

Water – Flooding

Background information for educators

White Cart flood defences, Glasgow

The White Cart River flows from the area south of Glasgow through the southern area of the city eventually joining the Clyde at Renfrew. It has, over many years, given rise to several very significant floods. A new flood prevention scheme was approved in 2006 and this is now being constructed. It combines detention of storm water in upstream, rural areas with more traditional flood defences in the urban areas, and it includes some of the most advanced construction of its kind ever undertaken.

The technical skills and knowledge required for flooding involve maths, physics, and geography skills. It is necessary to understand the water cycle and relate rainfall to topography. Statistics are also employed to determine likely flood levels. Physical and mathematical calculations, and sometimes actual physical models, can be used to determine flood areas and investigate solutions. Then mathematical skills are required to evaluate risk and cost-benefit ratios, so as to determine whether a scheme should go ahead or not.

Electronics and logic may be involved in designing warning systems.

On top of this, a wide range of skills relating to life and work are needed – communication with the public over risk issues, design decisions, the use of warning systems, insurance premium costs as well as more basic local environmental and economic impacts will be needed.

Overview of the process UK practice

Flood prevention is a complex process. The key technical approaches can however be described as:

- 1) Increase of capacity, and
- 2) Storm water detention.

The former is perhaps obvious - channels are widened or deepened - often by constructing flood walls above the height of the existing banks, so that more water can flow down the channel without spilling out to the sides. This works, but of course the flood is passed downstream, where it may cause problems for other communities. The second approach involves water being retained in safe areas upstream, held back by some form of flow control such as a weir, an orifice or a hydrobrake (see White Cart project details). This water is stored until the storm is past, and then let out at a gradual rate which the channel can safely handle.

One of the key issues with flood prevention is an understanding of risk. Risk in engineering terms is calculated on the basis of 'Return Period' - for example the 1 in 100 year return period storm is one which is likely, on average, to occur once every 100 years. This does not mean it will not occur tomorrow. Clearly designs have a cost-benefit: the likely damage to property and economic activity must be offset against the capital and ongoing costs of flood defences.

Another issue surrounds the use of natural flood plains for development - flat land close to waterways is prime building land, but the flood plains are nature's own flood defences - areas where flood water can accumulate until it can be passed downstream by the main channel. Development therefore impacts on the local environment's resilience to major rainfall events. Developed areas have hard paved roads and roofs, so more of the rain that falls becomes 'runoff', heading into drains and water courses, whereas in undeveloped areas it infiltrates naturally into the soil, becoming part of the water table.

It will be seen then that a key aspect of this area of water infrastructure is not so much the engineering technology as the prediction and management of risk. This is an ongoing area of research, led from Scotland, which focuses on trying to identify where flood waters will go, how quickly they might arrive and which properties are most at risk. This feeds both into practical systems to help people get to safety and save lives, and background for the insurance industry.

Whatever the local cause of flooding, and however it is managed, it is clear that climate change is having an effect, increasing the risk of flood damage in many areas. This means that issues of greenhouse gas emissions and global warming underly all the other details.

Overview of the process – the developing world

There is no technical difference between UK and overseas flooding- though the precise climatic causes may be different, and, for example, many overseas areas such as the Netherlands are subject to tidal flooding rather than that due solely to rainfall. However, flood defences are expensive and even where there is clear cost-benefit in their construction, developing countries such as Bangladesh find it difficult to invest in them. Relief of suffering is also made more difficult due to lack of other infrastructure such as roads and water supply, so that people whose homes are destroyed by floods are more likely to suffer for longer.

Some appropriate technologies exist, for example the use of hand-placed sandbags to stabilize river banks. This is an on-going research project of the author.

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