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The Determination of Rainfall Conditions Leading to Debris Flow

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The debris flows of August 2004 affected key parts of the Scottish main road network linking both cities and smaller, remote communities.

Following these events a study was commissioned to determine a way forward for dealing with such events in the future. The main purpose of the work was the development of management and mitigation options, as described in a separate paper. These are based upon a rigorous assessment and ranking of the debris flow hazards relating to the road network.

The reduction of the exposure of road users to risks from debris flows is a critical objective and is broadly based upon the logical sequence of Detection, Notification and Action (DNA). In the short term exposure reduction actions are largely anticipated to be responsive to events. These might include the actions such as the closure of a section of road known to be particularly vulnerable to landslides immediately after the (detection and notification of the) first event.

A longer term strategy is to develop a system for the proactive detection of conditions

during which landslides are more likely due to the prevailing rainfall conditions. This involves the monitoring of rainfall to detect conditions likely to lead to debris flow formation and propagation. Thus the detection ceases to be of an event, but of the conditions potentially leading to an event. Thus, detection, notification and action can be brought forward in anticipation of any actual landslide event.

A review has been conducted of international approaches to the back analysis of rainfall events associated with debris flows. It was concluded that while many back analyses have been conducted, only in relatively few cases has the work been reported as being implemented in practical systems for the forecasting of conditions likely to lead to debris flows.

The relation(s) between rainfall and debris flow activity in Scotland have generally been poorly understood, other than at a relatively simple level. Considerable work is thus required to develop suitable rainfall Intensity-Duration relations, for example. A back analysis of rainfall events known to lead to debris flows has been conducted for a wide area of Scotland. Additionally, a trial area on the A83 road has been selected and rainfall gauges installed to enable the analysis of future events. This paper describes the findings of the review of international approaches to understanding the relations between rainfall and landslides and of the back analysis of Scottish events.