de etilo	140-88-5	10,000			11,340	x		x
Ethyl chloroformate	Chloroformiate d'éthyle	Cloroformiato de etilo	541-41-3	10,000			11,340	x		x
Ethylbenzene	Éthylbenzène	Etilbenceno	100-41-4	10,000			11,340	x		x
Ethylene	Éthylène	Etileno	74-85-1	10,000			11,340	x		x
Ethylene glycol	Éthylèneglycol	Etilén glicol	107-21-1	10,000			11,340	x		x
Ethylene oxide	Oxyde d'éthylène	Óxido de etileno	75-21-8	10,000			11,340	x		x
Ethylene thiourea	Imidazolidine-2-thione	Etilén tiourea	96-45-7	10,000			11,340	x		x
Fluoranthene	Fluoranthène	Fluoranteno	206-44-0	50 **			45 **	x		x
Fluorine	Fluor	Fluor	7782-41-4	10,000			11,340	x		x
Formaldehyde	Formaldéhyde	Formaldehído	50-00-0	10,000	5,000	100	11,340	x	x	x
Formic acid	Acide formique	Ácido fórmico	64-18-6	10,000			11,340	x		x
Gamma-Hexachlorocyclohexane (lindane)	Lindane	Lindano (HCH)	58-89-9		5	100	11,340		x	x
HCFC 124 (and all isomers)	Chlorotétrafluoroéthane (HCFC-124)	Clorotetrafluoroetano (HCFC-124)	--	10,000	5,000	1,000	11,340	x	x	x
HCFC-123 (and all isomers)	Dichlorotrifluoroéthane (HCFC-123)	Diclorotrifluoroetano (HCFC-123)	--	10,000	5,000	1,000	11,340	x	x	x
Heptachlor	Heptachlore	Heptacloro	76-44-8		5	100	4.5		x	x
Hexachlorobenzene	Hexachlorobenzène	Hexaclorobenceno	118-74-1	***	***	***	***	x	x	x

§ Manufacture/Process/Otherwise Used

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006 (continued)

English	Français	Español	CAS Number	NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
				M/P/U§	M/P/U§	Emissions level	M/P/U§	Can	Mex	US
Hexachlorobutadiene	Hexachlorobutadiène	Hexacloro-1,3-butadieno	87-68-3		2,500	1,000	11,340		x	x
Hexachlorocyclopentadiene	Hexachlorocyclopentadiène	Hexaclorciclopentadieno	77-47-4	10,000	5,000	1,000	11,340	x	x	x
Hexachloroethane	Hexachloroéthane	Hexacloroetano	67-72-1	10,000	5,000	1,000	11,340	x	x	x
Hexachlorophene	Hexachlorophène	Hexaclorofeno	70-30-4	10,000			11,340	x		x
Hydrazine	Hydrazine	Hidracina	302-01-2	10,000	5,000	100	11,340	x	x	x
Hydrochloric acid	Acide chlorhydrique	Ácido clorhídrico	7647-01-0	10,000			11,340	x		x
Hydrogen cyanide	Cyanure d'hydrogène	Ácido cianhídrico	74-90-8	10,000			11,340	x		x
Hydrogen fluoride	Fluorure d'hydrogène	Ácido fluorhídrico	7664-39-3	10,000			11,340	x		x
Hydrogen sulfide	Sulfure d'hydrogène	Acido sulfhídrico	7783-06-4	10,000	5,000	1,000		x	x	
Hydroquinone	Hydroquinone	Hidroquinona	123-31-9	10,000			11,340	x		x
Indeno(1,2,3-c,d)pyrene	Indéno(1,2,3-c,d)pyrène	Indeno(1,2,3-c,d)pireno	193-39-5	50 **			45 **	x		x
Iron pentacarbonyl	Fer-pentacarbonyle	Pentacarbonilo de hierro	13463-40-6	10,000			11,340	x		x
Isobutyraldehyde	Isobutyraldéhyde	Isobutiraldehído	78-84-2	10,000			11,340	x		x
Isophorone diisocyanate	Diisocyanate d'isophorone	Diisocianato de isoforona	4098-71-9	10,000			11,340	x		x
Isopropyl alcohol	Alcool isopropylique	Alcohol isopropílico	67-63-0	10,000			11,340	x		x
Isosafrole	Isosafrole	Isosafrol	120-58-1	10,000			11,340	x		x
Lead (and its compounds)	Plomb (et ses composés)	Plomo y compuestos	--	50	5	1	45	x	x	x
Lithium carbonate	Carbonate de lithium	Carbonato de litio	554-13-2	10,000			11,340	x		x
Maleic anhydride	Anhydride maléique	Anhídrido maleico	108-31-6	10,000			11,340	x		x
Manganese (and its compounds)	Manganèse (et ses composés)	Manganeso y compuestos	--	10,000			11,340	x		x
Mercury (and its compounds)	Mercure (et ses composés)	Mercurio y compuestos	--	5	5	1	4.5	x	x	x
Methanol	Méthanol	Metanol	67-56-1	10,000			11,340	x		x
Methoxychlor	Méthoxychlore	Metoxicloro	72-43-5		50	100	45		x	x
Methyl acrylate	Acrylate de méthyle	Acrilato de metilo	96-33-3	10,000			11,340	x		x
Methyl iodide	Iodométhane	Yoduro de metilo	74-88-4	10,000			11,340	x		x
Methyl isobutyl ketone	Méthylisobutylcétone	Metil isobutil cetona	108-10-1	10,000			11,340	x		x
Methyl methacrylate	Méthacrylate de méthyle	Metacrilato de metilo	80-62-6	10,000			11,340	x		x
Methyl tert-butyl ether	Oxyde de tert-butyle et de méthyle	Éter metil terbutílico	1634-04-4	10,000			11,340	x		x
Methylenebis (phenylisocyanate)	Méthylènebis (phénylisocyanate)	Metileno bis (fenilisocianato)	101-68-8	10,000			11,340	x		x
Michler's ketone	Cétone de Michler	Cetona Michler	90-94-8	10,000			11,340	x		x
Molybdenum trioxide	Trioxyde de molybdène	Trióxido de molibdeno	1313-27-5	10,000			11,340	x		x
Monochloropentafluoroethane (CFC-115)	Chloropentafluoroéthane (CFC-115)	Cloropentafluoroetano (CFC-115)	76-15-3	10,000	5,000	1,000	11,340	x	x	x
N,N-Dimethylaniline	N,N-Diméthylaniline	N,N-Dimetilanilina	121-69-7	10,000			11,340	x		x
N,N-Dimethylformamide	N,N-Diméthylformamide	N.N-Dimetilformamida	68-12-2	10,000			11,340	x		x
Naphthalene	Naphtalène	Naftaleno	91-20-3	10,000			11,340	x		x
n-Butyl alcohol	Butan-1-ol	Alcohol n-butílico	71-36-3	10,000			11,340	x		x
n-Hexane	n-Hexane	n-Hexano	110-54-3	10,000			11,340	x		x

§ Manufacture/Process/Otherwise Used

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006 (continued)

English	Français	Español	CAS Number	NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
				M/P/U§	M/P/U§	Emissions level	M/P/U§	Can	Mex	US
Nickel (and its compounds)	Nickel (et ses composés)	Níquel y compuestos	--	10,000	5	1	11,340	x	x	x
Nitric acid and nitrate compounds	Acide nitrique et composés de nitrate	Ácido nítrico y compuestos nitrados	--	10,000			11,340	x		x
Nitrilotriacetic acid	Acide nitrilotriacétique	Ácido nitrilotriacético	139-13-9	10,000			11,340	x		x
Nitrobenzene	Nitrobenzène	Nitrobenceno	98-95-3	10,000			11,340	x		x
Nitroglycerin	Nitroglycérine	Nitroglicerina	55-63-0	10,000			11,340	x		x
N-Methyl-2-pyrrolidone	N-Méhyl-2-pyrrolidone	N-Metil2-pirrolidona	872-50-4	10,000			11,340	x		x
N-Methylolacrylamide	N-(Hydroxyméthyl)acrylamide	N-Metilolacrilamida	924-42-5	10,000			11,340	x		x
N-Nitrosodimethylamine	N-Nitrosodiméthylamine	Nitrosodimetilamina	62-75-9		2,500	100	11,340		x	x
N-Nitrosodiphenylamine	N-Nitrosodiphénylamine	N-Nitrosodifenilamina	86-30-6	10,000			11,340	x		x
Paraldehyde	Paraldéhyde	Paraldehído	123-63-7	10,000			11,340	x		x
Parathion Methyl	Méthyl parathion	Metil paration	298-00-0		5	100	11,340		x	x
PCBs (polychlorinated biphenyls)	Biphényles polychlorés	Bifenilos policlorados	1336-36-3		5	any	4.5		x	x
Pentachloroethane	Pentachloroéthane	Pentacloroetano	76-01-7	10,000			11,340	x		x
Pentachlorophenol	Pentachlorophénol	Pentaclorofenol	87-86-5		2,500	1,000	11,340		x	x
Peracetic acid	Acide peracétique	Ácido peracético	79-21-0	10,000			11,340	x		x
Phenanthrene	Phénanthrène	Fenantreno	85-01-8	50 **			11,340	x		x
Phenol	Phénol	Fenol	108-95-2	10,000	5,000	1,000	11,340	x	x	x
Phosgene	Phosgène	Fosgeno	75-44-5	10,000			11,340	x		x
Phosphorus	Phosphore	Fósforo	--	10,000			11,340	x		x
Phthalic anhydride	Anhydride phtalique	Anhídrido ftálico	85-44-9	10,000			11,340	x		x
p-Nitroaniline	p-Nitroaniline	p-Nitroanilina	100-01-6	10,000			11,340	x		x
P-Nitrobiphenyl	Nitro-4 diphényle	4-Nitrodifenilo	92-93-3		2,500	1,000	11,340		x	x
Polychlorinated alkanes (C10-C13)	Alcanes poychlorés (C10-C13)	Alcanos policlorinados (C10-C13)	--	10,000			11,340	x		x
Polymeric diphenylmethane diisocyanate	Diisocyanate de diphénylméthane (polymérisé)	Diisocianato de difenilmetano polimerizado	9016-87-9	10,000			11,340	x		x
Potassium bromate	Bromate de potassium	Bromato de potasio	7758-01-2	10,000			11,340	x		x
p-Phenylenediamine	p-Phénylènediamine	p-Fenilenodiamina	106-50-3	10,000			11,340	x		x
Propargyl alcohol	Alcool propargylique	Alcohol propargílico	107-19-7	10,000			11,340	x		x
Propionaldehyde	Propionaldéhyde	Propionaldehído	123-38-6	10,000			11,340	x		x
Propylene	Propylène	Propileno	115-07-1	10,000			11,340	x		x
Propylene oxide	Oxyde de propylène	Óxido de propileno	75-56-9	10,000			11,340	x		x
Pyridine	Pyridine	Piridina	110-86-1	10,000	5,000	1,000	11,340	x	x	x
Quinoline	Quinoléine	Quinoleína	91-22-5	10,000			11,340	x		x
Quinone	p-Quinone	Quinona	106-51-4	10,000			11,340	x		x
Safrole	Safrole	Safrol	94-59-7	10,000			11,340	x		x
sec-Butyl alcohol	Butan-2-ol	Alcohol sec-butílico	78-92-2	10,000			11,340	x		x
Selenium (and its compounds)	Sélénium (et ses composés)	Selenio y compuestos	--	10,000			11,340	x		x

§ Manufacture/Process/Otherwise Used

Appendix 2. Pollutants Common to at Least Two of the Three North American PRTRs, 2006 (continued)

English	Français	Español	CAS Number	NPRI thresholds (kg/year)	RETC thresholds (kg/year)		TRI thresholds (kg/year)	Reporting of the pollutant is mandatory in		
				M/P/U[§]	M/P/U[§]	Emissions level	M/P/U[§]	Can	Mex	US
Silver (and its compounds)	Argent (et ses composés)	Plata y compuestos	–	10,000			11,340	x		x
Sodium nitrite	Nitrite de sodium	Nitrato de sodio	7632-00-0	10,000			11,340	x		x
Styrene	Styrène	Estireno	100-42-5	10,000	5,000	1,000	11,340	x	x	x
Styrene oxide	Oxyde de styrène	Óxido de estireno	96-09-3	10,000			11,340	x		x
Sulfur hexafluoride	Hexafluorure de soufre	Hexafluoruro de azufre	2551-62-4	10,000	5,000	any		x	x	
Sulfuric acid	Acide sulfurique	Ácido sulfúrico	7664-93-9	10,000			11,340	x		x
tert-Butyl alcohol	2-Méthylpropan-2-ol	Alcohol terbutílico	75-65-0	10,000			11,340	x		x
Tetrachloroethylene	Tétrachloroéthylène	Tetracloroetileno	127-18-4	10,000			11,340	x		x
Tetracycline hydrochloride	Chlorhydrate de tétracycline	Clorhidrato de tetraciclina	64-75-5	10,000			11,340	x		x
Thiourea	Thio-urée	Tiourea	62-56-6	10,000			11,340	x		x
Thorium dioxide	Dioxyde de thorium	Dióxido de torio	1314-20-1	10,000			11,340	x		x
Titanium tetrachloride	Tétrachlorure de titane	Tetracloruro de titanio	7550-45-0	10,000			11,340	x		x
Toluene	Toluène	Tolueno	108-88-3	10,000			11,340	x		x
Toluene-2,4-diisocyanate	Toluène-2,4-diisocyanate	Toluen-2,4-diisocianato	584-84-9	10,000			11,340	x		x
Toluene-2,6-diisocyanate	Toluène-2,6-diisocyanate	Toluen-2,6-diisocianato	91-08-7	10,000			11,340	x		x
Toluenediisocyanate (mixed isomers)	Toluènediisocyanate (mélange d'isomères)	Toluendiisocianatos (mezcla de isómeros)	26471-62-5	10,000	5,000	1,000	11,340	x	x	x
Toxaphene	Toxaphène	Toxafeno	8001-35-2		5	100	4.5		x	x
Trichloroethylene	Trichloroéthylène	Tricloroetileno	79-01-6	10,000	5,000	1,000	11,340	x	x	x
Trichlorofluoromethane (CFC-11)	Trichlorofluorométhane (CFC-11)	Triclorofluorometano (CFC-11)	75-69-4	10,000	5,000	1,000	11,340	x	x	x
Triethylamine	Triéthylamine	Trietilamina	121-44-8	10,000			11,340	x		x
Vanadium and its compounds	Vanadium et ses composès	Vanadio y compuestos	--	10,000			11,340	x		x
Vinyl acetate	Acétate de vinyle	Acetato de vinilo	108-05-4	10,000			11,340	x		x
Vinyl chloride	Chlorure de vinyle	Cloruro de vinilo	75-01-4	10,000	5,000	1,000	11,340	x	x	x
Vinylidene chloride	Chlorure de vinylidène	Cloruro de vinilideno	75-35-4	10,000			11,340	x		x
Warfarin	Warfarin	Warfarina	81-81-2		5	100	11,340		x	x
Xylene (all isomers)	Xylènes	Xilenos	--	10,000			11,340	x		x
Zinc (and its compounds)	Zinc (et ses composés)	Zinc y compuestos	--	10,000			11,340	x		x

§ Manufacture/Process/Otherwise Used

* In Canada, only hexavalent chromium (VI) compounds are reported separately from other chromium compounds (with a reporting threshold of 50 kg)
** In Canada, polycyclic aromatic hydrocarbons (PAH) must be reported if released or used in combined quantity of 50 kg or more.
** In US: polycyclic aromatic compounds (PAC) must be reported if released or used in combined quantity of 100 lbs (45 kg) or more (except for benzo (g,h,i) perylene, which has a lower threshold).
*** The following individual or groups of substances are reported differently in each country: (a) dioxins, dioxin-like compounds, and furans; and (b) hexachlorobenzene.

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