

Use and Releases of MTBE in Canada

***A report based on responses to Environment
Canada's May 26, 2001 information gathering
notice on Methyl tertiary-Butyl Ether***

**Joanna Bellamy
Jeffrey Guthrie
Steven Groves (student)
Oil, Gas and Energy Branch
Environment Canada**

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Questions and comments on the content of this report should be directed to:

**Oil, Gas and Energy Branch
Air Pollution Prevention Directorate
Environmental Protection Service
Environment Canada
Place Vincent Massey, 10th Floor
Ottawa, Ontario
K1A 0H3
Fax: (819) 953-8903**

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Executive Summary

On May 26, 2001, Environment Canada published a Notice in the Canada Gazette requiring the reporting of information on the use and releases of methyl *tertiary*-butyl ether (MTBE) in Canada. This report is based on the information provided by companies in response to the Notice in July 2001. The report summarizes findings from the Notice, including an assessment of the extent to which MTBE has been detected in ground water and drinking water in Canada, and lays out the steps being taken by the federal government to address the issue.

Twenty three responses¹ to the CEPA 1999 Notice were submitted to Environment Canada. MTBE was reported as having been detected in ground water at two hundred and fifty locations and in every province in Canada². Among the two hundred and fifty locations, six were sites where ground water was used as a source of drinking water. All six sites were located in PEI. In all six cases, the concentration of MTBE was at levels below the United States Environmental Protection Agency's (EPA's) consumer advisory level of 20 to 40 parts per billion. Data later provided to Environment Canada indicated that as a result of remediation, MTBE was no longer detected at three of the six locations. In Canada, as in other jurisdictions, ground water contamination with MTBE is believed to be linked to releases of gasoline from storage tanks systems.

In 1998, gasoline containing MTBE accounted for 10% of the Canadian gasoline pool. This fell to 2% in 2000, was projected to drop to less than 1% by the end of 2001, and to decrease further in subsequent years. By the end of 2002, use of gasoline containing MTBE in Canada was projected to fall by 95% from the 1998 peak. However, contamination of ground water resulting from the past use of MTBE may persist for some time due to its slow rate of degradation in the environment.

Only one company, Alberta Envirofuels, reported producing MTBE in Canada. It reported that it would cease production of MTBE in 2002 and instead produce iso-octane. Eleven refining and marketing companies reported having used MTBE; only Irving Oil and North Atlantic Refining indicated that they intended to continue producing gasoline containing MTBE after 2001. Both of these Atlantic refiners export reformulated gasoline, which must contain oxygenate, to the U.S. While North Atlantic Refining reported that it plans to continue marketing gasoline containing MTBE in Canada, Irving Oil has indicated that it will not.

While addressing contaminated sites is primarily an area of provincial jurisdiction, the federal government plans to coordinate a number of actions to address the issues related to MTBE contamination. Given the substantial decrease in use of

¹ Several nil responses were also submitted.

² There were no releases reported in the three territories.

MTBE in Canada, the following initiatives, falling into three areas, are considered appropriate:

1. Preventing releases of MTBE into the environment:
 - Codes of practice for underground and above ground storage tanks developed in 1993 by the Canadian Council of Ministers of the Environment (CCME) are being updated (expected to be published in 2003).
 - New federal regulations are being developed to put technical requirements such as leak detection in place for all tanks under federal jurisdiction (expected to be completed in 2003).

2. Detecting ground water and drinking water contamination:
 - On a broader level, Environment Canada will continue to study and report on the use of MTBE in gasoline in Canada in order to monitor potentially affected regions;
 - Environment Canada will monitor MTBE contamination of ground and drinking water across Canada through information provided to the department by provinces and territories.

3. Remediating contaminated sites:
 - The CCME is developing Canadian water quality guidelines for the protection of aquatic life and the Federal-Provincial-Territorial Subcommittee on Drinking Water is developing Guidelines for Canadian Drinking Water Quality for MTBE. These guidelines may be used to guide clean up for cases where standards do not exist (expected to be completed in 2003-2004).

These actions will provide an ongoing understanding of MTBE usage in Canada, mitigate the potential for further MTBE releases, and give guidance for remediation of contaminated sites.

1.0 Introduction

In February 2001, the Federal Minister of the Environment published a Notice of Intent on Cleaner Vehicles, Engines and Fuels, laying out the federal agenda to address related environmental issues. One item addressed in the Notice was the use of MTBE in Canadian gasoline. Specifically, the Notice indicated that:

- the Minister would publish “a notice under paragraph 71(1)(b) of the Canadian Environmental Protection Act (CEPA 1999) requesting information on usage and releases of MTBE”; and
- “following a review of the information, Environment Canada will consider whether further action in respect of MTBE is warranted”.

The MTBE information gathering notice referred to above was published in the Canada Gazette on May 26, 2001. It required persons handling MTBE or gasoline containing MTBE to provide information to the Minister on use and releases of MTBE by July 31, 2001 (for full text of the Notice, see Appendix A).

This report is a summary of the information provided to Environment Canada in response to the Notice. The report also outlines the proposed path forward by the federal government to prevent future releases of MTBE.

2.0 Background

2.1 Nature and cause of problem

MTBE is a synthetic organic compound known as an oxygenate. It may be used in gasoline to improve gasoline octane and also because it reduces vehicle emissions. (Oxygenates are a required component in U.S. reformulated gasoline for the latter reason.) MTBE has a higher solubility in water and a slower rate of degradation than many other components of gasoline. As well, MTBE has a low taste and odour threshold. Because of its strong turpentine-like taste, MTBE can render water undrinkable at concentrations as low as 15-20 parts per billion (ppb).

Releases of gasoline containing MTBE from gasoline storage tank systems have contributed to significant drinking water contamination problems in some jurisdictions during the last decade, particularly in the U.S. In 2001, the U.S. Geological Survey (USGS) reported that MTBE was detected in approximately 5 percent of ground water samples across the U.S. However, less than one percent of the samples exceeded the EPA consumer advisory concentration of 20 micrograms per litre (approximately equal to 20 ppb). As well, MTBE was detected in nine percent of community water systems in twelve North East and mid-Atlantic states looked at by the USGS. Again, less than one percent of the

samples exceeded the EPA consumer advisory concentration³. While remediation of contaminated drinking water is feasible, it is often difficult and expensive.

The health and environmental effects of MTBE were assessed by the federal government under CEPA 1999 as part of the first Priority Substance Assessment process. Based on the level of use at the time, the 1992 Assessment report on MTBE concluded that, *“the predicted concentrations of MTBE in the environment in Canada do not constitute a danger to the environment or...to human life or health”*⁴. As a result, MTBE was found not to be “toxic” as defined in the *Canadian Environmental Protection Act*.

Assessments by other agencies have examined the health risk of MTBE more recently:

- In 1997, the U.S. Interagency Assessment of Oxygenated Fuels released by the White House National Science and Technology Council indicated that, *“While there are no studies on the carcinogenicity of MTBE in humans, MTBE should be regarded as posing a potential carcinogenic risk to humans based on animal cancer data”*⁵.
- In 1998, the World Health Organization’s International Programme on Chemical Safety published a report on MTBE which concluded that, *“MTBE is not genotoxic but has induced tumours in rodents primarily at high concentrations”* and that *“data are considered currently inadequate for use in human carcinogenic risk assessment”*⁶.
- In its March 2000 Advance Notice of Proposed Rulemaking to control MTBE in gasoline, the EPA stated, *“low levels of MTBE can make drinking water supplies undrinkable due to its offensive taste and odor. At higher levels, it may also pose a risk to human health”*.

2.2 Responses to the problem by other jurisdictions - actions to prevent contamination

MTBE contamination of ground water has become an issue of serious concern in the U.S., where use of MTBE or other oxygenates has been required in reformulated gasoline since 1993. MTBE has been the refiners’ oxygenate of choice in the U.S. and in 1998 was present in 87% of the U.S. reformulated gasoline pool at levels of 10% to 15% by volume, amounting to an average MTBE concentration across the U.S. gasoline pool of approximately 3%.

³ Clawges, Rick, Rowe, Barbara, and Zogorski, John, 2001, National Survey of MTBE and Other VOCs in Community Drinking-Water Sources: U.S. Geological Survey Fact Sheet.

⁴ Government of Canada, Canadian Environmental Protection Act Priority Substances List Assessment Report No. 5, Methyl *tertiary*-Butyl Ether, 1991, pp. v, 12-13.

⁵ White House Office of Science and Technology Policy, Interagency Assessment of Oxygenated Fuels, 1997.

⁶ World Health Organization, International Programme on Chemical Safety, Environmental Health Criteria 206, Methyl *tertiary*-Butyl Ether, 1998, p. 9.

One of the best known examples of drinking water contamination with MTBE is in Santa Monica, California. In 1996, seven wells in Santa Monica providing 50% of the city's drinking water supply were found to be contaminated at levels up to 600 ppb⁷. Releases of gasoline from underground storage tanks were identified as the cause.

In March 1999, California Governor Gray Davis announced that MTBE would be phased out "*at the earliest date, but not later than December 31, 2002*". In December 1999, California approved its Phase 3 gasoline regulations banning the use of MTBE by the end of 2002. In the interim, California requires prominent labelling of pumps which dispense gasoline containing MTBE, "*in order to allow consumers to make an informed choice as to the type of gasoline they purchase*"⁸. On March 15, 2002, Governor Davis announced a decision to delay the ban until January 1, 2004 because of concerns that gasoline shortages could result.

Sixteen other states are also taking or have taken action to ban or limit MTBE in the 2003-2004 time frame, and several others are considering taking action. Several states require labelling of gasoline containing MTBE. Table B.1 in Appendix B summarizes actions taken or proposed by U.S. states with respect to MTBE.

In Canada, *CEPA 1999* does not currently provide the authority to ban MTBE as a gasoline additive as this substance was found not to be toxic in an assessment conducted by Environment Canada in 1992 based on the levels of production prior to 1992. There is extremely limited constitutional authority for the federal government to require labelling at the pump - although limited authority exists under the *CEPA 1999* to require labelling of fuels, this does not provide the power to require the labelling for MTBE at the pump.

In November 1998, the U.S. EPA administrator commissioned a Blue Ribbon Panel on Oxygenates in Gasoline to assess the water quality problems associated with oxygenates in gasoline. In July 1999, the panel recommended that the current mandate for oxygenates in reformulated gasoline "*be removed... while quickly reducing usage of MTBE and maintaining air quality benefits*".

As follow-up to the Blue Ribbon Panel report, in March 2000 the EPA issued an Advance Notice of Proposed Rulemaking under Section 6 of the Toxic Substances Control Act to control MTBE in gasoline. The Advance Notice indicated that "*the outcome of this rulemaking could be a total ban on the use of MTBE as a gasoline additive or a limitation preventing the use of MTBE in*

⁷ U.S. National Groundwater Association, Position Paper on MTBE.

⁸ California Air Resources Board website, <http://www.arb.ca.gov/cbg/Oxy/mtbelabl/mtbelabl.htm>

gasoline in amounts greater than those designed to provide octane enhancement.”⁹

A major energy bill in the last session of the U.S. Congress would have banned MTBE within four years of the bill coming into effect. However, the bill was not passed. It is understood that a revised version of this bill (including the MTBE ban) will soon be introduced into the U.S. Senate..

A March 2001 study for the European Commission, “MTBE and the Requirements for Underground Storage Tank Construction and Operation in Member States” indicated that, “*contamination is unlikely if standards governing the construction and operation of underground storage tanks at service stations are robustly enforced*”¹⁰. The EU Commission has not proposed any restrictions on the MTBE content of gasoline¹¹. In addition, Denmark has looked at the use of tax incentives on gasoline to speed up investment aimed at protecting soil and ground water from leaks of MTBE from underground tanks.

In Australia, legislation has been passed to limit the concentration of MTBE in gasoline to 1% by volume (approximately 0.18% oxygen by volume), beginning January 1, 2004¹².

2.3 Responses to the problem by other jurisdictions - water quality guidelines for MTBE

Some jurisdictions have developed water quality guidelines for MTBE based on the threshold concentration at which MTBE can be tasted (aesthetic level). Other jurisdictions have set guidelines at which MTBE is a threat to aquatic life. California has, in addition, developed a guideline for health effects. In some jurisdictions, these guidelines are used as standards for ground water remediation.

In December 1997, the U.S. EPA issued a drinking water advisory on MTBE. The advisory recommended controlling levels for taste and odour acceptability - levels of 20-40 ppb - that would also protect against potential health effects. Other jurisdictions have also developed guidelines for acceptable levels of MTBE in water (see Table 2.1).

⁹ US EPA, Office of Transportation and Air Quality, Advance Notice of Proposed Rulemaking to Control MTBE in Gasoline, March 2000.

¹⁰ Arthur D. Little Limited, Report to the European Commission, “MTBE and the Requirements for Underground Storage Tank Construction and Operation in Member States”, April 2001, p. 2.

¹¹ European Union, Proposal for a Directive of the European Parliament and of the Council of the Quality of petrol and diesel fuels and amending Directive 98/70/EC, Document 501PC0241, s 6.4.

¹² Australian 2001 Fuel Standard (Petrol) Determination, 8 October 2001.

Table 2.1 - Water quality guidelines for MTBE

	Level (ppm)
B.C. guidelines (aesthetic)	20 ppb
B.C. guidelines (marine, estuarine)	440 ppb
B.C. guidelines (aquatic life)	3400 ppb
P.E.I. guidelines (aesthetic)	15 ppb
EPA guidelines (aesthetic)	20-40 ppb
California guidelines (aesthetic)	5 ppb
California guidelines (health)	13 ppb

2.4 Canadian situation - what was known prior to the CEPA Information Gathering Notice

MTBE has been used in Canada since 1986, although use in Canada has been much less widespread than in the U.S. as the addition of oxygenates has never been required in Canadian gasoline. The U.S. Clean Air Act has required the addition of oxygenates to reformulated gasoline since 1993.

Prior to the publication of the 2001 CEPA 1999 Notice, Environment Canada was aware of three cases of ground water contamination with MTBE in Canada:

- In 1997, low levels of MTBE were detected by the U.S. Geological Survey (working with Environment Canada) in the Abbotsford-Sumas Aquifer in southern British Columbia.
- In May 2000, Chevron and the province of British Columbia indicated that MTBE had been found in ground water at Chevron's Burnaby refinery.
- In March 2001, Prince Edward Island's Department of Fisheries, Aquaculture and Environment informed Environment Canada that MTBE had been detected in monitoring wells on, and adjacent to, sites contaminated with gasoline.

The average concentration of MTBE in the Canadian gasoline pool reported by gasoline producers and importers under the *Benzene in Gasoline Regulations* fell from 0.33% to 0.14% between 1999 and 2000. However, since the regulations do not require reporting of oxygenate blended downstream of refineries (except for a few special incidences described in the regulations), these values underestimate MTBE usage. In comparison, the average concentration of MTBE in the U.S. gasoline pool was approximately 3% in 1998.

3.0 Information on MTBE Provided Pursuant to the CEPA 1999 Notice

Twenty three responses¹³ to the CEPA 1999 Notice were received by Environment Canada. Table 3.1 lists the companies that provided responses to the Notice:

- eleven respondents reported importing gasoline containing MTBE;
- nine respondents have produced or blended gasoline containing MTBE;
- eight respondents have imported MTBE; two have exported MTBE;
- one company reported producing MTBE;
- three companies reported that they have handled/transported MTBE.

Table 3.1 - Companies responding to Notice

Company	MTBE-related activity	Location of company headquarters
Alberta Envirofuels Inc.	Manufacturer of MTBE	Edmonton, Alberta
BP Global Fuels Technology	Importer of MTBE; producer, importer and exporter of gasoline containing MTBE	Naperville, Illinois
Cami Automotive Inc.	Importer of gasoline containing MTBE	Ingersoll, Ontario
Chevron Canada Limited	Exporter of MTBE; producer of gasoline containing MTBE	Vancouver, B.C.
Consumers' Co-operative Refineries Limited	Importer of MTBE; producer of gasoline containing MTBE	Regina, Saskatchewan
Esso Imperial Oil	Importer of MTBE; producer and importer of gasoline containing MTBE	Toronto, Ontario
Fisher Scientific	Importer of MTBE	Nepean, Ontario
Ford Motor Company of Canada, Limited	Importer of gasoline containing MTBE	Oakville, Ontario
Gibson Petroleum Company Limited	Operator of MTBE loading facility	Calgary, Alberta
General Motors of Canada Limited	Importer of gasoline containing MTBE	Oshawa, Ontario
Honda of Canada Mfg.	Importer of gasoline containing MTBE	Alliston, Ontario
Irving Oil Limited	Importer of MTBE; producer and exporter of gasoline containing MTBE	Saint John, New Brunswick
Methanex Corporation	Trans-shipper of MTBE	Kitimat, B.C.
Neste Canada Inc.	Exporter of MTBE	Calgary, Alberta
North Atlantic Refining Limited	Importer of MTBE; producer and exporter of gasoline containing MTBE	Come by Chance, Newfoundland
Northern Transportation Company Limited	Importer of gasoline containing MTBE	Montreal, Quebec
Olco	Importer of gasoline containing MTBE	Montreal, Quebec
Petro-Canada	Producer and importer of gasoline containing MTBE	Mississauga, Ontario
Pétroles Norcan Inc.	Importer of gasoline containing MTBE	Montreal, Quebec
Sunoco Inc.	Importer of MTBE; producer of gasoline containing MTBE	North York, Ontario
Toyota Motor Manufacturing Canada Inc.	Handles gasoline containing MTBE	Cambridge, Ontario
Trans Mountain Pipe Line Company	Ships gasoline	Calgary, Alberta
Ultramar	Importer of MTBE; blender and importer of gasoline containing MTBE	St-Romuald, Quebec

¹³ Several nil responses were also submitted.

3.1 Production, import and export of gasoline containing MTBE

Paragraphs 1(b) and (d) of the CEPA 1999 Notice required reporting of information relating to the production, import and export of gasoline containing MTBE in Canada between 1991 and 2000 and the intended production, and import of such gasoline from 2001 to 2005.

Companies that reported producing, exporting or importing gasoline containing MTBE between 1991 and 2000 are listed in Figure 3.1.

- Seven companies reported producing gasoline containing MTBE;
- three¹⁴ companies reported blending¹⁵ MTBE into gasoline;
- ten¹⁶ companies reported importing gasoline containing MTBE;
- two companies reported exporting gasoline containing MTBE.

It is important to note that due to commercial exchanges of gasoline between fuel companies, companies other than those listed below would have handled, stored and sold gasoline containing MTBE.

Figure C.1 in Appendix C shows the production, blending, imports and exports of gasoline containing MTBE on a regional basis from 1991 to 2000. The figure shows that imports of gasoline containing MTBE have occurred in every region of the country during the ten year period. Production or blending has also occurred in every region. Exports have occurred from the Atlantic and Western regions only.

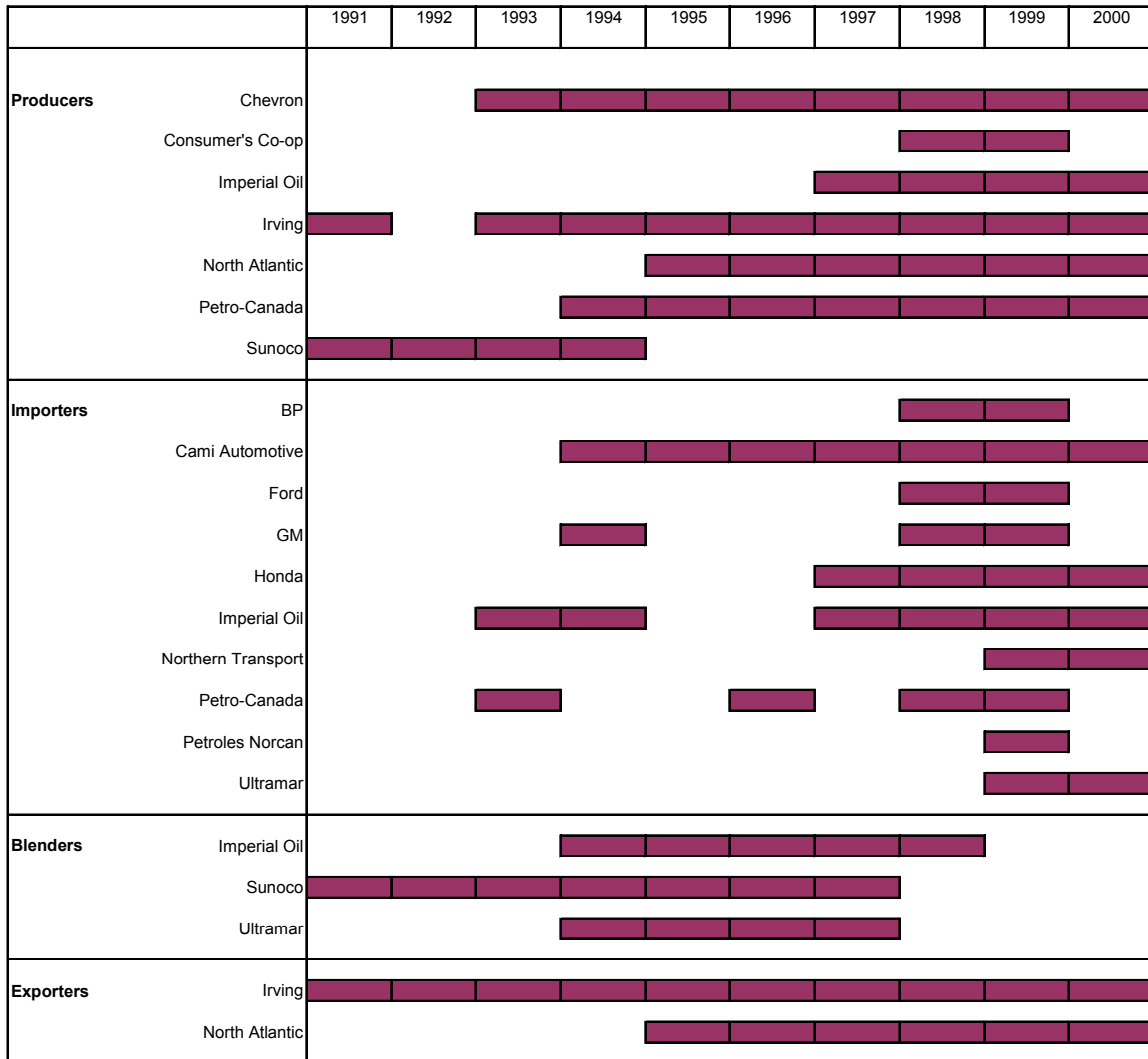
Figure 3.2 shows the volumes of gasoline containing MTBE that were reported to have been produced in, imported into, and exported from Canada between 1991 and 2000, as well as the net volumes of gasoline containing MTBE remaining in Canada (production + imports - exports).

¹⁴ One additional company, BP, reported adding MTBE to gasoline in Canada in 2001. All of this gasoline was subsequently exported.

¹⁵ Blending is considered to be the addition of MTBE to gasoline at a point in the distribution system which is downstream of a refinery.

¹⁶ An eleventh company, Olco, imported gasoline containing MTBE, but not until 2001.

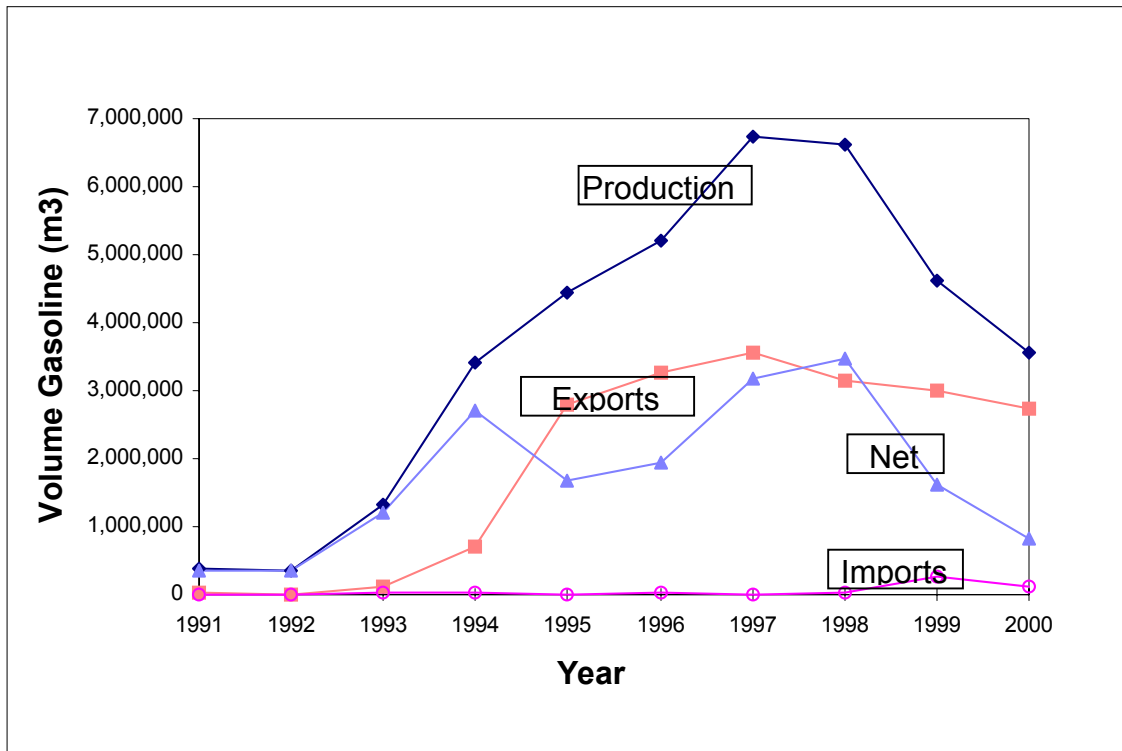
Figure 3.1 - Companies reporting producing, exporting or importing gasoline containing MTBE in Canada, 1991-2000



Between 1991 and 2000, a total of approximately 34.2 million m³ of gasoline containing MTBE, equivalent to approximately 10% of the total gasoline pool, was produced in Canada. As Figure 3.2 shows, production peaked in 1997 at about 6.5 million m³, while the net volume of gasoline containing MTBE in Canada (production + imports - exports) peaked in 1998 at about 3.5 million m³. By 2003, net volumes are expected to fall by over 95% from the 1998 peak.

In 1998, gasoline containing MTBE at concentration in excess of 0.6% by volume accounted for 10% of the gasoline Canadian pool. This fell to 2% in 2000, and is estimated to have been less than 1% in 2001.

Figure 3.2 - Reported production, imports and exports of gasoline containing MTBE in Canada, 1991-2000



Only two refining companies, Irving Oil Ltd. and North Atlantic Refining Ltd., reported that they intend to continue using MTBE in gasoline in Canada post-2001. North Atlantic Refining Ltd. indicated that 90% of the gasoline it produces containing MTBE will be exported. Irving has informed Environment Canada that it no longer sells gasoline in Canada that contains MTBE.

Three companies, Cami Automotive, Honda and Northern Transportation, indicated that they intend to continue to import small volumes of gasoline containing MTBE post -2001. In addition, Ultramar reported that imports of gasoline containing MTBE could be possible but are not planned.

3.2 Production, import and export of MTBE

Paragraphs 1(a) and (c) of the CEPA 1999 Notice required the reporting of information relating to the production, import and export of MTBE in Canada between 1991 and 2000 and the intended production, import and export of MTBE from 2001 to 2005.

Figure 3.3 lists the companies that reported producing, importing or exporting MTBE in Canada between 1991 and 2000. A total of six companies imported

MTBE into Canada during this period¹⁷, two companies exported MTBE, and only one company, Alberta Envirofuels Inc., produced MTBE.

Figure 3.3 - Companies that reported producing, exporting and importing MTBE in Canada, 1991-2000

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Producers	Alberta Envirofuels		■	■	■	■	■	■	■	■	■
Importers	Consumer's Co-op								■	■	
	Imperial Oil				■	■	■	■	■	■	■
	Irving	■	■	■	■	■	■	■	■	■	■
	North Atlantic				■	■	■	■	■	■	■
	Sunoco	■	■	■	■	■	■	■	■	■	■
	Ultramar				■	■	■	■	■	■	■
Exporters	Chevron		■	■	■	■	■	■	■	■	■
	Neste		■	■	■	■	■	■	■	■	■

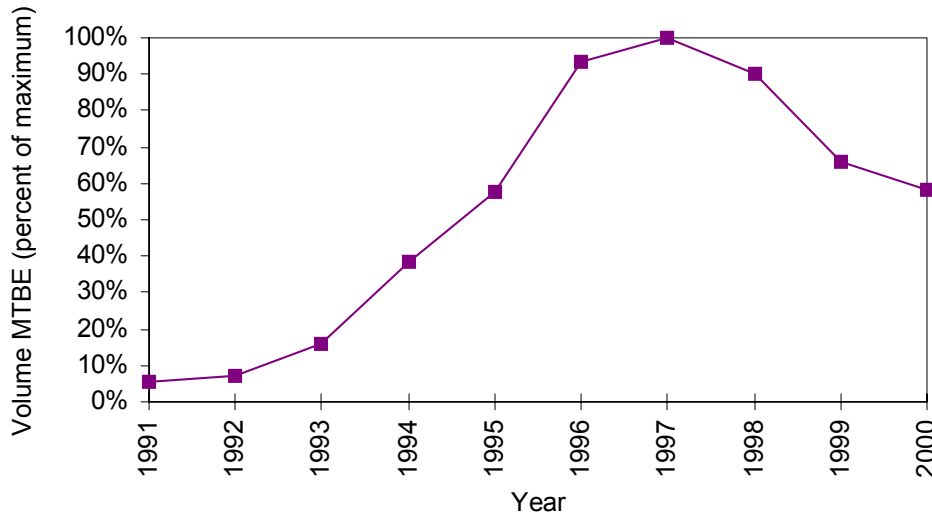
Figure C.2 in Appendix C shows the production, exports and imports of MTBE on a regional basis between 1991 and 2000. While imports of MTBE occurred in every region during the ten year period, production and exports were limited to the west of Canada.

Production of MTBE in Canada peaked in 2001. It was reported that production would cease in 2002. There were imports of MTBE into each region of Canada between 1991 and 2000, with 89% of the volume being imported into the Atlantic region.

Figure 3.4 shows the net volumes of MTBE remaining in Canada (production + imports - exports) between 1991 and 2000 as a percentage of the 1997 peak volume.

¹⁷ at volumes greater than 2 m³/year or greater.

Figure 3.4 - Net volume (production + imports - exports) of MTBE in Canada, 1991-2000



3.3 Reported releases of gasoline containing MTBE

The CEPA 1999 Notice required the reporting of spills or leaks into the environment of more than 150 litres at any one time of a fuel containing at least 0.6 percent by volume MTBE. Table 3.2 presents the dates, volumes and locations of the nineteen releases of gasoline containing MTBE in Canada during 1991 to 2000 as reported by three companies. These releases occurred in British Columbia (B.C.), Ontario, Quebec and Nova Scotia.

Five of the releases were reported to be due to human error (overfilling, loading errors); others were due to equipment failure, such as leaks from tanks and piping. Twelve of the nineteen releases were reported to have been contained. For the seven releases that were not contained, the follow-up action consisted of:

- soil remediation (one case);
- soil and ground water remediation (two cases);
- remedial action was not described in four cases.

Table 3.2 - Reported releases of gasoline containing MTBE in Canada, 1991-2000

Date	Province	Volume Released (litres)
1992	ON	unknown
1993	ON	unknown
1994	QC	960
May-94	BC	2,700
Jul-94	BC	250
Jan-95	BC	600
Apr-95	BC	429
Sep-95	BC	300
Sep-95	BC	150
Apr-97	BC	400
1998	NS	150
Jan-98	BC	184
Feb-98	BC	1,600
May-98	BC	1,300
Jul-98	BC	440
Sep-99	BC	9,000
Jan-00	BC	1,350
Mar-00	BC	900
Aug-00	BC	1,500
Total		22,213

In addition to the above-noted nineteen releases, three companies reported a total of 460 releases of gasoline which may have contained MTBE during 1991 to 2001. These releases occurred in Ontario, Quebec and the Atlantic provinces.

3.4 Reported releases of MTBE

Section 1(e) (i) of the CEPA 1999 Notice required the reporting of spills or leaks into the environment of more than 10 litres of MTBE at one time resulting from the operations of the respondents. Table 3.3 presents the dates, volumes and locations of the seventeen reported releases of MTBE in Canada during 1991 to 2000. These releases were reported by six companies.

Eleven of the releases occurred in Alberta. Others occurred in Newfoundland and B.C. Three of the releases were reported to be due to human error (overfilling); others were due to equipment failure, such as leaks at valves, pumps and piping. Seven of the seventeen releases were reported to have been contained. For the ten releases that were not contained, MTBE was detected in ground water in eight cases and the follow-up action taken was:

- ground water and soil were remediated (one case);
- ground water was remediated (one case)
- soil remediated (two cases);

- ground water monitoring (three cases);
- remedial action was not described in one case.

Table 3.3 - Reported releases of MTBE in Canada in 1991-2000

Date	Province	Volume released (litres)
Mar-92	AB	50
Apr-92	AB	200
Feb-96	AB	60
Jul-96	AB	250
Jul-96	AB	100
Jul-96	BC	10
Oct-96	BC	750
Jan-97	BC	4,500
Sep-97	NF	143,100
Oct-97	AB	100
Oct-97	AB	10
Nov-97	AB	10
Jul-99	AB	18
99	AB	155
Oct-00	AB	12
May-00	BC	27,500
May-00	BC	50
Total		176,875

3.5 Reported ground water and drinking water contamination

Section 1 (e) (iii) of the Notice required the reporting of instances of MTBE detected in ground water, surface water or drinking water at a concentration exceeding 0.0005 mg/L (approximately 0.5 ppb).

3.5.1 Ground water contamination

MTBE was reported as having been detected in ground water at 250 locations and in every province in Canada but none of the territories. Among these, six locations in PEI were sources of drinking water and are discussed in more detail in section 3.5.2. Figure 3.5 shows the number of sites at which ground water contamination was reported for each province. Approximately three-quarters of the sites are located in western Canada.

Approximately eighty percent of incidents were reported by two companies. These two companies and one other were the only respondents that indicated that they have routine monitoring in place for MTBE contamination of ground water. It is expected, therefore, that the ground water contamination reported under the Notice may under-represent the contamination that exists in some regions.

Some form of follow-up to the incidents of ground water contamination reported under the Notice was indicated for 97% of incidents:

- remediation of contaminated soil and/or ground water was being carried out for 36% of the reported incidents;
- respondents indicated that water monitoring programs were in place for a further 20% of incidents;
- a further 27% were being investigated and remediation may have followed;
- for a further 8% of incidents remedial action had been completed.

Figure 3.5 - Reported number of sites with MTBE contamination of ground water

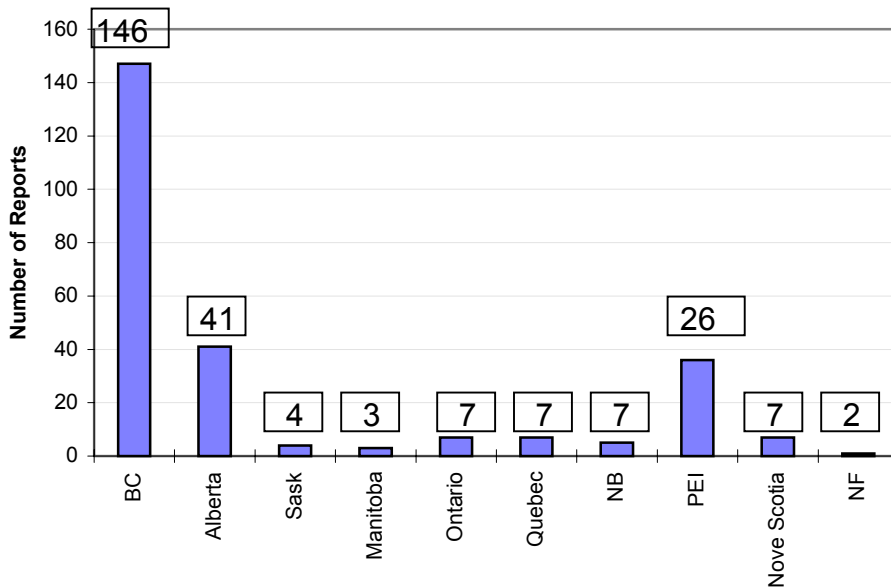
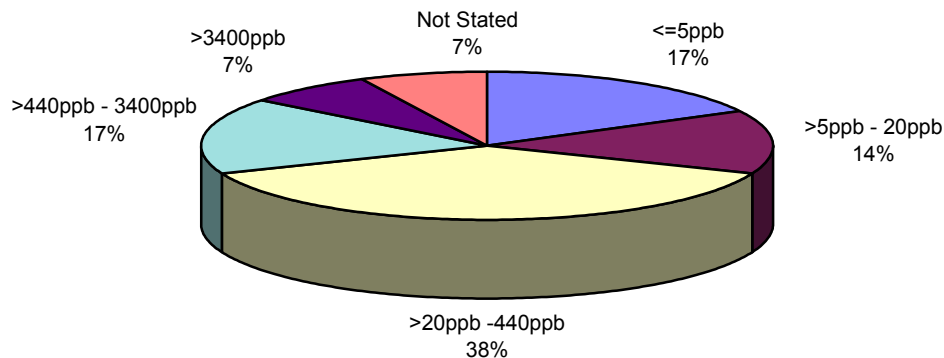


Figure 3.6 shows the distribution of maximum reported concentrations of MTBE in ground water. Sixty percent of these concentrations were at levels above the EPA's threshold consumer advisory level for aesthetics of 20 ppb, and over seven percent were at levels exceeding B.C.'s guideline for aquatic life of 3400 ppm.

Figure 3.6 - Distribution of maximum reported concentrations of MTBE in ground water (ppb)¹⁸



Based on 250 reported incidents of ground water contamination

Figure 3.7 shows a breakdown of the type of facilities at which MTBE ground water contamination was reported:

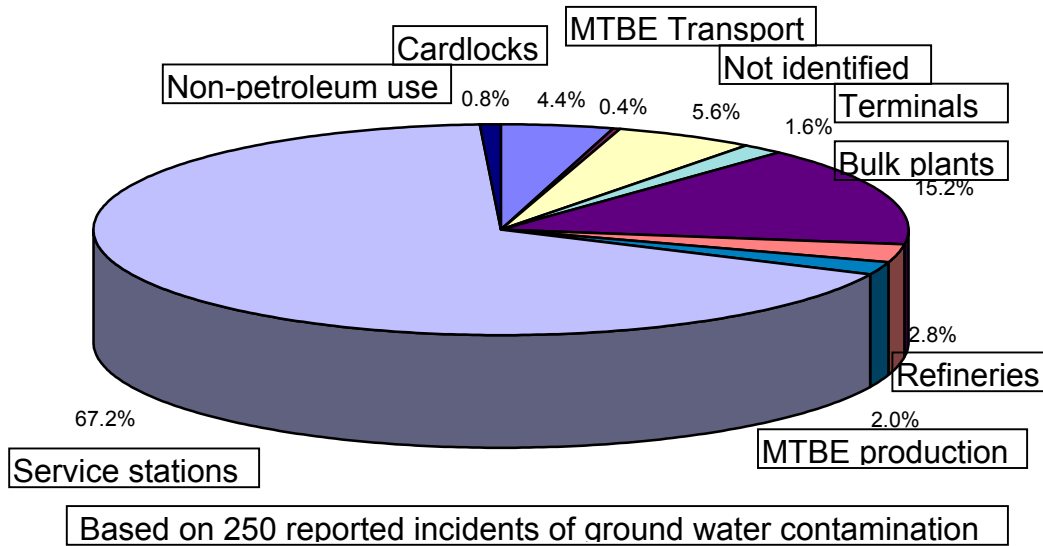
- sixty-seven percent of the reported incidents of ground water contamination were measured at sites that were active or former service stations;
- contamination was also reported at bulk plants (15%), cardlocks (4%), refineries (3%), terminals (2%) and other facilities.

The cause of contamination was reported for approximately a quarter of incidents. At service stations, the most common reason provided was releases from underground storage tank systems; other causes at service stations were identified as releases from piping and handling.

Table D.1 in Appendix D provides a list of the municipalities in which ground water contamination was encountered and the level of MTBE reported.

¹⁸ Ranges in the graph were established from: California aesthetic guidelines for MTBE concentration of MTBE in drinking water (5 ppb); lower limit of EPA consumer advisory for MTBE in drinking water (20 ppb); and B.C. guidelines for MTBE in water for marine and estuarine life (440 ppb) and for aquatic life (3400 ppb).

Figure 3.7 - Distribution of facility types for which ground water contamination was reported



3.5.2 Drinking water contamination

Among the 250 locations at which MTBE was detected, six were sites where ground water was used as a source of drinking water. All six sites were located in PEI. The locations and MTBE concentrations for each of these incidents are presented in Table 3.4 below. The reported maximum concentrations of MTBE ranged from 1 to 5 ppb - all below the PEI guideline for aesthetics of 15 ppb and the threshold EPA consumer advisory for aesthetics of 20 ppb.

In all six locations the ground water was being remediated. In fact, by November 2001, the concentration of MTBE had fallen to non-detectable levels in three of the six locations.

Table 3.4: Reported incidents of drinking water contamination with MTBE in Canada, 1991-2000

	Date last sample	City/town	Province	Max. Rptd Conc. MTBE (ppb)
1	August 2001	Miscouche	PEI	5
2	August 2001	New London	PEI	4
3	August 2001	Bedford	PEI	1
4	August 2001	Mt. Carmel	PEI	2
5	August 2001	Wellington	PEI	4
6	August 2001	O'Leary	PEI	2

3.6 Procedures to monitor and prevent MTBE releases and to monitor for contamination

Under section 1(f) of the Notice, companies were requested to provide descriptions of the procedures to monitor and prevent MTBE releases that they have implemented any time after January 1, 1991, or that they plan to implement before April 1, 2002. The nature of the responses was qualitative.

Sub-section 1(f) (i) requested the reporting of procedures to monitor the release of MTBE or gasoline containing at least 0.6 percent by volume MTBE. Twenty-one companies responded to this question. Of the 21 that responded, three responded with 'No Monitoring'.

The companies that did respond cited these procedures to monitor releases:

- Volume management to identify loss (6 firms);
- Visual inspections for evidence of leakage (5 firms);
- Reporting policies and procedures for spill reporting (5 firms);
- Installation of ground water monitoring wells (4 firms);
- Following CCME Environmental Code of Practice for Underground Storage Tanks Containing Petroleum Products (2 firms);
- Leak detection system between primary and secondary containment (1 firm);
- Double-walled underground storage tanks with interstitial leak detection (1 firm);
- Environmental monitoring program (1 firm);
- Transportation of Dangerous Goods audits (1 firm);
- Leak detection system (1 firm);
- Ambient air monitoring (1 firm);
- Fugitive emission survey (1 firm);
- Effluent and cooling water monitoring (1 firm).

In general, a patchwork of procedures was identified without a consistent standard being applied for monitoring of MTBE releases.

Sub-section 1(f) (ii) requested the reporting of procedures to prevent the release of MTBE or gasoline containing at least 0.6 percent by volume MTBE. Twenty-three companies responded to this question. Of the 23 firms that responded, one felt this was not applicable and one firm does not use or intend to use MTBE. One firm indicated there were no specific procedures for the prevention of leaks.

In general, a variety of procedures was identified. Thirteen firms identified work procedures and/or spill prevention procedures. Eleven firms identified various technical solutions for containment at the tanks, piping and connectors. Nine

firms identified secondary containment through the use of double walled tanks, concrete berms, liners or earth.

The companies that responded cited the following as their procedures to prevent the releases of MTBE or gasoline containing MTBE:

- Emergency response procedures (8 firms);
- Standardized work procedures to prevent spills (8 firms);
- Inspection and Maintenance program (5 firms);
- Cathodic protection (4 firms);
- Employee education (4 firms);
- Spill containment at fill locations (4 firms);
- Volume balance in system (3 firms);
- Containment at dispenser locations (3 firms);
- Following CCME Environmental Code of Practice for tanks (2 firms);
- Double-walled tanks (2 firms);
- Double-walled piping (2 firms);
- Vessel inspection before loading (2 firms);
- Volume balance upon receipt of gasoline not to exceed tank capacity (2 firms);
- Liquid accumulators (2 firms);
- Tanks located within polyethylene lined dikes (2 firms);
- Secondary containment around tanks (2 firms);
- ISO 14001 work procedures (2 firms);
- Spill prevention training (1 firm);
- Fibreglass reinforced plastic liner for MTBE storage tanks (1 firm);
- Interstitial leak detection on double-walled tanks (1 firm);
- Interstitial leak detection on double-walled piping (1 firm);
- Turbine pump containment (1 firm);
- Vapour recovery (1 firm);
- Tanks located within earth berm (1 firm);
- Spill kits located by tank system including storm sewer covers (1 firm);
- Internal floating roof tanks with rim seals and wipers (1 firm).

Sub-section 1(f) (iii) requested a description of procedures to test for contamination by MTBE of soil, ground water, surface water or drinking water. Sixteen companies responded to this question. Of the sixteen firms that responded:

- 11 have done some ground water contamination testing;
- 36 locations were identified as having some ground water monitoring or testing;
- 3 firms have performed studies on ground water contamination;
- 6 firms identified ongoing monitoring of ground water through the use of monitoring wells; and
- 1 firm identified testing for MTBE in surface water runoff.

3.7 Future use of MTBE

Under section 1(g) of the Notice, companies were requested to provide information on financial impacts, compositional effects, and replacement options if MTBE were not available as a gasoline component.

Sub-section 1(g) (i) requested the costs and financial benefits associated with ceasing the use of MTBE in gasoline. Nineteen companies responded to this question:

- 4 firms felt it was not applicable to them;
- 7 firms were either not using, or plan on phasing out the use of MTBE;
- 4 firms felt there would be an increase in the cost of gasoline;
- 1 firm was performing a cost / benefit analysis;
- 1 firm was unsure of the costs or benefits from ceasing the use of MTBE;
- 1 firm indicated there would be no financial effect of reducing MTBE in gasoline;
- 1 firm identified that ceasing the use of MTBE was not feasible as long as it was required for EPA emissions testing.

Sub-section 1(g) (ii) requested the reporting of the effects, or an estimate of the effects, on the composition characteristics of gasoline if MTBE is not used in gasoline. Thirteen companies responded to this question:

- 5 firms felt it was not applicable to them;
- 2 firms identified requirements to meet Canadian General Standards Board (CGSB) specifications; and
- 2 firms were not using MTBE and therefore identified no compositional changes.

Four firms identified effects on compositional characteristics and these included:

- Replacement of MTBE with ethanol (2 firms);
- Reduction of octane may be compensated by increasing alkylate content of gasoline (2 firms);
- Use of another oxygenate (2 firms);
- Increase in lighter high octane components (1 firm);
- Some gasoline products to become heavier during distillation (1 firm);
- Increased use of t-butanol (1 firm); and
- Increased use of methanol (1 firm).

Sub-section 1(g) (iii) requested options available for replacing MTBE in gasoline with other components, along with the nature of those components. Fourteen companies responded to this question. Of these, three felt the question did not apply to them. Replacements identified for MTBE included:

- Alternative alkylate (6 firms);

- Ethanol (3 firms);
- Toluene (2 firms);
- Reformulate (1 firm);
- Alternative Oxygenates (1 firm);
- Ethyl HiTEC 3046 (MMT) (1 firm); and
- Iso-octane (2 firms).

Under section 1(h) of the Notice, companies were requested to provide information on how they would convert their MTBE production facilities. This was to include alternative uses and estimates of costs and financial benefits associated with the conversion. Nineteen companies responded to this question; eighteen of these firms did not have MTBE production facilities and therefore replied “Not Applicable”. The one firm directly responsible for production of MTBE identified converting its facility to produce isooctane in 2002.

Under section 1(i) of the Notice, companies were requested to provide information on the use of other aliphatic ethers other than MTBE. The scope included past use after January 1, 1991, present use, and estimates of future annual use from 2001 through to 2005. Sixteen companies responded to this question. Of the respondents:

- 3 responded “Not Applicable”;
- 11 firms indicated that they did not plan to use other aliphatic ethers;
- 1 firm identified the possible use of newly developed aliphatic ethers;
- 2 firms identified past use and potential future use of Tertiary Amyl Methyl Ether (TAME). These two firms indicated that they received gasoline that contained TAME from others.
- 1 firm purchased gasoline already containing aliphatic ethers which included Di-Methyl Ether (DME) and Diisopropylether (DIPE); and
- 1 firm mentioned importing gasoline containing Ethyl Tertiary Butyl Ether (ETBE).

3.8 Discussion

3.8.1 Summary of key findings

i) Intended future use of MTBE in Canada

Responses to the Notice in July 2001 indicated that by 2002, use of gasoline containing MTBE would be reduced significantly - by over 95% from the 1998 peak level. The Canadian Petroleum Products Institute (CPPI), representing most Canadian refiners, has indicated that its member companies ceased adding MTBE to gasoline by the end of 2001 and that none have the intention of using MTBE in the future. CPPI noted that imports of gasoline by member companies may incidentally contain MTBE. As well, responses to the Notice indicated that

there may be imports of small volumes of gasoline containing MTBE by vehicle manufacturers.

The continued addition of MTBE to gasoline for use in Canada will be limited to Atlantic Canada. Only Irving Oil and North Atlantic Refining indicated that they intend to continue producing gasoline containing MTBE after 2001. Both of these Atlantic refiners export to the U.S. reformulated gasoline, which must contain oxygenate. While North Atlantic Refining reported that it plans to continue marketing MTBE-containing gasoline in Canada, Irving Oil has indicated that it will not. North Atlantic reported that 90% of the gasoline it produces containing MTBE will be exported.

ii) Reported ground water and drinking water contamination

MTBE was detected in ground water at a total of 250 locations across the country. Contamination was reported to have occurred in every province, with most incidents (78%) reported in western Canada. In 60% of cases, MTBE was found to be present at a concentration above the EPA consumer advisory for taste of 20 to 40 ppb.

Approximately 80 percent of incidents were reported by two companies. These two companies and one other were the only respondents that indicated that they have routine monitoring in place for MTBE contamination of ground water. It is expected, therefore, that the ground water contamination reported under the Notice under-represents the contamination that exists in some regions.

Most of the ground water contamination (67%) reported under the Notice occurred at sites that were active or former service stations. In most of these cases, the cause of contamination was not identified. In 11% of cases, the contamination was linked to underground storage tank systems.

Ground water contamination was also reported to have occurred at bulk plants (15% of reported incidents), cardlocks (4%), refineries (3%) and terminals (2%). The cause of the contamination was not identified for most cases.

MTBE was also detected at six sites where ground water was used as a source of drinking water. All six sites were located in PEI. The reported maximum concentrations of MTBE ranged from 1 to 5 ppb, levels below the PEI water quality guidelines for aesthetics and below the EPA consumer advisory for aesthetics of 20 to 40 ppb.

There were few reported releases of gasoline containing MTBE (nineteen) relative to the number of incidents of ground water contamination (250). Based on conversations with respondents and tank system experts, it is understood that most ground water contamination encountered at service station sites is due to leaks from underground storage tank systems, i.e. the tanks themselves and

associated piping and pumps. Some sources, however, have indicated that they believe ground water contamination is due to small releases of gasoline at services stations during fill-up.

iii) Remediation of contaminated ground water and drinking water

The concentration of MTBE in contaminated water can be expected to decrease slowly without active remediation, as MTBE degrades naturally over time¹⁹. It is understood from the information provided under the Notice that remediation of contaminated soil and/or ground water was being carried out for 36% of the reported incidents. A further 27% were being investigated and subsequent remediation may have followed. For a further 20% of incidents, respondents indicated that water monitoring programs were in place. Remediation was reported to have been undertaken and completed for a further 8% of incidents. Some form of follow-up to the incidents of ground water contamination reported under the Notice was indicated for 97% of incidents.

All six locations at which MTBE was detected in ground water used as a drinking water source were being actively remediated. In fact, by November 2001, the concentration of MTBE had fallen to non-detectable levels (levels below 0.1 ppb, and below the PEI water quality guidelines of 15 ppb and the EPA consumer advisory level of 20-40 ppb) in three of these six locations.

3.8.2 Addressing the problem

i) Preventing releases of MTBE into the environment

Environment Canada does not expect that there will be significant use of MTBE in Canada outside of the Atlantic region post-2002. Only two refineries, both in Atlantic Canada, plan to use MTBE and one of those will use it only in gasoline that is exported. Nevertheless, it will be important to monitor the use of MTBE and replacement oxygenates in Canada. Environment Canada intends to do this by monitoring reports submitted to the department by gasoline producers and importers pursuant to requirements of the *Benzene in Gasoline Regulations*. Environment Canada will also monitor imports of MTBE into Canada through Statistics Canada's database of imports.

In addition, revisions to the CCME Environmental Codes of Practice are underway for the following: Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products, and Aboveground Storage Tanks containing Petroleum Products. The Codes of Practice, published in 1993

¹⁹ The half-life of MTBE in ground water has been estimated to be between 56-360 days under aerobic conditions, and 112 to 720 days under anaerobic conditions (World Health Organization, International Programme on Chemical Safety, Environmental Health Criteria 206, Methyl *tertiary*-Butyl Ether, 1998, p. 31).

and 1994, respectively, specify a model set of technical requirements which are designed to protect the environment from leaking storage tank systems. The Codes also provide recommendations concerning design and installation of new systems and the upgrading of existing systems.

The CCME Codes of Practice have been adopted into regulations by all provinces, except B.C. and Newfoundland. Table 3.5 outlines the current requirements in provincial petroleum storage tanks requirements.

Table 3.5 - Comparison of Provincial Petroleum Storage Regulations

PROVINCE	REGULATION	CCME BASED	VOLUME EXEMPTION	INSPECTIONS	ENFORCEMENT
Newfoundland	Yes	No	Above-ground storage tank (ast) or underground storage tank (ust) ≤ 2500 litres (L) when connected to heating oil appliance	No (see note 4)	Yes
Prince Edward Island	Yes	Yes	None	Yes	No (see note 5)
Nova Scotia	Yes	Yes	ust < 2000 L ast < 4000 L	Yes	Yes
New Brunswick	Yes	Yes	non-marina ast < 2000 L	Yes	Yes
Quebec	Yes	Partially	risk based according to product stored	Yes	Yes
Ontario	Yes	Yes	None	No (see note 4)	Yes
Manitoba	Yes	No	ast < 1000 gal (4545 L)	Yes	Yes
Saskatchewan	Yes	Yes	ast < 4000 L	Yes	Yes
Alberta	Yes	Yes	None	Yes	Yes
British Columbia	No				
Nunavut	No				
Northwest Territories	No				
Yukon Territory	No				

Background: The table was developed by asking the following questions of provincial and territorial regulators.

1. Does the authority having jurisdiction have a petroleum storage regulation?
2. If yes, is the regulation based on the CCME Codes of Practice?
3. Does the regulation apply to all tank sizes or are there volume based exemptions?
4. Does the regulation include an inspection programme? This was interpreted to mean a programme outside of the equipment calibration and monitoring that is ongoing and is the responsibility of the owner of the storage tank system.
5. Does the regulation include enforcement? This was presented as a separate section within the regulation as opposed to the enforcement permitted by the Act under which the regulation was promulgated.

In 2002, the CCME updated the Codes and combined them to make requirements consistent with advances in technology and operating experience. The revised Code will be published in 2003. The Code will call for secondary containment with interstitial leak detection for all tanks within the scope of the Code, and for the removal of underground steel tanks that have never had cathodic protection. The Code will be an important measure for preventing leaks of gasoline from storage tanks and associated equipment from entering the environment. Some provinces intend to incorporate the Code into their regulations.

It is estimated that that there are approximately 10,000 tanks containing fuels that are operated by the Federal Government. In 2003, Environment Canada is intending to recommend new regulations for fuel storage tanks on federal lands, aboriginal lands, and those fuel tanks owned or operated by the Federal Government, Crown Corporations and federal works and undertakings. The regulations will include requirements consistent with the new CCME codes of practice for above ground and underground storage tanks.

ii) Detecting ground water and drinking water contamination with MTBE

Only three respondents reported that they had routine monitoring programs in place to detect ground water contamination with MTBE. It is quite possible, therefore, that the ground water contamination reported under the Notice under-represented the contamination that exists in the environment.

Protection and monitoring of ground and drinking water are areas of provincial jurisdiction. Environment Canada is aware of provincial monitoring programs in PEI, New Brunswick and B.C. as well as source or drinking water monitoring activities in all provinces and territories:

- P.E.I. has shared their data with Environment Canada; responses to the Notice are consistent with that data.
- B.C. has carried out monitoring at wells that are not located adjacent to service stations and found very little contamination. B.C. has no plans for further testing of ground water for MTBE contamination.
- At their June 2001 meeting, the Federal-Provincial-Territorial Subcommittee on Drinking Water requested that provinces and territories share information on MTBE contamination of drinking water contamination with the Subcommittee. Incidents of contamination of private wells were reported by New Brunswick. No other incidents were reported to the Secretary by other provinces or territories during the June-December 2001 response period.

Environment Canada plans to continue to monitor MTBE contamination of ground water and drinking water across Canada through information shared with the department by provinces and territories. On a broader level, Environment Canada will also continue to monitor the use of MTBE in gasoline in Canada as described in the previous section.

iii) Remediating contaminated ground water and drinking water

Remediation requirements differ by province. The Atlantic provinces have adopted a risk based approach in which remediation requirements depend upon the potential use of the ground water source. It is Environment Canada's understanding that only PEI and B.C. have guidelines for the remediation of ground water contaminated with MTBE, although guidelines may exist in other provinces for other components of gasoline, such as benzene and toluene. B.C. has set guidelines of 20 ppb for drinking water (aesthetic) and 3400 ppb for aquatic life and PEI has set a guideline of 15 ppb for drinking water (aesthetic).

In 2001, the Federal-Provincial-Territorial Subcommittee on Drinking Water undertook the development of Guidelines for Canadian Drinking Water Quality for MTBE. The CCME has work underway to develop water quality guidelines for MTBE for the protection of aquatic life. Both of these guidelines will be able to be used as clean up standards in remediating releases of MTBE into the environment.

4.0 Path forward

While addressing contaminated sites is primarily an area of provincial jurisdiction, the federal government plans to coordinate a number of actions to address the issues related to MTBE contamination. Given the substantial decrease in use of MTBE in Canada, the following initiatives, falling into three areas, are considered appropriate:

1. Preventing releases of MTBE into the environment:
 - Codes of practice for underground and above ground storage tanks developed in 1993 by the Canadian Council of Ministers of the Environment (CCME) are being updated (expected to be published in 2003).
 - New federal regulations are being developed to put technical requirements such as leak detection in place for all tanks under federal jurisdiction (expected to be completed in 2003).
2. Detecting ground water and drinking water contamination:
 - On a broader level, Environment Canada will continue to study and report on the use of MTBE in gasoline in Canada in order to monitor potentially affected regions;
 - Environment Canada will monitor MTBE contamination of ground and drinking water across Canada through information provided to the department by provinces and territories.
3. Remediating contaminated sites:
 - The CCME is developing Canadian water quality guidelines for the protection of aquatic life and the Federal-Provincial-Territorial Subcommittee on Drinking Water is developing Guidelines for Canadian Drinking Water Quality for MTBE. These guidelines may be used to guide clean up for cases where standards do not exist (expected to be completed in 2003-2004).

These actions will provide an ongoing understanding of MTBE usage in Canada, mitigate the potential for further MTBE releases, and give guidance for remediation of contaminated sites.

Appendix A

May 26, 2001 CEPA 1999 Notice on MTBE Use and Releases

<http://canadagazette.gc.ca/partI/tempPdf/g1-13521.pdf>
pp.1760-1764

Appendix B

Table B.1: U.S. states having passed or considering legislation to limit or ban MTBE

States banning MTBE	Date ban/phase-out to take effect	States considering action
Arizona	2004	Hawaii
California	Jan. 1, 2004	Maryland*
Colorado	Apr. 30, 2002	Massachusetts*
Connecticut	Oct. 1, 2003	Missouri*
Illinois	Jul. 1, 2004	Mississippi
Indiana	Jul. 23, 2004	Montana
Iowa	Jan. 1, 2000	New Hampshire
Kansas	Jul. 1, 2004	New Jersey*
Kentucky	Jan. 1, 2006	Pennsylvania*
Maine	Jan. 1, 2003 (state goal)	Rhode Island
Michigan	Jan. 1, 2003	Vermont*
Minnesota	Jul. 1, 2000 (limit), Jul. 2005 (ban)	
Nebraska	Jul. 13, 2000	
New York	Jan. 1, 2004	
Ohio	Jul. 1, 2005	
South Dakota	Mar. 2001	
Washington	Dec. 31, 2003	

Source: International Fuel Quality Center, February 25, 2003.

* States that in 1999-2002 considered action on banning MTBE (Source: National Conference of State Legislatures, Issue Brief, MTBE: summarizing state legislative activity for 1999-2002).

Appendix C

Figure C.1 - Reported production, imports and exports of gasoline containing MTBE in Canada by region, 1991-2000

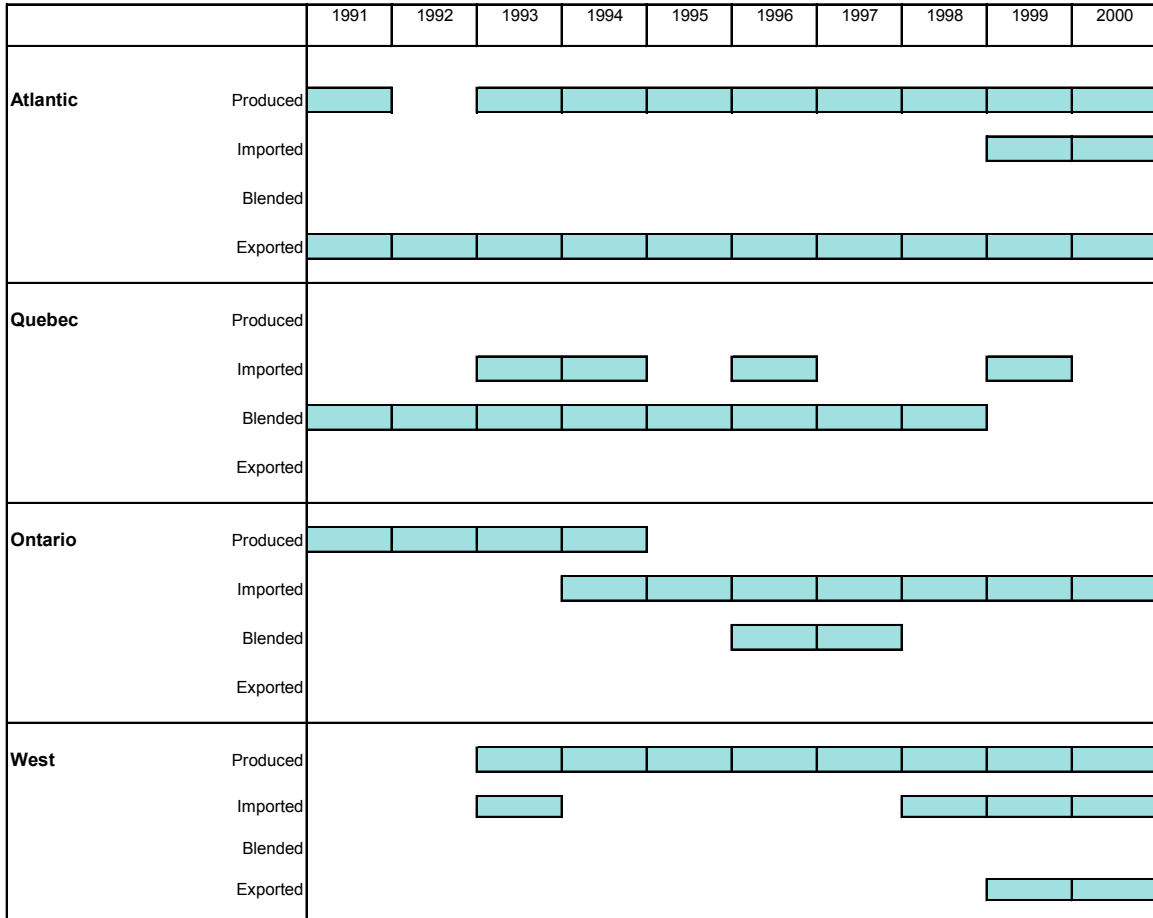


Figure C.2 - Reported production, imports and exports of MTBE in Canada by region, 1991-2000

		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Atlantic	Produced										
	Imported	■		■	■	■	■	■	■	■	■
	Exported										
Quebec	Produced										
	Imported	■	■	■	■	■	■	■	■		
	Exported										
Ontario	Produced										
	Imported	■	■	■	■		■	■			
	Exported										
West	Produced		■	■	■	■	■	■	■	■	■
	Imported								■		
	Exported		■	■	■	■	■	■	■	■	■

Appendix D

**Table D.1 - Reported Incidents of Ground Water Contamination with MTBE
in Canada, 1991- 2000**

	Date/ Date Last sample	City	Province	Max. Rptd Conc. MTBE (ppb)
1	Jul-96	Close to Edmonton	AB	120,000
2	not stated	Edmonton	AB	100
3	Aug-98	Calgary	AB	2,200
4	not stated	Edmonton	AB	not stated
5	Apr-00	Bassano	AB	480
6	Apr-00	Calgary	AB	16
7	Apr-00	Medicine Hat	AB	170
8	May-00	Etzikorn	AB	39
9	May-00	Calgary	AB	300
10	Jun-00	Red Earth Creek	AB	980
11	Jun-00	Drayton Valley	AB	420
12	Jun-00	Airdrie	AB	91
13	Jul-00	Red Deer	AB	580
14	Aug-00	Sangudo	AB	170
15	Sep-00	Coronation	AB	29
16	Sep-00	High River	AB	6
17	Oct-00	Calgary	AB	410
18	Nov-00	Medicine Hat	AB	7
19	Nov-00	Viking	AB	17
20	Nov-00	Hays	AB	130
21	Nov-00	Cardston	AB	1,900
22	Nov-00	Edmonton	AB	16,000
23	Nov-00	Calgary	AB	11
24	Nov-00	Magrath	AB	23
25	Feb-01	Edmonton	AB	54
26	Feb-01	Edmonton	AB	2,600
27	Feb-01	Calgary	AB	56
28	Mar-01	Edmonton	AB	9
29	Mar-01	Calgary	AB	64
30	Mar-01	Calgary	AB	20
31	Mar-01	Pincher Creek	AB	15
32	Apr-01	Fort McMurray	AB	6
33	Apr-01	St. Albert	AB	1,000
34	May-01	Calgary	AB	2,100
35	May-01	Stoney Plain	AB	15,000
36	Dec-01	Edmonton	AB	410
37	not stated	7 km East of Jasper	AB	not stated
38	not stated	High Prairie	AB	50
39	not stated	Edmonton	AB	200
40	not stated	Edmonton	AB	370
41	not stated	Valleyview	AB	470
42	Jul-96	Kitimat	BC	1,098,000
43	Jan-97	Abbotsford	BC	not stated
44	Oct-97	Vancouver	BC	3,000
45	Sep-99	Houston	BC	15
46	Sep-99	Oliver	BC	30
47	Oct-99	Abbotsford	BC	5
48	Nov-99	Victoria	BC	2
49	Nov-99	Vancouver	BC	16
50	Jan-00	Courtenay	BC	2
51	Feb-00	Clinton	BC	1
52	Mar-00	Vernon	BC	7
53	Mar-00	Squamish	BC	14
54	Mar-00	Chilliwack	BC	11
55	Apr-00	Vancouver	BC	1,420
56	Apr-00	Richmond	BC	414
57	Apr-00	Vancouver	BC	72
58	May-00	Abbotsford	BC	527
59	May-00	Chilliwack	BC	290
60	May-00	Vancouver	BC	28,000
61	May-00	Vernon	BC	68
62	May-00	Port Alberni	BC	8
63	May-00	Vernon	BC	89
64	May-00	Victoria	BC	17

	Date/ Date Last sample	City	Province	Max. Rptd Conc. MTBE (ppb)
65	May-00	Vancouver	BC	9,000
66	Jun-00	Fort Nelson	BC	42
67	Jun-00	Nanimo	BC	9
68	Jun-00	Victoria	BC	33,400
69	Jun-00	Rosedale	BC	1
70	Jul-00	Kelowna	BC	30
71	Jul-00	Squamish	BC	440
72	Jul-00	Langley	BC	86
73	Jul-00	Delta	BC	11
74	Jul-00	Kamloops	BC	30
75	Aug-00	Fort Nelson	BC	510
76	Aug-00	Cranbrook	BC	3
77	Aug-00	Fraser Lake	BC	270
78	Aug-00	Langley	BC	55
79	Aug-00	Prince George	BC	60
80	Aug-00	Houston	BC	3
81	Aug-00	Houston	BC	3
82	Aug-00	Vancouver	BC	3
83	Aug-00	Burnaby	BC	3
84	Aug-00	Kamloops	BC	630
85	Aug-00	Victoria	BC	474
86	Sep-00	Langley	BC	350
87	Sep-00	Princeton	BC	73
88	Sep-00	Merritt	BC	393
89	Sep-00	Victoria	BC	1,950
90	Sep-00	New Westminster	BC	13,100
91	Sep-00	Burnaby	BC	440
92	Sep-00	Burnaby	BC	688
93	Sep-00	Richmond	BC	527
94	Sep-00	Maple Ridge	BC	1,160
95	Sep-00	Delta	BC	3,340
96	Sep-00	Vernon	BC	50
97	Sep-00	Coquitlam	BC	1,090
98	Sep-00	Burnaby	BC	5,790
99	Sep-00	Vancouver	BC	456
100	Sep-00	Smithers	BC	1,630
101	Sep-00	Burns lake	BC	4,100
102	Sep-00	Vancouver	BC	185
103	Sep-00	Vancouver	BC	39
104	Sep-00	Burns Lake	BC	348
105	Sep-00	Prince George	BC	2
106	Sep-00	Prince George	BC	19
107	Sep-00	Prince George	BC	930
108	Oct-00	Vancouver	BC	2
109	Oct-00	Mackenzie	BC	160
110	Oct-00	Nelson	BC	50
111	Oct-00	Terrace	BC	8
112	Oct-00	Vancouver	BC	105
113	Nov-00	Nanimo	BC	71
114	Nov-00	Kelowna	BC	2
115	Nov-00	Richmond	BC	1
116	Nov-00	Salmon Arm	BC	260
117	Nov-00	Kitimat	BC	2
118	Nov-00	Victoria	BC	2,170
119	Nov-00	Vancouver	BC	73
120	Nov-00	Vanderhoof	BC	2,670
121	Nov-00	Port Alberni	BC	3
122	Nov-00	Vanderhoof	BC	112
123	Dec-00	Port Clements	BC	53
124	Dec-00	Prince George	BC	260
125	Dec-00	Vancouver	BC	610
126	Dec-00	Abbotsford	BC	300
127	Dec-00	Sardis	BC	24
128	Dec-00	Squamish	BC	3

	Date/ Date Last sample	City	Province	Max. Rptd Conc. MTBE (ppb)
129	Dec-00	Vancouver	BC	6
130	Dec-00	Hope	BC	1
131	Dec-00	Vancouver	BC	3
132	Dec-00	Surrey	BC	390
133	Dec-00	North Vancouver	BC	1,150
134	Dec-00	Vancouver	BC	16
135	Dec-00	Chilliwack	BC	28
136	Dec-00	Vancouver	BC	73
137	Jan-01	Whistler	BC	80
138	Jan-01	Prince Rupert	BC	27
139	Jan-01	Sidney	BC	15
140	Jan-01	Victoria	BC	3
141	Feb-01	Vancouver	BC	650
142	Feb-01	Surrey	BC	3
143	Feb-01	Masset	BC	44
144	Feb-01	Masset	BC	33
145	Feb-01	Vancouver	BC	86
146	Feb-01	North Vancouver	BC	3
147	Feb-01	Richmond	BC	2
148	Feb-01	Port Alberni	BC	84
149	Feb-01	Burnaby	BC	22
150	Feb-01	Surrey	BC	2,000
151	Mar-01	Power River	BC	6
152	not stated	Terrace	BC	not stated
153	Mar-01	Kelowna	BC	2
154	not stated	North Vancouver	BC	not stated
155	Apr-01	Coquitlam	BC	9
156	Apr-01	Chilliwack	BC	1,010
157	May-01	Langley	BC	124
158	May-01	Burnaby	BC	5,100
159	May-01	Vancouver	BC	1,720
160	May-01	Kelowna	BC	13
161	May-01	Salmon Arm	BC	77,000
162	May-01	Vancouver	BC	16
163	May-01	Sidney	BC	122
164	May-01	Sunshine Coast	BC	43
165	May-01	Kelowna	BC	329
166	May-01	Vancouver	BC	160
167	May-01	Campbell River	BC	22
168	May-01	Burnaby	BC	218
169	Jun-01	Vancouver	BC	54
170	Jun-01	Kelowna	BC	6
171	Jun-01	Powell River	BC	1,570
172	Jun-01	Surrey	BC	213,000
173	Jun-01	Vancouver	BC	9
174	Jun-01	Surrey	BC	55
175	Jun-01	Surrey	BC	1,380
176	Jun-01	Victoria	BC	2
177	Jun-01	North Vancouver	BC	16
178	Jun-01	Coquitlam	BC	3
179	Jun-01	Coquitlam	BC	705
180	Jul-01	Port McNeill	BC	16
181	Dec-01	Sunshine Coast	BC	84
182	Feb-01	Burnaby	BC	169,000
183	Apr-01	Burnaby	BC	2,100
184	Jun-00	Burnaby	BC	5
185	Jun-00	Burnaby	BC	15,000
186	Dec-01	Burnaby	BC	26
187	not stated	Richmond	BC	101
188	Apr-00	Winnipeg	MB	200
189	May-00	Winnipeg	MB	92
190	Jan-01	Virden	MB	36,100
191	Aug-00	Moncton	NB	160

	Date/ Date Last sample	City	Province	Max. Rptd Conc. MTBE (ppb)
192	Aug-00	Oromocto	NB	1
193	Dec-00	Bathurst	NB	46
194	Feb-01	College Bridge	NB	1
195	Feb-01	Fredericton	NB	5
196	Sep-95	Newcastle	NB	not stated
197	Apr-01	Campbellton	NB	not stated
198	Sep-97	Come By Chance	NF	59,000,000
199	Feb-01	Corner Brook	NF	not stated
200	Dec-94	New Glasgow	NS	not stated
201	May-99	Sydney	NS	not stated
202	Jul-00	Bridgewater	NS	1
203	Oct-00	Bedford	NS	6,000
204	Jan-01	Halifax	NS	50
205	Apr-01	Barrington Passage	NS	6
206	Jul-01	Seal Island	NS	370
207	Apr-00	Orangeville	ON	86
208	Jul-00	Ottawa	ON	1
209	Sep-00	London	ON	67
210	Oct-00	Kitchener	ON	2
211	Oct-00	Ajax	ON	60
212	Oct-00	Erin	ON	141
213	Nov-00	Belleville	ON	2,700
214	Aug-01	Miscouche	PEI	8
215	Aug-01	O'Leary	PEI	28
216	Aug-01	Bedford	PEI	220
217	Jan-92	Vernon Bridge	PEI	not stated
218	Oct-91	Wood Island	PEI	not stated
219	Aug-01	New London	PEI	4
220	Sep-94	Elmsdale	PEI	not stated
221	Aug-01	Richmond	PEI	160
222	Jan-92	Mt. Pleasant	PEI	not stated
223	Aug-01	Bloomfield	PEI	4
224	Aug-01	Bedeque	PEI	4
225	Aug-01	Miminegash	PEI	1
226	Aug-01	Summerside	PEI	1
227	Aug-01	St. Eleanors	PEI	290
228	Aug-01	Parkdale	PEI	700
229	Aug-01	Dundas	PEI	10
230	Aug-01	Georgetown	PEI	30
231	Aug-01	Hunter River	PEI	250
232	Aug-01	Charlottetown	PEI	3
233	Aug-01	Wellington	PEI	4
234	Jan-92	Baltic	PEI	not stated
235	Jun-93	Charlottetown	PEI	not stated
236	Aug-01	Mt. Carmel	PEI	51
237	Feb-00	Charlottetown	PEI	not stated
238	Aug-00	Charlottetown	PEI	not stated
239	Jul-01	Charlottetown	PEI	153
240	Sep-00	Longueuil	QC	4
241	Sep-00	Boucherville	QC	2
242	Sep-00	Montreal	QC	1,300
243	Sep-00	Montreal	QC	70
244	Nov-00	Montreal	QC	580
245	Nov-00	Verdun	QC	610
246	Mar-01	Saint Hubert	QC	2
247	Jun-00	Regina	SK	1,250
248	Sep-00	Langenburg	SK	85
249	Nov-00	Melville	SK	28
250	Dec-00	Melville	SK	11