

ICE STORM '98

by

Eugene L. Lecomte

with

Alan W. Pang and James W. Russell



© ICLR, December 1998



The Institute for Catastrophic Loss Reduction (ICLR) was established in 1998 with the mission to reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions to improve society's capacity to adapt to, anticipate, mitigate, withstand and recover from natural disasters.

**For further information, please contact:
Institute for Catastrophic Loss Reduction
151 Yonge Street, Suite 1800
Toronto, Canada M5C 2W7
Telephone: (416) 362-2031 – extension 374
Fax: (416) 362-2062
E mail info@iclr.org**

Copies of this paper can be obtained from the Institute for \$25 plus taxes, shipping and handling.

The Institute for Business and Home Safety is an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters.

**For further information, please contact:
Institute for Business and Home Safety
73 Tremont Street, Suite 510
Boston, Mass. 02108-3901, U.S.A.
Telephone: (617) 292-2003
Fax: (617) 292-2022
E mail: info.@ibhs.org**

The opinions expressed in this paper are those of the authors and not necessarily those of the Institute for Catastrophic Loss Reduction or the Institute for Business and Home Safety.

This material may be copied for purposes related to the document as long as the authors and copyright holders are recognized.

ICE STORM '98

by

Eugene L. Lecomte

with

Alan W. Pang and James W. Russell

ACKNOWLEDGEMENTS

The assistance of the individuals listed below is gratefully acknowledged. Without the sharing of their experiences, knowledge, information, expertise and free giving of their time, the material in this report would have been lacking in content and impossible to compile.

André Cadieux, Supervisor, Consumer Information Centre, Insurance Bureau of Canada

Gilles Chevrier, Vice President, Indemnisation Assurances, AXA Assurances Inc.

François Côté, Director, Ministry of Public Security, Government of Quebec

Jean-François Gauthier, Political Attaché, Ministry of Public Security, Government of Quebec

Jean-Bernard Guindon, Director, Civil Security Centre, Montreal Urban Community

Jacques Henault, Office of the Senior Scientific Advisor, Emergency Preparedness Canada

Paul Kovacs, Executive Director, Institute for Catastrophic Loss Reduction

Claude Lapointe, Manager Member Services, Insurance Bureau of Canada

Marc Lavallée, Assistant to the Deputy Minister of Public Security, Government of Quebec

Simon Law, Researcher and Student, Malden, Massachusetts

Raymond Medza, General Manager, Insurance Bureau of Canada

Evan Mills, PhD., Director, Center for Building Sciences, Lawrence Berkeley National Laboratory

Eric Shipley, Executive Director, Emergency Preparedness Canada

Edward A. Thomas, Director, Operations Support Division, Region I, Federal Emergency Management Agency

Chris Tucker, Senior Scientific Advisor, Emergency Preparedness Canada

Tracy Waddington, Policy Analyst, Insurance Bureau of Canada

James Lee Witt, Director, Federal Emergency Management Agency

ABOUT THE AUTHORS

Eugene L. Lecomte is President Emeritus of the Institute for Business and Home Safety, Boston, Massachusetts. A veteran of more than 50 years in the insurance business Mr. Lecomte has served as President and CEO of the Insurance Institute For Property Loss Reduction, National Committee on Property Insurance and the Property Insurance Plans Service Office. He also served as President of the Massachusetts Automobile and Workers Compensation Rating Bureaus.

Alan W. Pang is Managing Director of the Institute for Catastrophic Loss Reduction, Toronto. Mr. Pang is on sabbatical from Aon Re Canada where he is a Vice President. A reinsurance broker, he has extensive experience in modeling and assessing the impact of severe weather on the insurance community.

James W. Russell, Ed.D. is Vice President of the Insurance Institute for Business and Home Safety and is responsible for outreach. Dr. Russell was associated with the Massachusetts Public School System for 33 years. He also served in the Massachusetts National Guard for 37 years, rising to the rank of Colonel.

TABLE OF CONTENTS

	Page
Foreword	1
The Meteorology	3
The Canadian Event	3
The United States Event	8
The Occurrence	9
The Canadian Experience	9
The Chronology	9
Freezing Rain Facts	13
The United States Experience	15
The Losses	17
General Observations	17
Canadian Losses	17
United States Losses	19
Mitigation Recommendations	21
General Observations	21
Canada’s Ice Storm Mitigation Efforts	23
Role of Provincial Government	24
Role of Municipalities	24
Role of Citizens	25
Insurance and the Role of Insurers	25

TABLE OF CONTENTS (Continued)

	Page
Lessons Learned	26
Provincial Government	26
Municipalities.....	26
Citizens.....	26
United States’ Ice Storm Response and Mitigation Efforts	26
Mitigation Recommendations	28
General Recommendations	28
Incentives.....	29
Mitigation, Incentives and Insurers	30
Mission Statements and Key Result Areas.....	31
Sustainable Development: Energy Sources and New Building Materials	32
Conclusions	37
References	38
<i>Appendices</i>	
Appendix 1 500 kPa Height and Vorticity Analysis – 00Z Mon 5 Jan to Sat 10 Jan 98	
Appendix 2 Surface Analysis – 00Z Mon 5 Jan to Sat 10 Jan 98	
Appendix 3 Insurance Coverages	
Appendix 4 News Release, Emergency Preparedness Canada – “Don’t Feel Powerless – Prepare for Electricity Outages.”	
Appendix 5 Members of IBHS and ICLR	

FOREWORD

Starting late on January 4, 1998 and continuing for the next six days until January 10, 1998, freezing rain fell on eastern Ontario, southwestern Quebec, and southern New Brunswick and Nova Scotia. These areas were pelted with 80 millimetres or more of freezing rain. The event doubled the amount of precipitation experienced in any prior ice storm. The result: a catastrophe that produced the largest estimated insured loss (\$1.44 billion Cdn) in the history of Canada. The combined Canadian and United States insured loss stands in excess of \$1.2 billion U.S. or \$1.75 billion Cdn as at October 1, 1998.

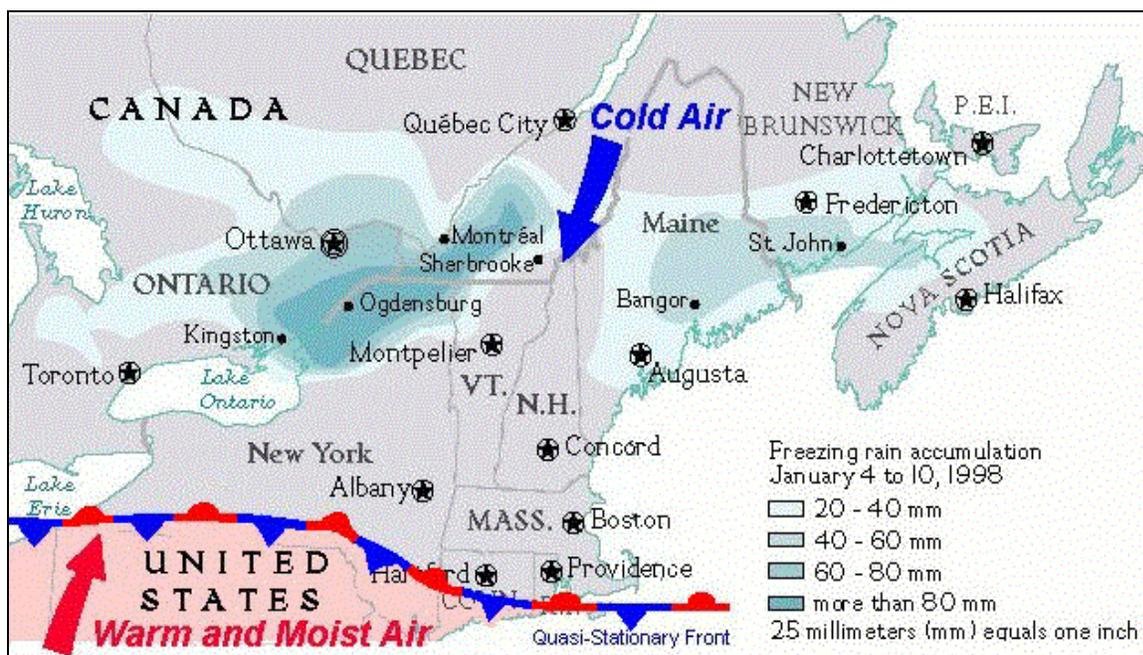


Figure 1: Freezing rain accumulation

Courtesy of the National Geographic Society

The same storm slashed across northern New York and parts of Vermont, New Hampshire and Maine in the United States, leaving a vast trail of damage and destruction (approximately \$200 million U.S. in insured losses). Nevertheless, the damage in the United States paled in contrast to that sustained in Canada. (See Figure 1 above.)

In Canada, 28 deaths were attributable to the storm, while in the United States, 17 people lost their lives. According to Emergency Preparedness Canada, electric outages in the affected areas of Canada deprived 4.7

million people or 16 percent of the Canadian population of power. In the United States, there were 546,000 people without electricity. Thus, in both countries more than 5 million people were without power (heat, light and in many instances, water) in the cold of the mid-winter, which intensified the human suffering.

Ice Storm '98 produced in excess of 840,000 insurance claims from policyholders in Canada and the U.S. That is 20 percent more claims than created by Hurricane Andrew, the largest natural disaster in the history of the United States.

The report that follows will focus on the catastrophic Canadian experience and can serve as a learning laboratory for insurance practitioners. It will seek to enhance their understanding of the causes of such events and ways by which the potential losses can be mitigated. It will assist the public in understanding these phenomena, examine the potential for future occurrences and appeal for the support of actions that will reduce human suffering, property damage and economic loss. The report will stress the benefits derived from a sharing of knowledge and call for the support of research where the common good will be served. Finally, it will encourage public-private partnership in those instances where that is the most efficient media for serving society. Among other questions, the report will address the following:

- ◆ Is it possible that changing climate patterns and rising global temperatures will produce more frequent and severe freezing events?
- ◆ Will the narrow band of territory from Ontario to Nova Scotia remain the primary region for future ice storms?
- ◆ Is there any causal relationship between Ice Storm '98 and El Nino?
- ◆ Could an ice storm similar to that which paralyzed Montreal wreak havoc on Toronto, Boston, New York City, Buffalo, Detroit, Cleveland, Chicago, Minneapolis and/or St. Paul?
- ◆ What property, lifeline, economic-consequential loss and infrastructure vulnerabilities did Ice Storm '98 reveal?
- ◆ What steps can be readily and economically initiated to reduce and/or eliminate future human, property, consequential (business interruption and additional living expense) and economic losses?
- ◆ Has Ice Storm '98 placed an additional emphasis on the need for:
 - alternative energy sources?
 - energy-efficient, loss reductive building materials?
 - building construction practices?

THE METEOROLOGY

The Canadian Event

Over the past four decades Canada has been the victim of numerous major ice storms – in February 1961, Montreal; in January 1968, Ontario; in March 1983, Winnipeg; in April 1984, St. John's Newfoundland; in 1986 Ontario/Quebec and most recently, in January 1998, from the Maritime Provinces through the St. Lawrence and Ottawa Valleys.

Other sections of this report will focus on the devastation wrought by the 1998 Storm. Included will be the insured, uninsured and economic losses; mitigation opportunities; and an examination of products which would sustain development while concurrently reducing human suffering as well as property and economic damage. But first, a look at the meteorological causes of ice storms.

According to Lee Greci, Pennsylvania State University, as reported in *Weatherwise*, May/June 1998, Glazed over, freezing rain occurs

when a layer of warm, moist air several thousand feet above the ground wedges between cold air at high altitudes and a relatively thin layer of cold air next to the earth's surface. In delicatessen terms, the atmosphere makes a warm air sandwich. When snowflakes fall into a meaty layer of sandwiched warm air, they melt into rain drops. Then, on descent into the thin slice of cold air, raindrops often become "supercooled" as their temperatures drop below 32 degrees Fahrenheit. On touchdown, supercooled drops are primed to freeze on contact with cold objects such as trees, power lines, and untreated roads, forming a treacherous, sometimes weighty glaze.

This concept has the concurrence of Etkin and Brun when they state the physical processes of sleet and freezing rain:

The formation of sleet and freezing rain is a result of frozen precipitation falling through an irregular vertical temperature profile. Normally, the air through which snow falls in winter is warmer – though still below freezing – closer to the

ground, and hence snowflakes remain frozen. Occasionally, instead of this characteristic temperature profile, a layer of warm temperatures hovers on the order of 100 meters above the surface (i.e. an inversion layer). In winter inversion layers are common just ahead of warm fronts and over large cities, though the main cause of freezing rain is due to inversion layers associated with warm fronts. Cold air trapped in valleys as warmer air advances into a region can also contribute to this phenomenon. In cases where this inversion layer is present, as snow falls towards the surface, it will pass through a layer of warmer air. Depending on the thickness of this layer, snowflakes falling through it will melt either partially or completely. When they pass into the lower colder layer, they may completely refreeze or remain as supercooled liquid drops. If they refreeze, the original snow flakes are transformed into solid pellets of ice, normally called ice pellets in Canada or sleet in the US. If they become supercooled liquid drops, they produce freezing rain. The drops freeze instantaneously onto surface objects, forming a thin coating of ice. In extreme events, tons of ice may form on a single tree or power transmission lines, causing extensive damage. (See Figure 2.)

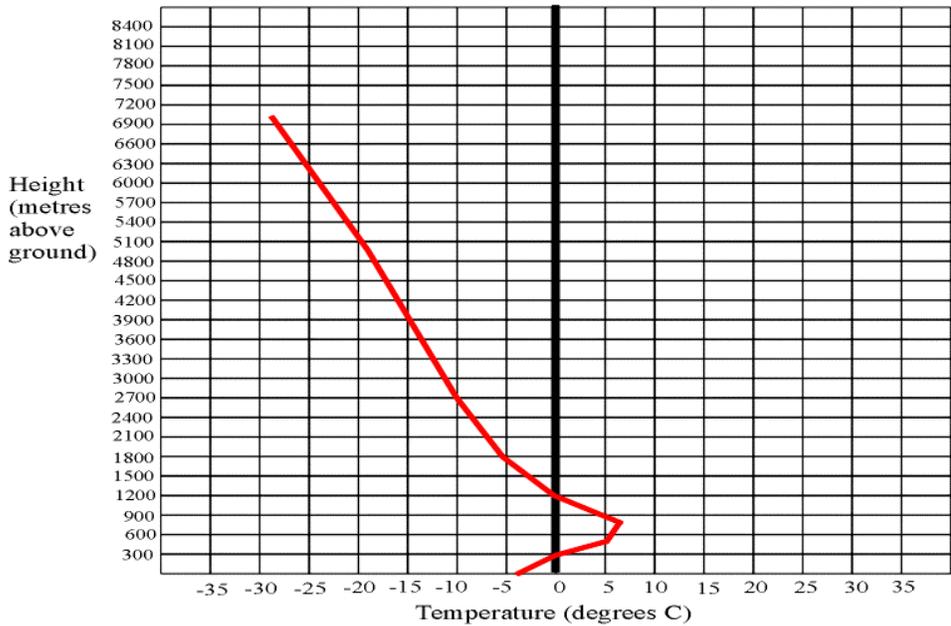


Figure 2: Typical vertical temperature profile associated with freezing rain

The severe icing—freezing rain—began to fall on January 4 and continued intermittently until January 10. Amounts of 80 mm or more fell in some areas. That precipitation was almost double the amounts of prior major ice storms.

“Ice Storm ’98 - The Meteorological Event” prepared for Aon Re Canada by Environment Canada offers the following observations that fit the Grenci definition of freezing rain and assist in understanding the meteorological aspects of the 1998 event:

Upper atmosphere features...

1. At the upper levels in the atmosphere, moderate to strong south to southwesterly winds (i.e. winds blowing from the southwest) pumped warm and very moist air from the Gulf of Mexico area northwards to central and eastern Canada [see Appendix 1 - 500 kPa Height and Vorticity Analysis, 00Z Mon 5 Jan 98 to 00Z Mon 10 Jan 98.]
2. A blocking circulation produced a strong high atmosphere ridge over the southern Atlantic Ocean called the Bermuda High. This strong ridge prevented the normal eastward motion of weather systems in the southern air stream.

Surface or lower atmosphere features...

3. A large nearly stationary surface high pressure area from Hudson’s Bay to central and eastern Quebec with very cold temperatures associated with it [see Appendix 2 – Surface Analysis, 00Z Mon 05 Jan 98 to 00Z Sat 10 Jan 98]. A circulation from the east to northeast out of this High maintained a supply of very cold air in the lowest levels of the atmosphere over the St. Lawrence and Ottawa River Valley areas and parts of the Maritimes.
4. A nearly stationary surface trough of low pressures and associated front from southern Lake Michigan to the Maritimes. The front formed when cold air at the lower altitudes from central and eastern Quebec met warm moist air at higher altitudes pushing northwards from the Gulf of Mexico. When cold and warm air meet, the warm air tends to ride over or “overrun” the denser cold air, causing precipitation to form. These surface and upper altitude flows led to temperature conditions in the vertical that favoured freezing rain.

The Environment Canada report goes on to state:

Prior to the ice storm, a low-pressure weather system over the Texas Panhandle had pumped moist, warm air from the

Gulf of Mexico into southern Ontario and Quebec at the higher altitudes (cloud levels). By January 5, over Hudson's Bay, a large stationary Arctic high pressure area had established itself over central Quebec with its circulation pumping very cold air into Southwestern Quebec, the Ottawa River valley, and the Maritimes. Because the warm air from the Gulf of Mexico was unable to dislodge the denser, cold air near the ground, the southerly (i.e. from the south) current of moist air overrode the wedge of cold air at the surface, setting the scene for the onset of freezing precipitation.

Figure 3a – Snapshot of a typical North American winter jet stream

Figure 3b – Snapshot of a typical North American winter jet stream In an El Niño year

Figure 3c – Meteorological factors which contributed to the Eastern Canada Ice Storm of 1998

The question of whether El Niño was a contributing factor to the ice storm is an issue vexing the experts. Figures 3a to 3c display the typical North American winter jet stream, the winter jet stream in an El Niño year and meteorological factors which contributed to Ice Storm 98. There are those who contend that the Polar (North) jet stream's normal pattern had been disrupted as a consequence of El Niño, in the days prior to the ice storm, causing it to dip south when it reached central Canada. This caused extremely cold Arctic air to flow into the upper atmosphere above Ontario and Quebec. Concurrently the Subtropical (South) jet stream was pursuing its normal pattern moving east across Southern California, Texas and Florida. This year, however, there were exceptionally large amounts of precipitation and severe flooding in some of the southern states. The severe weather conditions in the south were also attributed by some scientists to El Niño.

The Environment Canada Report states: “Ice storms in eastern Canada are not thought to be more frequent during El Niño winters.” Other experts also disclaim or discount any connection. Reuters News, however, quotes NOAA Research Director Joe Friday as saying that the warming condition known as El Niño was “probably the leading cause” for the ice storms in the northeast and Canada. At this time the debate continues and the question of whether there was a causal relationship between El Niño and the '98 Ice Storm remains open.

The question of whether global climate change and accompanying variations in weather patterns will produce more frequent and severe freezing events is a topic requiring additional research. Although there is growing acknowledgment about Earth’s rising temperature, the question lingers regarding its cause and whether it is cyclical or permanent in nature. In their report titled: Natural Hazards in Canada, Chapter 3.0. Etkin and Brun advise regarding climate model predictions:

The results of most numerical climate models predict that over the next half century a doubling in CO₂ will lead to:

- ◆ an average overall warming of the earth’s global climate by 1.5° C and 4.5° C; and
- ◆ a proportional increase in global average precipitation (Ahrens, 1984; Mitchell, et al., 1995; IPCC, 1995).
- ◆ The results of various theoretical and empirical studies strongly suggest an increase in certain types of extreme events.

The Etkin and Brun report covers tropical cyclones, extra-tropical storms (mid-latitude cyclones), thunderstorms, extreme temperature events, floods, drought and other hazards and offers the following summary:

Conclusions on how climate change will affect the frequencies and intensities of events in Canada are mixed. In a warmer climate, it seems likely that the number of convective events (e.g. thunderstorms with extreme rainfall, tornadoes and hail), heat waves, floods and drought will increase in many areas, while the frequencies of cold waves will become rarer. The relationship between the frequency and intensity of tropical cyclones and global warming is inconclusive.

Insurers recognize the importance of these issues but do not view them as topics that they should address, as they lack the scientific expertise to conduct such studies and/or investigations. Insurers believe that they should

pursue the business of providing indemnification for fortuitous loss from insured natural hazards and vigorously pursue ways by which those losses can be reduced or eliminated.

Likewise, the question remains regarding whether freezing losses will continue to occur in the narrow band of territory that has produced a majority of the prior Canadian events. This question and its associated issues require continued exploration.

The United States Event

The freezing losses that struck Maine, New Hampshire, New York and Vermont from January 4 through January 10, 1998 had their genesis in the meteorological explanation provided from the Canadian event.

According to climatologist Stanley Changnon of Mahomet, Illinois, ice storms are likely to occur in the band of territory from central Missouri across central Illinois and on into central Indiana and northern Ohio. The orientation of these storms will be west-southwest to east-northeast, extending northeastward into upper New York state and southern Canada.

Experts concur that freezing losses similar to those which devastated Montreal in 1998 could impact Toronto, Boston, New York City, Buffalo, Detroit, Cleveland, Chicago, Minneapolis and/or St. Paul. It is acknowledged that at present the ability to predict such occurrences is for all intents and purposes non-existent. This fact places an added urgency and importance on setting in motion meaningful and effective mitigation strategies and programs.

THE OCCURRENCE

The Canadian Experience

The severity of an ice storm increases depending on:

- ◆ the accumulation of ice;
- ◆ the duration of the event;
- ◆ the size of the affected area; and
- ◆ the wind speeds.

These factors as well as other salient data will now be examined. A review of the following chronology prepared by Swiss Re Canada will set the stage. Among other things it depicts the human and emotional suffering experienced, identifies major areas of damage, and highlights many of the economic consequences.

The Chronology *

- Sun. Jan. 4: Late in the day, freezing rain starts to fall on eastern Ontario and southwestern Quebec.
- Mon. Jan. 5: Spotty power outages begin as ice loads on trees, poles, lines and pylons.
- Tues. Jan. 6: Early estimates put at 650,000 the number of Ontarians and Quebecers who are without power.
- Wed. Jan. 7: The crisis in Montreal begins as the Drummondville line fails. Montreal schools, universities and businesses close. More than one million Quebec customers are without electricity and tens of thousands of eastern Ontario homes are blacked out.
- Thurs. Jan. 8: The storm turns uglier as ice continues to accumulate. Hydro-Quebec seeks help and the first members of the Canadian Armed Forces reach Montreal. Much of eastern Ontario declares a state of emergency.

- Fri. Jan. 9: The Quebec government asks for more troops on the “worst day of the crisis.” The number of Quebec customers without power peaks at 1.4 million. Much of Montreal loses its water supply after pumping stations lose power. The storm hits the Maritimes.
- Sat. Jan. 10: Three million Quebecers — roughly half the province’s population, are without power.
- Sun. Jan. 11: Hydro-Quebec predicts it will need up to two weeks to restore power fully in the area south of Montreal. The number of soldiers in the affected area rise to 11,000. Crime is down 57 percent.
- Mon. Jan. 12: Over 4,000 customers in New Brunswick are without power. Police are given special powers to go door-to-door to order Montrealers from their homes. The federal government estimates storm damage at \$500 million or more.
- Tues. Jan. 13: Soldiers are given the power of arrest. Hydro-Quebec turns off the giant illuminated Q on its headquarters and vows not to relight it until the crisis is over.
- Wed. Jan. 14: Most of Montreal is back on line but outages still plague the south shore, parts of rural Quebec and eastern Ontario. Ottawa pledges aid of \$50 million for Quebec and \$25 million for Ontario. The death toll reaches 15.
- Thurs. Jan. 15: There is a minor setback in Quebec when 4,000 Pointe Claire residents lose power. The downtown core of Montreal is re-opened, a day earlier than expected.
- Fri. Jan. 16: Warnings are still being issued to avoid downtown Montreal due to falling ice.
- Sat. Jan. 17: Hydro-Quebec announces that it expects to have service completely restored within 10 days. So far, 460 transmission towers have been replaced. The *Montreal Gazette* estimates that total costs attributable to the storm could reach \$1.5 billion.
- Sun. Jan. 18: The number of Quebec customers without service drops to 242,000 but still represents well over 500,000 people.

Businesses in downtown Montreal are asked to open only between 9 a.m. and 4 p.m. The death toll reaches 25.

- Mon. Jan. 19: A major link is re-established in the ring of power that supplies Montreal after one 735-kilovolt line between Boucherville and Hertel is restored. About 500,000 Quebecers and 50,000 Ontarians are still without power, Montreal high school and university students return to classes. The Insurance Bureau of Canada reports that the 250,000 claims filed as of noon total \$365 million.
- Tues. Jan. 20: Voluntary restrictions on business hours for downtown Montreal are lifted. However a four-hour blackout hits the still-fragile system, affecting 110,000 customers in the metro area. About 200,000 Quebec customers are still without power. Service is restored to 100,000 out of 118,000 customers in eastern Ontario.
- Wed. Jan. 21: Approximately 12,000 customers in Boucherville, Quebec lose power after regaining service only days before. Soldiers began leaving the province as part of a gradual withdrawal. Ottawa announces it will help compensate dairy farmers and businesses affected by damaged maple and fruit trees.
- Thurs. Jan. 22: More than 400,000 Quebecers remain without power. Hydro-Quebec concedes that it can't make its January 25 deadline for getting all of its customers back on line. Ontario Hydro has restored power to over 110,000 of its customers in eastern Ontario, leaving about 8,125 without service.
- Fri. Jan. 23: The Conference Board of Canada estimates the cost of the ice storm will be close to \$1.6 billion. Ottawa creates a task force to deal with the city's trees, more than 45,000 of which were damaged or destroyed by ice.
- Sat. Jan. 24: Three roofs collapse in Montreal under the weight of ice and 20 centimetres of new snow, which fell through the night Friday.
- Sun. Jan. 25: Crews restore power to a key sub-station that serves Quebec's south shore. The utility says half of the 60,000 customers are still without power – most in the Triangle of

Darkness – will be hooked up within one week. About 1,500 customers are still without power in eastern Ontario.

- Mon. Jan. 26: At least 60,000 Quebec customers representing 150,000 people are still without power. The Insurance Bureau of Canada reports that the 378,000 claims filed as of noon total \$476 million.
- Tues. Jan. 27: Over 220 linemen arrive from British Columbia and Manitoba to help rebuild Quebec's power grid. Hydro-Quebec announces that in just three weeks it has exhausted its normal five-year supply of materials. Ontario Hydro says damage suffered to its system totals at least \$100 million and may double by the end of the crisis.
- Wed. Jan. 28: Quebec's Premier announces that an independent commission will be set up to examine the handling of the ice storm crisis. Hydro-Quebec says it will be February 15 before power is fully restored in the province. Ontario Hydro announces that only 10 year-round customers in eastern Ontario are without power. The utility says that 85,000 insulators, 2,800 kilometres of wire and cable, 11,647 poles and 2,100 transformers were delivered to eastern Ontario in the days following the storm.
- Thurs. Jan. 29: At least 45,000 Quebec customers in 213 municipalities are still without power, and some who were told they'd have their power back by January 25 hear they may have to wait as long as February 15.
- Fri. Jan. 30: Canada's Minister of Defence says the military's bill to help clean up Quebec and Ontario after the ice storm is \$60 million. Power is fully restored in Ontario and the provincial government starts to hand out relief cheques to farmers – about \$1,000 for every week the power was off, for a total of about \$10 million.
- Sat. Jan. 31: Over 50 shelters remain in operation, housing 1,700 people per night.
- Sun. Feb. 1: Hydro-Quebec officials warn of more blackouts, saying its hastily repaired distribution system is still fragile. Thousands of people on the south shore enter their fourth week without power.

- Mon. Feb. 2: Hydro-Quebec moves up its deadline for restoring power to all its customers from February 15 to February 8. Over 19,500 customers representing 65,000 people remain without electricity in the province.
- Tues. Feb. 3: Officials from Emergency Preparedness Canada and Agriculture Canada tell a House of Commons agriculture committee that the country should re-examine everything from personal readiness and insurance to farming practices following the disaster. More than 36,000 farms were affected by the storm.
- Wed. Feb. 4: Quebec's Public Security Minister announces he will introduce new legislation March 10 obliging municipalities to adopt emergency contingency plans and keep them up to date. One municipality affected by the storm had a plan dated from 1980.
- Thurs. Feb. 5: An estimated 1,900 Hydro-Quebec customers – or about 4,800 people – are without electricity. The utility says all Quebecers should have power by February 6.
- Fri. Feb. 6: With the exception of about 100 temporary customers (chalets, campgrounds and sugar shacks), power is fully restored in the province of Quebec.

** The dollar amounts shown in this chronology are expressed in the value of Canadian dollars. Also, care should be taken to recognize and distinguish between "customers" served by the Electric Power Companies and "people" affected.*

Freezing Rain Facts

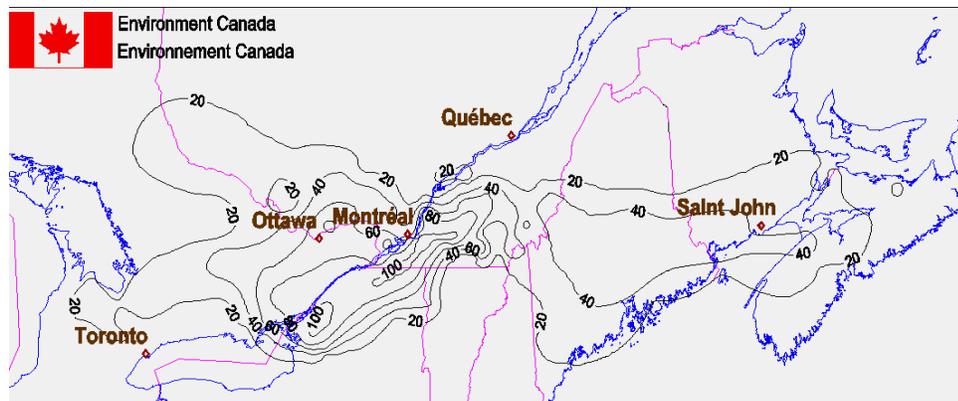


Figure 4: Total precipitation accumulations in millimetres from January 4-10, 1998.

The freezing rain accumulated in amounts not previously experienced, as evidenced by the following readings: 73 mm in Kingston, 105 mm in Cornwall, 85 mm in Ottawa and 100 mm in Montreal. These accumulations collapsed electricity transmission lines, which in turn forced people from their homes, caused businesses to close, adversely impacted livestock farmers and resulted in public and private service provider organizations being significantly hindered. According to Statistics Canada:

Several thousand kilometres of power lines and telephone cables were rendered useless; over 1,000 transmission towers, of which 130 were major structures worth \$100,000 each, were toppled; more than 30,000 wooden utility poles, valued at \$3,000 each, were brought down.

The Canadian Geographic, March/April 1998 edition, in the article titled: Lethal Beauty, reported on the following outages:

Province	No. of Customers without Power
Quebec	1,393,000
Ontario	232,000
New Brunswick	28,000
Nova Scotia	20,000
Total	1,673,000

As a result of the occurrence, Statistics Canada reported these facts:

- ◆ Over 2.6 million people were impeded or prevented from getting to work altogether. This represents 19 percent of all employment in Canada.
- ◆ Canada's economic output declined by a relatively modest 0.7 percent in January.
- ◆ Canadian retail sales dropped by 1.6 percent in January.
- ◆ Stores in Quebec have assessed their losses at \$250 million during the storm and its aftermath. Total retail sales, amounting to \$4.4 billion, declined 5.0 percent in January.
- ◆ Farmers suffered financial losses from damage to barns and equipment, incurred costs in generator rentals and fuel purchases, and lost cattle and other livestock. The ice storm has translated into huge losses for most farmers, especially those involved in sugar bush, orchards and greenhouse operations.

The economic loss is dependent upon a variety of issues and data which are not fully identified, explored and/or analyzed in this report.

According to Florent Gagné, Deputy Minister, Quebec Ministry of Public Safety, the occurrence revealed the need for:

- ◆ high power generators for health establishments;
- ◆ candles and batteries;
- ◆ vehicles for transportation of the citizenry;
- ◆ salt for roadways and sidewalks;
- ◆ readily accessible fuel supplies, including wood;
- ◆ a way to resolve cellular and telephone communications problems;
- ◆ 1,000 emergency beds;
- ◆ programs and procedures to deal with widespread major blackouts; and
- ◆ a way to handle the problems associated with the stoppage of water filtration plants.

Although plans had been made for many of the foregoing, consideration must be given to the availability of huge reserves as well as to services that are readily accessible.

The United States Experience

The factors which define the severity of an ice storm and are set forth under The Canadian Experience are applicable to the losses in the States. While devastating large areas of northern Maine, New Hampshire, Vermont and New York, the ice storm struck the less populated centres of these states. The duration of the storms tracked with those of their northern neighbours, as did the rates of precipitation. Thus, the severity of the event in the States was comparable to that impacting Canada.

The storm left more than 500,000 people without power. A by-state breakdown follows:

State	No. of Customers Without Power
Maine	315,000
New Hampshire	67,586
Vermont	33,200
New York	130,000
Total	545,786

A Federal Emergency Management Report titled: A Blueprint for Action, chronicles the damage and destruction as described below:

Dairy farmers in the region suffered significant loss of livestock, decreased milk production, and damaged farm

equipment and fencing. In New York alone lost maple syrup production was estimated at \$1.2 million U.S.; a \$9.3 million U.S. loss in livestock and a \$12.7 million U.S. loss in milk.

The natural beauty of Maine, New Hampshire, Vermont and New York which has long made these states a haven for tourist and outdoor enthusiasts sustained heavy damage and destruction. In New Hampshire tourism, the state's largest industry sustained loss to its alpine ski industry estimated at \$1.5 million U.S..

Ice damaged utility poles and downed electric lines caused widespread power outages across the four-state region, leaving 500,000 or more customers without power.

Up to 70 percent of the forests (17.5 million acres) received some form of damage. The timber industry was especially hard hit, as were loggers, sawmill owners, truckers, and countless other businesses tied to the timber industry.

The foregoing does not account for the damage sustained by structures (residential or commercial) and their contents, including loss of food in freezers cut off from power or additional living expenses. The cost of sheltering individuals forced from their homes by the loss of electricity (light and heat).

Regardless of whether the destruction occurred in Canada or the United States, the Ice Storm '98 must be viewed as a historic event.

THE LOSSES

General Observations

To assist in the understanding of this extreme event and to permit the development of meaningful and cost-effective mitigation initiatives, it is essential to have a comprehension of the size of the losses – i.e., human, property (real and personal – residential and commercial), agricultural and economic. Also, it would be helpful to quantify the insured losses so that the burdens of society and government come into clear focus. This portion of the report will attempt to segregate and quantify the loss costs. This is not an easy task as neither government agencies (federal, state or provincial and/or municipal) nor insurers segregate and quantify these losses identically or in formats that are readily retrievable. The dollar losses displayed in this section are in the value of the currency of the applicable country (Canada or United States).

Canadian Losses

Deaths and Injuries

Ice Storm '98 caused the deaths of 28 persons from the following causes:

Cause of Death	No. of Deaths
Trauma	9
Carbon monoxide poisoning	7
Fire	5
Hypothermia	4
Hazardous activities, i.e. removal of snow and ice from roofs	3
Total	28

Statistics regarding injuries have not been provided. Considering the severity and duration of the storm, the number of deaths should be viewed as being held in check by the actions of an informed and attentive public.

Economic Losses

According to the Conference Board of Canada the manufacturing, transportation, communications and retail sectors sustained a short-term loss of \$1.6 billion to Canada's economic output – a 0.2 percent loss in overall real gross domestic product (GDP). In addition to this, loss of income was approximately \$1 billion. Contributing to this result was the fact that there was a slight rise in unemployment, from 8.6 percent to 8.9 percent. Further, new housing starts dropped by 4 percent and the GDP dipped by 1.5 percent.

The agricultural community incurred losses of \$25 million (\$14 million in Quebec and \$11 million in Ontario). These losses primarily impacted the poultry, livestock and maple syrup industries.

To the foregoing must be added the costs of repairing the Hydro-Quebec and Ontario Hydro electric towers and transmission lines, which are estimated to approximate \$1 billion.

An estimated 2,000 dairy producers in Ontario and 3,500 dairy farmers in Quebec lost production. About 10 million litres of milk, worth approximately \$6 million, were dumped in Ontario and 3.5 million litres, worth nearly \$1.8 million, were dumped in Quebec. Agriculture and Agri-Food Canada (AAFC) helped the Ontario and Quebec governments arrange for generators to be supplied to dairy farms without power. Where local milk processing plants had shut down, AAFC, the Canadian Food Inspection Agency, the Canadian Dairy Commission and the Department of Foreign Affairs and International Trade worked together to obtain temporary authorization from the U.S. Food and Drug Administration to export unpasteurized milk to the United States for processing and return to Canada.

The costs to government and ultimately the taxpayers were increased by the:

- ◆ use of the federal military and national guard forces;
- ◆ need for emergency and overtime police, fire and medical services;
- ◆ necessity to undertake emergency repairs to infrastructure (bridges, roadways etc.) and clear fallen trees, power lines and poles;
- ◆ cost of sheltering and feeding thousands of individuals;
- ◆ cost of operating administrative and emergency services; and
- ◆ cost of debris removal and extra garbage collections.

Added to these items must be the costs of disaster assistance and relief payments made to the victims.

A review of the assembled loss costs and estimates paints a vivid picture regarding the size of this disastrous event, to which must be added the

insured losses. These insured losses are described as the largest in the history of Canada's insurance business.

In assessing the insured losses consideration should be given to the insurance coverage that would have been available for individual risks. The indemnification provisions vary and may have restricted the coverage. In this regard reference should be given to the Insurance Bureau of Canada publication titled: *Eastern Ontario Ice Storm, January 1998, Insurance Coverage* (see also Appendix 3).

Canadian Insured Losses as at July 21, 1998 *

Province	No. of Claims	% of Total	Incurred Loss Cdn. \$	% of Total	Average Claim (Cdn \$)
Nova Scotia	Included		Included		
New Brunswick	Included		Included		
Subtotal	600	.09	2,000,000	.18	3,333
Quebec					
Personal Prop.	512,971		697,070,666		1,359
Commercial Prop.	35,762		312,522,745		8,739
Automobile P.D.	63,128		88,233,091		1,398
Subtotal	611,861	87.83	1,097,826,502	99.80	1,794
Ontario					
Personal Prop.	64,698		126,376		1,953
Commercial Prop.	14,861		81,227		5,466
Automobile P.D.	4,580		5,510		1,203
Subtotal	84,129	12.08	213,113	0.02	2,533
Combined Total	696,590		1,100,039,615	100.00	7,660

* Source: Insurance Bureau of Canada.

Note: By October 1 the total had increased to \$1.44 billion, although detailed claim information was not available.

United States Losses

Deaths and Injuries

The Ice Storm produced 17 deaths in the United States, the causes of which parallel those in Canada. As in Canada, there was no central body to collect the information pertaining to the nature or type of injuries sustained by individuals.

Economic Losses

The Federal Emergency Management Agency (FEMA) has documented the general economic destruction and damage in its report titled: A Blueprint for Action. The report delineates the following activities and losses:

- ◆ 500,000 homes and businesses were without power;
- ◆ 70 percent of the forests in the region or 17.5 million acres of urban and rural forests were damaged, creating an immediate safety hazard and long-term economic loss;
- ◆ dairy farmers in New York alone reported a loss in livestock of \$9.3 million (U.S.) and a \$12.7 million (U.S.) loss in milk;
- ◆ the loss of maple syrup production in the Empire State was set at \$1.2 million (U.S.);
- ◆ in Maine the snowmobile industry sustained staggering losses. The cost of debris removal was set at \$500,000 (U.S.) and loss of revenue from this tourist attraction was set at \$2.5 million (U.S.).

These losses should be evaluated in conjunction with the limited area of each state that was involved, the sparseness of the population and the fact that no major population centres were involved. To these economic losses must be added the insured and other uninsured losses.

United States Insured Losses as at September 18, 1998

The loss statistics from Maine, New Hampshire, Vermont and New York are summarized below.

Type of Claim	No. of Claims	% of Total	Incurred Loss (U.S. \$)	% of Total	Average Claim (U.S. \$)
Personal Property	106,248	76.1	140,779,000	69.7	1,325
Commercial Property	27,132	19.4	53,721,000	26.6	1,980
Automobile	6,270	4.5	7,541,000	3.7	1,371
Total	139,650	100.0	202,041,000	100.0	1,447

Source: Property Claims Services.

MITIGATION RECOMMENDATIONS

General Observations

To facilitate an understanding of the role of the federal governments, both Canadian and American, in matters of national emergency, the following background material is provided.

The Emergencies Act, (S.O.C.) 1988 Chapter 29, establishes and authorizes the Canadian government to initiate “special temporary measures to ensure safety and security during national emergencies...” Additionally, the Act gives Emergency Preparedness Canada (EPC) the responsibility for the preparedness and coordination of emergency situations, thus establishing it as the paramount federal authority in these matters.

The *Emergencies Act* recognizes and defines the following four types of national emergency:

1. Public Welfare Emergency
2. Public Order Emergency
3. International Emergency
4. War Emergency

While the other types of emergencies have or could have insurer implications, Public Welfare Emergency is the one which is most pertinent. It is defined to mean an emergency that is caused by real or imminent (a) fire, flood, drought, storm, earthquake or other natural phenomenon, (b) disease in human beings, animals or plants, or (c) accident or pollution that results or may result in a danger to life or property, social disruption or a breakdown in the flow of essential goods, services or resources so serious as to be a national emergency.

The law recognizes that Canada’s geography and demographics vary significantly, further than the ability of governments’ resources and services (i.e., both provincial and municipal) differ. Also, it recognizes the variety of resources and services available in the private sector. Thus, the Act acknowledges that a uniform standard for national emergency arrangements is neither practical nor possible and that planning must leave room for flexibility.

There is nothing in the Act that changes or alters the right, power or primary responsibility of the provinces to provide for the health and welfare of their populations. Additionally it acknowledges certain basic planning principles among which are:

1. That the response is initiated by those affected, then augmented by successive orders of government as additional resources are needed.
2. That the operations are managed by the lowest order of government that can ensure an effective coordinated response.

The *Emergency Preparedness Act* prescribes the responsibilities of EPC. First among many is the development of policies and programs for achieving an appropriate state of national civil preparedness for emergencies.

The EPC publication titled *Guidelines for National Emergency Arrangements* provides detailed particulars to assist the provinces and municipalities in the planning and execution of their responsibilities. The Guidelines examine, among others, the following subjects:

- ◆ the planning principle;
- ◆ the steps of coordination;
- ◆ federal/provincial coordination;
- ◆ national emergency environments;
- ◆ the need for a crisis management system;
- ◆ an examination of the constitutional framework, and
- ◆ planning assumptions.

The *Emergencies Act* and *Emergency Preparedness Act* provide the framework on which, under the leadership of EPC, the federal, provincial and municipal governments built co-operative and co-ordinated disaster response and mitigation programs. These are programs which recognize the uniqueness of Canada, its governments and the varying needs of its people.

In the United States the Federal Emergency Management Agency (FEMA) provides the federal point of contact for state and local governments on matters regarding emergency preparedness and response for all disasters regardless of cause. Under the *Robert T. Stafford Disaster Relief and Emergency Act* of 1988 (P.L. 100-707) FEMA is given the authority to provide for all disasters, regardless of cause. The Act lists FEMA's disaster assistance programs and, in conjunction with the Federal Response Plan of 1992, the process by which specialized assistance is afforded to victims. "Regardless of cause" has been defined to mean man-induced (caused) disasters as well as those resulting from environmental and natural sources.

FEMA investigates the need for and identifies, designs and promotes mitigation initiatives. It develops and causes to be implemented preparedness, response and recovery programs through its work with state and local emergency managers.

In *Disaster Management in the U.S. and Canada: The Politics, Policymaking, Administration and Analysis of Emergency Management*, Richard T. Sylves and William L. Waugh describe FEMA's traditional strategy as:

1. Enhancing the capability of state and local governments to respond to disasters;
2. Coordinating the 26 federal agencies assigned to provide resources to respond to disasters;
3. Giving federal assistance directly to citizens recovering from disaster;
4. Granting financial assistance to state and local governments; and
5. Providing leadership, through grants, flood plain management and other activities, for hazard mitigation.

Thus it can be observed that EPC and FEMA play similar, though not identical, roles in the respective countries.

Canada's Ice Storm Mitigation Efforts

Since the province of Quebec sustained the largest portion of the Ice Storm's damage and loss, the remainder of this section of the report will draw on their response effort, which was built on the requirements of the federal law.

Pursuant to the mandates of the federal Act, the civil security protection enactments of the province require that "operations are managed by the lowest order of government that can ensure an effective coordinated response". Further, municipalities are required to identify the measures, take advantage of training offered by federal and provincial governments, and conduct drills or exercises. The point to be stressed is that mitigation, both pre and post-event, is local and that effective, efficient programs begin and are implemented locally. Nevertheless, the roles of the federal and provincial governments must be understood. To help with this understanding, a brief explanation of their roles would be appropriate.

Some of the principal criteria found in the federal and provincial Acts provide that: emergency operations are most effective when managed at the lowest level of government; the response structure should be built upon permanent organizations; coordinated support from government (federal and

provincial) should come from their external partners; intervention must respect the responsibilities of the participants; and that the response and recovery structure must be flexible enough to accommodate all circumstances.

Now for the key points in the roles of the major players.

Role of Provincial Government

The main role of the government is to coordinate all phases of the model, i.e., prevention, preparation, intervention and reconstruction. It carries out these responsibilities by:

- ◆ establishing, implementing and maintaining an external support system;
- ◆ providing an emergency manpower resource;
- ◆ training the emergency responders;
- ◆ providing management support; and
- ◆ apprising all partners of their respective roles (duties and responsibilities).

Role of Municipalities

The municipality shoulders the absolute responsibility for pre-event planning and preparation, event intervention and post-event response. It accomplishes its tasks by:

- ◆ identifying the risks in its territory;
- ◆ developing and adopting measures to prevent or diminish, wherever possible, these risks;
- ◆ preparing for the deployment of emergency measures;
- ◆ participating in training and exercises offered by the province; and,
- ◆ maintaining, at all times, an Emergency Plan and a high level of preparedness.

Role of Citizens

The citizenry bears the obligation of ensuring that they maintain minimum self-protection in times of disaster. The citizens are assisted in preparing for the discharge of their responsibilities, by government, through:

- ◆ awareness and education programs;
- ◆ news releases (electronic and print media);
- ◆ public service announcements; and,

- ◆ brochures and publications.

The roles of these key stakeholders must be clearly defined and understood if mitigation and incentive programs are to be effectively developed and implemented. Their roles place on them individually and collectively the obligation to assist in the elimination and/or reduction of the risk and, in turn of the potential loss.

Insurance and the Role of Insurers

In these discussions it must be remembered that while insurers have considerable persuasive powers, they possess no public policy or policing authority. Also, it should be recognized that insurers do not seek those types of responsibility but rather contend that these authorities should continue to be the prerogatives of government. Further, although insurers believe they have the confidence of their clientele and can be influential in developing attitudes, they do not seek to impose mitigation actions on their policyholders. Because of their significant history, knowledge and expertise in matters relating to loss elimination, reduction and control, insurers believe that they should be consulted by government where appropriate.

What is insurance? What is the role of insurers?

Insurance is an economic institution that allows the transfer of financial risk from an individual to a pooled group of risks by means of a two party contract. The insured party obtains a specified amount of coverage against an uncertain event (e.g., an earthquake or windstorm) for a smaller but certain payment (the premium).

The foregoing definition was excerpted from *Paying the Price*, published by the John Henry Press.

LESSONS LEARNED

Ice Storm '98 tested the “functional model” and provided lessons which if heeded will provide for future efficiencies and loss reduction. In this section the “lesson learned” and/or needs will be outlined.

Provincial Government

The following needs were identified:

- ◆ the creation of a civil security auxiliary team to facilitate increased intervention activity;
- ◆ the publicizing of the roles and mandates of every participant; and
- ◆ an explanation of the coordinating role of the Security Direction to the partners and population.

Municipalities

These actions are deemed necessary:

- ◆ initiate steps to prevent or diminish the risk;
- ◆ enhance the ability to rapidly deploy emergency measures;
- ◆ devise alert and mobilization mechanisms; and
- ◆ develop the ability to quickly and adequately intervene.

Citizens

They need to develop minimum self-protection reflexes.

In the remainder of this section, following brief comment regarding the United States, specific mitigation and incentive recommendations will be advanced and the Missions of the Institute for Catastrophic Loss Reduction (ICLR) and Institute for Business and Home Safety (IBHS) discussed.

United States' Ice Storm Response and Mitigation Efforts

The Federal Emergency Management Agency (FEMA) is the federal agency responsible for the United States' mitigation policies and programs. FEMA recognizes that mitigation is a local issue and strives to create policies and

programs which are fully supported and implemented by the states, cities and towns. FEMA endeavours to establish “collaborative partnerships,” which Michael Armstrong, Associate Director for Mitigation describes as:

based on open communication; mutually identified values and measures of success; [and] a working relationship that creatively seeks out and utilizes all opportunities and resources available to achieve the partnership’s goals and trust.

Through these “partnerships,” which will comprise federal and state agencies, voluntary agencies, the business community and other non-traditional organizations, FEMA will seek to bring about a national mitigation capability.

FEMA envisions a Comprehensive Partnership Mitigation Plan (CPMP) as including, at the federal level.

- ◆ technical support;
- ◆ training;
- ◆ policy dissemination;
- ◆ guidance;
- ◆ information clearinghouse functions;
- ◆ coordination of federal agencies; and
- ◆ policy resolution.

At the state level the CPMP would:

- ◆ develop and integrate statewide mitigation efforts,
- ◆ manage state-based mitigation programs; and
- ◆ provide local communities with training, technical assistance and guidance.

In advancing the collaborative partnership concept, Associate Director Armstrong stated:

The limitations of the potential in some of the existing processes like mitigation planning combined with the separation, if not isolation of programs (such as the Earthquake Program, Hurricane Program, NFIP, Dam Safety and HMGP) have provided a dampening effect on the development of a holistic approach to mitigation.

While there are many similarities in the mitigation programs and efforts of Canada and the United States, they are not identical, nor are the vexing

problems which give rise to these initiatives. Nevertheless, where a commonality exists it behooves the two nations to share their experiences and expertise in the interests of expediency and mankind. Ice Storm '98 was such a situation.

Mitigation Recommendations

The mitigation recommendations which follow have been cast in broad categories and terms, in anticipation that they will serve a twofold purpose:

1. to stimulate the thoughts and suggestions of those with hands-on experience, and
2. to assist in developing specific recommendations.

When pursuing the development of specific recommendations, it is suggested that the Probable Maximum Loss (PML) event be defined. While acknowledging that PML can be defined in a number of ways, it is recommended that it be established consistently as: the cost of repair (excluding business interruption) as a percent of the cost of replacement after an event (i.e., 100 year flood; earthquake with a 475 year recurrence) with a 90 percent confidence level that the estimated repair cost will not be exceeded. Such a definition is needed to assist in the development of mitigation initiatives and determination of their cost justification.

General Recommendations

The following areas are identified as requiring review and possible specific recommendations:

- ◆ communications (cellular and telephone);
- ◆ vulnerability of water filtration plants and water systems;
- ◆ availability of large, heavy-duty generators for chronic care facilities, hospices, nursing homes, hospitals and emergency operation centres both public and private;
- ◆ development of alternative sources of energy to offset the staggering demands on normal sources at times of crisis;
- ◆ sheltering accommodations, food and feeding;
- ◆ medical, counseling, prescription services and security;
- ◆ emergency fuel supplies – oil, gas (auto, diesel, propane) and wood.;
- ◆ building, health, fire, safety and energy codes;
- ◆ limited time pre-event actions; and
- ◆ event response activities, (i.e., help lines and courtesy and emergency transportation).

Numerous sound mitigation initiatives can emanate from the foregoing. Also, specific pamphlets such as those published and distributed by both Canadian and United States governments; EPC and FEMA; Canadian and American Red Cross; the Institute for Catastrophic Loss Reduction and the Institute for Business and Home Safety. By way of example, EPC's news release titled "Don't Feel Powerless -- Prepare for Electricity Outages" (Appendix 4) is worthy of note.

Insurers have the knowledge, experience and expertise and can argue persuasively on matters regarding loss control and reduction. These insurer attributes must be recognized, tapped and utilized as part of insurers' contributions to the mitigation efforts of government.

Incentives

As with matters relating to mitigation, insurers understand "incentives", (their value, and how they function) and realize that they must be cost-justified. This reservoir of knowledge must likewise be tapped.

Incentives can flow from many sources, including but not limited to:

- ◆ federal, provincial or state and municipal agencies;
- ◆ financial markets;
- ◆ banks;
- ◆ private lenders; and
- ◆ insurers.

Creative ideas and incentive sources must be developed to foster the undertaking of the mitigation initiatives. These could include:

- ◆ waiving of sales tax on items or materials used in the mitigation effort;
- ◆ a reduction in property taxes that gives recognition to the loss reduction enhancements (contemplates a certification of the work undertaken).;
- ◆ discounting or waiving of the building permit, plan check or inspection fees when a retrofit is made in accordance with approved standards and procedures and the work is certified;
- ◆ low-interest loans for retrofitting;
- ◆ discounts on new construction loans when the materials and construction exceed the codes;
- ◆ federal and state (provincial) income tax credits for retrofitting;
- ◆ premium incentives;

- ◆ reduced deductibles and coinsurance percentages reflecting changes in the risk from the implementation of mitigation initiatives; and
- ◆ availability of coverage and amounts that otherwise would not have been available.

To be effective the incentives must provide the property owner with sufficient remuneration to make the undertaking cost-justifiable and not cause financial strain. Incentives can have a favourable effect, but cannot become the burden of a single stakeholder.

Mitigation, Incentives and Insurers

Over the years insurers have championed the institution of both mitigation initiatives and premium incentives. It was insurers who brought the first fire departments into existence, initiated the first building codes, commenced boiler, machinery and elevator inspections, established the Underwriters Laboratory (UL) and promoted the use of airbags in automobiles. Insurers have given premium credits (incentives) for the installation of sprinkler systems, smoke detectors, burglary alarms and the use of airbags. Likewise, insurers have been outspoken advocates for stronger building codes, stronger automobile standards and the enactment of land use measures such as those that take people out of harm's way while permitting the enjoyment of property rights. Insurers' concern for the well-being of people and property continues and is evident by their establishment of the ICLR in Canada and of the IBHS in the United States.

The development of specific mitigation measures is well underway by insurers; their trade organizations and other governmental agencies, firms, and academics. This report is designed to render an overview of the mitigation responsibilities and to provide a context for the specifics being developed elsewhere.

ICLR's and IBHS's Mission Statements and key objectives provide visible evidence of their on-going commitment to matters of personal safety and economic and property loss reduction.

MISSION STATEMENTS AND KEY RESULT AREAS

Institute for Catastrophic Loss Reduction (ICLR)

Mission Statement:

To reduce the loss of life and property caused by severe weather and earthquakes through the identification and support of sustained actions that improve society's capacity to anticipate, mitigate, withstand and recover from natural disasters.

Key Result Areas:

- ◆ building safer communities;
- ◆ establishing safety partnerships;
- ◆ enhancing industry awareness; and
- ◆ promoting consumer awareness.

Institute for Business and Home Safety (IBHS)

Mission Statement:

To reduce deaths, injuries, property damage, economic losses and human suffering caused by natural disasters.

Key Result Areas:

- ◆ public outreach;
- ◆ community land use;
- ◆ construction of new buildings;
- ◆ retrofitting of existing structures; and
- ◆ collection, analysis and dissemination of information.

ICLR and IBHS are similar, though not identical, organizations. Both are striving to institutionalize mitigation as a national value. Working with all the other stakeholders, that objective will be reached and society will be served.

SUSTAINABLE DEVELOPMENT: ENERGY SOURCES AND NEW BUILDING MATERIALS

The buzz words “sustainable development” have many definitions and are used in numerous ways by writers. For the purpose of this report these words will pertain to structures, their occupancy and use, and the economic value derived therefrom. In this context consideration will be given to the structures’ ability to withstand the rigours of natural hazards and endure over time.

Advances in the science of building construction, when coupled with new and improved building materials, mean that structures can be erected which are highly, though not totally, impervious to the impacts of seismic motions, water (flood), wind and ice. Buildings constructed in strict accordance with the codes and made of the new damage-resistant materials should not readily succumb to the effects of natural hazards. Likewise, structures which are rehabilitated to incorporate construction strengthening technology and new materials will have a significantly reduced failure potential.

During construction of new edifices and the retrofitting of existing structures, consideration should be given to the improvements in the building, fire, safety and health codes as well as to the many advances in energy codes. Prudence dictates that attention be given to new materials and construction practices since all of these features (codes, materials and practices) offer the potential of dramatic damage reduction and loss savings.

The savings derived from new energy codes, practices and materials could be particularly meaningful when consideration is given to society’s dependency on electricity. Electricity is used to heat and cool buildings; provide light; cook food; purify and pump water; operate computers, printers, and fax machines; pump fuel; operate life safety devices in hospitals, nursing facilities and homes; drive safety systems such as traffic lights, rail signals and air traffic control; maintain and operate communication links; run sewage plants; operate elevators, escalators and moving sidewalks. It is clear that society has a heavy dependency on energy. It is also clear that efforts to mitigate loss from natural hazards must include energy considerations.

Ice Storm '98, with its destruction of 1,000 or more high-tension wire pylons, 25,000 to 35,000 wooden utility poles, and 120,000 kilometres of transmission and distribution lines (enough to circle the globe three times), all of which left 5.2 million people in Canada and the United States without power, light and heat, proved how vulnerable the electric service is. As there was no power to run elevators, offices, computer and manufacturing equipment, to pump water or provide heat in the cold of winter, business, commerce and manufacturing were brought to their knees. Reinforcing the dependency issue is the fact that Quebecers used electricity for 41.0 percent of their energy consumption in 1996 compared to the national average of 23.8 percent. Thus, is it any wonder that energy must be elevated to a place of greater prominence in the mitigation pecking order? Should not the approach to hazards mitigation be holistic?

Consider the following “Holistic Approach to Mitigation” offered by Dr. Dennis S. Mileti of the University of Colorado:

We believe that continuing along the same hazards research and practice will bring increased frustration (and losses) for everyone. We need an approach with a much broader perspective so that far more complexity in both natural and human systems can be taken into account. We need a paradigm that ensures true long-term mitigation and loss reduction that is as permanent as we can imagine, avoiding burdening future generations with risk. We need to be able to increase the long term equilibrium between humans and the environment.

We propose a new framework for hazard research and management. Although the new paradigm will embrace the idea of adjusting to the environment, it will go far beyond that. It will be underlain by a global systems perspective; it will embrace the concept of sustainability; and it will derive its moral authority from local consensus. We call this new approach “sustainable hazards mitigation.” Its goal is not simply reducing losses, but building sustainable local communities throughout the nation. Under the new approach, actions to reduce losses would only be taken when they are consistent with the five other principles of sustainability: environmental quality, quality of life, disaster resiliency, economic vitality, and inter- and intra- generational equity.

We emphasize that all five must be incorporated to achieve true sustainability.

Now is the time to discuss and debate this new mitigation paradigm, to acquire an understanding of what would be required and what would be saved by its implementation, and to set aside parochial considerations for the benefit of all stakeholders.

Examination of this paradigm requires a thorough review and evaluation of all hazards (earthquake, wind, tornado, hurricane, hail, flood, snow, ice, wildfire, etc.). The hazards analysis should be undertaken to give recognition to the impact of that new and existing hazards would have on the current and future life/business styles and dependencies of society. These hazards include geomagnetic storms. The report titled *Coping with Natural Hazards in Canada: Scientific, Government and Insurance Industry Perspectives* delineates the hazard and risks from this type of event:

Geomagnetic storms are probably one of the least known atmospheric hazards. They have wreaked considerable havoc in the high northern mid-latitudes. For instance on the morning of March 13, 1989, a powerful geomagnetic storm occurred causing a major power failure from northern Quebec to Montreal. The storm tripped a voltage regulator and shut down one of the main lines stemming from the la Grande hydro electric complex in northern Quebec. During the next 60 seconds, voltage levels became increasingly erratic within the grid. Within 90 seconds, the entire 9,500 megawatt power complex was isolated from the rest of the system. In all, the storm cost Hydro Quebec \$10 million and its customers between \$10 and \$100 million (Lerner, 1995).

This same storm was responsible for the failure of three “fault tolerant” disk drives at the Toronto Stock Exchange, halting trading for three hours (Dayton, 1989).

Because of society’s dependency on electrical energy there must be an awareness of the problems that can flow from its disruption. An example is the near-catastrophe which occurred on January 9, 1998 when at approximately 12:20 p.m., both of the water filtration plants that provide Montreal and the 15 surrounding municipalities with drinking water shut down simultaneously. Andre Lacroix describes this event in his article “Water Crisis – A Close Call for Montreal.” Without electricity to power the water pumping and filtration plants, homes, hospitals and businesses would not have water for drinking, sanitation, air-conditioning and heating systems, or fire fighting. Depending upon the length of the interruption, serious health, fire suppression and business problems mount.

If electricity and energy can give rise to problems, they also offer opportunities to maintain structures and their occupants. Increased energy efficiency can reduce, if not eliminate, the damage associated with “ice dams.” A variety of energy efficiency measures can be applied to homes and businesses to mitigate this type of loss, including:

- ◆ better attic, roof, and eave insulation;
- ◆ reduced filtration of warm air from living or working areas to attics;
- ◆ sealing of heating ducts to prevent the escape of warm or hot air into attics; and
- ◆ the use of more efficient (less heat-producing) ceiling lighting fixtures.

Particular opportunities abound in steel frame structures (an increasingly widespread construction approach for both residential and commercial edifices) because the steel components conduct heat. If society avails itself of the opportunities to control and mitigate loss in a holistic manner, natural hazard events, while not eliminated, will be rendered manageable and communities safer.

Building, energy, fire, safety and health codes must be scrutinized and evaluated for their life and loss saving qualities. Code enforcement professionals will require training to meet the requirements and expectations of the new paradigm. Also, the practices in use by inspectors must be carefully reviewed and updated where warranted.

New building materials must be sought and only those with the ability to reduce or prevent loss or damage and sustain the utility of the structure retained. The use of pressurized wood, waterproof exterior siding, enhanced window systems and glass, and insulation must be promoted so that they are the builders’ choice and in demand by property owners.

Energy sources and alternatives (i.e., photovoltaic cells and windmill farms) must be thoroughly studied, evaluated and recommendations advanced.

It should be acknowledged that what will work in one place may not work in another. Flexibility in the design of the mitigation plan/strategy is essential, thereby providing room for alternative plans and procedures to function.

The new paradigm must not ignore politically difficult tasks or sensitive issues. The issues associated with land-use measures must be confronted. How people and structures that are in harm’s way are handled is extremely important to the sustainability of an environment that is subject to natural hazard events.

The holistic approach must evaluate the risks that are present and provide an indication of the potential loss frequency and severity facing inhabitants, businesses and governments that are susceptible to the vagaries of the various hazards. Also, the plan must give an indication of the cost benefits to be derived if a comprehensive course of action is pursued. These facets must be accomplished using state-of-the-art technologies and methodologies.

Insurers will need to evaluate the application of the “standards of insurability” in conjunction with the mandates of the new paradigm. Questions regarding the potential for catastrophe, occurrence cycles and the ability of insurers to price the product must be addressed. In other words, a holistic approach should not be viewed as guaranteeing the availability or affordability of insurance in the private sector.

The success of developing safer and more sustainable communities hinges on the willingness of those with knowledge, insights and expertise to champion the concept. Ice Storm '98 provided a real-world situation and served to demonstrate the need for a holistic approach to mitigation. That approach will succeed only if pursued vigorously by all stakeholders – i.e., government at all levels (federal, state or provincial, municipal), insurers and banks, businesses (mercantile and manufacturing), utilities (public and private), academics, scientists and engineers, and the citizenry.

CONCLUSIONS

Ice Storm '98 is the costliest natural disaster to occur to date in Canada's history. It left 4.7 million people without electricity and heat for a prolonged period in the middle of winter. It caused property damage, insured and uninsured, and economic loss approximating \$6.4 billion Cdn. It demonstrated the need for planning and the benefit of the emergency preparedness work already undertaken. It also revealed the stoutheartedness of the Canadian people.

This storm placed a spotlight on the ability of insurers, both in Canada and the United States, to underwrite those hazards which have catastrophic potential, and raised questions regarding the possible frequency and severity of future events. It caused people to stop and think about the impact of climate on their lives. It brought to prominence issues relating to mitigation, land use, sustainable development and incentives for loss reduction activities. It brought into focus the need for all stakeholders – government at all levels, including emergency planners and code officials, insurers and banks, businesses and manufacturers, academics, scientists, engineers and just plain people – to work together, to form partnerships and to toil in the spirit of full cooperation.

This event pointed out how dependent society has become on electricity. It signaled an urgency regarding the examination of how natural hazards are handled and questioned whether the time has arrived for a holistic approach. It showed that natural hazards do not recognize national boundaries, and gave testimony to the importance of neighbouring countries planning and working together to meet the challenges of these events. Through the sharing of experiences, knowledge and expertise, human suffering can be reduced, property destruction and damage lessened, infrastructure and critical lifelines secured, and the sustainability as well as safety of communities enhanced.

The matters outlined in this conclusion reflect noble goals and constitute the reasons for which the Institute for Catastrophic Loss Reduction (ICLR) and the Institute for Business and Home Safety (IBHS), initiatives of the Canadian and United States insurance industries, have joined hands. The Institutes reach out to the other stakeholders and urge them to join us in our continuing efforts to reduce deaths, injuries, property damage and economic loss caused by natural hazards

