



**Municipal Emergency Plan  
Hazard Analysis**

2002

## PREFACE

Major emergencies and disasters can occur anywhere, anytime. Some are primarily seasonal while others can occur swiftly and without warning. Having an awareness of the particular natural and technological hazards and their potential affects will assist the City of Edmonton to implement effective mitigation, preparedness, response and recovery plans and programs.

- JUNE 2002

# **Table of Contents**

<b>Introduction</b> .....	1
Emergency Management in Edmonton.....	1
Overview of the City of Edmonton.....	1
Demographics .....	2
Employment.....	2
Transportation.....	3
Primary Dangerous Goods Routes.....	3
Primary Dangerous Goods Routes Map .....	4
Schools - Hospitals - Nursing Homes.....	5
Historical Data .....	5
 <b>Hazard Summary</b> .....	 6
 <b>Accidents</b> .....	 7
Airplane Crash .....	7
Roadway Collision.....	7
Train Collision/Derailment .....	9
 <b>Atmosphere</b> .....	 10
Blizzard/Snowstorms .....	10
Ice Storms .....	13
Hail.....	13
High Wind.....	14
Lightning.....	14
Thunderstorm.....	14
Tornado.....	15
 <b>Dangerous Goods/Hazardous Materials</b> .....	 17
Biohazardous Material .....	18
Dangerous Goods Spill .....	18
Dangerous Goods Storage.....	20
 <b>Diseases and Epidemics</b> .....	 21
Human Diseases/Public Health Threat .....	21
Pest Infestation.....	22
<i>Deer Mice/Hantavirus Pulmonary Syndrome</i> .....	22
<i>Invasive Pest Species</i> .....	23
<i>Mosquitoes/Mosquito-Borne Diseases</i> .....	23
Plant Diseases .....	23
 <b>Explosions and Emissions</b> .....	 24
Industrial Facility .....	24

---

Oil and Gas Well Accident .....	25
Pipeline Break Release .....	26
<b>Fire</b> .....	28
Grassland/Brush Fire/Wildland Interface .....	28
Industrial Facility .....	29
Landfill.....	29
Urban Fire .....	30
<b>Geological/Hydrological</b> .....	31
Flood (surface).....	31
Flood (waterway).....	32
Landslide/Landsubsidence .....	34
<b>Public Disorder</b> .....	35
Civil Disorder.....	35
Labour Disputes .....	35
<b>Seismic</b> .....	36
Earthquake .....	36
<b>Structural</b> .....	36
Structural Collapse.....	36
<b>Terrorism</b> .....	37
Hostile Acts.....	37
<b>Utility Disruption</b> .....	37
Communication Failure .....	37
<i>Telephone Systems</i> .....	37
<i>Private Broadcasters</i> .....	38
<i>Emergency Services Communications</i> .....	38
Heat/Natural Gas Disruption.....	38
Power Failure/Shortage.....	39
Water Contamination .....	40
Water Supply/Shortage .....	41
<b>Summary - Secondary Events</b> .....	42
<i>References</i> .....	43

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## INTRODUCTION

Edmontonians, and those in the surrounding communities, enjoy great access to economic and educational opportunities, top-notch medical services, varied communication systems, and an abundance of shopping, recreational, and cultural activities.

However, as society increasingly concentrates in urban settings and becomes more reliant on technological and industrial advances, so too does the exposure to, or affects from particular hazards increase.

The City of Edmonton **Hazard Analysis** is a historical review of hazards within the City and general surrounding geographic region. While specific hazards may cause secondary effects, only the prime vulnerabilities will be presented. For ease of reference, particular hazards are profiled in alphabetical order.

### Emergency Management in Edmonton

In Alberta, all municipalities are required by the Alberta Disaster Services Act to implement plans and programs to assist in mitigating the effects of, preparing for, responding to, and recovering from, major emergencies or disasters. The overall objective of the emergency planning program in the City of Edmonton is to foster timely and effective preparedness to:

- Preserve the lives and safety of individuals;
- Minimize damage to public and private property and municipal infrastructure;
- Preserve the economic viability of the City of Edmonton; and
- Expedite the restoration of essential services and the rapid and complete recovery from the effects of any major emergency or disaster;

### Overview of the City of Edmonton<sup>1</sup>

The City of Edmonton is the largest metropolitan centre between Toronto and Vancouver and Canada's fifth-largest city. Edmonton is situated roughly in the geographic centre of the western prairie province of Alberta, and is the provincial capital. The city is at an elevation of 671 metres, or roughly 2,000 feet. The North Saskatchewan River divides it into two sectors. Topography is flat except where steep grades occur on the banks of the river valley. The principal business district lies on the north bluff of the river. The city encompasses a land area of more than 70,000 hectares (701.5 square kilometers or 271 square miles), of which a substantial portion is rural.

## Demographics<sup>2</sup>

Edmonton has a population of 666,104 residents (2001 Census), with a projected growth to 711, 200 by 2007. The population swells during normal daytime working hours due to a workforce entering from commuter centres within the metropolitan region. Within the greater metropolitan region the population is estimated to be at 937, 845 (2001 Census) and will grow to just over one million in 2007 (1,015,900).<sup>2</sup>

## Employment

### *The 30 Largest Employers in the Edmonton Metro Area<sup>1</sup>*

Organization	Product	Employees
Capital Health	Health administration	15,000
Government of Alberta	Legislative administration	14,012
City of Edmonton	Civic and economic administration	9,066
Edmonton Public Schools	Elementary and secondary education	7,127
University of Alberta	Post-secondary education	6,135
Government of Canada	Intergovernmental affairs	6,000
TELUS Corporation (Metro Edmonton)	Telecommunication carriers industry	5,034
Canada Safeway Limited (Metro Edmonton)	Supermarkets	5,000
Edmonton Garrison	Defense services	4,500
Edmonton Catholic Schools	Elementary and secondary education	2,633
Northlands Park	Horseshoe tracks	2,554
Finning (Canada)	Industrial machinery, wholesale	2,300
Capital Care Group Inc.	Other institutional social services	2,200
Northern Alberta Institute of Technology	Post-secondary education	2,132
Stantec Inc.	Offices of engineers	2,000
Lilydale Foods	Poultry products industry	2,000
ATCO Ltd. (Metro Edmonton)	Other utility industries	2,000
Grant MacEwan Community College (Edmonton)	Post-secondary education	1,801
Canadian National Railways	Railway transportation industry	1,787
EPCOR	Electric power systems industry	1,700
Good Samaritan Society	Civic and fraternal organizations	1,600
Alberta Motor Association	Property and casualty insurers	1,206
McDonald's Restaurants (Metro Edmonton)	Restaurants, unlicensed	1,200
Alberta Hospital (Edmonton)	Psychiatric Hospital	1,200
Brown & Root Inc.	Metal fabricating industries	1,100
Initial Security	Security and investigation service	1,000
Business Development Bank of Canada	Business financing companies	1,000

*Employment by Industry - September 2000<sup>3</sup>*

Trade.....	86,500
Health Care and Social Assistance .....	52,800
Manufacturing .....	48,000
Accommodation and Food Service.....	37,000
Construction .....	35,400
Professional, Scientific and Technical Service.....	34,000
Transportation and Warehousing.....	33,000
Other Service.....	29,200
Educational Service.....	29,100
Finance, Insurance, Real Estate and Leasing.....	25,700
Public Administration.....	24,700
Information, Culture and Recreation .....	21,400
Management, Administrative and Other Support .....	17,700
Forestry, Fishing, Mining, Oil and Gas .....	10,300
Utilities .....	5,700
Agriculture.....	5,500
	<b>496,000</b>

**Transportation**

Canadian National Railways (east/west), Canadian Pacific Railways (north/south), and Via Rail have routes that pass through Edmonton. Major highways through and around Edmonton are 2, 14, 15, 16, 16A, 21, 28, and 37.

Although the City Centre Airport is capable of supporting large charter airliners, public and commercial air traffic has shifted to the Edmonton International Airport located 28 kilometres south of the city centre. MediVac, flying clubs, corporate shuttles and small charters are the primary users of the City Centre Airport. Military aircraft are flown here occasionally for repair and maintenance not routinely carried out at Canadian Forces Base Edmonton.

The Edmonton International Airport supports air passenger traffic of nearly 4,000,000 passengers per year. With the newly opened south air terminal, that number is expected to increase significantly as new carriers begin supporting the airport.

Several major bridges traverse the North Saskatchewan River, as well as pedestrian bridges and a number of secondary bridge structures that span various creeks in the city

Approximately 117 regional and inter-provincial freight carriers serve the area.

**Primary Dangerous Goods Routes**

To ensure the safety and security of its residents, the Edmonton has a number of designated dangerous goods routes. Carriers transporting dangerous goods commodities are restricted to these routes.

## Schools – Hospitals – Nursing Homes<sup>3</sup>

There are 398 public, separate, and private schools; three vocational colleges; and one university. Edmonton also has seven acute care sites (each with a 24-hour Emergency Room), six hospitals plus Northeast Capital Health Centre, 14 public health centres, four specialty clinics, and three outreach offices. There are 28 publicly funded long-term care facilities operated by 15 different organizations under contract to Capital Health (including Capital Care Group, a wholly-owned subsidiary), and Capital Health Link (a 24-hour, 7-day phone advice and information service).

## Historical Data<sup>4</sup>

Because of the city's combined rural and urban nature and location, there are a variety of hazards that can impact population and property. Significant occurrences in Edmonton's history have included:

1903	Blizzard stranded thousands. Bright sunlight reflecting off snow left livestock and people snow blind.
June 1915	The North Saskatchewan River flooded leaving over 2,000 people homeless.
1918	Spanish Flu pandemic left 262 people dead and thousands ill. (Edmonton's population in 1918 was 53,846.)
1944,1952,1954,1972	Flooding of the North Saskatchewan River.
March 1979	Pipeline rupture spilled liquid propane into the sewer system in the southeast part of Millwoods. Seventeen thousand people were evacuated. Co-ordinated efforts averted a major disaster.
October 1979	A piece of heavy equipment ruptures a 50-centimetre pipeline spilling crude oil into the river valley. Oil flowed for six hours until containment efforts were successful.
December 1981	During its approach to the City Centre Airport, a twin engine turbo prop executive airplane embedded itself into the side of the Royal Alexandra Hospital. One hundred gallons (456 litres) of explosive fuel leaked down six floors.
March 29, 1985	Two Canadian Armed Forces Hercules transport planes collided in mid-air on the city's northern outskirts (Canadian Forces Base Edmonton, Namao) killing 10 airmen. The base's wooden shipping and receiving building at the crash site caught fire sending flames an estimated 300 metres into the air. Although not within city limits, several municipal resources were used to fight the fire.
July 1986	Worst flood in 71 years caused the evacuation of 900 people and \$4,000,000 in damages. The flood affected 300 homes in the communities of Rosssdale, Riverdale, and Cloverdale. The city required 500 extra employees to cope.
July 31, 1987	A tornado 40 kilometres (25 miles) long and up to one kilometre wide with winds of 420 kph (260 mph) went through the eastern part of Edmonton and parts of neighbouring Strathcona County. Twenty-seven people were killed and 300 were injured. Property damage is estimated at \$360,000,000. This was the worst natural disaster in Alberta's recent history and one of the worst in Canada's history. (N.B. July 31, 1987 was dubbed "Black Friday" by the media.)
July 1989	A tornado went through the west end of Edmonton, sending two to hospital and causing at least \$500,000 damage.
October 23, 1999	One home in the Whitemud Hills subdivision of Terwillegar slid down the embankment of the North Saskatchewan River; six other adjacent homes, although still left standing, were evacuated and remain uninhabitable. As a

	precautionary measure, 14 families directly across from the affected site were evacuated for one evening.
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### HAZARD SUMMARY

For ease of organization and reference the following is an alphabetical listing of hazard groups and the related hazards within each group.

Hazard Group	Hazard
Accidents (Transportation)	<ul style="list-style-type: none"> <li>• Airplane Crash</li> <li>• Roadway Collision</li> <li>• Train Collision/Derailment</li> </ul>
Atmosphere	<ul style="list-style-type: none"> <li>• Blizzards/Snow storms/Ice Storms</li> <li>• Hail</li> <li>• High Wind</li> <li>• Lightening</li> <li>• Thunderstorm</li> <li>• Tornado</li> </ul>
Dangerous Goods/Hazardous Materials	<ul style="list-style-type: none"> <li>• Biohazardous Materials</li> <li>• Dangerous Goods Spill</li> <li>• Dangerous Goods Storage</li> </ul>
Diseases and Epidemics	<ul style="list-style-type: none"> <li>• Human Diseases/Public Health Threat</li> <li>• Pest Infestation</li> <li>• Plant Diseases</li> </ul>
Explosions and Emissions	<ul style="list-style-type: none"> <li>• Industrial Facility</li> <li>• Oil and Gas Well Accident</li> <li>• Pipeline Break/Release</li> </ul>
Fire	<ul style="list-style-type: none"> <li>• Grassland/Brush Fire (Wildland Interface)</li> <li>• Industrial Fire</li> <li>• Landfill</li> <li>• Urban</li> </ul>
Geological/Hydrological	<ul style="list-style-type: none"> <li>• Flood (surface)</li> <li>• Flood (waterway)</li> <li>• Landslide/land subsidence</li> </ul>
Public Disorder	<ul style="list-style-type: none"> <li>• Civil Disorder</li> <li>• Labour Disputes</li> </ul>
Seismic	<ul style="list-style-type: none"> <li>• Earthquakes</li> </ul>
Structural	<ul style="list-style-type: none"> <li>• Structural Collapse</li> </ul>
Terrorism	<ul style="list-style-type: none"> <li>• Hostile Acts</li> </ul>

Utility Disruption	<ul style="list-style-type: none"> <li>• Communication/Telephone Failure</li> <li>• Heating/Natural Gas Disruption</li> <li>• Power</li> <li>• Water Contamination</li> <li>• Water Shortage</li> </ul>
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## ACCIDENTS

Transportation incidents can be devastating. A crash could cause such things as injuries, fatalities, fires, transportation and supply disruptions.

### Airplane Crash

Edmonton is currently served by two airports: Edmonton International (28 km from the city centre) and City Centre (near the city core). Commercial and large passenger services are all channeled through the International and small private and restricted passenger traffic continues at City Centre. The City Centre Airport is the third largest general aviation airport within Canada with nearly 100,000 flights per year originating from, or terminating at the airport. There are also several smaller airports such as Villeneuve, Cooking Lake, and a number of private airstrips in the region where flights terminate or originate.

During World War II the Edmonton Municipal Airport (now called City Centre Airport) was the busiest airport in Canada, if not all of North America. Although it was used as a supply depot for military equipment and transport for U.S. military destined for Alaska, there are no records of any significant number of plane crashes during this busy time period.

There have been at least 30 airplane crashes recorded in Edmonton, mostly involving small private passenger planes. A number of significant events have been<sup>4</sup>:

Date	Event
March 29, 1929	First air crash in Edmonton city limits. A Tiger Moth crashed into the Calder yards, narrowly missing several rail cars.
1954	Plane crashed into the Calder yards knocking several rails cars off the tracks
March 29, 1985	Two Canadian Armed Forces Hercules transport planes collided in mid-air near CFB Namao killing 10 airmen.
December, 1981	A twin engine turbo prop executive airplane, on a landing approach to the City Centre Airport, embedded itself into the roof of the Royal Alexandra Hospital. Both the pilot and co-pilot were killed.
September 24, 1992	A suicidal man circled Edmonton for several hours trying to gain the attention of his former girlfriend before deliberately crashing his plane into the side of a house.

**Roadway Collision**<sup>5</sup>

A roadway collision is a serious transportation incident involving multiple vehicles delaying or halting traffic flow for more than two hours. This is generally confined to highways, freeways, or high-density roads and rerouting may not be an option.

Edmonton has not experienced any major roadway accidents like those seen on Toronto’s Highway 401. However, the threat is ever present with Edmonton’s rapid weather changes causing icy or foggy conditions making roads and bridges treacherous.

Edmonton has several high-traffic volume roadways, each of which has numerous collisions per year. The average daily traffic volumes on major roadways are:<sup>6</sup>

Quesnel Bridge	110,600
Whitemud Drive – 104 to 111 Street	100,900
Yellowhead Trail - Airport Road to 107 Street	74,600
170 Street - 87 Avenue to Stony Plain Road	63,800
Wayne Gretzky Drive north of 106 Avenue	62,200
97 Street - Yellowhead Trail to 153 Avenue	57,700
Calgary Trail at Ellerslie Road	55,100
St. Albert Trail at 137 Avenue	47,500
Stony Plain Road at 142 Street	43,200
178 Street - 87 Avenue to Stony Plain Road	38,800
Sherwood Park Freeway	35,900
Fox Drive	35,600
50 Street at Sherwood Park Freeway	35,600
Manning Freeway to Yellowhead Trail	35,000
Kingsway at 116 Street	34,100
Walterdale Bridge	33,400
Argyll Road	30,900
High Level Bridge	26,800
Anthony Henday Drive	26,700

There are specific times of day that have dramatically increased traffic flow and, as a result, a higher rate of incidents that affect traffic flow.

The City of Edmonton Transportation and Streets Department indicates that in the Year 2001, the 10 highest collision locations were<sup>7</sup>:

- Yellowhead Trail at 149 Street;
- 118 Avenue at Groat Road;
- 87 Avenue at 170 Street;
- 137 Avenue at 97 Street;
- 90 Avenue at 85 Street;
- Capilano Drive – Fort Road – Yellowhead Trail;
- Yellowhead Trail at 127 Street;
- 107 Avenue at 142 Street; and

- 23 Avenue at Calgary Trail (southbound)/Gateway Boulevard (northbound).

### **Train Collision/Derailment**

The City of Edmonton is serviced by a number of commercial rail lines: Canadian National (CN), running east/west and paralleling the Yellowhead Freeway; Canadian Pacific (CP), which enters the city from a north/south direction; Rail Link, which is "short line" track system that serves the north. <sup>8</sup>Various commodities are shipped by rail to and through Edmonton on a yearly basis and range from automobiles to grain to a number of chemicals and fuels. When viewed from a distance a train derailment produces destructive images. However, on a kilometre by kilometre basis, rail mode is considered to be much safer than road mode. Most train incidences occur out on the line with many instances of vehicles trying to "outrun" a train at controlled or uncontrolled rail crossings. In the City of Edmonton, trains reduce normal speed to less than 30 km/h (20mph) and in the main switching yard speeds must be reduced to less than 7 km/h (4mph).

<sup>9</sup>Edmonton also has a light rail passenger transit system (LRT). Initial construction was completed in 1978. The double track rail line is approximately 22 kms. in length - 11 kilometres in each direction. The LRT line starts above ground in the Clairview area in the north, travels underground through the central downtown area and emerges out of ground before travelling south on the LRT Bridge crossing the North Saskatchewan River. The final destination is the University of Alberta station. Each day, 38,000 passengers use the LRT system and that number has been slowly increasing. There are a number of controlled roadway crossings and only eight train/vehicle collisions have occurred, all as result of vehicles attempting to our run or bypass the lowered crossing arms. As well, there have only been three instances of car derailment. Despite these occurrences, the LRT rail line is extremely safe. Regular radio and communication checks are completed as well as a number of LRT emergency response exercises have been held in recent years.

Edmonton Transit is a member of the American Public Transit Association (APTA) and the LRT Section prescribes to their Rail Safety Management Program. This program provides an independent system safety audit of the LRT system on a regular basis. LRT also has established rules, policies and standard operating procedures in place to reinforce safe practices.

## **ATMOSPHERE<sup>10</sup>**

Climate-wise, the City of Edmonton experiences four distinct seasons - winter, spring, summer and autumn. While winters in Edmonton can be long, cold and snowy and the summers are usually warm and dry, these conditions are not necessarily the rule. Edmonton has increasingly been experiencing milder winters with less than anticipated levels of snowfall and some spring and summer months have been wet, with higher than average levels of precipitation and accompanying moderate temperatures. Weather-related effects can have devastating affects on an increasing urban population and can cause such things as widespread damage, injuries, death, and traffic disruptions.

**Blizzards/Ice Storms/Snowstorms**

A severe winter storm or blizzard occurs when heavy snowfall is accompanied by strong winds, blowing/drifting snow, and decreasing temperatures.

Being situated as far north as Edmonton is (53 degrees north latitude) the city has the potential for facing more severe winter weather-related hazards than any other city of comparable size in North America. At times temperatures will drop dramatically. On November 6, 1962 the temperature dropped 47° from 31°F to -16°F in only 32 hours.

In winter, one of the greatest, most consistent factors that must be dealt with is the cold. In times of extreme cold, machinery breaks or malfunctions, vehicles fail to start, water lines freeze and burst causing flooded streets that turn into sheets of ice. Demand on heating fuel skyrockets, schools close, humanitarian shelters become overcrowded, and incidents of hypothermia and death increase dramatically.

On January 13, 1911, an article in the Edmonton Bulletin noted that the city faced “...*the coldest day of present winter. Thermometer remains below forty below zero (F) throughout entire day. Mercury drops to fifty three below zero (F) early this morning.*” On January 14, 1911, another article in the Edmonton Bulletin noted that the two coldest days in the Edmonton area were recorded in January 1886 and February 1893 when it reached -57°F. January 18, 1935, was noted as the 28<sup>th</sup> day of a frigid spell with the daytime temperature being -33°F. January 25, 1950, was noted as the 40<sup>th</sup> day of below zero (F) weather. In 1969, in a typical touch of Edmonton humor, the Edmonton Journal issued certificates to anyone that survived the 26-day long cold snap when the temperature never rose above 0°F (-18°C).

*Blizzards/Snowstorms*

During winter the potential exists for life threatening blizzards and heavy snowfalls. A few of the significant snowfalls and blizzards in the history of Edmonton are<sup>11</sup>:

1903	Blizzard stranded thousands. Bright sunlight reflecting from the snow left livestock and humans snow blind.
November 1942	Blizzard with 19.5 inches (49.53 centimetres) of snow derailed seven streetcars and delayed milk and bread delivery. Snow drifts 36 inches deep (91.44 centimetres). Snowplow equipment available in southern Alberta was sent to Edmonton.
November 14, 1944	Winter storm closed trails in outlying areas preventing coal delivery.
October 4, 1957	One of the worst October blizzards on record.
December 14-16, 1964	Full-scale blizzard warning issued. Four people died.
December 6, 1979	Storm downed power lines leaving many residents without power for 40 minutes.

January 15–19, 1982	Blizzard with -30°C weather resulted in an 11-car pile-up. Broken water mains flooded the streets.
January 20, 1982	Severe cold resulted in two deaths from hypothermia. Water mains broke and schools closed while periods of ice fog made driving difficult. The cost of clean up was \$1.7 million as 45.3 centimetres of snow fell in the first 19 days in January

Spring snowstorms are not uncommon in Edmonton. Some significant events have been<sup>4</sup>:

April 20, 1955	16.5 inches (41.9 centimetres) of snow broke the previous record for April.
April 22, 1972	Six inches (15.24 centimetres) of wet, sticky snow downed power lines leaving parts of the city without power for up to 12 hours.
May 20, 1989	15 centimetres of wet, heavy snow snapped trees and caused 100 power outages.
May 21, 1997	Storm left 25,000 without power, broke 16,000 trees, damaged buildings, and caused major problems on highways.

There are many factors that can affect the impact of a winter storm other than the amount of snow received. They include speed of the prevailing winds (drifting), freezing rain (prior to snowfall), and the time period of the snowfall. Generally, significant snowfall over a short period of time affects the city's ability to react to and manage the situation more than snow falling at a slower consistent rate, but both scenarios have the potential to cause their own unique problems.

During a major snowfall, the City enforces parking bans on designated snow routes to allow for snow removal. The City of Edmonton can mobilize snow removal equipment, theoretically within a moment's notice, although at any given time a certain percentage of the fleet would be down for some type of mechanical maintenance.

The City of Edmonton has:

- 81 sanders (71 are also capable of plowing);
- 27 plows;
- 20 graders;
- 12 blowers; and
- 15 sidewalk plows.

Hired equipment:

- 10 bulldozers;
- 6 loaders;
- 10 tow trucks;
- 150 graders; and

- 250 end dump trucks (snow removal).

If required, the list of available hired equipment could expand contingent on availability.

*Ice Storm*

When winter precipitation falls as freezing rain or drizzle, heavy ice accumulations (ice storm) can cause significant damage, especially when accompanied by high winds.

Edmonton’s climate is such that during the most likely periods for ice storms, like those in Quebec and Ontario, there is very little moisture in the air. There are times, however, when freezing rainfall will dramatically affect traffic flow for several hours as well as cause hazards for pedestrians.

<sup>16</sup>During the early morning of May 21, 1997 Edmonton experienced a significant cold snap and steady, wet snow fell. Edmontonians woke up the next morning to snapped power lines and damaged trees. Traffic disruptions were widespread as numerous roadways were impassable and many traffic lights inoperable. While power restoration was an immediate priority, total clean up of tree debris took three days. Storm costs were estimated to be nearly \$1.2 million and many trees needed replacement in the following months.

**Hail**

Hail forms in the cores of thunderstorms. Water vapour in warm, rapidly rising air masses (convection currents) condenses into water at higher, cooler altitudes, producing heavy rain showers. If it is cold enough, ice crystals can form around minute particles, such as dust whipped up from the ground. These increase in size as more water freezes to their surfaces. When the ice pellets are too heavy for the ascending air currents to lift, they fall as hail. They may become larger, heavier and more damaging if they collect more water on the way down. Damage from hail can have devastating affect in the way of flattening crops and gardens, stripping trees and plants of foliage, damaging roofs and other property damage, and creating icy roadways which can cause treacherous driving conditions.

Not all hailstorms are widespread. In Edmonton many areas can experience a hailstorm while at the same time other areas in the city remain unaffected. Other than the hail preceding the devastating tornado that hit Edmonton on July 31, 1987, hailstorms causing significant property damage in the last 20 years have been:

July 1993	Estimated damage *\$21 million
July 1995	Estimated damage *\$34.5 million

\*In comparison, the most devastating storm in an urban setting occurred in Calgary, AB in September 1991. A 30-minute thunderstorm hit Calgary with downpours and golf-ball-sized hail. Homes were flooded and windows broken; estimated damage was pegged at \$884 million.

## **High Wind**

Often confused with tornadic activity, high winds are straight-line winds or microbursts in excess of 80 kilometres per hour (kp/h) that may cause adverse affects to life or property.

## **Lightning**

During a thunderstorm, the air is charged with electricity and the most striking sign is lightning. The bottoms of thunderclouds carry negative charges and the tops carry positive charges. Influenced by the charged clouds, the ground also becomes positively charged. When the electric build-up becomes too great, the lightning jumps from the negatively charged cloud base and strikes a positively charged object - usually another cloud. However, about one-third of lightening bolts strike the ground.

Lightning can start devastating fires, usually in the dense and unpopulated forest areas in Alberta. Most structures in Edmonton have lightning rods installed to counteract the effects from lightening. Despite this precautionary measure, urban fires can occur as a direct result of lightning strikes. As well, power outages may be experienced when a power line or transformer station takes a direct hit.

## **Thunderstorm**

A severe thunderstorm consists of most of the following elements: heavy rainfall, moderate to strong wind, hail, lightning, and the possibility of flash flooding/surface flooding.

Edmonton experiences thunderstorms that can cause serious damage and power outages as identified on the following page<sup>4</sup>:

July 12, 1901	Hail the size of pigeon eggs.
Summer 1962	Storm with tornadoes and hail.
July 8, 1963	Three violent thunderstorms with 48 mph (80 km/h) winds in close succession between 1:00 a.m. and 6:00 a.m. dumping seven inches of rain. Two thousand homes left without power.
August 3, 1983	Hail the size of golf balls smashed windshields, stripped leaves and damaged roofs.

Despite the havoc they can cause, severe thunderstroms are small-scale and short-lived as weather phenomena go. Through the assistance of several volunteer weather-watchers, timely and accurate observations of severe weather are an invaluable supplement to Environment Canada's full observation network. Environment Canada closely monitors weather systems and will issue applicable watches, warnings, and updates to ensure public safety.

**Tornado**

A tornado is a violent funnel-shaped, destructive, rotating column of air with wind speeds that can exceed 511 km/h (300 mph). Path widths can range from a few metres to over 1.3 kilometres. Average forward speed is 40 km/h (25 mph) but can exceed 130 km/h (80 mph).

Tornadoes are classified according to the *Fujita F-Scale of Severity*:

- F-0 (64-116 km/h) - light damage (broken branches, etc.)
- F-1 (117-180 km/h) - some minor roof damage (can overturn mobile homes)
- F-2 (181-252 km/h) - strong (can remove a roof or demolish a mobile home)
- F-3 (254-331 km/h) - severe damage
- F-4 (332-418 km/h) - devastating damage
- F-5 (419-511 km/h) - incredible damage (very rare)

Following is a list of tornadoes experienced<sup>4</sup>:

July 8, 1949	“Baby” tornado touched down on the outskirts of Edmonton but did little damage.
July 18, 1962	Storm with tornadoes and hail injured two people, flooded the exhibition grounds, and cut electrical service in many areas.
July 31, 1987	An F-4 tornado had devastating effects upon property, human life, and resources. Dubbed "Black Friday" by the media, a total of 27 people were killed, the majority being from the Evergreen Mobile Home Park. Property damage in Edmonton and in the surrounding jurisdictions was estimated in excess of \$360m.
July 28, 1989	Edmonton again had a small tornado touch down in the west, injuring two people and causing \$500,000 in damages
July 14, 2000	Although the "Pine Lake" tornado in the County of Red Deer had no major impact on Edmonton, City personnel were dispatched to assist.

On average there are 41 tornadoes reported in the prairies per year (16 per year in Alberta). The other Canadian “hot spot” for tornadoes is southwestern Ontario. Canada is second in the world to the United States for frequency of tornadoes.

Environment Canada, through the Prairie Storm Prediction Centre in Winnipeg, issues public broadcasts, weather watches, and warnings for Alberta, Saskatchewan and Manitoba. The centre has expertise in predicting severe weather and consolidates efforts previously carried out by facilities located in several locations across the prairies. Using specially trained warning preparedness meteorologists, the centre has an important training and educational role with schools, emergency response organizations, and media.

The centre receives information from a variety of sources across the prairies including weather stations, police, and other emergency responders. As well, Environment Canada

has developed the Canwarn System, which relies on hundreds of specially trained amateur radio volunteers to identify tornado precursors.

## DANGEROUS GOODS/HAZARDOUS MATERIALS

As identified in the Transportation of Dangerous Goods Act and Regulations, a dangerous good is *"any article or substance that is capable of posing significant risk to health, safety or property when transported."* The Act provides for nine classifications of dangerous goods (also known just as "DG" or hazardous materials), sets the standards for the safe movement of these materials and, identifies the documentation; safety marks (labels/placards) and training requirements. In addition, the Act specifies emergency incident reporting criteria and the circumstances when specific emergency response plans are required.<sup>12</sup>

Transportation of Dangerous Goods Act and Regulations classification system:

Class 1 - Explosives
Class 2 - Compressed Gases
Class 3 - Flammable liquids
Class 4 - Other flammable hazards
Class 5 - Oxygen rich material, oxidizers and organic peroxides
Class 6 - Material affecting health, poisons and infectious substances
Class 7 - Radioactive material
Class 8 - Corrosive material
Class 9 - Miscellaneous hazards

In Edmonton and in the surrounding communities, high volumes of various dangerous goods are produced or shipped to, or through Edmonton, by rail or road on an annual basis. These commodities, in the majority, are manufactured or reach their destination without incident. However, mishaps do occur. The City of Edmonton has a well-trained Dangerous Goods Response Team. As well, the city is represented on a number of industry specific safety committees (i.e. Canadian Chemical Producers Association, Strathcona Industrial Association (SIA), Edmonton Area Pipeline and Utility Operators Committee (EAPUOC)).

Not all dangerous goods are produced in large quantities. A quick look under your sink at home will probably reveal quite an astonishing array of products that come under the general heading of dangerous goods. Cleaners, bleaches, disinfectants, aerosols and so on, are all regulated dangerous goods. Gasoline/petrol, camping fuel, solvents, paints, pesticides, weedkillers are also all considered to be dangerous goods. All dangerous, all with hazard labels, all with instructions for proper use, all with details on how to safely use and dispose of them.

Alberta Transportation and Utilities has a number of Dangerous Goods Inspectors who regularly monitor dangerous goods/hazardous materials manufacturing and storage facilities.

**Biohazardous Material**

Biohazardous materials are substances that are hazardous to humans and can include materials such as AIDS viruses, infectious samples, bacterium etc. Specialized packaging and transport requirements usually provide safe protection. If any product escapes, response mechanisms exist to contain and mitigate the effects.

An emerging area of concern is the intentional manufacture and release of biological agents such as anthrax or smallpox. The terrorist attacks of September 11, 2001 and the subsequent anthrax scares in the United States increased the number of **false** reports in the City of Edmonton. Any white or powdered substance created suspicion and the City of Edmonton was kept busy responding, as were numerous other North American cities.

<sup>13</sup>From October, 2001, to April 30, 2002, the City of Edmonton responded to nearly 100 of these types of calls. All were deemed to be innocuous substances, and to date there are still no confirmed cases of intentional biological releases or attacks in Edmonton let alone in Canada. Government officials are monitoring the situation.

**Dangerous Goods Spill**

A Dangerous Goods Spill is the accidental release of chemical, biological, or radiological material during transportation or handling at a fixed site.

Under the Alberta Environmental Protection and Enhancement Act “*a release includes to spill, discharge, dispose of, spray, inject, inoculate, abandon, leak, seep, pour, emit, empty, throw, dump, place & exhaust*” of a substance that causes the “*impairment of or damage to environment, human health or safety of property*”.<sup>13</sup>

In 1980, the federal government passed the Transportation of Dangerous Goods Act (TDGA). This act promotes public safety when transporting dangerous commodities including chemicals. It applies, with specific exceptions, to all handling, offering for transport, and actual carrying of dangerous goods in Canada irrespective of their point of origin, destination, or means of conveyance.

On September 5, 1980, a system of dangerous goods transportation routes was proposed and implemented shortly thereafter. In July, 1985, the first regulations under the TDGA came into force and applied to all modes of transportation. On February 5, 1987, the Edmonton Fire Department placed the first fully trained and equipped Dangerous Goods Team into service.

A classification system has been established for response to dangerous goods incidents. Each level of response requires different levels of resources to effectively correct or deal with a situation, as shown on the next page:

<ul style="list-style-type: none"> <li>• Level I Spill</li> </ul>	<p>A small spill (less than 25 litres) involving any class of dangerous goods transported or stored in vehicle systems, pails, drums, cylinders (except one ton), packages, bags, etc., and having a low risk of fire/explosion, environmental</p>
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	contamination, or impact on human health and safety. The container is either undamaged or a small release has occurred that can be contained with available resources. Single pump response.
• Level II Spill	A spill (less than 100 litres) usually involving placarded quantities of dangerous goods transported or stored in cylinders, tanks, drums, multiple small packages, etc., having a medium risk of fire/explosion or environmental contamination and requiring some consideration for local evacuation. Containers may be damaged but capable of holding the contents for transporting from the event. Single pump, Dangerous Goods Response Team response.
• Level III Spill	A spill involving extremely hazardous substances transported, confined, or stored in buildings, tank cars/trucks, stationary tanks, multiple medium sized containers, etc., having a high/severe risk of fire/explosion or environmental contamination and requiring consideration for large scale evacuation. Containers may be damaged to a degree that catastrophic failure is possible. First Alarm required units, Dangerous Goods Response Team, Emergency Medical Services (EMS) response.

*If an incident escalates, additional resources are called upon as needed to bring the incident to a safe conclusion.*

Notable dangerous goods incidents<sup>14</sup>:

September 21, 1978	Gasoline tanker spilled 39,550 litres of gas into the sewer system at 98 Street and 85 Avenue. Forty homes were evacuated, natural gas was shut off, and crews extinguished two flash fires in the sewer.
April 17, 1980	270 litres of 2-4D spilled at 125 Avenue and 82 Street.
May 20, 1981	34,000 litres of gasoline and diesel spilled and caught fire at 92 Avenue and 39 Street when a truck and train collided.
May 19, 1982	38 railcars carrying sulphur residue caught fire at the Calder Yards creating a potentially hazardous toxic gas.
June 21, 1989	A 22-litre pail of dimethylaniline spilled near a school at Wagner Road and 86 Street. Seven people were admitted to the University of Alberta Hospital complaining of headaches and nausea.
June 27, 1996	Aqua ammonia release in the Millwoods Recreation Centre sent a number of patrons and staff to hospital.
July 9, 2001	A cloud of unknown substance at the Waste Recycling Centre at Clover Bar. The Dangerous Goods Team could find no trace of the substance but several staff members required medical attention.

In recent years, updated methods of recording and tracking Dangerous Goods incidents have been instituted by the Emergency Response Department (ERD), as shown below:

Year	Level I	Level II	Level III	Service Investigation	Regional Response	Total
1997	510	155	98	6	-	769
1998	678	154	125	6	1	964
1999	634	135	136	5	-	910
2000	653	133	125	2	1	914
2001	769	106	178	2	2	1,057

*After determining the severity of the spill, the Incident Commander can upgrade the incident to a higher level or downgrade the incident and return resources to service.*

As well as designated routes through the primary industrial areas, there are secondary routes where dangerous goods loads are transported. Hundreds of loads of dangerous goods are transported daily through the city by truck. Loads can be large quantities of individual products or mixed loads that, in the event of an accident, can lead to deadly consequences.

In 2000 there were a total of 147,606 rail cars loaded with dangerous goods using the Canadian National Walker Yards (Calder). Of those, 19,150 carried fuel oil, 14,857 carried propane, and the remaining carried 37 different types of products of various classifications.

Most incidents of chemical and other toxic material accidentally released in Edmonton have been of a minor nature consisting of spills of less than 20 litres.

### **Dangerous Goods Storage**

Dangerous Goods storage constitutes large quantities of stored chemical, biological and radiological materials at a fixed site. Accidents or leakage can result in a threat to life and property, or contamination of the environment.

Chemical distributors, storage, and manufacturing facilities within Edmonton are very fastidious regarding ongoing training of staff and maintaining high levels of monitoring of all aspects of their operation for hazardous incidents. These facilities hold joint training sessions with ERD and EMS personnel to maintain awareness and skill levels.

Programs such as the City of Edmonton's Fire Inspection Service and the Provincial Dangerous Goods Inspections also serve to ensure that fire protection systems are in good working order and that dangerous commodities are stored and handled in a safe manner.

## DISEASES AND EPIDEMICS

### Human Diseases/Public Health Threat<sup>15</sup>

A public health threat is a medical, health, or sanitation occurrence such as contamination, epidemic, or infestation that poses a threat to the general public.

Historic public health threats:

1892	Smallpox. Health officers inspected incoming trains and placed restrictions on travel from infected areas. Infected households quarantined. Led to the creation of the first Board of Health on July 23, 1892. During 1908-1911 there was obligatory smallpox vaccination for all school-aged children.
1911-1913	Scarlet fever endemic. Vigorous campaign to educate housewives on disease transmission and how to "swat flies."
1912-1913	Measles epidemic.
1912	Typhoid fever outbreak (264 cases). Filtration and chlorination of the north side water plant and, completion of the south side water treatment plant helped to prevent future outbreaks.
1918	Influenza. In two weeks 337 people were hospitalized and 1,926 were confined at home. A preventive approach adopted by arbitrarily closing public facilities including schools, large indoor social functions, and churches. Stores and offices could only open between 10:00 a.m. and 3:00 p.m. These efforts proved futile, so the Board of Health began treating the disease. By May 1919, 8,000 people out of 60,000 had influenza: 615 died.
1918-1920	Scarlet fever. Cases rose from 98 to 623.
1919-1921	Smallpox.
1925-1927	Polio. Twenty-three deaths plus numerous cases of paralysis.
1927	Smallpox. Fifty-four cases (all but three had not been vaccinated). Twelve thousand residents immunized in a few weeks.
1932	Measles.
1952-1953	Polio. In 1953 there were 322 cases and 33 deaths. Salk Vaccine introduced in 1954. All Grade 1 children vaccinated in 1955.
1957	Asian flu.
1962	Measles: 2,817 cases. Immunization against measles began in 1966 and the number of cases dropped dramatically.
1968	Hong Kong flu.
1979	Measles: 2, 012 cases.
1982-1983	Hydrogen sulphide gas leak at Lodgepole (respiratory problems).
1982	Giardiasis outbreak linked to North Saskatchewan River water: 895 cases.
1986	Flooding of North Saskatchewan River (considered a public health threat due to contaminants/residues left behind after the water receded. Public Health issues information bulletins in these circumstances for such things as cleaning carpets, floors, walls, etc.).

1990	Pertussis (whooping cough): 615 cases compared to 66 the previous year.
1997	Measles: 120 cases
1999-2001	Meningococcal disease: 60 cases
?	Currently, the greatest threat is the possibility of a pandemic influenza outbreak. These outbreaks have occurred at regular intervals (1918, 1957, and 1968) and the entire world is overdue for an outbreak.

Vaccination campaigns:

1976	Swine flu - 70,000 vaccinated.
1979	Measles - 1,738 vaccinated.
1997	Measles - 93,750 vaccinated.
2000-2001	Meningococcal disease - 230,000 vaccinated.
Every year	Influenza vaccination campaign.
Every year	Grade 5 Hepatitis B vaccination.
Catch-up program	Grade 12 Hepatitis B vaccination.

Edmonton is as vulnerable to a major health threat as any Canadian city its size. Increasing travel and mobilization of populations as well as increased imports, also increases the chances of swift transmission of human-borne diseases. However, the probability of a major health threat occurring is difficult to predict.

In spite of this, Edmonton is as prepared as it can be to withstand a public health issue:

- Specialized medical treatment and equipment;
- Over 15,000 healthcare workers (Capital Health Authority); experience in managing mass immunization campaigns and disease outbreaks;
- Sophisticated infectious disease intelligence with worldwide connections in place;
- Well-developed emergency response plans coordinated with partner agencies; and
- Mass casualty incident plans being tested.

**Pest Infestation**<sup>16</sup>

*Deer Mice/Hantavirus Pulmonary Syndrome*

Hantavirus was only first confirmed in Alberta in the late 1990s but has existed here previously for some considerable time. Although more frequently a concern in rural settings in north central Alberta, the disease has claimed human victims from the Edmonton area. The disease is contracted following exposure to infected mouse droppings or urine. In particular the deer mouse *Peromyscus maniculatus* has most frequently been responsible for transmission of Hantavirus to humans.

Public education on how to minimize exposure risk to Hantavirus is provided by Capital Health’s Information System. City of Edmonton Pest Management personnel performs rodent management in City-maintained facilities.

### *Invasive Pest Species*

In general, native insects like the forest tent caterpillar cause much alarm to citizens when population cycles peak and trees are stripped of their leaves. Natural control of these outbreaks mediated by many different natural enemies limits the damage to trees and in time causes the pest outbreak to crash. Similar outbreaks of non-native pests are less likely to resolve naturally. This can have more harmful or sometimes serious consequences on tree survival. Federally quarantinable pests like the Asian gypsy moth or the Asian long-horned beetle are examples that warrant emergency measures due to the environmental destruction these species will cause if left unchecked.

The status of federally quarantinable pests is assessed through the use of monitoring devices and inspections conducted under the auspices of the Quarantine Pest Act. Typically the presence of these insects in Edmonton would generate resource assistance from provincial and federal agencies under the Critical Pest Infestation Response Plan if local government resources were insufficient to eradicate the problem.

### *Mosquitoes/Mosquito-Borne Diseases*

The wetter summer months of June and July typically produce heavy nuisance mosquito activity in the Edmonton region. Invasions of mosquitoes regularly pose serious annoyance, which curtails many outdoor activities. The build-up of nuisance mosquito populations which breed quickly in more temporary standing water bodies over the land follows cycles in the availability of wetter conditions. The risk of human disease transmission by local mosquito species has lowered since outbreaks of Western Equine Encephalitis in central Alberta in the 1930s that caused horse and human deaths.

Climate change coupled with the introduction of new species of mosquito vectors like the Asian tiger mosquito, and new mosquito-borne diseases like West Nile virus in Canada are notable public health risks that are spreading towards Alberta and require ongoing evaluation.

The City of Edmonton mosquito abatement program provides an organized approach to the suppression of mosquito biting while reducing exposure of citizens to chemical insecticides. The program monitors the mosquito species that are competent disease vectors and delivers effective control of aquatic developmental stages of those species that cause annoyance.

### **Plant Diseases**<sup>16</sup>

Dutch Elm disease (DED) threatens 70,000 elms planted on public and private property throughout Edmonton. This non-native disease has ravaged American elm populations throughout the United States and south central and eastern Canada. The disease spreads from infected to healthy elms that are growing close enough together, by means of their inter-connecting root systems. In addition, broods of elm bark beetles emerging from infected elms physically transmit spores of the fungal disease to healthy elms by feeding on the vascular tissues of the tree. Long distance movements of the disease are typically mediated by human-assisted transmission such as the movement of disease-infected or vector-infested elm firewood. Very small populations of the smaller European elm bark beetle live in Edmonton. Whereas this species is non-native, and likely receives little

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control by natural enemies, Edmonton winters appear to be the main reason populations of this disease vector remain at lower levels.

Along with furthering a number of strategies to prevent the disease, the City of Edmonton's Dutch Elm Disease bylaw provides the legal basis for managing cases of DED on private property. Public education on the bylaw and the disease itself is coordinated through a DED telephone hotline. Monitoring of elm bark beetle populations and Elm Wilt disease symptoms in Edmonton provides an early warning system for this devastating condition.

## **EXPLOSIONS AND EMISSIONS**

In, and around Edmonton, there are a number of large industrial facilities. Manufacturing or processing a variety of products from cement to chemicals, cellulose fibres to petroleum and natural gas, these huge plants are made up of a sophisticated network of pipes, pressurized chambers and vessels, gauges, control panels and other related systems. In addition, the prairie landscape is dotted with oil and gas pumps, controlling the flow of product. These types of facilities and the oil and gas industry are heavily regulated by the federal and provincial governments to ensure the safety of the public and the environment.

### **Emissions**

<sup>17</sup>The Strathcona Industrial Association (SIA) operates 28 monitoring stations to measure general (or ambient) air quality in the region. Together these stations are called the SIA Ambient Air Quality Monitoring network. There are three types of air quality measurements on the Network. Seven stations offer continuous and intermittent monitoring while 21 exposure cylinders offer static monitoring (collection of substances during a one-month span). The SIA Ambient Air Monitoring Network exists to:

- Determine air quality trends;
- Alert industry and government to changes in air quality;
- Review effectiveness of emission control measures;
- Provide data for scientific studies;
- Make air quality information available for our neighbours; and
- Provide real-time (or immediate) data 24-hours a day, seven days a week.

The Network continuously monitors hydrogen sulphide, total hydrocarbons, wind speed and direction, and nitrogen oxides every 30 seconds to produce five-minute, one-hour, 24-hour, and annual averages. The Network intermittently monitors total suspended particulates for a 24 hour period, once every six days. Static monitoring is done for total sulphation and hydrogen sulphide at one-month intervals.

Air quality is affected by emissions from industrial operations, motor vehicles, home heating, and natural biological processes. Weather conditions (precipitation, temperature and wind) also affect the measured quality of ambient air. Some significant events, as identified on the following page, have been<sup>4</sup>

May 1968	Natural gas explosion at the Dunston Apartments (12629 Stony Plain Road) left nine injured and two dead.
April 1980	Explosion at the Boardwalk sent 10 firefighters to hospital.
September 1980	25,000 gallons of methanol gas exploded at the Turbo Refinery sending flaming debris 200 metres into the air.
April 1982	Explosion at the CIL Plant (44 Street and 101 Avenue - now AT Plastics) was heard and felt 30 kilometres away.
July 1989	Gas explosion in Holyrood (7912-93A Avenue) damaged 35 homes killing one person.

### **Industrial Facility**

The greater Edmonton community has a number of large industrial facilities involved in the processing of chemical and petro-chemical commodities. While each of these facilities has excellent maintenance schedules and well-developed emergency response plans incidences have occurred. For example, in July of 1987, the Stelco steel plant (now Alta Steel) was hit by a tornado and suffered significant structural damage as well as damage to the environmental protection systems. However the situation could have been far worse as the tornado passed directly between two major refineries.

### **Oil and Gas Well Accidents**<sup>18</sup>

An accident is the uncontrolled release of oil or natural gas, or the extremely poisonous byproduct hydrogen sulphide from production wells. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in oil or brine and is released upon exposure to atmospheric conditions.

Over the last 25 years, there have been many accidents involving sweet and sour gas wells within the city where varying amounts of product were released into the environment. One hundred and ten of the incidents involved sweet gas, and 17 involved sour gas (hydrogen sulfide).

The petroleum and natural gas industry is highly regulated and has a fine safety record, however the threat of accidental releases, fires, and explosions still exists. In addition to these hazards, many of Alberta's oil and gas wells contain hydrogen sulfide.

At concentrations of 700 parts per million (PPM), as little as one breath of hydrogen sulphide can kill. Although hydrogen sulphide can be detected by a "rotten egg" odor in concentrations from .03 to 150 PPM, larger concentrations paralyze the olfactory nerves so that odor is no longer a hazard indicator.

Small concentrations can cause coughing, nausea, severe headache, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulphide forms an explosive mixture with air temperatures at 500° Fahrenheit (F) or above and is dangerously reactive with powerful oxidizing materials. Hydrogen sulphide can also cause the failure of high strength steel and other metals. This requires that all company and government responders

be familiar not only with emergency procedures for well sites but also with the kinds of material that are safe for use in a sour gas well response.

Hydrogen sulphide concentration and symptoms:

Amount	Symptom
10 ppm	Onset of eye irritation.
50-100 ppm	Slight conjunctivitis and respiratory tract irritation after one hour.
100 ppm	Coughing, eye irritation, loss of smell after 2-15 minutes. Altered respiration, eye pain and drowsiness after 15-30 minutes. Throat irritation occurs after one hour. Several hours of exposure results in a gradual increase in severity of these symptoms and death may occur within 48 hours.
200-300 ppm	Marked conjunctivitis and respiratory tract irritation after one hour.
500-700 ppm	Loss of consciousness and possibly death in 30 minutes to one hour.
700-1000 ppm	Rapid unconsciousness, cessation of respiration, and death.
1000-2000 ppm	Unconsciousness at once with early cessation of respiration and death in a few minutes. Death may occur even if a person is immediately removed to fresh air.

### **Pipeline Break/Release**<sup>18</sup>

A pipeline break/release is the accidental release of substances, liquid or gaseous, transported through an underground network of medium or large diameter pipes.

Edmonton is surrounded and bisected by several pipelines. As well, a "Transportation Utility Corridor" rings the city. Major corridors cross Edmonton diagonally from 156 Street and 41 Avenue to 15 Street and 90 Avenue. Another travels along Calgary Trail north to Ellerslie Road and then diagonally from 101 Street to 34 Avenue and Whitemud Drive. Pipeline Alley, originating in Fort Saskatchewan, intersects the city at approximately 130 Avenue and the eastern city limits to 10 Street and 118 Avenue and then into Refinery Row.

Through these major pipeline corridors, there are approximately 70 pipelines varying in diameter from 80 to 864 millimetres. The lines transport a variety of products such as salt water, oil, nitrogen, hydrogen, natural gas, methanol, propane, ethane, and gasoline.

The pipeline industry in Alberta and Edmonton is tightly regulated and monitored by the Alberta Energy and Utilities Board. As a direct result of the 1979 Millwoods pipeline disaster, the Edmonton Area Pipeline and Utilities Operators Committee (EAPUOC) was formed. EAPUOC organizes and facilitates communication among owners of buried pipelines, utility installations, emergency responders, and regulators in the event of an emergency. Each year EAPUOC organizes an emergency training exercise and safety seminar for the general public and industry. Twenty-nine member companies and agencies can be notified of a problem within a short time. On January 1, 2001, a test call-down was conducted and 51 telephone calls were placed to the members within 26 minutes.

The number of contact damage hits on pipelines continues to drop. Companies that fail to meet requirements or follow Alberta Energy and Utilities Board direction are subject to escalating enforcement consequences. The required response and subsequent continued compliance with regulations results in the company's compliance status reverting back to satisfactory.

The Alberta Pipeline Act requires all pipeline licensees to report a pipeline failure to the Alberta Energy and Utilities Board regardless of cause, magnitude, or consequence. Staff verifies the cause of the failure and ensures that measures are taken to reduce future failures. A percentage of new pipeline installations are inspected for compliance with appropriate codes, acts, and regulations. As well, staff conducts inspections on licensed systems to ensure that operators meet record and maintenance requirements for continuous pipeline integrity. Staff also holds awareness seminars for operators and contractors to reduce the incidents of pipeline hits, enhance public safety, and reduce environmental impacts. One hundred metre-wide protection zones surround pipelines to ensure development does not encroach on the lines. The pipelines are patrolled daily within the city limits, by air or ground, to survey for encroachment, trespass, construction, or heavy equipment crossing.

The most common reason for pipeline failure is third party contact such as contractors digging without contacting the pipeline owners or Alberta First Call. Alberta First Call is an agency funded by pipeline and utility operators and was put in place so a contractor or property-owner developing a property can have the location of underground utilities and pipelines clearly marked. Random samplings of pipeline failures are:<sup>4</sup>

March 3, 1979	Edmonton's initial experience with a major pipeline rupture. Liquid propane entered the sewer system in the southeast part of Millwoods resulting in the evacuation of 17,000 people. Through co-ordinated efforts, a disaster of major proportions was averted.
October 4, 1979	Heavy equipment cuts through a 50-centimetre diameter pipeline spilling crude oil into the river valley. Oil flowed for six hours until containment efforts were successful.
June 8, 1997	Evacuation caused by a backhoe rupturing a natural gas line at 101 Avenue and 101 Street.
October 29, 1998	Trencher hit an eight-centimetre diameter natural gas line at 73 Avenue and 180 Street resulting in a second alarm response.

In the event of an emergency, each pipeline operator maintains a 24-hour control centre and emergency shutdowns are initiated when notification is received. In most cases, a member from the company's first response team will arrive within a half-hour to work with the site management team from the police and fire response teams. While police and fire co-ordinate evacuation and safety measures, pipeline companies focus on repair and restoration of the scene.

Not all pipeline breaks/releases involve hazardous products as many pipelines carry fresh or salt water. From 1975 to July 2001, there were 153 leaks and 31 pipeline ruptures were recorded. Fresh water was being transported through pipelines during 15 of the reported incidents and 70 incidents involved salt water.

## FIRE

### Grassland/Brush Fire/Wildland Interface

Edmonton has a picturesque river valley and an extensive park system based around this asset. As well as the river valley park system, there are hundreds of parks throughout the city that are the traditional manicured and well-maintained parks, or naturalization parks deemed a low maintenance resource. There are also thousands of acres within the city limits of environmental reserves, agricultural, and wild lands being held for future development.

Large grass fires have been a part of Edmonton's history since it was a fur trading post. During an average year there are approximately 318 grass and brush fires within the city limits. Notable exceptions have been:<sup>19</sup>

1949 - 485 fires	1952 - 350 fires	1966 - 372 fires
1968 - 527 fires	1969 - 510 fires	1976 - 410 fires
1980 - 443 fires	1983 - 534 fires	1984 - 499 fires
1988 - 596 fires	1997 - 484 fires	1998 - 437 fires
1999 - 393 fires	2000 - 515 fires	2001 - 953 fires

Climatic conditions in Edmonton have a strong bearing on the seasonal grass and brush fire situation with snowfall, warm drying spring winds, and rainfall dictating the extent and duration of the most hazardous periods. During normal years March, April, May, September and October are peak wild land fire months.

<sup>20</sup>From October 1, 2000, to May 1, 2001, there was only 38 millimetres of rain and snowfall recorded in Edmonton, the driest seven-month period since weather records have been kept. From January 1 to May 15, 2001, there were 556 grass and brush fire responses within the city limits - 537 requiring equipment and manpower.

Grass and brush fires can burn with such intensity that ecosystems can be drastically changed. Without intervention, these burned lands recover slowly and are susceptible to undesirable changes in vegetation composition. For example, when finer species of grass become established in burn areas replacing other vegetation, it disrupts natural systems and, with seasonal changes, creates additional fire risks.

Given the nature and quantity of urban wild land in Edmonton, grass and brush fires are unavoidable. Through concerted efforts of resource management and training of emergency response teams overall impacts can be lessened, but not eliminated. In times of low precipitation, the Emergency Response Department will issue fire bans. However, based on historic averages, Edmonton can expect to see at least 300 brush and/or grass fires per year.<sup>14</sup>

### **Industrial Facility**

The City of Edmonton's commercial and industrial activity has gone through many transitions. Starting with the fur trading industry, moving to an agricultural base, and to the "Gateway to the North" - oil and gas servicing. In the 1950s, numerous chemical and petrochemical refineries were constructed to the east of the municipal limits and are still in operation today. This strong economic base has attracted other heavy industries to locate in and around Edmonton. Fire safety records in general, have been very positive. The City's working relationships with such groups as the Strathcona Industrial Association (SIA), the Strathcona District Mutual Aid Plan (SDMAP, the Canadian Chemical Producers Association (CCPA), Edmonton Area Pipeline and Utility Operators Committee (EAPUOC) has been beneficial in collaborating on improving prevention and response processes.

### **Landfill**<sup>21</sup>

The City of Edmonton operates the Clover Bar Landfill in northeast Edmonton and there is one private landfill in west Edmonton. The Clover Bar Landfill currently holds approximately 13 million tons of municipal solid waste and will be in operation for another decade. The private landfill holds several million tonnes and has about the same remaining life. There are also several closed landfills within the city limits – notably at the Mill Woods golf course and Rundle Park. Another closed landfill is adjacent the City limits at the Strathcona Science Park.

Landfill fires can occur in both operating and closed landfills. In closed landfills, fires generally occur due to spontaneous combustion. Edmonton has never had such a fire in a closed landfill. In operating landfills, spontaneous combustion can occur in deep completed areas, but the more common landfill fire is the result of “hot” loads of waste being deposited or of lightning strikes on elevated surfaces. A hot load is one in which there are embers from a fire – often a domestic barbecue. Such fires occur occasionally at Edmonton’s landfills – once or twice a year. There have not been any serious fires of this type in recent history. Generally such fires are controlled by applying water and by smothering the material with soil moved by construction equipment, which is always on site at an operating landfill. The Emergency Response Department is generally notified and attends. Deep fires in operating or closed landfills represent an entirely different challenge. They generally pose no immediate catastrophic risk, but can lead to venting of hot, potentially toxic gases and collapse of surfaces as material below is consumed. They can be fought by injection of water and/or inert gases. There are specialty consultants and service providers who deal with such fires. Extinguishing of such fires can take weeks or months.

The health risk from landfill fires is generally that which arises from atmospheric discharge of gases, smoke and particulates that can have impacts on susceptible individuals.

## **Urban Fire**

<sup>22</sup>An urban fire is an uncontrolled fire in a populated area beyond normal response capabilities.

Edmonton is considered a relatively new city, even though it has been incorporated for almost a century. The population base is spread over 701.5 sq. kilometres (271 sq. miles). Of the total population, approximately 52% live in single-family dwellings, 21% in high-rises (over five stories) and the remainder residing in apartments (less than five stories), mobile homes or institutions (i.e. nursing homes, extended care facilities).<sup>2</sup> Thus, with a considerable amount of land and the relative newer vintage of construction, widespread urban fires are a rarity. In the event a large residential or industrial fire occurs, the Emergency Response Department has procedures in place ("second-alarm/third-alarm").<sup>14</sup>

For comparative purposes, West Edmonton Mall has concentrations of 15,000-20,000 people attending during peak seasons. It would be difficult to duplicate a more concentrated mass of people in one residential building.

Edmonton's "inner city" still contains a number of structures that are questionable in any quality review. This type of neighborhood is subject to urban decay and is undergoing a form of deterioration based on the nature of occupants, low (or non-existent) maintenance, and surrounding culture.

Modern codes and standards and safer building practices have produced better buildings using more non-combustible construction along with the installation of fire sprinkler protection. The Alberta Building Code is thought to be a leader and will set the standard for national and other provincial codes. As such, the risk and impact of major fires is somewhat less of a concern.

<b>FIRE/RESCUE SERVICE</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>
Alarms	3,378	3,069	3,341	3,276
Structural Fire	1,634	1,428	1,449	1,624
Non-Structural Fire	1,947	1,861	1,955	2,717
<b>Total Alarms/Structural/ Non-Structural Fire</b>	<b>6,959</b>	<b>6,358</b>	<b>6,745</b>	<b>7,617</b>
<b>TOTAL FIRE/RESCUE SERVICE EVENTS</b>	<b>27,647</b>	<b>29,105</b>	<b>31,657</b>	<b>29,446</b>

## GEOLOGICAL/HYDROLOGICAL<sup>23</sup>

### Flood (surface)

A flash flood is a localized flood of relatively great volume and short duration as a result of heavy rainfall or dam failure.

On July 20, 2000, the northeast corner of Edmonton experienced a very sudden, intense rainfall that resulted in localized surface flooding, turning the Beverly Bridge into a waterfall.

Edmonton is fortunate in that it is not subject to flash floods like the Saguenay region of Quebec where sudden snow melts, rain, and breaking ice jams caused water to dramatically overflow the banks of the Gatineau River.

Storm cells that affect Edmonton tend to be limited in size, one-kilometre diameter being normal. However, depending upon the intensity, duration, and frequency of seasonal rainfall, several areas have been impacted by sudden heavy downpours. Results include flooded basements and underpasses, plugged catch basins, popped manhole covers, and impassable streets. During exceptionally wet years, land slippage has occurred, especially along riverbank and freeway embankments. On average, from 1971 to 2000, 311 homes (out of 260,200) per year were flooded during heavy rainfalls.

Significant surface flooding that has occurred:<sup>4</sup>

1974, 1975	Mayfield area (156 Street to Mayfield Road, 107 to 111 Avenue).
June, July, and September 1978	Most residential areas of the south side.
July 22, 31, and September 2, 1987	Citywide.
July 5, 1988	Basements flooded citywide.
July 3, 1990	North side, business core, and university areas.
June 7 and 8, 1991	63 to 87 Avenue, 107 to 117 Street, Millbourne Road to 23 Avenue, 66 to 91 Street.
July 4, 1995	50 to 76 Street and 82 to 98 Avenue.
1999	Citywide.
July 20, 2000	Northeast corner of the city.

Although Edmonton has a history of significant intense rainfall, the overall effects are rarely of a lasting nature. When backups occur, the storm water disposal system is designed so that areas are drained quickly and flooding of a dramatic nature rarely lasts more than a few hours.

A year does not pass where residents do not experience flooded basements, streets, and plugged catch basins in some part of the city.

**Flood (waterway)**

A waterway flood is “a rising or overflowing tributary or body of water that covers land that is normally dry. The 100-year flood usually defines flood-prone areas. A 100-year flood has a 1% chance of occurring in any given year. It is possible to have a 100 year flood each year.”<sup>24</sup>

<sup>24</sup>Mountain streams via Abraham Lake and the Brazeau and Nordegg Rivers feed the North Saskatchewan River. The North Saskatchewan River builds to become a significant Canadian river eventually feeding into the Hudson Bay. The North Saskatchewan River has fluctuations of flow, height, color, and clarity throughout the year, along with constantly shifting sandbars.

Unlike other rivers across the prairies that tend to flood in the spring, the North Saskatchewan River has its greatest flow in early summer when the snow pack melts in the mountains. If torrential rains in the southwest follow sudden hot weather on the eastern slopes, the river can overflow its banks. In modern times, the greatest known flood of the North Saskatchewan River took place in late June of 1915 when Riverdale was flooded all the way to the alley east of 93 Street. With the Big Horn and Brazeau dams controlling flow upstream, flooding can now be avoided for the most part.

The base water level of the North Saskatchewan River is 609.4 metres above sea level with 612.05 metres being the average summer flow level. Flood conditions develop when the water level exceeds the base level by nine meters. Previous floods occurred in:<sup>4</sup>

Year	Level
1915	Water levels reached 12.1 metres above base level.
1944,1952,1954, 1972	Water levels reached 9.04 metres above base level.
1986	Water levels reached 10.57 metres above base level.

Concern begins when water levels increase beyond 4.5 metres above base. At 4.6 metres, floodwater becomes a problem at Fort Edmonton Park. At 5.2 metres, Rundle and Gold Bar Parks, and Keillor Road are affected. At 5.5 metres, all trails through the river valley park system are closed. At 5.8 metres, the trail system is covered and boat launches are closed.<sup>25</sup>

Advance flood warning is provided through Alberta Environment Services, Water Sciences Branch, who monitor conditions year round. Through monitoring of seasonal snowfall and rainfall, information is issued to the public regarding current issues affecting stream flows in the province. Issues that may pertain to current advisories are high stream flow, spring runoff, river freeze-up or break-up, as well as information that could affect river conditions in the province and Edmonton.

*Forecaster’s comments, Near Real Time Hydrometeorological Advisories and Warnings, and Water Supply and Weekly River reports* are available on the Alberta Environment web site at: <http://www.gov.ab.ca/env/water.html>. In addition, the water treatment plants and river valley park rangers closely monitor river conditions.

Due to increased monitoring of eastern slope snow packs, spring thaws, and late spring rainfall (as well as water level maintenance through upstream dams), the City is able to put in place flood mitigation procedures.

### **Landslide/Land subsidence**<sup>26</sup>

A landslide is the rapid downward movement of a mass of rock, earth, or artificial fill on a slope.

Edmonton is not subject to landslides by definition, but rather land slippages that occur at a slower rate and tend to give warning signals (small surface cracks on roadways, sidewalks, and embankments) before they happen.

Edmonton has a long history of land slippages along the river valley, freeways, ravines and creeks. Slippage can usually be attributed to heavy rainfall.

The most spectacular incident of a land slippage in Edmonton in recent history occurred October 23, 1999. It resulted in the evacuation of 23 families after a residence on Whitemud Road slipped off the eroded riverbank. Three homes were destroyed (one through direct collapse and two were demolished after being deemed unsafe). The combined value of the homes was over \$1,650,000 along with an estimated cost of \$90,000 to clean the site of debris. This area was on a layer of sand situated well below the surface. Combined with ground water, sources acting as a lubricant and the riverbank shifting through normal erosion, the area began to slip away from the more stable landmass beside it. Slow steady rain for a number of days caused water to percolate through the layers of topsoil resulting in a situation of “super saturation” that acted as a lubricant causing the instability.

Slides generally happen in high plastic types of materials. The slide mass could be composed of materials that are sitting on a layer of bentonite or another plastic-type material. The slide zone becomes wet and lubricated accelerating the slide. The depth of these surfaces is usually related to the size of the slide.

Along the river valley erosion is a constant factor taken into consideration with the constant undercutting of the banks by strong currents. Flooding, although a cause of damage, is less of a factor than the sudden subsidence of water level.

On average, seven or eight incidents of off-roadway land slippage and one incident every two to three years that affect roadways occur in Edmonton.

Through geotechnical engineering, potential problem areas are monitored regularly. Erosion protection is initiated along suspect or susceptible areas by measures that range from building retaining walls to maintain roadways, to simply rerouting trails and repositioning bridges through the park systems to more stable ground.

Significant slides have occurred at:

- Whitemud Drive from 156 to 159 Streets;

- 105 Street and 98 to 99 Avenue (retaining wall installed);
- Victoria Park Road;
- Saskatchewan Drive west of 99 Street;
- East and south on Emily Murphy Park Road;
- Grierson Road;
- Ada Boulevard at 38 Street;
- Fortway Drive at 109 Street.
- McDougall Hill;
- Groat Road at 102 Avenue; and
- Whitemud Drive at 142 Street.
- 

## **PUBLIC DISORDER<sup>27</sup>**

The City of Edmonton is considered to be a peaceful community. Numerous mass gatherings are held each year in celebration of sporting or cultural events and special holidays. As well, Edmonton has served host to a variety of political and social demonstrations on the steps and grounds of the Provincial Legislature. A number of factions throughout the years have also held strike posts due to real or imagined labour disputes. Each of these events is usually carried out without incident. However sporadic outbreaks of unruly demonstrations and public unrest have occurred.

### **Civil Disorder**

Typically this type of public disorder occurs at natural gathering places: Jasper Avenue, Whyte Avenue, the University area. Most violence, albeit infrequent, that has occurred has been aimed against property rather than people. Although no single condition or indicator precedes these unruly outbreaks, the consumption of alcohol has been a prime factor.

In May of 1984, when the Edmonton Oilers (NHL hockey team) won their first Stanley Cup, the length of Jasper Avenue quickly filled with vehicles and celebrants on foot. Efforts to manage and disperse the crowds were met with resistance. Numerous cars and plate glass windows fronting Jasper Avenue were damaged and litter was strewn everywhere. In the subsequent four-year streak that The Edmonton Oilers won the Stanley Cup, the Edmonton Police Service was prepared and street celebrations following these wins passed with little incident.

On July 1, 2001 (Canada Day), a rock concert was held on the Legislative Grounds. When the festivities were over, many of those in attendance made their way south over the High Level Bridge and joined an already swelling crowd of people along Whyte Avenue. When the Whyte Avenue bars closed shortly after, the already crowded sidewalks prompted many to spill out onto the street. Attempts by police to disperse the crowds were ignored and a huge melee ensued. When the evening was over, there were 37 arrests and a total of 93 charges laid. Seven people required transport to hospital with an unknown number of injured making their own way to medical facilities. Direct property damage was estimated to be \$165,000; in total, the City of Edmonton spent, over \$1,000,000 in clean up and overtime costs. As a result the Edmonton Police Service has reviewed and improved their crowd and event management procedures and have developed a Public Order Unit (POU).

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## **Labour Disputes**

The industrial revolution and mass production processes introduced in the 1920s gave rise to greater efficiencies in manufacturing and other industrial sectors. At the same time, many work forces formed coalitions or unions to represent the collective needs of workers or the workers of a specific industry segment. Over the years, many strikes have been organized in protest when perceived or real needs are not being met and contract negotiations break down. In the majority of cases, picket lines are set up and carried out without incident. However, in the spring of 1986, dissention broke out in a gathering of Gainers meat packing plant strikers. The Edmonton Police Service riot squad (now called the Public Order Unit) had to be called in and the strike was continually monitored throughout its duration. Since that time, many strikes have occurred and despite some minor vandalism, similar activity that occurred during the Gainer's strike has not occurred.

The Edmonton Police Service will not normally station uniformed officers at strike scenes, but will only intervene subject to a court order or emergent circumstances dealing with public safety. To ensure a consistent and knowledgeable approach to labour disputes, the Edmonton Police Service has appointed an Industrial Relations Committee chaired by a senior officer and further information can be obtained by contacting the chairman of that committee.

## **SEISMIC**

### **Earthquake**<sup>10</sup>

Edmonton is situated on a large, very stable, subterranean plate and although there have been minor earthquakes in other portions of the province, none have had a direct impact on Edmonton. Somewhat like standing on a large piece of concrete near a roadway where heavy trucks are travelling, vibrations are felt but the vibrations do no damage. In February 2001, an earthquake in Seattle was recorded at the University of Alberta and may have caused, for example, chandeliers in large churches to sway.

A large-scale earthquake may be possible on the eastern side of the Rocky Mountains that could, in turn, damage dams along the North Saskatchewan River. In the event of a dam failure upstream there is sufficient time and distance for Edmonton to prepare.

In the event of a catastrophic earthquake in the lower mainland of British Columbia, The cities of Edmonton and Calgary have been designated as geographic supply depots to assist in the response and recovery efforts.

## STRUCTURAL

### **Structural Collapse**<sup>28</sup>

Structural collapse is an uncommon occurrence in Edmonton. It is most likely to occur during construction, demolition or renovations. During these times all of the normal structural components may not be in place, which makes the structure vulnerable to wind pressures or snow and rain loads. Occasionally there have been problems where the bracing for wet concrete has not been sufficient to hold the product in place until it develops its own strength and thus collapses.

Structural collapse is also possible due to design flaws or poor construction practices but neither of these seem to be a significant problem in Alberta. Collapses have occurred due to snow or water buildup on roofs but they are very infrequent, as the building codes are strict in this area.

Structural collapse is also possible due to aging, poor maintenance, or weathering of structures. The most common concern in this area is likely rusting of steel beams and connections. Pieces of buildings fall off when steel connectors have deteriorated due to rust. A large concrete railing fell off a building in the West-end in the last few years. Rusting is a major problem with concrete structures that rely on steel reinforcing bars, and pre- or post-tensioned cables to supply structural strength. Years of freeze/thaw cycles create cracks in the concrete that allow water to contact the steel beams or connectors. There have been many rehabilitation projects completed on bridges and parking structures for this reason.

### **TERRORISM**<sup>27</sup>

Terrorism has been described as "*the calculated use of violence or the threat of violence to inculcate (to fix a person's mind by teach over and over again) fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religious or ideological (US Army).*"

#### **Hostile Acts**

There have been no known terrorists acts within the City of Edmonton or even within Canada. With the September 11, 2001, deliberate air plane crashes in the United States in New York City, Washington D.C., and Pennsylvania, "terrorism" is a new emerging hazard that is being closely monitored by government officials at all levels.  
(See also Dangerous Goods - *Biological Hazards.*)

## UTILITY DISRUPTION

### **Communication Failure**<sup>29</sup>

A communication failure is the widespread breakdown or disruption of normal communication capabilities. This includes telephone outages, loss of local government radio facilities, or long term interruption of electronic broadcast services.

Edmonton is served by many sophisticated methods of communication that have contingency plans, back-up systems, and recovery procedures in place.

#### *Telephone Systems*

In the event of a power failure, telephone systems in Edmonton are powered by back-up battery systems and are capable of being operational for up to eight hours before needing recharging.

In the event of long term power disruption, TELUS has specialized vehicles with power generation capabilities to recharge batteries in each exchange to restore service. TELUS has extensive recovery plans, specialized equipment, an emergency operation centre, and rapid response teams in place. Recovery time for restoration of telephone systems would depend on the magnitude of the incident. During events like the tornado in 1987, telephone systems were temporarily unable to handle phone calls due to volume.

In the newer areas of the city, telephone lines are buried underground, thus reducing the potential threat.

#### *Private Broadcasters*

In the event of disaster, private broadcasters are very important outlets for public information. Most people will rely on radios tuning in one of 15 radio stations in the city. The five television stations become an important factor for news distribution once power has been restored. The cable television provider (Shaw Cable) is also a key to assure that local news and updates are carried to those relying on cable connections rather than television aeriels.

Most broadcasters have back-up power generation capability at their transmission sites and studios. In the event of a lightning strike at a transmission site, back-up transmitters can be utilized to restore at least a portion of the service.

#### *Emergency Services Communications*

Communication systems within the 911, Police, Fire, and Ambulance systems are backed-up by emergency power generators. If a dispatch centre becomes inoperable, there are contingency plans and systems in place for transfer to alternate back-up sites.

Telecommunication companies and civic emergency broadcast systems have backup power sources and transmitters that would enable distribution of information.

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The City of Edmonton has back-up power for all emergency dispatch systems and alternate sites available in the event of a power failure and the need for evacuation of dispatch centres. It is unlikely there would be long term communication failures that would affect more than 10% of the population for an extended period of time.

**Heat/Natural Gas Disruption**<sup>30</sup>

The majority of homes in the Edmonton area are heated by natural gas. A small number of homes (mostly mobile homes) utilize propane for heating. There have been a number of natural gas supply interruptions in Edmonton over the years and are primarily caused by third party hits or damage to distribution lines. A random sampling of the types of incidents is listed below:

July 13, 1977	Gas line at 143 Street and 51 Avenue cut by bulldozer. Fifteen homes evacuated as a precaution.
June 14, 1985	West Edmonton Mall evacuated after a front-end loader ruptured a 4-inch gas line.
February 19, 1980	Intermediate 8-inch gas line on 97 Street and 39 Avenue ruptured by sub-contractors.
July 26, 1985	At 10:45 a.m. heavy equipment hit a 6-inch natural gas line near 178 Street and 90 Avenue evacuating six square blocks. At 12:45 p.m. a soil cement mixer hit the same gas line four metres from the first hit.
Spring 1997	Area evacuated after a backhoe hit a 4-inch gas line at 100 Street and 102 Avenue.

There has not been any widespread disruption to the natural gas or home heating supply. Depending upon severity of the circumstances, natural gas could conceivably be restored in 24 to 96 hours. The full repair to virtually original state could take several weeks or months.

The following are statistics that ATCO Gas has kept for the number of hit lines in the Edmonton region. Year 2000:

North Side (including St. Albert)	86 services	56 mains
South Side	<u>50</u> services	<u>25</u> mains
Total	136 services	81 mains
Grand Total for 2000	217	

**Power Failure/Shortage**<sup>31</sup>

Power failure/shortage is defined as long term or widespread loss or reduction of electric power, or a shortage of petroleum products, which could have an adverse effect on the preservation of life and property. Previous incidents include:

March 12, 1979	A 12-hour major power outage in the city's core sent thousands of downtown workers home.
July 4, 1980	Lightning knocked out 10 transformers resulting in some areas being without power for two hours.
July 23, 1980	Storm left parts of the city without power.
December 3, 1985	Millwoods Recreation Centre evacuated during a power outage that affected a 234 square block area.

EPCOR Distribution, the main supplier of power in Edmonton, has 205 circuits covering approximately 30 square blocks with 1,500 metered customers per circuit. There is a yearly average of 360 outages affecting a 20 square block or larger, calculated on 60% of total outages area. The average restoration time per circuit is 90 minutes with a worst case scenario being a total blackout of the entire province. The Power Pool of Alberta runs a "black start" exercise every year in which all companies participate. A realistic restoration time would be 12-14 hours for total restoration. A history of power outages by cause is shown on the following page:

Year	Extreme Winds	Ice Storms/Wet Heavy Snowfall	Storms	Lightning Strikes
1986	2	0	1	5
1987	95	19	0	4
1988	4	3	0	49
1989	24	39	0	54
1990	0	1	1	77
1991	0	0	n/a	n/a
1992	0	7	0	5
1993	3	6	6	38
1994	0	2	0	36
1995	0	0	1	15
1996	4	60	1	58
1997	0	51	6	35
1998	7	0	3	116
1999	44	0	3	12
2000	0	0	2	21

### **Water Contamination**<sup>31</sup>

Edmonton's two water treatment plants produced 120.8 billion litres of water in 1998. EPCOR Water Services supplies water to Edmonton and 40 surrounding communities with a total population of 850,000. The total capacity is 520 million litres per day. Currently, 10% of the capacity is surplus – enough to serve an additional 100,000 customers.

EPCOR Water Services does 120,000 tests per year using sophisticated lab equipment to ensure that its drinking water lives up to its credo "*better than it has to be.*" The tests are done with 149 physical, chemical, and microbiological parameters. Edmonton consistently tests well within safety limits.

In 1982, Edmonton's water supply was shown to have a higher than normal level of giardia, more commonly known as "beaver fever." There was little monitoring of the water being done at that time and because the majority of the incidents occurred in Rosedale, it was inferred that the water quality may be suspect. At that time a weak disinfectant, chloramine, was being used. There was little detention time for the chloramine to work before the water left the plant.

Since 1995, EPCOR Water Services (formerly Aqualta) was mandated to have a log removal greater than 3.0 (99.9% of the particles in the water removed), which means at least 99.9% giardia kill. Turbidity (removal of suspended particles in the water) must be greater than 1.0 nephelometric turbidity units and the turbidity trend over the last 10-15 years has been steadily decreasing. Particle count limits have also been added bringing turbidity monitoring to a finer degree.

A few hours of free chlorine contact is used in the plants followed by chloramine in the reservoirs and distribution system. An experimental high intensity ultraviolet light system is being put in place to provide one more level of protection against another water-borne parasite called cryptosporidium which, like giardia, causes flu-like symptoms. It was originally thought that ultraviolet was not very effective for cryptosporidium and giardia but research has since discovered that ultraviolet light, while not killing cryptosporidium and giardia, disrupts their DNA to make them non-infective and harmless. EPCOR Water Service's chlorinating system kills 99.99% of giardia but is less effective against cryptosporidium.

The treatment plants rely on clarification and filtration to remove 99.7% (2.5 log) of the "bugs." The chlorine and chloramine disinfection adds another 1–1.5 log and the new ultraviolet treatment will create yet another barrier.

With modern safeguards, monitoring, and higher levels of regulation, there is a decreasing risk of Edmonton's water supply becoming contaminated.

### **Water Supply Shortage**<sup>31</sup>

The North Saskatchewan River supplies the City of Edmonton and surrounding area with a steady supply of water. Water levels throughout the year follow a natural ebb and flow; as the snow pack melts high in the mountains and with spring and early summer rains, the river reaches its usual high peak.

On February 12, 2001, Alberta Environment forecasted that spring runoff would be "much below normal" across most of the province after 17 of 23 mountain snow measurements in

the last week of January set new "historic minimum values." In the Edmonton area, 2.2 millimetres of snow fell with the average being 23.3 millimetres.

Providing that reservoirs are full or close to full, and that demand is not higher than normal, Edmonton can last about two days without the treatment plants being operational. With demand management measures in place, at least another day could be added.

Low water levels in the river affect the suction lift of the low lift pumps that pump river water into clarifiers. Once the water is in the clarifier, the rest of the process flows by gravity. With suction reduced, the pump's output capacity decreases slightly. Rosedale's maximum capacity is about 270 million litres per day. There are pumps installed with a low lift capacity in excess of 350 million litres per day so low water levels do not have a major effect on the water treatment plants.

In the event that water service is disrupted to residential and commercial areas for an extended period, the city has methods and systems in place to supply water to its customers. The most predominant provision for water service would be through a system of hoses connected to individual services in the affected area.

## **SUMMARY - SECONDARY EVENTS**

Only the prime hazards were listed, but secondary hazards or events can occur as a result of, or in concurrence with a major event. A high windstorm or tornado is a major hazard. Secondary events such as downed power lines, surface flooding, traffic tie-ups, and multiple casualties can occur.

Secondary events can cause as much disruption and destruction as a major event. Sometimes the effects are immediate; while at other times, the problems may not show up until much later. The deterioration of bridge footings during a flood or the weakening of tree limbs from heavy snow may not be immediately apparent.

The City of Edmonton, through Plan Edmonton and the Municipal Emergency Plan, endeavors to protect people, property and the environment. All the hazards addressed in this analysis are long recognized or are of a recent emerging nature. Changes in conditions in the City of Edmonton that significantly affect vulnerability will continue to be monitored.

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- <sup>31</sup>EPCOR, EPCOR Water Services - May 2001