Geo Factsheet

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FLOODING IN SHREWSBURY

Floods have cost millions!!

RISING TIDE OF FLOOD MISERY

Worst floods for 54 years

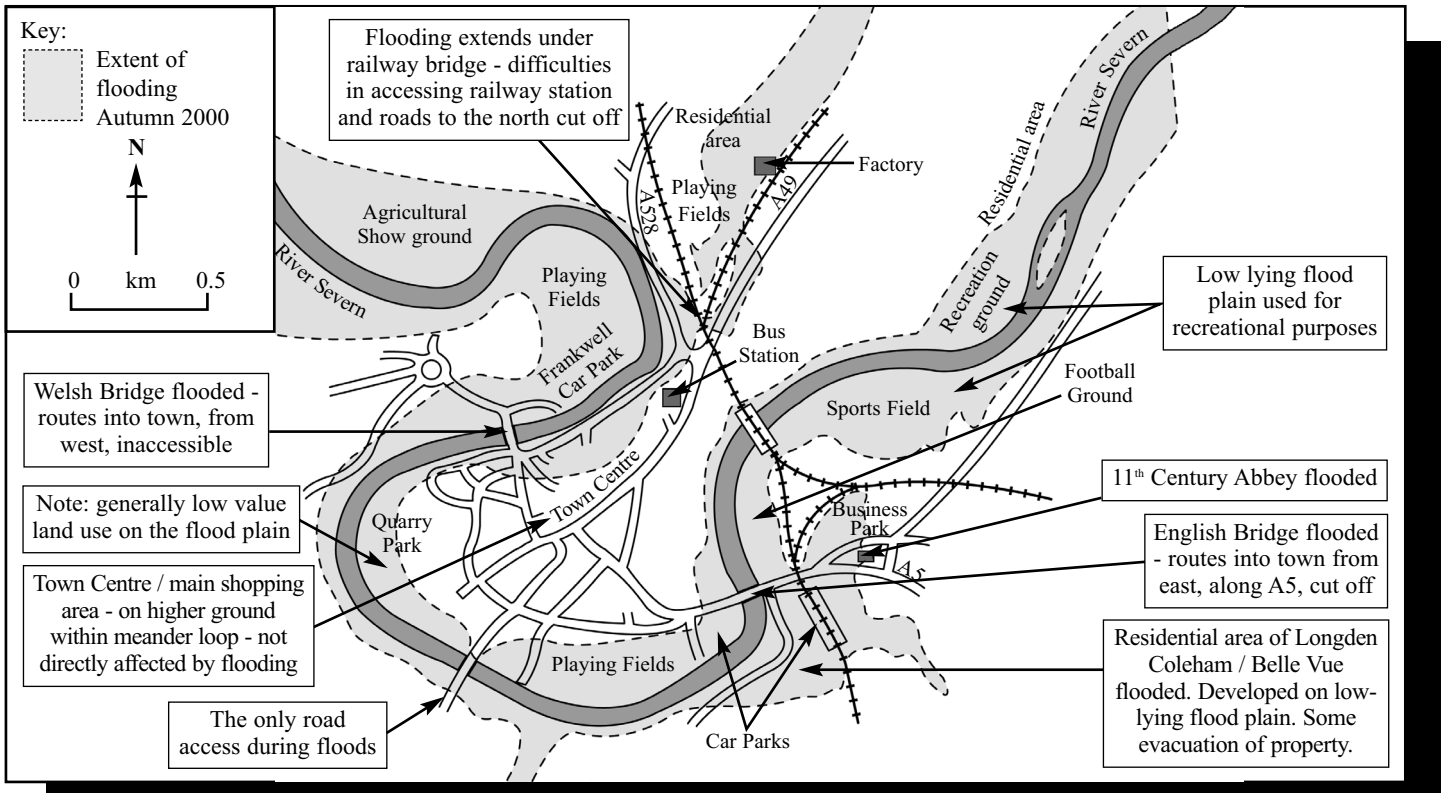
CHAOS AS RIVER SEVERN BURSTS ITS BANKS!

Although flooding is a natural phenomenon, over recent years, headlines like these seem to have become more frequent in the United Kingdom. The risk of flooding has increased as more land beside rivers has been brought into use. Consequently, flooding causes more disruption, damage to property and businesses and untold misery and upheaval to homeowners.

In the autumn of 2000, the River Severn flooded several times causing many such problems for the Shropshire town of Shrewsbury. Medieval in origin, the town has a rich architectural and historical heritage. It is located on an incised meander of the River Severn. Although the town centre itself is situated on high ground within the meander loop, many of the main transport routes into the town are very vulnerable to disruption.Over many years, development has spread down to the low-lying flood plain, particularly around the Welsh and English Bridges. This land forms part of the natural floodplain of the River Severn and so roads and properties here are inevitably at risk of flooding. When this occurs, the effect on the town is dramatic *(see Fig.1)*.

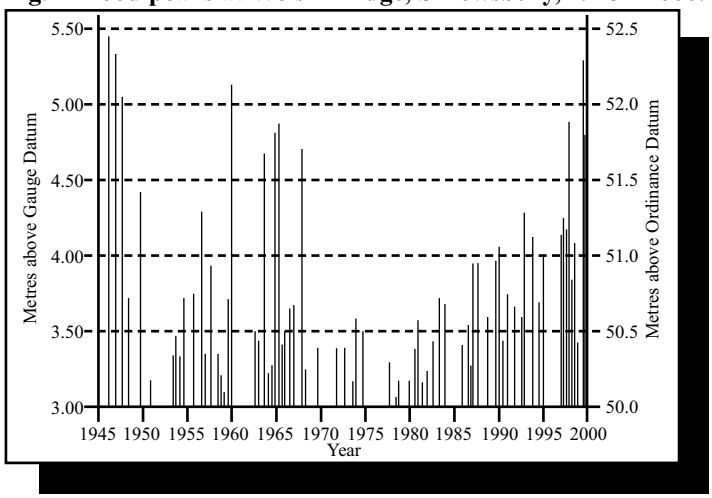
- The flooding problems are not new. The earliest reported flood occurred in 1338, and in 1348, a contemporary account records that: *"through a violent rain, from Midsummer to Christmas, a constant swell of the river was occasioned."*
- Reliable flood records go back to 1672.
- The highest recorded flow was in 1795 when the river at the Welsh Bridge rose to a level equivalent to 5.72 metres (18.7 feet) above normal on the present gauge. Bankfull level is reached at 2.9 metres on the gauge which means that the flooding must have been extensive.
- The worst flood in living memory occurred in 1946 when a water level of 5.48 metres (18 feet) was recorded at the same point. Floodwater entered the Abbey Church.

Fig. 1 The Shrewsbury floods in Autumn 2000.



Over the last 350 years, a major flood has caused significant damage, on average, every ten years, but the time between floods has varied greatly. In 1965 there were two floods within a week, but from 1968 through to the mid 1990s there were no major flooding events, an interval of nearly 30 years *(see Fig.2)*.

Fig. 2 Flood peaks at Welsh Bridge, Shrewsbury, 1945 - 2000.



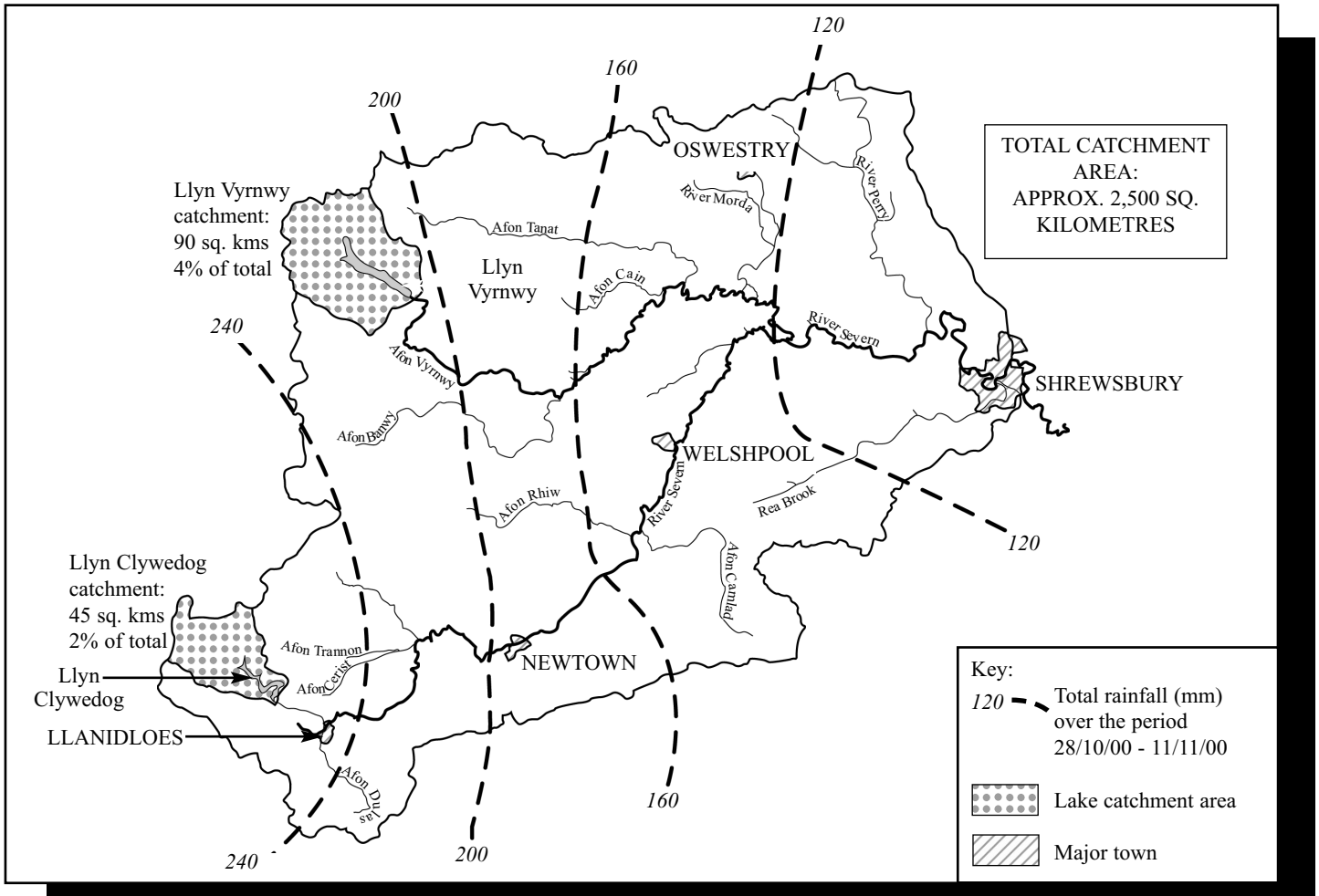
When managing such flood events, local authorities look at the **recurrence interval**. This shows the period of years within which a particular level of flooding is likely to occur. A 1 in 100 year flood might, therefore, be *expected* to occur once in a hundred-year period.

Planners can use the recurrence interval to assess the risk of flooding and to plan flood defences. Flood defences are expensive and useful for only relatively short periods of time. Decisions need to be made as to what **magnitude** of flood event to guard against and it is helpful to know how **frequently** a large flood is likely to occur as well as the likely **impacts**. **Risk assessment** is also useful for planning land use zones and designing new bridges.

During the early 1990s the National Rivers Authority (the predecessor of the Environment Agency) proposed a flood defence system for Shrewsbury. The plan was to reduce the risk of flooding in the low-lying areas of the town from 1 in 10 years to 1 in 100 years. The defences included the construction of walls along the riverside and in the main areas subject to flooding at the English Bridge and the Welsh Bridge.

However, there were doubts about some aspects of the proposals. People were concerned about the perceived visual impacts of the scheme. Moreover, not only had Shrewsbury not experienced serious flooding for a long time, but in this interval the Clywedog reservoir and dam had been built upstream. There was a misconception that this had solved the problem by allowing the storage of floodwater. In fact, although there is some protection immediately downstream, of the lake, the benefit in Shrewsbury, some 80 km downstream is very small indeed *(see Fig. 3)*. This is also true of Lake Vyrnwy, 60 km upstream of Shrewsbury beyond the confluence of the Severn and the Vyrnwy. However, many local people no longer perceived a flood threat and the flood defence scheme did not proceed. Subsequently, there were several more years with no serious flooding, but inevitably the good luck ran out and recently Shrewsbury has experienced more frequent and often damaging floods.

Fig. 3 The catchment of the River Severn above Shrewsbury.



Autumn 2000

Severe floods hit Shrewsbury in 1998 and then, in the autumn of 2000, the worst flooding for over fifty years devastated the length of the River Severn and Shrewsbury was particularly badly affected as the town was extensively flooded three times in the space of six weeks.

Fig. 4 shows that the flood peak reached 5.25 metres on November 1st 2000, the highest since March 1947. During normal conditions, the River Severn through Shrewsbury flows at just over 50 cubic metres per second. During the flooding, flow was approximately 450 cubic metres per second, some nine times greater than under normal conditions. This flood flow is the equivalent of one Olympic sized swimming pool passing under Welsh Bridge every second.

During November and December, there were a series of flood peaks at the Welsh Bridge. At times the town was effectively closed due to the disruption of communications. Both the Welsh Bridge and the English Bridge were closed for periods and flooding at the neck of the meander closed the roads here and disrupted rail transport *(Fig.1)*.

Residents and traders in the hard hit areas such as Frankwell and Abbey Foregate were forced to abandon their properties as the floodwaters continued to rise. The lower ground floor of the Wakeman School was ruined after gallons of floodwater swept through the information technology suite, home economics department and kitchen. Several car parks were completely submerged and sports grounds and parks, which are very close to the river, were badly affected.

Although most of the shopping area remained dry, being built on raised land within the meander loop, nevertheless trade in the town centre was seriously affected. Boots Chemist estimated that they lost approximately £250,000 in sales and Marks and Spencer not only lost an estimated £975,000 in sales, but also threw away £30,000 of food. In late December, traditionally a busy time for retail outlets, it was estimated that the number of shoppers in the Darwin Shopping Centre had slumped by 60%.

During the flood, the Borough Council, the Environment Agency and the emergency services worked together to do what they could to alleviate the situation. Flood warnings were issued through out the event. There is a four-stage system for the warnings, starting as the river reaches bankfull level *(see Fig. 4)*.

Several thousand sandbags were issued to shopkeepers and householders. Although too dangerous at first, as floodwaters receded slightly, boardwalks were constructed above the floodwater to allow access into the town for pedestrians. Punts were also used to ferry people to places that were flooded.

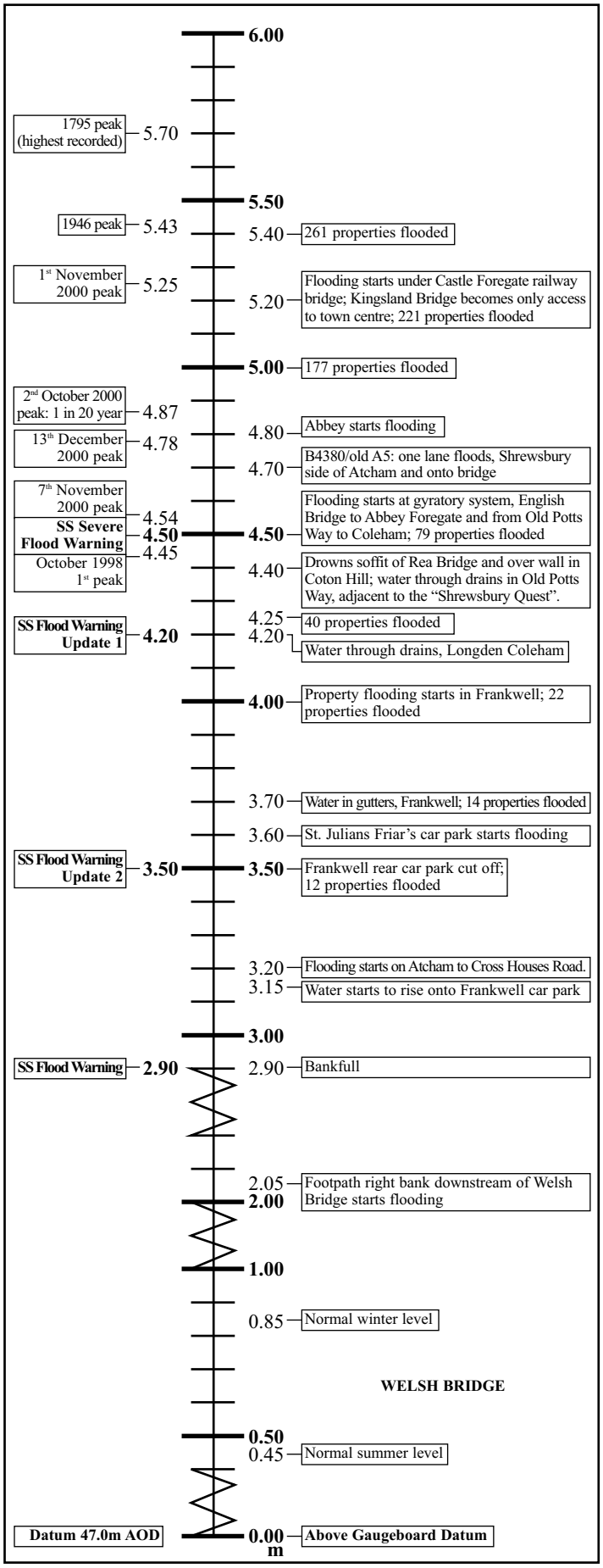
Houses close to the Rea brook, a small tributary that joins the Severn at Shrewsbury, were evacuated. Approximately 400 properties were flooded and the distress caused was exacerbated when clean up operations were wrecked due to recurring flooding.

Why is Shrewsbury prone to flooding?

The River Severn rises at Plynlimon in the Welsh Mountains. It then passes through many steep sided valleys, which results in high levels of runoff. Between the source and Shrewsbury there are a number of tributaries feeding into the river, all helping to increase the amount of water within the channel. Notably, these include the River Clywedog and River Dulas at Llanidloes, the River Vyrnwy at Melverley and the River Perry just west of the town.

The River Vyrnwy has a large catchment area and exerts a big influence on the hydrology of the Severn. The discharge of the Vyrnwy adds a significant quantity of water to the Severn during periods when there is a risk of flooding *(see Fig. 3)*.

Fig. 4 Upper Severn area gaugeboard data.



Source: Environment Agency

The catchment area of the Severn above Shrewsbury lies mainly on slatey-shales, impermeable rock, hence speeding up the flow of water to the river. During the autumn of 2000, precipitation levels, which are usually quite high, were even greater. Very high totals were recorded in the Welsh Mountains. Over the extended period 28 October 2000 to 11 November 2000, rainfall totals reached a maximum of 1 in 100 years. At Dolydd, close to the source of the River Severn, 331 mm fell in this period alone. During November, the Severn basin received 174% of the long-term average rainfall for that month, mainly due to two severe storms. In December, intense low-pressure systems swept across the region bringing further prolonged heavy rain *(see Fig.3 on page 2)*.

By November, soils were completely saturated with antecedent moisture and unable to soak up more water. This again increased the speed with which water reached the river. In December, the already saturated catchment responded very quickly to the heavy rainfall.

Much rain also entered the catchment of the River Vyrnwy. During the floods, it was impossible to make any releases from either Lake Vyrnwy or indeed, Lake Clywedog, due to the high levels downstream. Lake Vyrnwy continued to spill throughout the November flood event and no water could be released before the flooding in December. At the confluence of the River Severn and the River Vyrnwy at Melverley, the river overtopped the banks.

Natural flood meadows (wash lands) exist here and there is also a series of embankments (argae) dating back some 200 years which provide some protection for Shrewsbury. However, despite the inundation of large areas of agricultural land, the floods of autumn 2000 were too great to be held within this area and the floodwaters continued downstream to Shrewsbury (see Fig.5).

Possible solutions to the problem

The floods of autumn 2000 led to much public and political interest in Shrewsbury and there were calls for a flood alleviation scheme of some kind to be implemented. The cost of the 2000 floods in Shrewsbury was estimated to be in the order of £7 - 8 million. In addition, there are the costs which cannot be quantified such as the emotional distress and the inconvenience suffered by the residents of Shrewsbury.

Part of the Environment Agency's brief is to protect people from river flooding and it is in the process of looking at ways of minimising the impact of future flooding on the town. Money is raised through a levy on local authorities and Central Government grants. In addition, there is extra money from the Government for schemes that can commence quickly. As a result, the Environment Agency has secured £6 million for flood defences for Shrewsbury. There are many options that have been discussed, but any proposal must meet cost/benefit criteria and must not have negative impacts on communities downstream.

Conclusion

The 2000 floods have changed the way people in Shrewsbury perceive the risk of flooding and the need for flood defences. With the prospect of more episodes of severe hazardous weather and the increased urbanisation of the catchment, flood defences are now being built. Try the website to see what is happening.

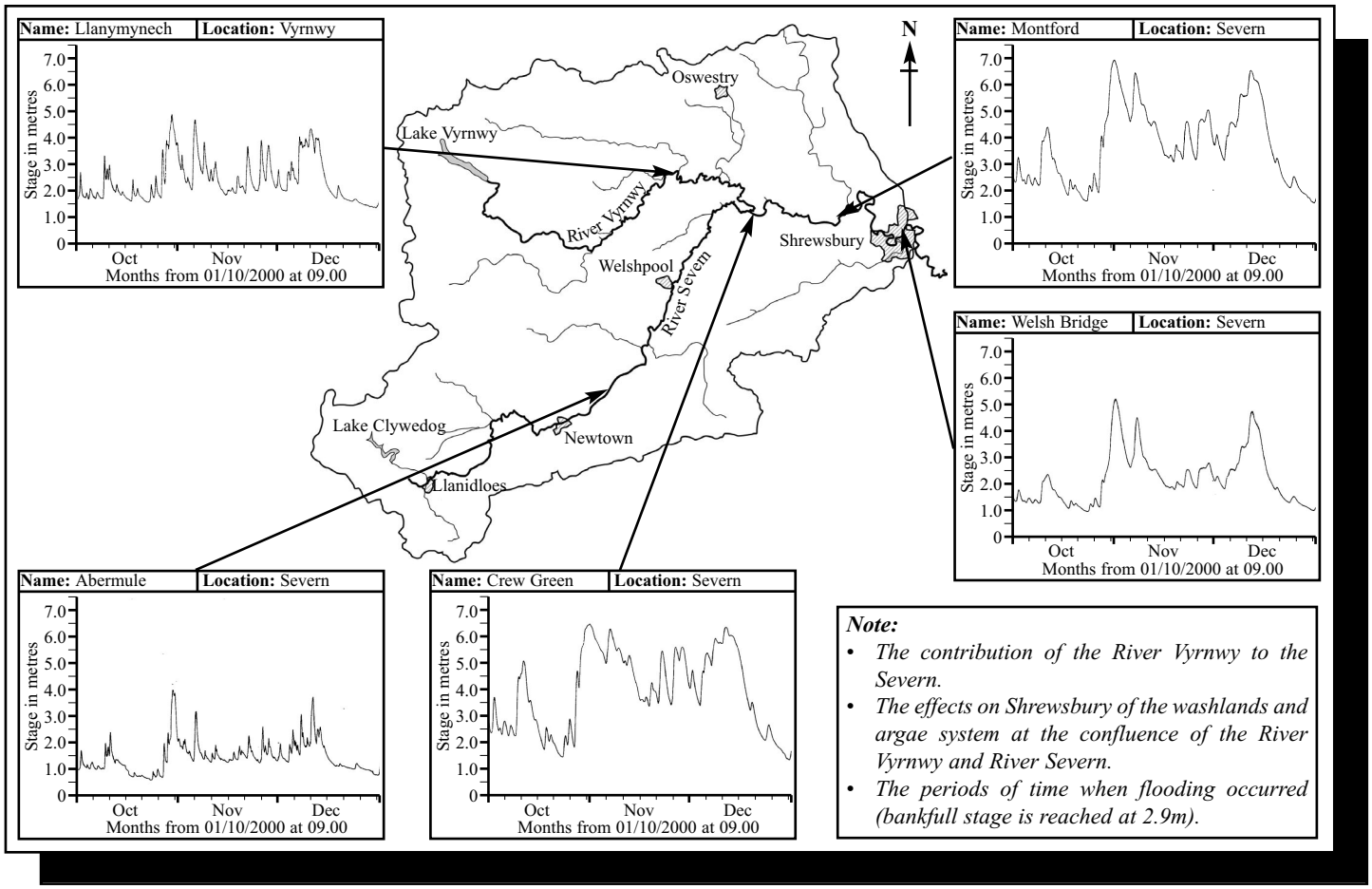
Further research

Geography Review, Volume 13, Number 1, September 1999
Geography Review, Volume 13, Number 4, March 2000
Environment Agency, Shrewsbury Flood Alleviation Scheme

Useful web sites

www.shrewsburyfloods.co.uk
www.shropshire-cc.gov.uk/floods
www.severnbore.ndirect.co.uk/floods4.htm
www.environment.agency.gov.uk/subjects/floods
www.sabc.freeserve.co.uk/magazine/issue12/flooding1

Fig. 5 Hydrographs upstream of Shrewsbury



Issues analysis exercise
Study each of the following solutions. Use a suitable technique to evaluate the strengths and weaknesses of each scheme.

1. Do nothing

If the Environment Agency do nothing to prevent the flooding, then the floods would continue and could grow worse with weakened banks and other riverside problems. Serious flooding could be expected about once every ten years. The 2000 flood was of the 1 in a 100 event size and as seen, had serious impacts on the town.

2. Dredging the river.

- During flood events, the River Severn flow is some nine times greater than under normal conditions. Dredging the river could create a channel deep enough to contain the water. However, because the flow is so enormous, the riverbed would have to be excavated by a depth of some 6-8 metres. To do this, rock blasting of the bed would be necessary.
- Large construction vehicles would be required close to the river to remove the debris brought up from the riverbed by the dredging boat. Machinery would also be required to clear the riverbanks and vegetation to allow access to the river and to increase the speed of floodwater to make it pass downstream quicker. The process is sometimes referred to as channelisation.
- Bridges, some of historic value, and other structures next to the river would need to be reconstructed. Many structures would be demolished up and downstream of Shrewsbury.
- The cost would be £45 million.
- The ecological balance of the river would be affected as habitats for plants, fish and animals are all affected by dredging.
- Dredging the channel would increase erosion along the adjacent riverbanks.
- It would require the disposal of many million tonnes of rock and silt. Furthermore, the dredging would need to be continual, as the river would immediately start to silt up again.
- During the summer the river would be way below the top of the channel.

3. Hard flood defences in the town

- This involves the construction of walls and embankments within the town to prevent flooding. They would require deep foundations to prevent groundwater seeping under the defences. There are four main areas of flooding in Shrewsbury located on either side of the Welsh and English Bridges. Defences would be constructed in three year long phases to reduce disruption to the town.
- Hard defences can be visually intrusive, particularly in a historical town such as Shrewsbury with its attractive riverside frontage. This was the main reason why such a plan was rejected in 1993. However, it is now possible to use demountable flood defences, which can be partially dismantled when not required. They can be used on their own or on top of low floodwalls. Cladding materials can also be chosen to complement the area.
- A negative impact of hard defences is that they can sometimes prevent surface water and waste water from draining into the river. This can lead to the drains backing up. Where combined drains (carrying surface water and sewage) back up, untreated sewage can escape causing great distress and a health hazard. It is proposed to prevent this from happening by incorporating one-way valves into the drainage system in Shrewsbury.
- The cost of providing such defences to resist a 1 in a 100 year flood is estimated to be in the region of £8 million.
- It is thought that the downstream effects of the defences in Shrewsbury are likely to be very small.

4. Upstream Storage

- Three areas of upstream storage have already been mentioned - Llyn Clywedog reservoir, Lake Vyrnwy and the Severn/Vyrnwy confluence area, near Melverley. Members of the Shrewsbury public have suggested that the two reservoirs should be used to greater effect to reduce flooding in Shrewsbury. This would require keeping the reservoirs low in the winter months so that in the event of a flood they could be used to store floodwater. However, their prime purpose is to supply Merseyside and the West Midlands with water in the summer months. To allow this to happen they are kept full in the winter months and could not store additional floodwater. Even if the reservoirs were kept operationally low in the winter they would only receive a small fraction of the drainage above Shrewsbury.
- The argae system at the Severn/Vyrnwy confluence is already utilised. The River Vyrnwy adds a significant amount of water to the Severn during flood risk periods. At this point the river tends to flood onto the surrounding farmland. The flat land and embankments store water and already have the effect of reducing the peak flow at Welsh Bridge in a 1 in a 100 year event from 2000 cumecs to approximately 590 cumecs.
- The feasibility of using these washlands upstream of Shrewsbury to store greater quantities of water has been assessed. To protect Shrewsbury from the effects of a 1 in a 100 year flood event, 36 km of existing argae would need reconstruction and a further 41 km would need to be built.
- These works would cost between £23 - £25 million.
- No further protection would be required in Shrewsbury.
- Large areas of agricultural land would be flooded and the depth and frequency of flooding would increase.
- Ecologically, this would be an opportunity to change the use of the land to a washland habitat increasing bio-diversity of the area. However, existing ecologically sensitive habitats in the washland area would be changed through longer periods of inundation and resulting higher groundwater tables.
- There would be access difficulties for houses and farms in the area and landowners would require compensation for the loss of their land.

5. Dams and Weirs

- A further upstream storage option has been investigated. This involves the construction of a 'dry reservoir' upstream of Shrewsbury which could be filled when necessary by Severn floodwaters. This would remove the need for defences in Shrewsbury, but would involve the construction of a dam. The Shropshire Plain is relatively flat and not suited to such a construction. Such a scheme would involve the flooding of at least 150 homes and a large area of land. The financial cost would be an estimated £25 million, plus huge social and personal costs for local communities.
- The weir in Shrewsbury keeps river levels artificially high upstream to allow for recreational use by boats and canoes. It has been suggested that removing it could reduce river levels. Smaller floods up to a 1 in 20 year event would have their peak levels reduced. A flood of any greater magnitude would soon drown out the weir. Removing it would have no impact at all in a 1 in a 100 year flood. Under normal conditions, because the river levels would be lower the banks would be exposed and the river's angling and boating potential would be reduced.

6. Bypass channel or tunnel

- A bypass channel has been suggested by a number of local people as a way of limiting the amount of water flowing into the town during a flood event. Several potential routes have been identified, including crossing the neck of the meander. However, although this is the cheapest bypass scheme at £13 million, the relatively flat gradient of the river channel through Shrewsbury would make it very difficult.
- Most other possibilities would involve the channel running through a tunnel for part of the length. Construction would be very disruptive to agricultural land, local residential areas and transport routes. Some homes would require demolition. A bypass channel would also take many years to complete and Shrewsbury would have no protection during this period. The cost of such a scheme is estimated to be between £50 - 100 million.

Acknowledgements
This Factsheet was written and researched by Cathy Carney who teaches sixth form geography in Shropshire.
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