The Natural Hazards Partnership

Advice provided by:

Met Office

Public Health England

Other partners:

British Geological Survey

Centre for Ecology & Hydrology

Environment Agency

Health & Safety Laboratory

National Centre for Atmospheric Science

National Oceanography Centre

NERC Science of the Environment

Ordnance Survey

SEPA Scottish Environment Protection Agency

UK Space Agency

Working together

Snow and Ice

This Note is one of a series of short guides covering a range of natural hazards. These guides aim to provide non-experts with a brief introduction to each hazard and to highlight key aspects that may need to be taken into account in decision-making during an emergency involving this hazard. They are not intended to be fully comprehensive, detailed analyses or to indicate what will happen on any particular occasion. Instead they will signpost issues that are likely to be important and provide links to sources of more detailed information. Each Note will be updated on an annual basis in line with the review of the National Risk Assessment.

What are snow and ice?

Most precipitation in the UK starts its life high in the atmosphere as ice or snow, but mostly it will melt before reaching the ground. If the atmosphere is colder than normal (or at high altitudes) melting does not occur and the precipitation reaches the ground in its frozen state. There are many forms of frozen precipitation, the main ones being snow and hail of varying size and water content. The ground temperature may be different from that of the air. Thus snow or hail may melt when it reaches the ground, but conversely, rain (or fog) may freeze, depositing black ice or glaze on the ground. Wet snow and freezing rain or fog can also accumulate in cold weather on trees, masts and cables, increasing their weight until they break or collapse. Freezing rain is liquid water falling into a layer of sub-zero air temperature where it freezes instantaneously on contact with surfaces – although rare in the UK it can cause severe black or glazed ice conditions in a very short period of time.

How does snow & ice affect the UK?

Most of the UK experiences periods of cold weather each winter which result in ice and snow being deposited on the ground. These periods are more prevalent in the east and north of the UK and on areas of high ground.

Snow and ice mainly affect transport in the UK. Extensive winter maintenance operations are managed by road operators to ensure that main routes are kept largely free of ice and snow. Ice and snow are also significant issues for rail operators and for airports. Airport delays occur not only because the runways and taxiways must be cleared of snow, but also because aircraft wings must be cleared of any ice for take-off. Large numbers of accidents to pedestrians occur due to slipping on ice and snow affected pavements. Snow and ice are also important causes of loss of power and communications due to accumulation of snow and ice on cables, trees and masts resulting either in cable breakages directly, or in damage from falling trees. In extreme snowfalls, the weight of snow can cause collapse of weak roof structures, though this is rare in the UK.

Unlike snow, severe impacts from hail occur in summer in the UK and are rare. When large enough, hail can cause direct damage to glass and vehicles (and potentially roof slates), however this is very rare in the UK. On the ground, hail

accumulates causing similar problems to deep snow, including blocked roads. However, it normally melts quickly, transferring the impact to flooding.

What are the impacts of snow & ice?

- **Road transport**

  The main effect of snow and ice on roads is to reduce adhesion of the surface, resulting in loss of control and collisions. On hills, loss of traction may result in vehicles being unable to progress uphill. Blockage of the road leads to disruption according to the traffic density. Road operators attempt to maintain adhesion of the surface by application of salt and grit, both prior to and during ice and snow formation. However, heavy snow at temperatures well below $0^{o}C$ requires very frequent treatment which can be impossible to deliver to congested roads.

- **Rail transport**

  Trains are also affected by loss of adhesion, and this is treated at vulnerable locations by application of sand. However, the main impacts of snow and ice on rail transport are freezing of points and loss of electrical connection between electric trains and power supply from catenaries or especially from the third rail.

- **Airports & aircraft**

  The lift surfaces (mainly the wings) of aircraft must be ice free for safe take-off, so any aircraft that has accumulated ice or snow while on the ground must be de-iced before take-off. This is a time-consuming procedure which can result in delays. Large civil aircraft do not generally accumulate much ice during flight and heaters keep the critical areas free. However, other aircraft flying at low levels are vulnerable to icing, and must follow defined procedures to maintain safe flight. The biggest delays at airports are usually caused by snow that impedes progress along taxiways and aprons. Compared with runways, these cover a vast area, and are difficult to maintain in a clear state.

- **Energy supply & Telecommunications**

  Snow and ice accumulate on transmission cables, trees, masts and pylons, especially when the temperature is close to freezing. The additional weight can lead to sagging of cables and collapse of trees and masts. Collapse of pylons is exceptional in the UK, but has occurred in other countries in these conditions. Ice on electricity cables can affect transmission. The most frequent impacts are from falling trees that pull down local transmission cables with them.

- **Water Supply**

  Low temperatures can lead to freezing and bursting of water supply pipes in the ground or in buildings, leading to loss of supply, freezing of the escaped water on surrounding roads or other surfaces, and water damage to buildings and their contents, including potential impacts of electrical short-circuits through the water, including electrical fires.

- **Environmental impact**

  The main effects of snow and ice on the environment are:

  - The polluting potential from treatments used to prevent and remove ice from roads, vehicles and buildings.
  - The polluting potential from accumulations of slurry and milk on farms due to road disruption.
  - Disposal of salt, grit and oil contaminated snow into rivers.
  - Release of polluting materials as a result of freezing pipes etc. at industrial processes.

- **Health & Health services**

  Health impacts of snow and ice may be divided into 2 categories. Cold temperatures usually coexist with snow and ice and have separate and more significant health effects. The effects of cold are covered in a separate advice note.

  - Health: The direct impacts are mainly broken bones and lacerations resulting from falls on ice-covered pavements and roads. The indirect impacts are injuries resulting from accidents incurred from the impact of snow and ice on travel – leading to road traffic accidents, etc. Loss of mains water supplies due to frozen pipes which burst can also be a health risk, particularly for vulnerable individuals (such as those dependant on renal dialysis). Loss of power supplies during and after a snowstorm also impacts on health, including obtaining health care supplies and continuing medical treatment for chronic illness in the community such as dialysis. Injuries/infections sustained while clearing snow after a snowstorm**.**
  - Health services: Impacts on health services include increases in hospital admissions for acute injury and trauma from slips and falls and other ice and snow related incidents and acute presentation of chronic illnesses due to loss of essential services such as power, water and transport. This occurs on the background of increased demand for health services in winter, due to circulating infections such as influenza and the impact of cold temperatures on health.

Who is vulnerable to snow & ice?

High ground is generally more susceptible to snow, but frost hollows in shaded valleys are susceptible to ice. Frequently used transport routes that traverse complex terrain, especially secondary roads, are likely to see patches of ice or snow may make the route vulnerable during periods of colder weather. Icy patches are especially likely when cold weather follows wet weather leading to surface water freezing. Exposed high routes may become snow-covered in high winds due to drifting; even when there is no further snowfall. Remote rural areas are particularly vulnerable to power and communications losses, whereas networks generally have built in redundancy for urban areas. People are vulnerable to trips and falls when pavements are icy, particularly when snow melts and refreezes over

a lengthy period. However, those who have reduced mobility or dexterity may be more at risk if they go out in icy conditions.

How can I assess the severity of the impact of snow or ice?

The Met Office National Severe Weather Warnings Service gives advance notice of snow storms and of freezing temperatures which may produce ice on untreated roads &/or pavements.

The Met Office and other companies provide bespoke services to road maintenance engineers to assist in the maintenance of ice-free roads.

The web sites of the Highways Agency & other highway organisations provide updates on traffic conditions, including disruption caused by ice and snow.

Timeline of a major snow & ice event

The typical major event consists of a snowstorm, followed by a period of daytime thaw and night-time re-freezing, followed by a gradual thaw as follows, with day numbers relative to the arrival of the snowstorm. Note that the extent of the event may vary enormously, from a few days to several weeks and that this timeline does not include the effects on health or health services from the associated cold temperatures

5 days before: First indications of major snowstorm

1 day before: Warning of areas at high risk of disruption

Day 0: Heavy snow fall overwhelming salt, grit and snow ploughs. Vehicles lose traction at vulnerable locations (e.g. slopes, sharp bends, junctions) and collide blocking major roads/motorways and preventing access by ploughs. Minor roads become impassable due to deep snow. The Red Cross is called in to get hot drinks etc to trapped motorists. Injured, and some vulnerable people are evacuated to hospital. There are widespread power and communications outages. Airports and railways are closed in affected area.

Day 1: Snow belt clears leaving light winds and clear skies. Thin areas of snow start to melt in the sun, but refreeze as black ice overnight. Major roads are gradually cleared of vehicles and reopened. Minor roads remain blocked. Pavements are well trodden, and beginning to turn to ice due to pressure and heating from the ground underneath. Hospitals and major community health facilities become more accessible. Power and communications reconnected for main urban areas. Main airports reopen. Main rail routes reopen – but with reduced timetables due to icing of rails and catenaries.

Day 2: Daytime snowmelt from fields and road margins flows on to roads and refreezes at night, causing icy patches except where treated. Minor roads are made passable by clearance or through use by 4x4s or tractors. The remaining snow turns to ice and becomes very slippery at night. Pavements begin to be cleared, but become steadily more slippery where not cleared. Melting and refreezing at the edges of cleared areas creates particularly dangerous conditions. Peak of hospital admissions (e.g. for broken bones etc) during this period. Gradual reconnection of remaining power and communications.

Later (may be as soon as 2 days or as long as a few weeks): Warmer weather starts to spread from the west, preceded by rain. Western coastal areas thaw and are cleared. Freezing rain falls in some places creating black ice on main routes and leading to major accidents and disruption in specific local areas. The rain belt stops and turns to snow east of this, probably not enough to create problems on major routes, but reinforcing the ice problem on minor routes and pavements.

Later (may be as soon as a few days or as long as many weeks): Subsequent slow moving belts of rain continue to move in from the west and get stuck with further episodes of freezing rain and light to moderate snow, causing mainly localised disruption which may be significant if it affects the urban areas. Eventually one of these bands clears across the country introducing warmer air generally that melts the remaining snow and clears the hazard.

Example Historical Events

There have been many examples of snow and ice events in the UK:

- **Late January to early March 1947** - Extensive snow across large parts of the UK. Severe drifting of snow. Major disruption to everyday life.
- **Late December 1962 to early March 1963** – Extensive snow across England and Wales. Severe drifting of snow. Major disruption to everyday life.
- **Late December 1978 to mid-March 1979** – Long periods with snow cover and/or very icy conditions over the UK. Continual problems for transport.
- **Mid-December 1981 to mid-January 1982** - Extensive snow across England and Wales. Drifting snow at times. Major disruption at times.
- **January to February 1985** – Periods of snowy weather, especially across southern UK. Disruption to transport.
- **Late November and December 2010** – Extensive snow eventually across much of the UK. Major disruption to transport.

References

1. Met Office National Severe Weather Warning Service: http://www.metoffice.gov.uk/public/weather/warnings/
2. SEPA at: http://www.sepa.org.uk/about_us/news/other/severe_weather_guidance.aspx
3. Cold Weather Plan at: https://www.gov.uk/government/publications/cold-weather-plan-for-england-2013