

## 9.3 Snow and Ice

- Seattle’s weather is regulated by the Pacific Ocean, which remains relatively even in temperature throughout the year. Occasionally, cold air from the interior of the continent pushes into the Puget Sound region and causes dramatic cold spells, ice, and snow.
- While Seattle does not receive as much snow on average as many parts of the country, snowfall is not uncommon and can be heavy.
- Accurate weather records began only about 100 years ago, but based on historical accounts, Seattle’s winters seem to have been colder and snowier in the 19<sup>th</sup> and early 20<sup>th</sup> centuries.
- Meteorologists have made great strides in forecasting snow and ice storms. Roughly 80% of snow storms in the Puget Sound lowlands occur when cold air from the interior of the continent pushes through the Frasier Gap near Bellingham and meets a low-pressure system coming off the ocean. If the cold front lingers, snow and ice can be on the ground for weeks.<sup>538</sup>
- Snow and ice impede transportation and because most social and economic activity is dependent on transportation, snow and ice have serious impacts, especially if it remains on roadways for many days.
- Other significant impacts from snow are:
  - Public safety impacts resulting from the inability to get emergency vehicles where they need to go.
  - Utility outages as power demand peaks and pipes freeze. Power losses during extreme cold have resulted in deaths from carbon monoxide poisoning when victims attempted to keep warm by lighting charcoal fires indoors.
  - Economic losses due to business closures and lost wages by workers unable to get to work or required to stay home with children when schools and childcare facilities close.
- Seattle does not have dedicated snow plows. Trucks have to be outfitted with snow removal equipment when snow threatens. There are not enough of these trucks to plow every street in the city.
- Due to Seattle’s steep topography, some streets are too steep to keep open during snow and ice events.
- During snow and extreme cold, Public Health – Seattle & King County issues public warnings about the dangers of carbon monoxide poisoning. A regional “Take Winter by Storm” campaign also helps educate on winter preparedness and safety.
- Occasionally, rapidly melting snow can contribute to saturating the ground and becomes a factor in triggering landslides. The last time this happened was in the winter of 1996/97.
- Snow load has collapsed roofs, most recently in 1996/97.

### 9.3.1 Context

Seattle’s winter weather is shaped by the Cascade and Olympic mountains, and the Pacific Ocean. Our region’s maritime climate usually keeps Seattle warm in the winter. The prevailing westerly winds that blow in from the Pacific keep cold arctic air from reaching the Puget Lowlands most of the time. Occasionally, an arctic front develops in which cold air from the Yukon moves south into British Columbia and through a gap in the Cascade Mountains, northeast of Bellingham. If this push of cold air is

met by moist warm air from the Pacific, snow is often the result. Usually, the snow starts near Bellingham and moves south. Such fronts account for roughly 80% of Puget Sound snow.<sup>539</sup>

Seattle sits within the Puget Sound Convergence Zone, an area of colliding wind currents that can cause lower temperatures and higher precipitation, typically between Everett and North Seattle. The convergence zone can mean that in the winter, Seattle can experience snowfall while areas a few miles north and south of the zone do not, or, that Seattle experiences variability in snowfall between its own neighborhoods.<sup>540</sup> Seattle's steep topography can also create localized events. It is not uncommon for snow to fall at high elevation areas, such as Capitol Hill or Queen Anne Hill, while areas closer to sea level remain snow-free.<sup>541</sup>

Because Seattle does not see routine snow events, the City lacks the snow clearing capacity that cities in the upper Midwest and Northeast have. During major snow storms the transportation system shuts down, sometimes trapping people at home or work. The Seattle Department of Transportation (SDOT) removes snow from arterial streets within 12 hours of a lull in a snow storm.<sup>542</sup> Residents and business owners are responsible for plowing their own property and adjacent sidewalks. Vehicle accidents rise among those who attempt to drive. In 2015, snowy or icy roads contributed to 3% of traffic collisions in Washington State.<sup>543</sup> Access to emergency services can be impaired. During exceptional storms, structures can be damaged. This happened in the 1996/97 storm when a number of roofs collapsed. Energy use skyrockets, placing a demand on power generation and distribution systems. Elsewhere in the nation, energy demand spikes have reached crisis levels. During the 1993/94 winter, some parts of Pennsylvania had to ration power. In some cases, those with low or fixed incomes cannot afford the extra expense and must suffer through the cold.<sup>544</sup>

SDOT monitors winter weather conditions. They use a forecasting tool called SNOWWATCH, to predict the consequences of storms at the neighborhood-level. When possible, SDOT will treat major roads and bridges with salt brine before a storm to prevent ice formation. Once 1 inch of snow has accumulated, SDOT begins plowing roads, prioritizing those that are critical for major institutions and emergency services, and those leading to Seattle's major employers.<sup>545</sup>

While it's difficult to link snow events directly to economic activity, some evidence suggests that widespread, lingering snow can negatively impact the overall economy. Economists believe that severe snowstorms across the United States from 2013-2014 contributed to the economy declining 2.1% in the first quarter of 2014, mainly due to interruptions in supply chains.<sup>546</sup> Another account claims that Massachusetts alone lost around \$1 billion in wages and profits due to snow during the 2014-2015 winter season.<sup>547</sup>

One study that analyzed vehicle accidents caused by winter weather (snow, ice, or sleet) between 1975 and 2011 reported that an average of nearly 900 fatalities occur nationally each year.<sup>548</sup> Additionally, researchers have found that indirect effects of storms have resulted in fatalities, from traffic accidents, sledding accidents, exposure to cold, falls, and carbon monoxide poisoning.

Research by the National Weather Service has found that:

- Ice is deadlier than snow;
- About 70% of deaths occur in automobiles;
- About 25% of deaths are people caught outside;
- 50% of hypothermia cases are over 60 years old, 75% are male and 20% occur at home.

The cold that often lingers after a snow storm can produce its own dangers, especially when accompanied by power outages. The primary danger in this situation is hypothermia. Those most

vulnerable populations are people experiencing homelessness, those without heat, the elderly, and the socially isolated.

### 9.3.2 History

Seattle's unofficial record for the most snow in one winter is 64 inches in 1880. The single-day record is 21.5 inches in 1916.<sup>549</sup> Other historical records that extend back beyond modern record keeping indicate that Seattle was colder and snowier in the past.

Data from the National Climatic Data Center for the Sandpoint weather station shows that from 1990 to 2018 there have been 45 days of measured snowfall. This includes 19 days of snow accumulation of less than 1 inch and 26 days between 1 to 8 inches. These events occurred as early as November and as late as March. **Error! Reference source not found.** in the Community Profile indicates the snowfall from October through March between 1948 and 2009.

**December 1861.** Very cold, with an unofficial record temperature of -4 degrees Fahrenheit. Newspapers mentioned ice-skating on Lake Union covered in six inches of ice.

**Winter 1880.** Estimated the snowiest winter in Seattle. 64 inches of snow fell during the season. Snow drifted three to five feet at the waterfront, possibly indicating even bigger drifts at higher elevations. Most significantly, roofs collapsed throughout the city.

**January 1893.** 45.5 inches fell in less than two weeks.

**February 1, 1916.** Single-day snow record set at 21.5 inches. The roof of the St. James Cathedral collapsed. Snow drifts were up to five feet.

**January 1920.** A sledding accident on Queen Anne killed four children and injured five more.

**February 1923.** 16 inches of snow.

**January 1943.** Total of 18.4 inches of snow in one week closed schools and caused power outages.

**January 13, 1950.** Near record one-day snowfall of 21.4 inches at SeaTac accompanied by 25-40 mile per hour winds. 57.2 inches fell the entire month at SeaTac. This storm claimed 13 lives in the Puget Sound area. The winter of 1949-50 was the coldest since official records began.

**Winter 1956.** 23 days of measurable snowfall.

**December 1964.** Eight inches of snow.

**December 1968** Ten inches of snow fell on New Year's Eve.

**January 1969.** 19 inches of snow accumulated at SeaTac on the 28th. Nearly 46 inches fell during the month.

**January 1972.** Intense cold. Nine inches of snow fell at SeaTac. Schools closed. This storm was connected to landslides later that year.

**December 1974.** Nearly ten inches of snow fell as the power went out in many parts of the city.

**November 1985.** Eight inches of snow fell on Thanksgiving Day.

**December 1991.** Snow closed SeaTac and brought traffic to a halt.

**December 1996** Near-record snow fell the day after Christmas. Metro halted service completely for the first time in its history. Freeze and snowmelt contributed to flooding and landslides during the following week.

**December 2008.** Seattle experienced a rare, extended period of lingering snow with some areas of the city receiving 3-6 inches. The temperature dropped to a record-tying 14 degrees Fahrenheit. Metro had

fewer than half of their usual bus routes running, and Amtrak trains stopped running altogether. Seattle officials did not salt city streets, making driving difficult. At SeaTac, passengers were stranded for several days due to flight cancelations.<sup>550</sup>

**November 2010.** Seattle received 1-2 inches of snow, causing dangerous road conditions. A cargo plane skidded off the runway at SeaTac airport, causing flights delays. Three fatalities were attributed to accidents caused by the icy road conditions. High winds caused power outages as temperatures dropped into the 20s.<sup>551</sup>

**January 2012.** 3-9 inches of snow fell throughout the area with subsequent freezing rain. Metro reduced service by 30%. 6,500 Seattle City Light customers experienced power outages.

**February 2017.** SeaTac airport records 7.1 inches of snow, almost twice the average yearly amount.<sup>552</sup> Power outages occurred, affecting 110,000 Puget Sound Energy customers and 11,000 Seattle City Light customers.

### 9.3.3 Likelihood of Future Occurrences

Climate change may be decreasing the frequency of snow events. The University of Washington Climate Impacts Group projects that greater Puget Sound area will see less winter precipitation falling as snow by the 2040s. This change will be most significant in mid-elevation basins that typically receive a mix of snow and rain in the winter. Mountain snowpack is projected to decline 42-55% by 2070, as more precipitation falls as rain rather than snow.<sup>553</sup> A climate change study on snowpack in the Puget Sound lowlands has not yet been conducted.

Other global weather patterns will continue to overlay climate change. These include the El Niño Southern Oscillation (ENSO) that alternately brings El Niño and La Niña to the Pacific Northwest. El Niño is characterized by warmer, somewhat dryer winters; La Niña is characterized by wetter, cooler, and snowier winters. The Pacific Decadal Oscillation (PDO) can also bring climate variability. The PDO is a 20 to 30-year cycle of cooling or warming in the sea-surface temperatures and winds over the Pacific Ocean. It appears the PDO has been in a warming phase since the mid-1970s.<sup>554</sup>

### 9.3.4 Vulnerability

Seattle's geology and climate increase the city's vulnerability to snowstorms. First, the hilly topography makes many areas of the city impassable even after a light snowfall. Queen Anne Hill, Beacon Hill, parts of West Seattle, and areas facing Lake Washington and Puget Sound seem especially prone to isolation during storms because of the many steeply graded streets that serve them. Second, the relative infrequency of heavy snowstorms makes it challenging to plan a response and discourages the use of City funds for dedicated equipment.

Those experiencing homelessness are the most vulnerable to winter weather and are a growing population in Seattle. Although attempts are made to find extra space for them in shelters during winter, many remain on the streets in harsh conditions. Seattle's unsheltered population has grown by around 90% since 2009. The city's low-income and aging residents typically bear the most consequences of winter storms. People without back-up sources of heat suffer from the cold during outages. In 2006, several incidents of carbon monoxide poisoning occurred when people attempted to burn charcoal indoors to maintain heat.

Anyone needing medical care is vulnerable when the transportation system is impaired. Aging residents are indirectly affected since they require medical care most frequently and snow can make it more difficult for them to receive it. When critical outpatient services cannot be accessed, medical needs may escalate. Patients may deteriorate and require ambulance transport and emergency department care and admission. This places an additional burden on the healthcare system in King County. Children are



another vulnerable population because they play on dangerous, icy streets. Several have been killed in sledding accidents.

Seattle retailers are vulnerable because a major part of the snow season overlaps the holiday shopping season. The loss of sales at this time can be critical. Seasonal, temporary, contract, and other workers who lack paid time off can lose income during snow storms if they cannot get to work or their employer closes due to weather conditions.

### 9 3.5 Consequences

The two biggest direct impacts of snow and ice are cold temperatures and immobility. These drive the main secondary impacts, which get worse the longer the snow and ice remain on the ground. As the 2008 experience demonstrated, snow and ice can linger for weeks in Seattle and the city government, residents, workers and business must be prepared for this situation.

Seattle faces transportation impairments while snow is falling and up to eight hours after it has stopped along most snow routes. Non-designated streets will face longer impairments. The City does not have enough snow removal equipment to plow every street in the city.

Power outages during snow storms and the cold weather that often accompanies them remains a serious threat. Hypothermia and carbon monoxide poisoning will continue to be risks.

A snow storm may slow the local economy. Hourly workers will lose wages, plane flights will be cancelled, and retail stores and restaurants will lose revenue. However, there is a debate about whether these slowdowns cause permanent revenue losses. Productivity and sales may decline temporarily, but often accelerate after a storm. People who cannot make a purchase due to snow will likely still make that purchase later. More permanent effects may occur if Seattle faces a localized snow event (i.e. convergence zone snow). For example, holiday shoppers may go to Bellevue to buy Christmas presents if they cannot get to Seattle stores.

For the local government, responding to a snowstorm will likely be a major unbudgeted expense. Many cities have spent more than their original snow-removal budgets when faced with unexpected or unusually large storms. In 2011, a blizzard that hit New York City cost over \$68 million, \$30 million more than their yearly snow-removal budget.<sup>555</sup> Since snow and ice are common occurrences, it can be very difficult to get an official disaster declaration for snow events and therefore, difficult to receive federal aid.

Climate change may introduce new challenges. The frigid weather places increased demands on the power system as people try to heat their homes. In the past, demand peaks have not reached the point of crisis and there have been no cases of power rationing as in other parts of the country. However, if projections are correct and future snowpack is reduced, Seattle City Light may have to purchase additional power from external sources to meet winter demand.

Secondary hazards of snow storms can be flooding and landslides as the snow melts. In heavy snowstorms, structural damage is likely. During the 1996 snowstorm, over 80 roofs suffered damage. These failures are always a danger since the Seattle area is prone to wet, heavy, and sticky snow.

### 9 3.6 Conclusions

Despite a relatively mild climate, Seattle is a northern city, so it can and does receive heavy snowstorms. This creates a dilemma for the government and the population. Extensive preparations become very costly if the snow fails to materialize; if snow does come and the city has not prepared, significant transportation problems arise.