



Hazard Facts

- ▶ Landslides are defined as “the movement of a mass of rock, debris, or earth down a slope” (Cruden, 1991).
- ▶ Landslides can be classified into six types: falls, topples, slides (rotational or translational), flows, spreads and slope deformations.
- ▶ A landslide displaying a combination of the above types in termed as ‘Complex’.
- ▶ The damage caused by a landslide is very much dependent on its speed, location and proximity to people and assets.
- ▶ In Scotland, with its steep slopes, glacial deposits and high precipitation levels, debris flow landslides are the most common.

How to reduce the effects of landslides

Be aware of your surroundings:

- ▶ Avoid construction or excavation on steep slopes and existing landslides.
- ▶ Avoid loading, or tipping, on or above steep slopes.
- ▶ Avoid removing trees and bushes from steep slopes - the vegetation may be acting to bind the soil and remove groundwater.
- ▶ Watch the pattern of water drainage in your local area so you are familiar with drainage channels and areas to avoid during a storm .

During periods of heavy or prolonged rainfall:

- ▶ Stay alert if you are travelling in areas known to be prone to landslides or debris flows.
- ▶ Take note of any warning signs, emergency notifications or travel warnings.
- ▶ Move away from potential paths of landslide or debris flow as quickly as possible.

After a landslide:

- ▶ Stay away from the slide area as there may be a potential for further movement.
- ▶ Listen for emergency information.
- ▶ Report any events such as damage to housing, infrastructure or utilities.
- ▶ If the event has occurred on your property seek advice from a geotechnical expert.



A property is partially buried by a mudslide in Pennan, Aberdeenshire, August 2007. Image ©NERC

Landslides in Scotland

Due to its steep mountain slopes and glacially eroded landscapes, a number of locations in Scotland are particularly susceptible to landslides.

The highlands have a geology that is sufficiently prone to debris flow failures, involving weathered (degraded) bedrock material and granular superficial deposits. High velocity failures with a long run-out may occur depending on the material, slope angle and length, and water content.





Landslide debris blocking the A83, Rest and Be Thankful, August 2012. Image © NERC

Landslide Triggers

Landslides are the result of a change of stress within a material. Landslides occur when there is an increase in 'shear stress' (the force referred to when parallel surfaces slide past each other) and/or a decrease in shear strength (the ability of the material to resist the force). Landslides can be triggered by:

- ▶ Intense or prolonged rainfall or snowmelt.
- ▶ Poor drainage or over-steepening of the slope.
- ▶ Structural (lithological) weaknesses of the slope material.
- ▶ Removal of material at the toe of the slope (e.g. coastal erosion or man-made cutting).
- ▶ Loading or addition of water to the slope (e.g. adding weight to the upper slope).
- ▶ Removal of slope stabilising features (e.g. deforestation).
- ▶ A secondary hazard of flooding or earthquakes.

Impact of landslides in Scotland

Although landslides occur with some frequency in the Scottish Highlands, these rarely affect the infrastructure networks directly. However, a small number of failures turn into major events that can impact upon infrastructure and assets. Previous well publicised events have affected buildings (e.g. Aberdeenshire), road networks (e.g. debris flows at A85 Glen Ogle, A83 at Rest and be Thankful), and rail routes (e.g. Loch Treig). These can have an effect on communities, economy (with major diversions) and raise issues around public safety. Landslides can, in some cases, cause secondary hazards. Examples of these can be fire, if utilities such as gas are disrupted or flooding if waterways are blocked.

Notable Landslide Events in Scotland

A83 Rest and Be Thankful

Debris flows occurring along a section of the A83, near the Rest and be Thankful, have resulted in numerous road closures. The recent landslides here have largely been associated with intense rainfall, and unconsolidated (loose) slope deposits. The A83 has been the subject of recent reviews and mitigation surveys. Flashing warning signs (wig-wags) are in place to alert drivers to a higher debris flow during periods of forecasted and heavy rainfall and in December 2015, recently installed mitigation measures proved successful during the high profile Storm Desmond. Debris from several large failures was captured, and held, in engineered netting during the intense storm. www.bgs.ac.uk/landslides/RABTAug2012.html

Stob Coire Sgriodain, Scottish Highlands

On 28th June 2012, a shallow landslide initiated on the western slopes of Stob Coire Sgriodain, Loch Treig, following heavy rainfall. The landslide moved down slope as a debris flow finally losing momentum and depositing debris on the track. A train derailment occurred after a train impacted on a boulder on the track, away from the main toe of debris. www.bgs.ac.uk/landslides/tulloch.html

A85 Glen Ogle, Locheearnhead

On Wednesday 18 August 2004, the A85 in Glen Ogle, north of Locheearnhead, Stirlingshire, was blocked by what was widely reported as two landslides. The landslides followed a period of considerable rainfall. Fifty seven people were reportedly trapped on the roadway and either left the scene on foot or were rescued by helicopter. No injuries were reported. The landslides that caused the disruption on the A85 originated in two streams, one leading to a culvert under the road and a second 435 m further along the road. www.bgs.ac.uk/landslides/GlenOgle.html