Flood Review July 2007

Curbridge

An investigation into the causes and flood risk management options

David McKnight February 2008

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Executive Summary

Following the flooding of July 2007, which affected 3 properties in Curbridge, we have investigated options to improve the level of flood protection. This study aims to outline the extent of the recent floods, record the damage and document the response. Opportunities for any improvements that could reduce flood risk for local residents and businesses will be investigated.

The keys findings are that an unusually wet May and June with rainfall up to 195% of the long term average combined with an exceptional level of rainfall on 19 and 20 July created unprecedented levels of flow in the Elm Bank Ditch and the wider land drainage system. Water levels and flows exceeded the capacity of culverts and bridges forcing flood water over and/or around the structures, into roads and residential areas. This caused widespread flooding across the catchment which was worsened by surface water flooding in places.

The classification of the Elm Bank Ditch is an ordinary watercourse (see glossary). We do not have powers or funding to carry out works on ordinary watercourses. We are also unable to spend funds on the installation of river monitoring equipment to provide a flood warning system for this area.

There are no mills or sluices that we are aware of that could affect the flooding of July 2007. However, the Elm Bank Ditch passes under Main Road and the junction with Well Lane at the north of the village in culvert. The capacity and condition of this culvert has the potential to effect flood risk in the village. Oxfordshire County Council (O.C.C.) Highways Department have surveyed this culvert and have confirmed that there is damage which may have reduced its capacity to convey flows during the July flood event. However, it should be noted that had the culvert not been damaged, it would not have had the capacity to convey the volume of water during the July flood event. O.C.C Highways Department are investigating this matter further.

A number of positive recommendations are made with the objective of reducing the consequences of future flooding. The key recommendations of the review are:

- we will work with W.O.D.C and riparian owners to increase awareness of riparian rights and responsibilities of watercourses and structures to ensure adequate maintenance and conveyance of river flows
- inspection and repair of the Elm Bank Ditch culvert under Main Road/Well Lane (Oxfordshire County Council – Highways Department)
- O.C.C and W.O.D.C. are investigating options to provide increased flood storage capacity upstream of Curbridge to the north of Downs Road, these investigation will continue
- we will continue to work with West Oxfordshire District Council (W.O.D.C) to prevent inappropriate development in the flood plain
- increased flood resistance and resilience of properties at risk from flooding via flood prevention products and construction techniques
- we will work with communities to produce local flood plans so they are better prepared for future flooding and better able to respond.

David McKnight Flood Risk Engineer

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1Background

Introduction

Following the floods of July 2007, we have undertaken flood reviews to understand the meteorological conditions that contributed to the flooding, the mechanism of flooding and the number of properties affected in order to identify works to reduce flood risk and its impacts. The reviews will also identify responsibilities for flooding, provide guidance on other flood risk management tools such as flood warning, flood resistant construction and flood resilience. This review has been written in consultation with West Oxfordshire District Council (W.O.D.C).

Curbridge is a small village in West Oxfordshire, it is located approximately 1 km south-west of Witney in West Oxfordshire District. The Elm Bank Ditch (ordinary watercourse) enters the village in a culvert which passes under the Main Road/Well Lane junction and through private gardens before opening back into a watercourse on farm land. It flows through the village from a north west direction to a south east direction and becomes a main river south of the village. The Elm Bank Ditch flows into the Brighthampton Cut downstream of Yelford and discharges into the River Thames approximately 1 km upstream from Newbridge.

2 The problem

Flooding mechanism & history

Meteorology
May and June 2007 were unseasonably wet months across the UK with many areas receiving rainfall above the long term average (LTA) for the period 1961-1990. The Thames Region received 109mm of rainfall in May and 88mm in June (195% and 160% of the long term average respectively).

The unsettled weather continued into July 2007 as low pressure dominated across the UK. This was due to the abnormal southerly position of the Polar Jet Stream, a narrow band of fast moving air in the upper atmosphere which steers weather systems from west to east across the Atlantic. The jet stream is usually further north during the summer period, allowing high pressure to form across the UK more frequently.

During 19 July 2007, low pressure across northern France deepened and tracked northwards, extending a vigorous trough and active frontal system across southern Britain on the 20 July 2007. This meeting of warm, moist air from the south and colder air from the north resulted in widespread torrential downpours across the region, particularly between 0900 and 1500 GMT.

In July the Thames catchment received 121mm compared to the long term annual average rainfall amount of 49mm (247% of the long term average), as illustrated in Figure 1. The Brize Norton rain gauge recorded 127 mm in 20 hours.

Figure 1: Rainfall totals compared to the long term average (LTA) (1961-90)

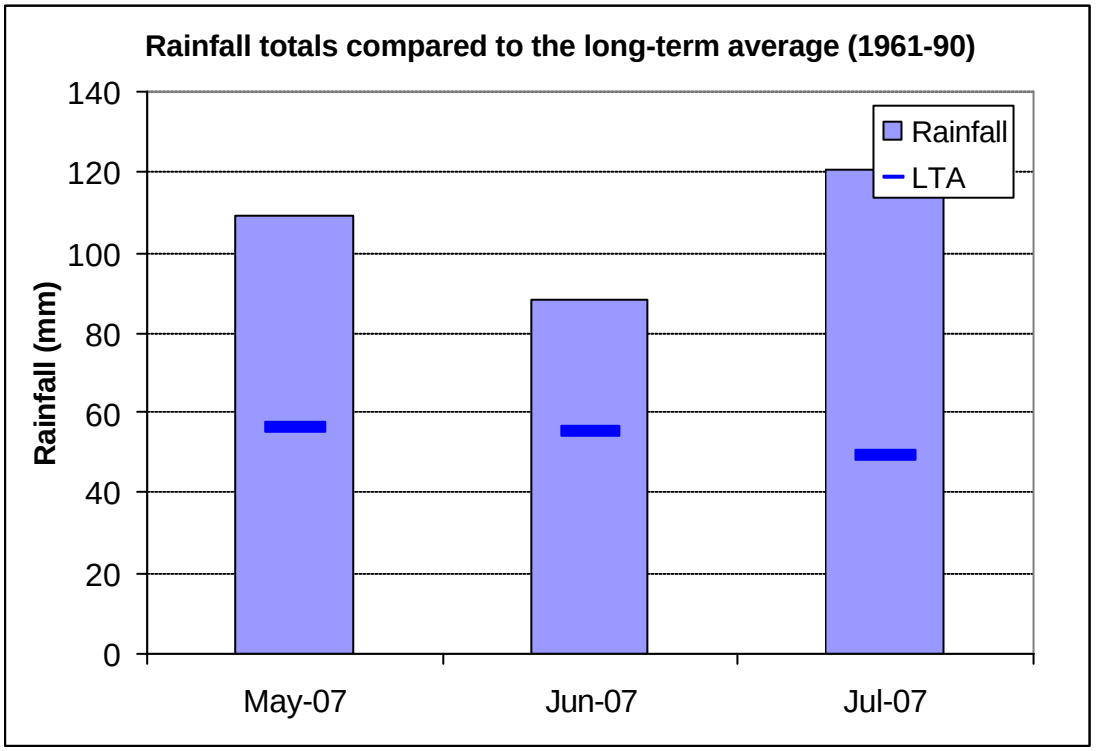


Table 1: Rainfall totals compared to the long term average (LTA) (1961-90)

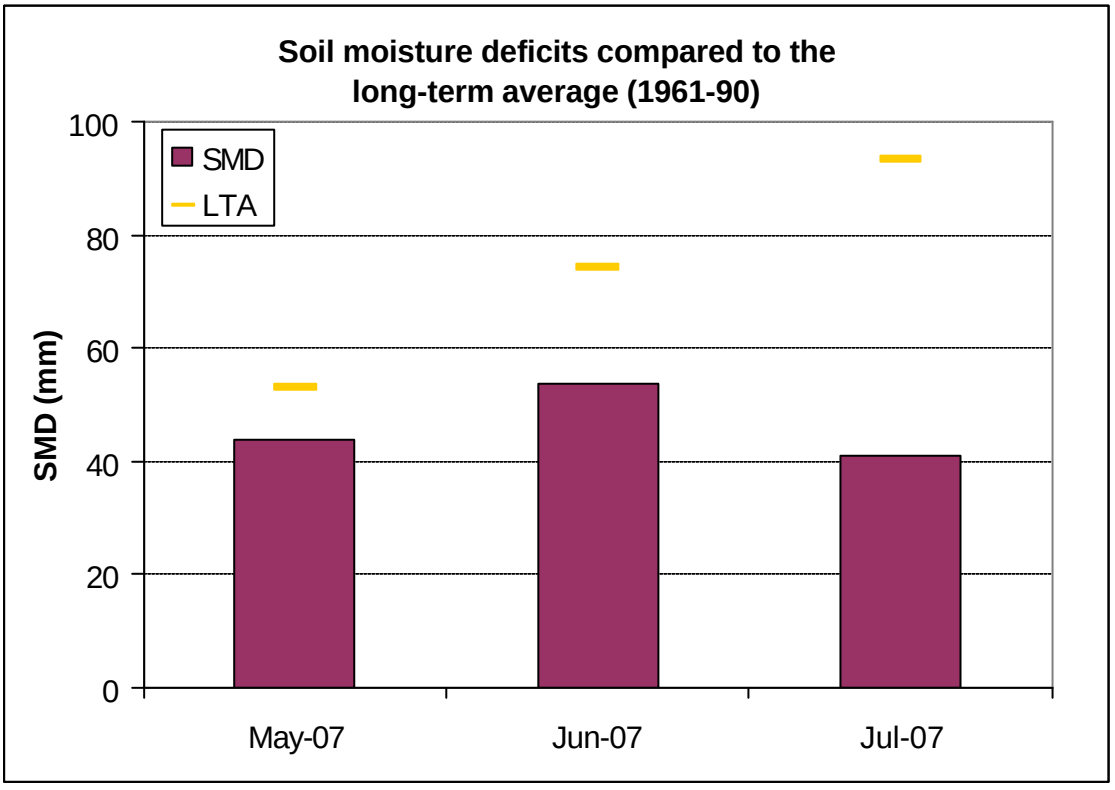
Month	Total rainfall for Thames Region (mm)	Long Term Average (1961-1990) (mm)	2007 rainfall as % of LTA
May 2007	109	56	195
June 2007	88	55	160
July 2007	121	49	247

Hydrology

Soil Moisture Deficit (SMD) is a measure of the saturation of the soil. Low SMD means that the soil is wetter than usual, and SMD above the LTA means that it is dryer than usual. The SMD in May and June 2007 are compared with long term averages for 1961-90 in Figure 2. Extended periods of wet weather across much of the Thames Region resulted in lower than average SMD leading up to the July 2007 event. This means that less rainfall was needed for the soils to become fully saturated, increasing the potential for greater runoff into rivers.

The extremely high rainfall totals and intensities coupled with the low soil moisture deficits for the time of year caused flows (i.e. the volume of water in the river) at many locations to increase rapidly. By the end of July 2007 average monthly river flows at many sites were the highest on record for July.

Figure 2: Soil moisture deficits (SMD) compared to the long term average (LTA) (1961-90)



The combination of exceptional rainfall and low soil moisture deficit resulted in extremely high flow and levels in many of the watercourses in the Region.

Flood history

There have been a number of major floods in the River Thames catchment since records began, most notably in November 1894, March 1947, October/November 2000 and January 2003. All occurred during the winter months and affected the upper Thames tributaries as well as the Thames itself.

Historically, summer floods on the Thames and larger tributaries are less common. However it is interesting to note that the highest levels at Thames locks upstream of Oxford since records began in the 1880s were generally recorded in the flood of June 1903. Also, the July 1968 floods caused severe flooding in the lower Thames tributaries and the highest flows on record in the neighbouring lower Severn catchment.

Table 2 gives a summary of the main historic flood events that have affected similar areas to those in the July 2007 event. It is by no means a comprehensive record of every flood in the Thames catchment.

Table 2: Historic flood events

Date	Description
November 1894	Catchment-wide flooding in the Thames catchment. Highest levels downstream of Oxford since records began. Numbers of properties affected unknown.
June 1903	Flooding on the upper Thames. Highest levels locks upstream of the Cherwell since records began. Numbers of properties affected unknown.
March 1947	Basin-wide flooding in the Thames, including the Lee catchment (over 10,000 properties affected).
July 1968	Flooding in the mid to lower Thames and severe flooding in the Mole and Wey catchments (about 10,000 properties affected).
November 1974	Flooding in the lower Thames and its tributaries including Addlestone Bourne, Blackwater, Beam, Loddon, Emm Brook.
Easter 1998	Flooding in the Cherwell catchment – Approximately 1000 properties affected
October/November 2000	Basin-wide flooding in the Thames. Approximately 1100 properties affected.
January 2003	Basin-wide flooding in the Thames. Over 500 properties affected.

Examination of the rainfall data and runoff characteristics from the July flood event has enabled an estimation of the flood return period in excess of 1 in 100 years (1% annual probability of occurrence).

Flood mechanism / source of flooding

The flooding in July was from several sources: rivers (fluvial), surface water (pluvial) and sewers. It is very difficult to distinguish the exact source of flooding due to the complex connection between rivers and drainage systems.

The smaller the area these systems serve the more rapidly they will respond: the larger the area they drain, it will take a longer time for the majority of the rainfall to reach any point. Flooding will often occur in a time sequence that reflects this e.g. first we see a puddle in the garden, then overflowing drains, ditches overspill, small river floods then finally large rivers flood.

Curbridge is located at the top of the Elm Bank Ditch, some distance from main river section, (See glossary). Due to its location at the top of the catchment and for the above reason, it is likely to be fast-reacting after rainfall. Any area with a rainfall catchment of less than 3 km^2 were not considered in our first National Flood Map outlines, which explains why the floodplain limit does not extend into the village. (See figure 3 in Appendix B).

The flooding of roads, roadside drains and gullies immediately after the exceptionally heavy rainfall from mid morning to late afternoon on Friday 20 July occurred due to insufficient capacity to cope with the volume of water. The ditches, streams and larger watercourses were already rising due to the runoff from fields and surface water drainage systems. The above drains and watercourses discharged into the larger watercourses including the Elm Bank Ditch whilst the intense rainfall was falling on Friday 20 July, flooding on Main Road followed early on Friday afternoon.

Flood flows entering the culvert under Main Road exceeded the capacity of the culvert and the excess water flowed overland through residential gardens and entered Main Road. At the lowest point of Main Road, flood waters entered approximately 3 properties as flood water tried to find an overland route back to the Elm Bank Ditch. (See Appendix A for photographs).

Parts of Bampton Road also suffered from flooding as water flowed from adjacent fields across the road.

Planning controls and floodplain development

Current planning guidance contained in Planning Policy Statement 25 (PPS25 – published December 2006) states that flooding is a material planning consideration and explains how flood risk should be considered at all stages of the planning and development process. It places the onus on the developer to assess flood risk for a particular site and its impact on adjacent sites. It allows the planning authority to adopt the precautionary principle when determining planning applications within the floodplain.

We are a statutory consultee in the town and country planning process. We have provided local planning authorities with maps identifying the flood plains to guide development away from these areas.

Prior to PPS25, planning authorities were not obliged to incorporate our comments or advice into their final decision, this may in certain circumstances have resulted in development going ahead against our recommendations.

Under the 'Flooding Direction' issued in conjunction with PPS25, where a local planning authority is minded to approve a planning application for major development yet we have objected to it on flood risk grounds, the application must be referred to the appropriate Government Office to consider, on behalf of the Secretary of State, whether it should be called in for determination.

We will object to any inappropriate development within the floodplain that may result in:

- increased resident population in the floodplain;
- a loss of floodplain storage capacity;
- impede flood flows routes;
- result in increased flood risk elsewhere.

We are not aware of any recently approved or proposed developments in the vicinity that may effect flood risk to Curbridge. We continue to work with W.O.D.C. to ensure that flood risk is considered at every stage in the planning process.

We are also working with W.O.D.C. to produce their strategic flood risk assessment (SFRA). The purpose of an SFRA is to identify areas within a development plan that are at risk of flooding and make objective judgements on land allocations using a risk based approach as advised in PPS25.

During investigations into the flood review at Curbridge, a number of residents raised concern over drainage works that have recently taken place at a Golf course to the north of the A40. This issue has been raised with the Local Planning Authority, W.O.D.C to look into further.

Flood warning

Flood warnings are issued on a best endeavour basis and aim to simultaneously warn homeowners, businesses, emergency services and local authorities of the threat of flooding. Flood warnings can be sent via telephone, fax, text or email.

Flood Warnings apply to flooding caused by main rivers and streams, not to flooding from other sources, such as sewer and surface water flooding, burst water mains, impounding, etc.

We can only provide a flood warning service where we are able to monitor river levels, to those at risk from flooding.

3 Management of Flood Risk

Catchment Flood Management Plan (CFMP)

Catchment Flood Management Plans (CFMP's) provide an overview for managing the long-term flood risk over the next 50 to 100 years.

A reliance on flood defence is no longer sustainable and we are moving towards managing the risks of flooding. This can be achieved by putting in place a range of flood risk management policies that can react to change.

Curbridge lies within the undeveloped natural flood plain catchment area as defined by the CFMP. The approach to flood risk management in these areas is about working with the natural characteristics of the catchments. The aim is to manage flood risk by taking opportunities to maximise the potential of the flood plain to retain water. Specifically the messages are:

- The flood plain is our most important asset in managing flood risk
- Maximising the capacity of the flood plain to retain water in these areas can have many advantages for people and the natural environment
- Managed flooding of some areas of the natural flood plain will reduce the risk to some communities
- We will do all that we can to prevent inappropriate development which reduces the capacity of the flood plain to retain water. Future maintenance work on river channels should aim to increase the capacity of the flood plain.

Third party structures & maintenance

There are no mills or sluices that we are aware of that could affect the flooding of July. However, the Elm Bank Ditch passes under Main Road and the junction with Well Lane at the north of the village in culvert. Oxfordshire County Council Highways Department have surveyed this culvert and have confirmed that there is damage to the culvert which may have reduced its capacity to convey flows during the July flood event. However, it should be noted that an un-damaged culvert would not have had the capacity to convey the volume of water during the July flood event. O.C.C. Highways Dept are investigating this matter further.

Maintenance regime

All rivers, streams and ditches forming the natural drainage system fall into two categories. They are: main river and ordinary watercourses. We are the operating authority for all main rivers. W.O.D.C. are the operating authority for ordinary watercourses and have similar powers to us but only for ordinary watercourses. O.C.C. Highways Department are responsible for the maintenance of structures that they own, this will generally include road culverts, bridges, gullies and some ditches.

The maintenance of all watercourses is legally the responsibility of the owner of the river (riparian owner). Many households own very small sections of the various watercourses and in many cases are also unaware of their responsibility for the watercourse. W.O.D.C. are currently working through a programme of minor flood defence work which involves identifying ditch and ordinary watercourse landowners and requesting maintenance if required.

We have permissive powers to carry out maintenance on any river that is classed as main river. Our maintenance role is scheduled on the basis of flood risk priority and recourses. There are no main rivers that cause flood risk to Curbridge, the Elm Bank Ditch is therefore not covered by our regular maintenance programmes.

We would support riparian owners wishing to undertake maintenance of watercourses, subject to them gaining our consent where this is required. Our support could include guidance and advice on various aspects of maintenance. Further information and advice relating to the need to gain our consent can be obtained from our National Customer Contact Centre on: 08708 506 506.

Details of the rights and responsibilities of riparian landowners are provided on the our website:

http://www.environment-agency.gov.uk/subjects/flood/362926/

The same information is also available on request from us in a hard copy booklet entitled 'Living on the Edge'.

Intervention options

Our aim is to reduce flood risk. For defended areas at flood risk we will inspect, maintain and improve flood risk management assets, on main rivers and the coast on the basis of risk (i.e. the likelihood and consequences of failure). In undefended areas we build and maintain assets where it is considered to be an appropriate use of our flood risk management resources and meets our risk-based criteria. The classification of the Elm Bank Ditch is ordinary watercourse, we do not have powers or funding to carry out works on ordinary watercourses.

W.O.D.C. have identified a location upstream of Curbridge to the north of Downs Road where there is potential to provide increased flood storage capacity. Flood Storage Areas can be part of the existing flood plain or on the edge of the flood plain. They are areas of land that can be excavated to provide increased flood storage capacity to reduce flood water levels elsewhere. W.O.D.C. are working with O.C.C. and landowners and their investigations are ongoing.

Historic works

There are currently no flood alleviation schemes in place for Curbridge.

Flood resilience

Flood resilience refers to measures that reduce the amount of damage caused by water entering properties. There are a wide range changes that can be made to a property and any changes would be very specific to each property in order to ensure that they are suitable.

At present our policy is not to provide financial assistance with any protection to individual properties, however the Department for Environment Food and Rural Affairs (DEFRA) are currently funding a pilot grant scheme to encourage flood resilience as part of the Making Space for Water strategy. The outcome of this study could influence the decision of householders in the future.

It is unlikely that flood defences can be provided for the homes at risk of flooding in Curbridge. Individual flood protection and flood resilience measures are recommended.

In general if such measures are installed as part of repairs after the recent floods then insurance companies will expect the householder or business to meet the extra costs themselves. Possible measures include:

- Raised cupboards & electrical circuits
- Water resistant door frames
- Non-return valves on drainage pipes

- Water resistant plaster
- Air brick covers
- Tanking (waterproofing internal walls).

Flood defence products for individual properties are also widely available and we support the BSI kite mark standard which signifies that the product has been rigorously tested. See 'references' for links to further information.

Community flood plans

Following the July flooding we are working with affected communities to produce their own flood plans. We can assist by providing flooding advice, supplying maps and other relevant information. They can also be adapted to include other emergency situations, thus increasing the resilience of a community. The community flood plan contains information on:

- Setting up emergency management teams
- Flood event procedures
- Communications – useful numbers, local media, Environment Agency
- Flood Maps including vulnerable properties & residents
- Key community skills & equipment
- Emergency accommodation.

4 Conclusions & recommendations

The floods of July 2007 were an exceptional event, particularly in terms of the rainfall and the catchment response. The widespread flooding experienced was caused by the volume of water and inability of the overloaded drainage systems including, drains, ditches, streams and rivers to convey the flood water.

We worked with our professional partners throughout the event to warn where possible and assist residents and businesses. Unfortunately, we are unable to offer a flood warning system to the residents of Curbridge as we can only provide a flood warning service where we are able to monitor river levels.

The classification of the Elm Bank Ditch is ordinary watercourse, we do not have powers or funding to carry out flood defence works, install river level or flow monitoring sites or undertake maintenance work.

The main physical structures that affect flood flows are road culverts, bridges and built development. These structures affected the way in which the flood plain operated and could pose increased flood risk if they became blocked with debris, but were not directly responsible for the flooding. The watercourses were already full to capacity due to the volume of water. However, the condition of the Elm Bank Ditch culvert in the vicinity of Main Road and Well Lane would have contributed to the timings and possibly the magnitude of the flooding locally.

Increased channel maintenance would not have significantly reduced the level of flooding experienced in July due to the volume of flood water. Increases in channel capacity would provide limited reduction in flood risk because the extra volume in the channel only equates to a very small proportion of the volume of water in the flood plain. However, channel maintenance would assist in flood risk reduction for smaller floods.

An important element of flood risk management is to address the consequences of flooding. Communities should work together with parish councils to produce community flood plans. We have provided templates to help, the plans will:

- identify the risks to the community and take action to reduce them
- identify vulnerable people in the community and develop plans to assist/protect them
- identify resources in the community available to assist during an emergency
- provide key contact details for the Emergency Management Team, key community recourses, the Emergency Services and local authorities.

In order to reduce the impact of any future floods there are several actions that should be taken forward as a matter of priority:

- inspection and repair of the Elm Bank Ditch culvert under Main Road/Well Lane (Oxfordshire County Council – Highways Department)
- O.C.C and W.O.D.C. are investigating options to provide increased flood storage capacity upstream of Curbridge to the north of Downs Road, these investigation will continue
- we will work with W.O.D.C. and riparian owners to increase awareness of riparian rights and responsibilities on watercourses and local land drainage system, including the Elm Bank Ditch culvert on Main Road
- being prepared - both at community (community flood plans) and householder level
- our continued role in the planning process – objecting to inappropriate development in the flood plain
- increased flood resistance and resilience for homes and businesses.

Appendix A – Photographs

Floodwater unable to enter the culvert and flowing through residential gardens into Main Road at the north of the village.

Low point in Main Road

Appendix B - Maps

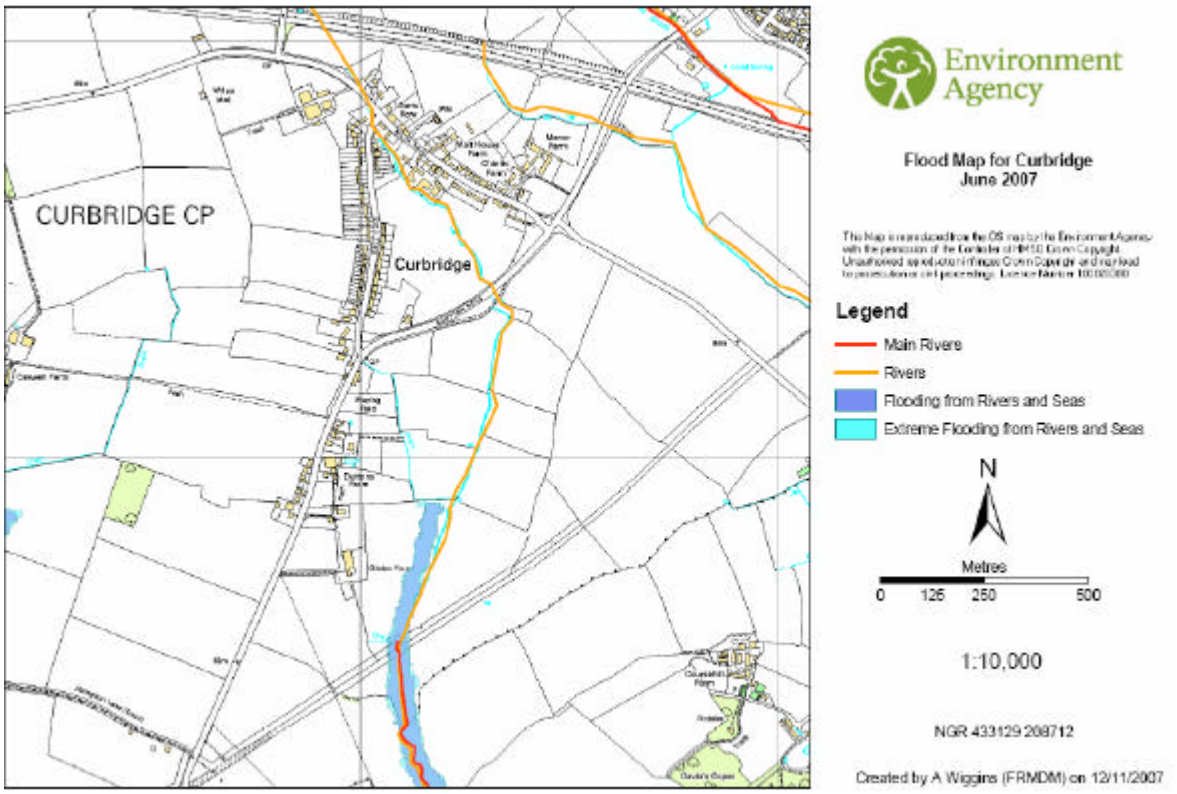


Figure 3– Curbridge –Flood Zone 3 (1% annual probability of occurrence) and FZ2 (0.1% annual probability of occurrence)

Glossary of terms

Cost Benefit Analysis
In order to receive funding for a flood defence scheme an analysis must be made of the costs and benefits. The costs include the design, construction and maintenance over a 100 year period. This is compared against the benefits – i.e. the reduction in damage caused by flooding of properties in financial terms. The higher the ratio of cost to benefit the more likely the scheme is to gain funding due to the national prioritisation of flood risk capital funding.

Critical Ordinary Watercourse
These are ordinary watercourses which have been identified by DEFRA as being strategically important and are to be enmained.

Culvert
A closed conduit for the conveyance of water, e.g. a pipe underneath a road.

Enmained
Procedure in which the Environment Agency assumes powers to legally chance the classification of an Ordinary Watercourse to a Main River in order to maintain exercise its Permissive powers for maintenance, flood warning and flood alleviation works.

Flood plain
A flood plain is an area of land over which river or sea water flows or is stored in times of flood. A flood plain can extend beyond the land immediately adjacent to a watercourse. (Living on the edge)

Flood Zone
Flood Zones are the Environment Agency's nationally agreed geographical layers of information that define the extend of flood risk. They are split into Flood Zone 1, 2 and 3.
Flood Zone 2 is flooding from rivers without defences at a 1% (1 in 100) chance of happening each year. It is the natural flood plain area that could be affected in the event of flooding from rivers.
Flood Zone 3 is the outline of a flood extent in an extreme flood with a 0.1% (1 in 1000) chance of happening each year.

Flood storage area
A flood storage area is a part of the flood plain that allows flood waters to be temporarily stored. The purpose of such an area is generally to retard larger floods from reaching a main watercourse for a designed flood return period.

Fluvial Flooding
Flooding where the source is river water.

Land Drainage Scheme
Post World War II the emphasis in river engineering was on increasing the farming capacity of the UK. This was achieved through land drainage schemes that increased the quality of farmland by maximising the drainage of water.

Main rivers
Main rivers are defined under the Water Recourses Act 1991, they are usually larger streams and rivers, but also include smaller watercourses of strategic drainage importance. A main river is defined as a watercourse shown as such on a main river map, and can include any structure or appliance for controlling or regulating the flow of water in, into or out of the main river. The Environment Agency's powers to carry out flood defence works apply to main rivers only. Main rivers are designated by the Department for Environment, Food and Rural Affairs in England (DEFRA) and by the Welsh Assembly Government. (Living on the edge)

National Flood and Coastal Defence Database (NFCDD)
The National Flood and Coastal Defence Database is a central store for Flood Risk Management related data. It aims to allow rapid access to national data, stored and maintained in a consistent manner.

Ordinary watercourse
An ordinary watercourse as defined under the Land Drainage Act 1991 is every river, stream, ditch, drain, cut, dyke, sluice, sewer (other than public sewer) and passage through which water flows which does not form part of a main river. On ordinary watercourses, the local authority and, where relevant, Internal Drainage Boards (IDB) have similar permissive powers as the Environment Agency has on main rivers. (Living on the edge)

Pluvial Flooding
Flooding where the source is surface water.

Priority Score
The national scoring system that is used by the Environment Agency and DEFRA to prioritise the capital funding of flood defence schemes.

Professional Partners
Professional partners are organisations we work with. Specifically, the emergency services, local authorities, health bodies, utilities, transport bodies and other Government agencies.

Public Surface Water Sewers
The sewerage undertaker is responsible for maintaining surface water sewers that are vested in them. Surface water sewers are likely to go directly into a watercourse.

Roadside Ditches and Highway Drainage
The County Council as Highway Authority is responsible for draining those highways, which are county roads, and has responsibility for certain bridges and culverts, under the Highways Act 1980. In general terms, it is usual for the roadside ditches to be the responsibility of the adjoining landowner; exceptions to this rule are where the ditch was constructed to drain the highway or where it falls within the land owned by the highway authority.

Riparian Owner
The owner of the river in terms of property. The usual situation is for the landowner of each bank to own up to the centreline of the river. There are responsibilities and rights associated with owning the river – principally that of maintenance of the watercourse and associated structures.

Sewer
Includes all sewers and drains which are used for the drainage of buildings and yards appurtenant to buildings, excluding a drain used for the drainage of a single building or of buildings within a single curtilage.

Trash Screen
A grill or grate that is installed on a culvert or other limited opening on a river to collect debris and prevent blockages.

List of abbreviations

AOD	Above Ordinance Datum
BSI	British Standards Institute
CFMP	Catchment Flood Management Plan
COW	Critical Ordinary Watercourse
DEFRA	Department for Environment, Food & Rural Affairs in England
FSA	Flood Storage Area
GMT	Greenwich Mean Time
NFCDD	National Flood and Coastal Defence Database
LTA	Long Term Average
PPS25	Planning Policy Statement 25
RICS	Royal Institute for Chartered Surveyors
SMD	Soil Moisture Deficit

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