

## Risk Analysis

Hazard	Risk Factors
<p><b>Air Crashes</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> A study completed by the International Civil Aviation Organization in 1981, found that the larger the aircraft, the less likely it is to crash so places in the flight path of large aircraft are less likely to be impacted by a crash.</li> <li><input type="checkbox"/> Since most air accidents occur on or near airports, at either landing or take-off, airports and areas with large numbers of flights are clearly more at risk.</li> <li><input type="checkbox"/> Areas near flight paths which are near mountains are more at risk.</li> <li><input type="checkbox"/> Areas near flight paths which are near areas of poor weather visibility are more at risk.</li> <li><input type="checkbox"/> Areas near air craft training stations.</li> <li><input type="checkbox"/> Areas near military missile and artillery training areas.</li> <li><input type="checkbox"/> Areas near air shows.</li> </ul>

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<p><b>Blizzards</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Arctic and inland prairie regions in Canada are most at risk.</li> <li><input type="checkbox"/> Major transportation corridors across flat windy areas.</li> <li><input type="checkbox"/> Altitude: temperature decreases 6.5 degrees C for every 1000 m. rise in altitude.</li> <li><input type="checkbox"/> Monthly temperatures vary fairly directly with latitude. The further north (in the Northern hemisphere) the colder.</li> <li><input type="checkbox"/> Ratings on climate severity index. The closer the rating to 100 points, the higher the uncomfortableness and hazardous rating (e.g., St. John`s has a rating of 56 versus Victoria with a rating of 13).</li> <li><input type="checkbox"/> Previous blizzards in the area.</li> </ul>

**References**

Phillips, David. (1990). *Climates of Canada*. 59-62. Ottawa, Canada: Canadian Government Publishing Centre, Supply and Services Canada.

Phillips, David. (1993). *The Day Niagara Falls Ran Dry!* 72-77. Canada: Key Porter Books.

Hazard	Risk Factors
<b>Dam Failure</b>	<ul style="list-style-type: none"> <li data-bbox="407 472 1100 500"><input type="checkbox"/> Areas below the floodpath of abandoned and neglected dams.</li> <li data-bbox="407 532 1892 592"><input type="checkbox"/> Areas below the floodpath of a dam which has not received regular inspections which take into account the construction of the dam, the structure of the dam, the overall maintenance of the dam and state of preparedness.</li> <li data-bbox="407 625 1665 652"><input type="checkbox"/> Typically, older dams are not seismically safe, were built of varied materials and with less stringent engineering codes.</li> <li data-bbox="407 685 1885 745"><input type="checkbox"/> All dams, may fail at some point. Clearly many of the older dams, built on and around old mining sites are the most at risk, but engineering errors and human error can lead to dam failure in any dam, including the more recently built ones.</li> <li data-bbox="407 777 1892 837"><input type="checkbox"/> Semi-arid areas where there has been heavy water usage for irrigation and farming, has led to the development of many dams which may be at risk.</li> <li data-bbox="407 870 1297 898"><input type="checkbox"/> Dams in steep mountainous areas may be susceptible to avalanches and landslides.</li> </ul>

Hazard	Risk Factors
<b>Drought</b>	<ul style="list-style-type: none"> <li data-bbox="491 1015 957 1042"><input type="checkbox"/> Inland areas are at more risk of drought.</li> <li data-bbox="491 1075 837 1102"><input type="checkbox"/> Previous droughts in the area.</li> <li data-bbox="491 1135 743 1162"><input type="checkbox"/> Degradation of land.</li> <li data-bbox="491 1195 764 1222"><input type="checkbox"/> Increased water usage.</li> </ul>

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<p><b>Earthquakes</b></p> <p><b>Natural Hazards</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> The most fundamental information for a hazard assessment is the record of past earthquakes in a region. Where earthquake occurred in the past, they will happen again.</li> <li><input type="checkbox"/> The intensity of ground shaking during an earthquake depends on local ground conditions. For example, when all other factors are equal, soft soils shake more than do stiff soils</li> <li><input type="checkbox"/> Areas of alluvial soil, modern day muds, fill, river channel sediments and beach sand: Ground shaking is strongly increased, and is most prone to ground failure and liquefaction.</li> <li><input type="checkbox"/> Areas nearest to fault segments that are likely to move. However, in some cases it is difficult to determine how recently a fault moved and it is not unusual to recognize that a fault exists until after a strong earthquake.</li> <li><input type="checkbox"/> Unconsolidated Sediments: where moderate or poorly consolidated youthful marine and river deposits exist shaking is increased, especially if sediments are thick and water saturated.</li> <li><input type="checkbox"/> Unstable Bedrock: Ground shaking may be slightly increased and there is susceptibility to landsliding, especially if on steep slopes or water saturated</li> <li><input type="checkbox"/> Susceptible areas include those adjacent to places prone to land slides, mudslides, avalanches and rock falls. Unstable areas generally on steep slopes which have failed in the past and may fall again during strong ground shaking.</li> </ul>

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<p><b>Earthquakes</b></p> <p><b>Person Induced</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Previous earthquakes have occurred in the past.</li> <li><input type="checkbox"/> Areas near major projects which are involved in filling large water impoundments.</li> <li><input type="checkbox"/> Areas in the same geological area as where projects involving deep well injections are being undertaken.</li> <li><input type="checkbox"/> Areas in the vicinity of underground explosions of nuclear devices.</li> </ul>

Hazard	Risk Factors
<b>Geo-Magnetic Storms</b>	<input type="checkbox"/> In the north these are more frequent around the northern auroral oval which encircles the north magnetic pole.

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<b>Hailstorms</b>	<input type="checkbox"/> Continental interior of North America. <input type="checkbox"/> May to July is the when the maximum size hailstorms occur in Canada. <input type="checkbox"/> Previously known hailstorms.

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<b>Hazardous Material Accidents - In Situ</b>	<input type="checkbox"/> Many industrial sites contain large amounts of toxic hazardous materials. Areas close to sites where dangerous substances are being handled in a quantity that could cause a serious accident.  <input type="checkbox"/> Generally speaking chemicals stored under pressure (greater than ambient pressure) pose a greater threat to employees, the community, and the environment than those not under pressure  <input type="checkbox"/> Although disagreement prevails concerning what constitutes a safe distance from a chemical plant, a distance of 2,000 feet has been considered as fatality free from flying fragments in 99% of plant explosions. The same source indicates that a distance of 4,900 feet or over is 100% safe, although the implementation of such a standard would probably not be economically feasible  <input type="checkbox"/> Areas near sites where hazardous materials have been stored for long periods of time.  <input type="checkbox"/> Areas in proximity to deteriorating hazardous material storage containers or buildings.  <input type="checkbox"/> Areas in proximity to large-scale chemical plants; especially if the area has large fluctuations in temperature and weather conditions.  <input type="checkbox"/> In the recent past, a material of increasing concern has been polychlorinated biphenyls (PCBs). Areas around PCB storage sites are at risk.  <input type="checkbox"/> Previous hazardous materials spills have occurred in the area.  <input type="checkbox"/> Areas in proximity of fixed sources of hazardous wastes and waste disposal sites.  <input type="checkbox"/> Areas near forest mills which have large quantities of anti-sapstains, a group of chemicals similar in chemical composition to PCBs which are applied to wood to prevent staining of timber in storage or transport.

	<ul style="list-style-type: none"> <li><input type="checkbox"/> Areas in the proximity of active pulp and paper mills which contain a number of serious pollutants which may contaminate the ocean and the air.</li> <li><input type="checkbox"/> Once valuable ores are extracted from the earth during mining processes, the remaining ore is discarded as waste rock or tailings. Areas near these sites can be at risk.</li> <li><input type="checkbox"/> Increased patients care produces a growing amount of biomedical or infectious wastes. For a number of years, these wastes were dumped in municipal landfills. Wastes are often stockpiled for several days between collections, a concentration of wastes which presents a threat to regional health, in the case of earthquake, flood, or other disaster.</li> <li><input type="checkbox"/> Areas in proximity to local municipal or regional garbage dumps.</li> <li><input type="checkbox"/> Areas in proximity to nuclear power plants.</li> <li><input type="checkbox"/> Areas in proximity to run-down areas susceptible to large urban fires..</li> <li><input type="checkbox"/> Lack of inspection of sites and willingness to enforce regulations for the storage of and training in the use of hazardous materials.</li> <li><input type="checkbox"/> Storage of radioactive and toxic materials (e.g. plutonium).</li> </ul>
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**References**

United Nations Environment Programme Industry and Environment Program Activity Centre. (1991). *Hazard Identification and Evaluation in a Local Community*. Technical Report No. 2. France: United Nations.

<b>Hazard</b>	<b>Risk Factors</b>
<b>Heat Waves</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Previous heat waves.</li> <li><input type="checkbox"/> Below 60°N Latitude and above 40°S Latitude.</li> </ul> <p>No known models or risk factors which have demonstrated any usefulness in the prospective prediction of heat waves.</p>

**References**

Kilbourne, Edwin M.. (1989) “Heat Waves.” In *The Public Health Consequences of Disasters 1989*. 51-62. Michael B. Gregg MD (ed). USA: US Department of Health and Human Services.

<b>Hazard</b>	<b>Risk Factors</b>
<b>Human Diseases - Human Transmitted</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> All urban areas with relatively high population densities are at greater risk.</li> <li><input type="checkbox"/> Decreased numbers of public health inspections and inability to adequately inspect and enforce public health safety regulations.</li>   <li><input type="checkbox"/> Deteriorating sewage systems.</li>   <li><input type="checkbox"/> Decreased use of vaccinations.</li>   <li><input type="checkbox"/> Increases in new diseases or strains of diseases which are resistant to medication.</li>   <li><input type="checkbox"/> Many of those affected by communicable diseases are children, who in turn can infect parents or other adults. Therefore, those areas with high numbers of school age children are also more at risk of spreading infectious.</li>   <li><input type="checkbox"/> Many infections are beginning to be spread through economically disadvantaged groups and cultural minorities.</li> </ul>

**References**

Blake, Paul A.. (1989) “Communicable Disease Control” In *The Public Health Consequences of Disasters 1989*. 7-11. Michael B. Gregg MD (ed). USA: US Department of Health and Human Services.

<b>Hazard</b>	<b>Risk Factors</b>
<b>Ice Fogs and Ice Storms</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> In the Northern hemisphere, the riskiest months for freezing precipitation are November and December in the west, November through February in the central regions and December to March in the east.</li> <li><input type="checkbox"/> Previous ice fogs and ice storms.</li> <li><input type="checkbox"/> High northern latitudes and coastal areas.</li> <li><input type="checkbox"/> In many urban and rural places in the province, wood burning emits high levels of particulate pollution and moisture to the atmosphere which increases the likelihood of ice fogs.</li> </ul>

Hazard	Risk Factors
<b>Landslides</b>	<ul style="list-style-type: none"> <li data-bbox="489 269 1829 329"><input type="checkbox"/> The most important risk factor is the presence of previous landslides as landslides are rarely occurring events and standard statistical methods do not apply to their prediction.</li> <li data-bbox="489 362 1839 422"><input type="checkbox"/> Fine-grained soils that lie on slopes and that are rich in swelling clays are particularly susceptible to creeping and slumping. Quick clays can flow quickly and with devastating consequences.</li> <li data-bbox="489 454 1524 483"><input type="checkbox"/> Road construction, logging, reservoir creation, irrigation and urban development along slopes.</li> <li data-bbox="489 516 1415 545"><input type="checkbox"/> Known faults, folds and layering of soils which affect the stability of soil and rocks.</li> <li data-bbox="489 578 1352 607"><input type="checkbox"/> Areas of deforestation and poor drainage increase the likelihood of landslides.</li> </ul>

Hazard	Risk Factors
<b>Rail Accidents</b>	<ul style="list-style-type: none"> <li data-bbox="489 794 1839 854"><input type="checkbox"/> The most fundamental information for a hazard assessment is the record of past earthquakes in a region. Where earthquake occurred in the past, they will happen again.</li> <li data-bbox="489 854 993 883"><input type="checkbox"/> Certainly any traffic crossings add to the risk.</li> <li data-bbox="489 883 1787 943"><input type="checkbox"/> Rail lines through avalanche areas are always at risk, and the potential for derailment would seem to be higher in the steep mountainous areas of the province.</li> <li data-bbox="489 943 688 972"><input type="checkbox"/> Shunting yards.</li> <li data-bbox="489 1005 1528 1034"><input type="checkbox"/> Lack of adequate inspections, enforcement of regulations and proper training for railroad staff.</li> <li data-bbox="489 1066 974 1096"><input type="checkbox"/> Areas of high rail volume are more at risk.</li> <li data-bbox="489 1128 1892 1188"><input type="checkbox"/> Rail lines which cross earthquake fault lines, are located on liquefiable soil or are otherwise at risk from earthquakes or volcanic activity.</li> </ul>

<b>Hazard</b>	<b>Risk Factors</b>
<b>Riots</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Areas most at risk would seem to be the large urban centres.</li> <li><input type="checkbox"/> Smaller municipalities which hold festivals which attract large numbers of outsiders to the community.</li> <li><input type="checkbox"/> Communities where riots have previously occurred and which attract outsiders “looking for trouble.”</li> <li><input type="checkbox"/> Of additional concern would seem to be heavy-metal and other types of concerts which attract certain young people.</li> <li><input type="checkbox"/> Major events which allow consumption of alcohol or where adequate enforcement of drinking is not maintained.</li> <li><input type="checkbox"/> Large sports stadiums or areas where sport celebrations are being held (e.g. parade routes).</li> </ul>

<b>Hazard</b>	<b>Risk Factors</b>
<b>Snow Storms</b>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Previous major snowstorms in the area.</li> <li><input type="checkbox"/> Generally the higher latitudes have less snow.</li> <li><input type="checkbox"/> Inland areas have less snow than coastal areas.</li> <li><input type="checkbox"/> The higher the elevation the higher the snowfalls.</li> </ul>

Hazard	Risk Factors
<p><b>Urban Wildfire Interface</b></p>	<ul style="list-style-type: none"> <li><input type="checkbox"/> Areas undergoing rapid urban growth, where pockets of suburban development infringe on wildlands, or undeveloped areas, are potentially high risk areas of wildland-urban interface fires.</li> <li><input type="checkbox"/> Fine Fuel Moisture - when the moisture content of forest litter and other fine fuels drops to a low level.</li> <li><input type="checkbox"/> Duff Moisture - when the moisture content of organic surface soils is at a low level.</li> <li><input type="checkbox"/> Drought - when the moisture content of deep organic soils is low (an indication of long term weather conditions).</li> <li><input type="checkbox"/> Initial Spread - fire fuel availability and the potential for high winds.</li> <li><input type="checkbox"/> Buildup - when there is a sufficient amount of fuel available for combustion.</li> <li><input type="checkbox"/> Fire Weather - weather conditions likely to precipitate a major fire.</li> <li><input type="checkbox"/> Certain fuel or forest types such as dry conifer and grasses are more combustible than deciduous forests.</li> <li><input type="checkbox"/> Lack of the existence or enforcement of bylaws regulating the building of homes and businesses in wildland areas. Some of these regulations would include restricting roofing materials such as shakes; allowing vegetation to physically touch the building, stockpiling of wood against the building, etc..</li> <li><input type="checkbox"/> Lack of fire fighting capacity in areas or urban and wildland interface (e.g. lack of fire hydrants, roads inaccessible by fire trucks, etc.).</li> </ul>