

Upland Hydrology Group

Flood risk, water resources and the uplands

Land management in the uplands can have an impact on the amount and timing of runoff, with implications both for water supply and for flood risk management. The uplands are critical in this respect because they supply a large percentage of our drinking water, and often contribute disproportionately to flood events downstream.

This briefing note has been written for the benefit of non-specialist colleagues and decision-makers, including for example members of regional flood and coastal committees.

Runoff from the uplands

The uplands of Britain are characterised by high rainfall and rapid runoff. The widely held view that upland peatlands behave like a sponge - buffering floods and sustaining low flows – does not hold true in most situations.

Land management can influence runoff by:

1. Changing the amount of water which flows off the hills.

Forestry in particular can have a significant impact. Establishing woodland can lead to a significant increase in the rate of evapo-transpiration from a given area.

2. Changing the timing and reducing peak runoff.

This can be achieved by slowing the rate of flow and / or by storing water. Principal measures which can be implemented include:

- a) Drawing down reservoirs to create spare capacity which can hold back flood water when an extreme rainfall event occurs. This practice has major limitations since managing reservoirs in this way can exacerbate water shortages in a subsequent drought.
- b) Creating temporary ponds and wetland areas which fill up at times of high flow, and then empty over the next 8-12 hours at a controlled rate through 'leaky dams'.
- c) Installing timber / woody debris dams in areas of wet woodland alongside streams.
- d) Restoring degraded moorland by blocking drainage grips and re-vegetating bare peat. Re-vegetation increases surface roughness which reduces the rate of overland flow.
- e) Managing grazing to allow longer vegetation which will slow down overland flow
- f) Increasing woodland cover within the catchment. Catchments with a significant amount of deciduous woodland in particular show a less flashy response to rainfall.
- g) Avoiding poaching and soil compaction, and hence promoting good soil structure which aids water movement through the soil profile.
- h) Re-naturalisation of river channels and increasing in-stream vegetation.

Sediment and erosion

Transport of sediment downstream becomes an issue in many flood events. Both the total volume of sediment, and the size of individual particles, increases dramatically during more extreme events. In a major flood vast quantities of gravel can be moved downstream, and if this accumulates in the river bed and on the floodplain it can further increase flood risk.

Sedimentation also has water resource implication as it can decrease reservoir capacity.

It will sometimes be more important to manage sediment than it is to delay or decrease peak flows, since this will help to maintain the conveyance capacity of the river system.

What upland land management can achieve

A number of case studies have demonstrated that land management can have a significant impact on runoff at a local scale (on catchments of up to 10km²). In this sort of catchment only a few properties or sites will benefit from any reduction in flood risk, but this can be achieved at small cost in comparison with major flood defence schemes downstream.

Smaller scale flood risk management crosses the boundaries between technical science and social science:

- Involving local people in identifying and taking ownership of the problems, and in implementing solutions, is often central to the approach (and this has resonance with the government's 'localism' agenda).
- What has been learnt to date must be applied elsewhere with care, recognising that every catchment has its own particular set of physical and social characteristics. Careful analysis of each case should enable us to focus resources where they will have the greatest impact.

The wider context

Upland land management measures should be seen as one part of an integrated approach to flood risk management. They need to be complemented by land based opportunities on floodplains downstream, hard engineering solutions, and decisions which steer development away from vulnerable sites.

Upland catchments invariably supply us with a range of ecosystem services. Within a purely hydrological context there is a link between reducing peak flows and improving water quality. One example of this is the way fine sediment can impact on river habitats, leading to a deterioration of the water body status under the Water Framework Directive (WFD).

Landscape, biodiversity and other benefits can also be achieved through actions which help us to manage runoff. Plans to establish new areas of forestry, for example, are likely to be focused on hill slopes and upland fringes where water quality and runoff benefits can be achieved at the same time as carbon sequestration and storage. The way funding is allocated for land management means that these multiple benefits may not always be recognised.

Limitations and uncertainties

Upland land management measures might have an impact on flood risk across larger catchments, but as a result of the additional factors which come into play as we move downstream this has never been demonstrated. The extent to which the flow from smaller sub-catchments is delayed, and the way these flows then synchronise, could theoretically either decrease or increase flood risk downstream under different conditions. The complexity of the different factors involved means that at present we are unable to predict how a large catchment will respond to different weather events / different upland land-use mixes.

Given this level of uncertainty, possible reductions in flood risk at a larger catchment scale should not be used on their own to justify land management measures in smaller upland catchments. For the same reason the possibility that synchronisation of drain flows might result in higher downstream flood peaks should not prevent us from pressing ahead with projects which are designed to benefit those living or working in upland areas.

Some obstacles to delivery in practice

- Land management measures nearly always require the active engagement of land-holders.
- Those who provide or authorise funding for land management works (e.g. OFWAT, EA) would like to see more evidence of impact. The same bodies however are sometimes reluctant to fund monitoring and research programmes, preferring to see their money spent on implementation.
- If temporary storage areas impounded by leaky dams have a capacity greater than 10,000m³ they fall within the scope of the Reservoirs Act 1975 / Flood and Water Management Act 2010, requiring registration and inspection.
- Silt traps in some cases are not maintained because contents are categorised as hazardous waste – cleaning them out requires a permit, and extra disposal costs will be incurred.