# Appendices

# A Historical flooding information

## A.1 Introduction

Cotswold District in recent years has seen a number of large scale flood events including Easter and October 1998, autumn 2000, February 2002, New Year 2003, February 2004, summer 2007, November/ December 2012 and winter 2013/14. The Environment Agency has produced a number of historic flood outlines within the District and the following events have been mapped: March 1947, July 1968, August 1977, September 1992, October 1993, April 1998, December 2000, July 2007, January 2008. The Environment Agency has provided historic fluvial flood outlines which are illustrated in Map 1.

### A.1.1 Winter 2013/14

Flooding problems were experienced in known flood risk areas e.g. Cirencester and South Cerney. Sewer flooding problems were again at Lakeside, Lechlade. The flood events did test the recently constructed defences at Moreton-in-Marsh and Fairford which were considered to have performed well.

### A.1.2 November/ December 2012

CDC provided a list of properties, businesses, roads and carparks flooded during the December 2012 flood event. Full addresses or postcodes were not available for all of these records, so it has not been possible to geo-reference them. The data should be considered only as indicative of a flooding problem, for the following reasons:

1. It only includes incidents where CDC was notified. Very short flash floods will, in some cases, result in property flooding before a contact can be made to the local authority. In other cases, residents or businesses make their own arrangements for protecting properties.
2. No reason for flooding is recorded.

The records were cleaned and combined into a single spreadsheet, which has been used to summarise numbers of incidents by road name and by settlement. This summary is presented below, see Table A-1 and Table A-2.

Table A-1 Roads flooded (December 2012)

| Town | Roads Reported as Flooded |
|---|---|
| Chipping Campden | B4035 |
| Cirencester | A419 |
| | Berry Hill Rd |
| | Dollar Street |
| | Dugdale Road |
| | Escote Road |
| | Estcote Road |
| | Gooseacre Lane |
| | Hereward Road |
| | Old Cricklade Road |
| | South Cerney Road |
| | Spitalgate Lane |
| | Trafalgar Road |
| Daglingworth | The Street |
| Driffield | A419 |

| Town | Roads Reported as Flooded |
|---|---|
| Lechlade | Lechlade Road |
| Moreton in Marsh | Moreton Railwa y Station |
| Preston | Preston Toll Bar |
| Shipton Moyne | Hedgeditch Lane |
| Siddington | Siddington Road |
| | The Common |
| South Cerney | Upper Up |

Table A-2 Cotswold District Council data on properties and Business flooded (December 2012)

| Location | | Source Reported | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Town** | **Street** | **Not Specified** | **Overloaded Drains** | **Overloaded Sewer** | **River** | **Surface Water** | **Unknown** | **Total Records Reported** |
| Ampney Crucis | Durncourt Cottages | | | | | ✓ | | 1 |
| Bourton on the Water | Rissington Road | | | | | ✓ | | 1 |
| Chipping Campden | Catbrook | | | | | ✓ | | 1 |
| Cirencester | Bowling Green Lane | ✓ | | | | | | 1 |
| | Admiralty Row | ✓ | | | | | | 7 |
| | Blake Road | | | ✓ | | | | 5 |
| | Dollar Street | ✓ | | | | | | 4 |
| | Dugdale Road | | | | | ✓ | | 2 |
| | Estcote Road | | | | | ✓ | | 3 |
| | Gloucester Road | | | ✓ | | | | 2 |
| | Greystones, Donside | | | ✓ | | | | 1 |
| | Grove Lane | | | | | | ✓ | 1 |
| | Hereward Road | ✓ | ✓ | ✓ | ✓ | | | 17 |
| | Kemble Road | ✓ | | | | | | 1 |
| | Melmore Gardens | | | | | ✓ | | 2 |
| | Spitalgate Lane | | | | | ✓ | | 1 |
| | Thomas Street | ✓ | | | | | | 1 |
| | Trafalgar Road | ✓ | | | | | | 2 |
| Daglingworth | Daglingworth | ✓ | | | | | | 1 |
| | The Street | ✓ | | | | | | 1 |

| Location | | Source Reported | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Town** | **Street** | **Not Specified** | **Overloaded Drains** | **Overloaded Sewer** | **River** | **Surface Water** | **Unknown** | **Total Records Reported** |
| Lechlade | St Johns Priory Park | ✓ | | | | | | 1 |
| Moreton in Marsh | Croft Holm | | ✓ | ✓ | | | | 2 |
| | The Green | | | | | ✓ | | 3 |
| Naunton | Naunton | | | ✓ | | | | 1 |
| South Cerney | Boxbush Road | ✓ | | ✓ | | | | 2 |
| | The Limes | | | ✓ | | | | 4 |
| Daglingworth | Daglingworth | ✓ | | | | | | 1 |

Gloucestershire County Council has provided records of all flooding linked to property flooding from the November/ December 2012 event, see Table A-3. It should be noted that some of these records may be a repeat of those described in Table A-1 and Table A-2.

Table A-3 Gloucestershire County Council data on properties affected during the flood event December 2012 - Cotswold District

| **own** | **Location** | **Not Specified** | **Overloaded Pumping Station** | **Overloaded Sewer** | **Overloaded Sewer and Pumping Station** | **River** | **Surface Water** | **Unknown** | **Total Records Reported** |
|---|---|---|---|---|---|---|---|---|---|
| Bibury | Church Road | | | | | | | ✓ | 1 |
| | The Street | | | ✓ | | | | | 1 |
| Cirencester | Gloucester Street | | | ✓ | | | | | 1 |
| | Beeches Road | | | ✓ | | | | | 3 |
| | Blake Road | | | ✓ | | | | | 6 |
| | Corinium Gate | | | ✓ | | | | | 1 |
| | Dugdale Road | | | ✓ | | | | | 2 |
| | Estcote Road | ✓ | | ✓ | | | | | 4 |

| own | Location | Not Specified | Overloaded Pumping Station | Overloaded Sewer | Overloaded Sewer and Pumping Station | River | Surface Water | Unknown | Total Records Reported |
|---|---|---|---|---|---|---|---|---|---|
| | Estcote Road/Dugdale Road | ✓ | | | | | | | 1 |
| | Estcote, Dugdale, Hereward Road generally | | | ✓ | | | | | 1 |
| | Gloucester Street | ✓ | | | | | | | 1 |
| | Hereward Road | | | ✓ | | | | | 1 |
| | Melmore Gardens | | | ✓ | | | | | 1 |
| | Queen Elizabeth Road | | | | | | ✓ | | 1 |
| | Siddington Road | | | ✓ | | | | | 1 |
| | Southmead | | | ✓ | | | | | 1 |
| | Spitalgate | | | ✓ | | | | | 1 |
| | The Mead | | | ✓ | | | | | 1 |
| | Thomas Street | ✓ | | | | | | | 1 |
| Kemble | Kemble | ✓ | | | | | | | 1 |
| Lower Slaughter | Mill Lane | | | ✓ | | | | | 1 |
| | Lower Slaughter | | | ✓ | | | | | 2 |
| Naunton | Naunton | | | | ✓ | | | | 1 |
| Somerford Keynes | Elm View | | ✓ | | | | | | 1 |
| South Cerney | Berkeley Close | | | ✓ | | | | | 1 |
| | Bow Wow area | | | | | ✓ | | | 1 |
| | Boxbush Road | | | ✓ | | ✓ | | | 2 |

| own | Location | Not Specified | Overloaded Pumping Station | Overloaded Sewer | Overloaded Sewer and Pumping Station | River | Surface Water | Unknown | Total Records Reported |
|---|---|---|---|---|---|---|---|---|---|
| | Broadway Lane | ✓ | | ✓ | | | | | 3 |
| | Clarks Hay | | | ✓ | | | | | 2 |
| | School Lane | | | | | ✓ | | | 1 |
| | The Limes | | | ✓ | | | | | 1 |
| | Winchcombe Gardens | | | ✓ | | | | | 1 |
| Lechlade | Lechlade | ✓ | | | | | | | 1 |

### A.1.3 July 2007[1]

During the July 2007 event, Cotswold District Council received over 1,150 reports of flooded homes and businesses. Approximately 40% of these properties were located in Moreton-in-Marsh, Bourton-on-the-Water and Chipping Campden to the north of the district. In total, 79 towns and villages across the Cotswold District are known to have been affected by the floods in summer 2007.

Rivers were reported as a source of flooding in 42 of the 79 (53%) locations affected. The River Windrush flooded over 100 homes and businesses in Naunton and Bourton-on-the-Water, while the River Churn flooded parts of Cirencester. The River Thames at Lechlade reached record levels and there were over 100 reports of property flooding at the confluence of the Thames and River Leach. The northernmost part of the District is located within the Avon catchment. The River Cam, a sub catchment of the Avon, caused severe flooding to a number of residential properties and businesses in Chipping Campden.

Some of the areas worst-affected by surface water flooding included Moreton-In-Marsh, Fairford and Whelford. Additionally, Thames Water has identified nine areas where properties were flooded internally by sewers (Fairford, South Cerney, Ampney St Peter, Ampney St Mary, Upper and Lower Slaughter, Moreton-in-Marsh, Bourton-on-the-Water, Quenington). However, it recognises that there were many other areas where sewers caused flooding to gardens and open spaces. Further, groundwater was reported as a source of flooding in nine locations. Blewbury Rd East Hagbourne, report on flooding of 20th July 2007[2]

The flooding followed unprecedented rainfall; the wettest-ever May to July period since national records began in 1766. The Centre for Ecology and Hydrology[3] states that May to July produced hydrological conditions with no close modern parallel for the summer period in England and Wales. Met Office records show that an average of 414mm of rain fell across England and Wales during a three month period - 228mm greater than the average May to July rainfall recorded.

The Environment Agency prepared reports detailing the flooding during the 2007 event in the following areas:

- Buscott and Kelmscott[4]
- Fairford, Whelford Kempsford and Lechlade[5]
- Burford, Bourton-on-the-Water, Naunton, Lower Slaughter[6]
- River Churn and Ampney Brook[7]
- Moreton-in-Marsh, Bledington, Milton-under-Wychwood, Shipton-under-Wychwood, Ascott under- Wychwood, Charlbury and Fawler.[8]

The Environment Agency's review attributed the widespread flooding to be primarily caused by the sheer volume of water and inability of the overloaded drainage systems including drains, ditches, streams and rivers to convey the flood water.

Appendix B Summary Sheets provides further details relating to historic events in particular settlements.

### A.1.4 April 1998[1]

The April 1998 flood event affected small rural areas along the River Evenlode to the west of Kingham.

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[1] CDC (2008) S Strategic Flood Risk Assessment for Local Development Framework Level 1 Volume 1 - FINAL

[2] Hyder Consulting (2008) Review of the Summer 2007 Floods in Cotswold District

[3] http://www.ceh.ac.uk/data/nrfa/index.html

[4] Environment Agency (2008) Buscot & Kelmscott Floods Review July 2007

[5] Environment Agency (2008) Fairford, Whelford, Kempsford & Lechlade Floods Review July 2007

[6] Environment Agency (2008) Lower Cotswolds Floods Review July 2007

[7] Environment Agency (2008) River Churn and Ampney Brook Floods Review July 2007

[8] Environment Agency (2008) Floods Review July 2007 Upper Cotswolds

### A.1.5 October 1993[1]

The October 1993 flood event affected small rural areas along the River Evenlode to the east of Sydenham Farm, west of Daylesford and along the District boundary to the west of Kingham.

### A.1.6 September 1992

The September 1992 flood event mainly affected locations along the River Thames, River Leach, River Churn and Ampney Brook. Along the River Thames, the historic flood outlines extend predominantly onto rural floodplain with some properties located within the historic flood outline at Somerford Keynes and Kempsford. To the East of Southrop, Baxters Farm is located within the historic flood outline for the River Leach; some rural areas along the Ampney Brook by Ampney St Peter and along the River Windrush and a supermarket adjacent to the River Churn are all shown to lie within the September 1992 flood outline.

### A.1.7 August 1977

The August 1977 event also affected locations along the River Thames, but was smaller in magnitude than the March 1947 flood event. The historic flood outlines indicate that flooding was predominantly experienced in rural locations with some flooding to the Mobile Home Park to the east of Lechlade on Thames. The primary cause of the August 1977 flooding was thought to be local drainage problems and surface water.

### A.1.8 July 1968

The July 1968 event occurred on the Knee Brook affecting a number of commercial and residential properties and a sewage works at Chipping Campden. A number of properties were also affected along an unnamed watercourse at Weston-sub-Edge.

### A.1.9 March 1947

The March 1947 flood event that occurred on the River Thames, Flagham Brook, Swill Brook and River Churn flooded parts of the District in both rural and urban locations affecting a number of residential and commercial properties. The main locations affected include properties along the River Thames through Ewen, Somerford Keynes, the Caravan Park by Ashton Keynes, Kempsford and Lechlade on Thames. Along the River Churn a Water Sports Centre and residential properties at Cerney Wick were also affected.

## A.2 Chronology of British Hydrological Events

The table below is extracted from the Chronology of British Hydrological Events (http://www.dundee.ac.uk/geography/cbhe/) filtered to contain events within the study area since 1800.

Table A-4 Chronology of Hydrological Events in Study Area, 1800 to Present

| Year | Month | Quotation | River basin |
|---|---|---|---|
| 1535 | 10 | Cricklade to Lechlade reach: "Of the weir at Watereaton we learn that in October 1535 Sir Walter Stonor....Sheriff of Oxfordshire and Berkshire....wrote to Thomas Cromwell....'I have pulled up the weir of Water Eyton according to the king's commandment.' " [upper Thames] | 039 - Thames |
| 1757 | 1 | "Northleach was reported as being partly flooded by melting snow upon the surrounding hills" | 039 - Thames |
| 1774 | 3 | "Three such dismal days as Monday, Tuesday, and Wednesday last, have scarcely been ever known in this climate. The rains on the two first days have occasioned an inundation that has only been exceeded by the great flood in 1770; the water rose so fast on Thursday, that it was feared we should have been much overflowed as at that memorable time; but it began to sink again on Friday, and in a few days we hope it will return to its usual channel. Nor were the hills less incommoded by Wednesday's snow, than the vale by the floods, for the road between this and Cirencester was entirely blocked up for two days." | 039 - Thames |
| 1789 | 11 | 1789 November 19 p[39]: "This day ... The Severn was united to the Thames by an intermediate canal ascending by Stroud, through the vale of Chalford, to the height of 343 feet, by 40 locks; there entering a tunnel through the hill of Sapertra, for the length of two miles and three furlongs, and descending by 22 locks, it joined the Thames near Lechlade ..." [ha 039, 054] | 039 - Thames |
| 1789 | 11 | 1789 November 19 p[39]: "This day ... The Severn was united to the Thames by an intermediate canal ascending by Stroud, through the vale of Chalford, to the height of 343 feet, by 40 locks; there entering a tunnel through the hill of Sapertra, for the length of two miles and three furlongs, and descending by 22 locks, it joined the Thames near Lechlade ..." [ha 039, 054] | 054 - Severn |
| 1814 | | 1814 winter Cirencester: "The frost commenced the 26th December, 1813; the thermometer (placed against a house in Cirencester and taken at half-past 8 a.m.) fluctuated between 12 [degrees F.] and 22 degrees for the first three weeks; during this period there were two falls of snow about 2 inches deep ... At the beginning of the fourth week ... a fall of 15 inches of snow with deep drifts ...; hard frosts followed, the thermometer falling to 10 degrees on the 25th of January; the wind then shifted to the south and day thaws succeeded by frosty nights followed ... on the 5th we had snow, and then a rapid thaw, leaving only drifts of snow. The frost then resumed and continued with keen winds to the end of February; a slight tendency to thaw in the beginning of March was followed by a week of steady, clear, frosty weather until the 12th, about which time crystals of snow fell, then a week of cold, easterly winds with severe frosts until the 20th March, when a south wind brought mild weather and rain." [ha 039, Churn] | 039 - Thames |

| | | | |
|---|---|---|---|
| 1852 | 9 | 1852 September 4 Further Barton, near Cirencester: "No [well water depth] record was kept as far back as 1852; but on September 4th of that year 2.83 ins. of rain was measured (in a gauge of 9 ins. diameter)." | 039 - Thames |
| 1867 | 11 | 1867 November para 2176 "I have gauged, I believe, every tributary of the Thames in Gloucestershire repeatedly during the last 25 years [to 1877]; [at Lechlade] I gauged the Thames by overfall, which is the most correct way of gauging it, in October and November 1867, at a dry season of the year, with a view to obtaining the summer flow of that stream. The gaugings which I have here for October give an average of 29,000,000 of gallons as the flow of the stream, but the rainfall was somewhat more, being 2.28 inches in October than I found it in November. para 2177. Lord Vernon] During what time was that 29,000,000 of gallons? In 24 hours. I took the flow of the water twice daily during the month of October 1867, between the 18th and 30th of that month. In November the rainfall was but .65 inches, and the mean of a vast number of gaugings is 19,165,041 gallons." | 039 - Thames |
| 1880 | 7 | 1880 July 14 Rainfall observer at Cirencester noted: "A very wet month, the greater part of the rain being in thunder showers. On the evening of the 14th about 1.50 in. fell in less than half-an-hour; many cellars flooded." [ha 039, Churn] | 039 - Thames |
| 1893 | 12 | 1893 December Observer at Cirencester, Further Barton noted p[77]: "The water in a well, 100 ft. deep, which was only 6 inches deep on November 15th, by December 8th had risen to 2 ft. 8 in., on 15th to 10 ft. 6 in., and by 29th to 20 ft." [ha 039] | 039 - Thames |
| 1893 | 10 | 1893 October Observer at Cirencester (Further Barton) noted p[71]: "A well, 100 feet deep had only 1 ft. 3 in. deth of water" [ha 039] | 039 - Thames |
| 1893 | 11 | 1893 November 15 Observer at Cirencester (Further Barton) noted p[33]: "A well, 100 feet deep reached its lowest, when there was only 6 inches of water left." [ha 039] | 039 - Thames |
| 1894 | 11 | 1894 November "... depth of water in a well 100 feet deep at Further Barton, near Cirencester: October 26th 10 ft. 4 ins. November 2nd 37 ft. November 9th 37 ft. 5 ins. November 16th 52 ft. 1 ins. November 23rd 40 ft. 11 ins. November 30th 30 ft. 6 ins." | 039 - Thames |
| 1895 | 5 | 1895 May 24 p[13]: "The Great Western Railway between Minety and Kemble [Glos.] was flooded to a depth of 2 feet." [ha 039, Swill Brook] | 039 - Thames |
| 1896 | 8 | 1896 August 28 Observer at Cirencester (Further Barton), Glos., noted, p[14], “Water in a well 100 ft. deep reduced to 3 ft. 3 in.” | 039 - Thames |
| 1899 | 11 | 1899 November 8 Observer at Cirencester noted, p[98], "Hill springs commenced to run on November 8th" [R. Churn] | 039 - Thames |
| 1900 | 11 | 1900 November Observer at Cirencester noted, p[98], "Although the springs were very full as late as early March, still the drought was severely felt even till November" [R. Churn] | 039 - Thames |
| 1900 | 2 | Rainfall observer at Cirencester (Further Barton) noted: "Excessively wet [month]. Very cold until 15th. The blizzard of 13th and 14th will long be remembered; almost all the roads were blocked. The heavy rain which followed every day afterwards caused severe floods. " [upper Thames] | 039 - Thames |
| 1901 | 12 | 1901 December 14 Observer at Cirencester (Dollarward House) noted, p[83], "After wet weather in the first half of April the rain was never sufficient to affect springs ... till December 14th, an unusually late date ..." [R. Churn] | 039 - Thames |

| | | | |
|---|---|---|---|
| 1904 | 2 | 1904 February 10 Rainfall observer at Cirencester (Further Barton) noted (p[30]) "Extremely wet ... The rain from 7th to 10th, amounting to 2.36 in., caused heavy floods in the Thames." [Upper Thames] | 039 - Thames |
| 1904 | 12 | 1904 December Observer at Cirencester (Further Barton) noted (p[88]) "...wells and springs were remarkably dry as late as the middle of December." [Churn] | 039 - Thames |
| 1905 | 4 | 1905 April Observer, Charles P. Hooker, at Cirencester (Dollarward House) noted in reviewing the year, p[75], "Had the wells not been filled in March and April, water would have been very scarce." [R. Churn] | 039 - Thames |
| 1908 | 4 | 1908 April 27/28 Rainfall observer at Lechlade noted (p[10]) "Rain and melted snow caused floods" | 039 - Thames |
| 1908 | | Cricklade to Lechlade reach: "Thacker writing of Hannington Bridge : ' The river was terribly choked with weeds; and I think most upward craft got stopped here in the summer of 1908...' " [upper Thames] | 039 - Thames |
| 1910 | 6 | 1910 June 7 p[116]: "... an equilateral triangle, about 16 miles in the side, near Chipping Norton and Stow-on-the-Wold, within which more than 2 inches fell. The greater part of this triangle received more than 3 inches, and near the centre a rain gauge at Churchill School recorded 4.25 in." [ha 039, R. Evenlode] | 039 - Thames |
| 1910 | 6 | 1910 June 7 "... at Stow-on-the-Wold the exceptionally heavy fall of 3.55 in. was recorded." [ha 039, Windrush / Evenlode interfluve] | 039-Thames |
| 1911 | 12 | 1911 December Observer, C.P.Hooker, at Cirencester (Dollarward House) noted, p[57], "The heat, sunshine and drought of the summer will be long remembered. Though the last three months were wet, yet the springs never rose till mid-December, and were only full in the last 10 days of the year, and the shortage of water was most severely felt." [R. Churn] | 039 - Thames |
| 1919 | | "The Churn, for instance, rises in seven wells in the Cotswolds. Gaugings have shown that at its source it discharged 31 cubic feet per minute, but went on accumulating as it passed over clays and other retentive soils until at 5.25 miles below its source it discharged 320 cubic feet per minute. After traversing a length of inferior oolite the volume gradually diminished. At 6.5 miles the flow had fallen to 290 cubic feet per minute; at 8.33 [miles] to 113 cubic feet per minute; and at Cirencester it was only 30 cubic feet per minute." NOTE: Although the book from this reference was extracted was originally published in 1919, the precise timing of the records above is not given. | 039 - Thames |
| 1922 | | Local TV news report 14/12/2000 of current flooding of the High Street, Fairford, Glos. said that it was the worst such event since 1922. [lower R. Coln] | 039 - Thames |
| 1923 | 2 | 1923 February p70: "In many places the precipitation was the largest ever known in February, this being the case in records covering 105 years at Ross-on-Wye, 80 years at Cirencester, 70 years at Bristol and 59 years at Wolstaston in Shropshire." A large area from Exmoor to Staffordshire, and in Aberdeenshire and Elgin, exceeded 300% of the 1881-1915 average for February rain. [ha 054, 055, 009, 012] | 054 - Severn |

| | | | |
|---|---|---|---|
| 1929 | 12 | "Extensive Floods at Cirencester Business Premises and Schools Closed Dwelling Houses Evacuated Cirencester, For a week or two extensive sheets of water have been standing in the meadows as the result of the abnormal rainfall of the past few weeks, and a week or ten days ago evidence of the extent of the swelling of the Churn was seen in the collection of water at the junction of Dollar-street and Thomas-street, which made this locality unpleasant for pedestrians. Towards the end of last week it was necessary to improvise a footway of raised planks on either side of the road in order that pedestrians might pass in comparative comfort. Cellars in this locality were generally flooded to a depth of several feet. Sunday saw a more serious state of affairs. Water had reached the furnaces of the heating apparatus of the Parish Church, also of the Congregational Church in Dyer-street, the Baptist Church in Coxwell-street, and the Wesleyan Church in Gloucester-street, and services in each of these buildings were considerably curtailed. The water in the centre of the roadway in Dollar-street rose to a depth of 18 inches and extended for a distance of about 150 yards. On the higher level of Gloucester-street was another great sheet of water, extending for a similar distance, this flowing in full stream from St. John's meadow through the playing ground of Powell's School. In the Whiteway and in Grove-lane there were also knee-deep floods, while the low-lying district of Watermoor also suffered. Fields within the vicinity of the Churn quickly became lakes. Sunday was a day of thunder storms and heavy downpours and many people who re-mained indoors were surprised to see the conditions which met their gaze on Monday morning, when rain continued to fall. Coxwell-street and Thomas-street were also affected by this time, and in many houses in these streets the inhabitants were forced to remain upstairs. Dams of brick and cement were hastily erected on doorsteps to keep back the flood, but the water continued to rise. The lower rooms of Powell's Schools were under several inches of water, and the schools were closed. The school house, too, was flooded, and Mr Henderson and his family had to seek shelter elsewhere. For several hundred yards in Gloucester-street dwellings were flooded, a similar state of things existing in the Whiteway Thomas-street, and Coxwell-street, and Purley-road were also grievously affected. The distress was sudden and great, many families being forced to remain in their upper rooms without fire or food. Immediate steps were taken to relieve cases of distress. On Tuesday, some houses water reached a level of three feet on the ground floor. The basements of any business houses have been flooded but the outstanding instance of interference to trade is that of Mr. J. M. Legg proprietor of Leggs Stores in Dollar-street, and of the Peoples Stores on the opposite side of the road, who has been seriously incommoded. When the flooding first became apparent Mr. Legg had everything in his shops raised to a level of twelve inches above the floor. On Monday morning, however, he found his shop flooded to a depth of 16 inches, and large quantities of his stock entirely spoilt in both establishments. | 039 - Thames |
| 1936 | 12 | "The Autumn of 1935 was unusually wet and in December the low-lying lands were generally in waterlogged condition. Shortly before Christmas there occurred a cold spell during which a layer of snow accumulated. During the lasr few days of December heavy rain set in and this joined with the melting snow caused extensive flooding.. The Thames was running bank high with further heavy rains on the 29th and 30th December, causing many thousands of acres to be under water in the Lechlade and Radcot areas. The heavy rains continued on the 31st December and many main roads in the Thames Valley became impassable.... " [upper Thames] | 039 - Thames |

# B Potential development area flood risk summary sheets

## B.1 Introduction

The following sections include summaries for the 20 key settlements in Cotswold District. Note that Cirencester and Siddington have been grouped together due to their proximity. These should be read in conjunction with the settlement maps provided alongside this report.

The information given is based on national and detailed mapping provided by the Environment Agency, and local evidence provided by the Councils.

The following points should be noted when interpreting the maps:

- Flood Zone 3a and Flood Zone 2 are based on the national Flood Map provided by the Environment Agency.
- Flood Zone 3b is based on the 20 year flood extent where there is detailed model information. Where no detailed information is available, Flood Zone 3a is used as a precautionary approach.
- Flood Zone 3a with climate change is based on the 100 year plus climate change flood extent where there is detailed model information. Where no detailed information is available, Flood Zone 2 is used as a precautionary approach.
- Flood Zone 2 plus 10m buffer is provided at CDC's request as a rough indicator of the impact of climate change on Flood Zone 2 for information only.
- The updated Flood Map for Surface Water (uFMfSW) is shown on a 1:50,000 map background at a 1:10,000 scale (or smaller), as stipulated by the guidance notes provided by the Environment Agency.
- The Areas Susceptible to Groundwater Flooding (AStGWF) map is very broad-scale on a 1km grid.
- The Detailed River Network shows all known watercourses, including those with catchment areas less than 3km², which may be too small to be included in the national Flood Map. Proximity to a small watercourse should be considered an indicator that there may be a flood risk.

## B.2 Andoversford

| Potential Development in Andoversford | | |
|---|---|---|
| **Total number of potential development sites within Andoversford:** 2 | **Proposed use**<br>Housing | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed). SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Andoversford** | To view potential development sites, refer to Map 1, and select Andoversford.<br>• Two potential development sites identified in the SHLAA | |

| Summary of flood risk to Andoversford | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | River Coln and unnamed tributary | |
| **Historic Flooding** | • July 2007 - 24 properties were flooded in the village of Andoversford due to a combination of river, groundwater and surface water flooding (1)<br>• 1979 - Anecdotal evidence from a resident suggests that flooding occurred (1) | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance and floodplain flows of the River Coln and unnamed tributary.<br>• Urban drainage - sewers, drains and gullies<br>• Surcharged culverts<br>• Roads and paths<br>• Surface water runoff - e.g. Manor Farm Field | • Domestic houses and commercial properties<br>• Manor Farm Field<br>• Livestock Market<br>• Andoversford Primary School<br>• Car park of the Royal Oak public house<br>• T H White site<br>• Roads such as:<br>- Hunters Way<br>- Station Road<br>- Gloucester Road<br>- A40 |
| **Flood Warning** | Andoversford is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Flood Zones are based on broad-scale JFLOW modelling. A 1D HEC-RAS model of River Coln and tributary was completed as part of the Andoversford Flood Study (Hyder, 2009) commisioned by CDC after the 2007 floods to examine possible flood alleviation options. The model does not cover any proposed sites. The model was not considered fit for purpose to provide flood extents to replace the Flood Zones, but has been used to inform on flood mechanisms, depths and hazards. | |
| **Flood Defences** | No known flood defences. Several structures and culverts may have an effect on flows and levels, including the culvert under the TH White site, which surcharged in 2007. | |

**Fluvial flood risk:**
Map 1 (Andoversford) shows the fluvial flood risk in Andoversford. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Hydraulic modelling has shown that flood depths around the Gloucester Road area are likely to be between 0.05m and 0.31m in a 100 year plus climate change event (1).

**Surface Water flood risk:**
Map 2 (Andoversford) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. There is no local evidence of notable surface water flooding problems at Andoversford, although some surface water runoff from fields to the west contributed to flooding in 2007. The uFMfSW follows the River Coln and its tributary continuing south parallel to the A40.

**Groundwater flood risk:**
Map 2 (Andoversford) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Andoversford) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register. No local evidence of foul sewer flooding

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the Coln and its tributary. Model results results indicate that fluvial flooding in Gloucester Road and Station Road would increase slightly in extent under a climate change scenario.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Andoversford - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Birdlip Limestone Formation and Whitby Mudstone Formation |
| **Superficial Deposits** | | Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control |
| Infiltration |  | Mapping suggests permeability at this site, a site investigation should be carried out to assess potential for drainage by infiltration. |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Andoversford - Implications for development**

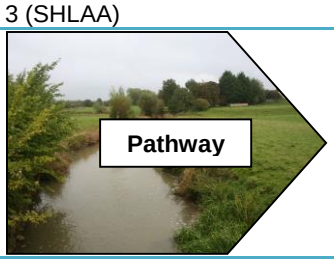
- Sites greater than 1ha in Flood Zone 1 require a full FRA.
- A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
- CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
- The effect of blockage of culverts should be considered as part of a FRA where appropriate.
- Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
- A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
- Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
- The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
- Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
- For major developments, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**
All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.3 Blockley

| Potential Development in Blockley | | |
|---|---|---|
| **Total number of potential development sites within Blockley:** 5 | **Proposed use**<br>Housing | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed). SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Blockley** | To view potential development sites, refer to Map 1, and select Blockley.<br>• Five potential development sites identified in the SHLAA | |

| Summary of flood risk to Blockley | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Blockley Brook | |
| **Historic Flooding** | • July 2007 - Estimated 5-10 properties flooded. Flooding was from the river and rapid surface water runoff (2)<br>• A highway drain blockage led to flooding of properties in Mill Close in April/May 2013. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>3 (SHLAA) | **FZ3:**<br>4 (SHLAA) |
|  |  |  |
| • Heavy rainfall<br>• Fluvial<br><br>**Source** | • Surface water runoff<br>• Channel exceedance of Blockley Brook and its floodplains<br>• Roads and paths | • Domestic houses and commercial properties<br>• Isolated ponding at the Recreation Grounds<br>• Roads such as:<br>-Station Road<br>-Northcot Lane<br>-Chapel Lane<br>-School Lane<br>-Lower Street<br>-Days Lane<br>-High Street<br>-Brook Lane |
| **Flood Warning** | No Environment Agency flood warning within this area. | |
| **Available survey/detailed modeling** | Flood Zones are based on broad-scale JFLOW modelling. | |
| **Flood Defences** | There are several sluices which act as flow controls through village. CDC are currently investigating ways to improve their operation. | |

**Fluvial flood risk:**
Map 1 (Blockley) shows the fluvial flood risk in Blockley. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** The fluvial floodplain of Blockley Brook is narrow and confined by topography. The Flood Zone is slightly misaligned in places but this does not affect any proposed sites. Flows are likely to be high velocity and therefore medium to high hazard depending on depths, but risk to people is minimal beyond the narrow confined floodplain.

**Surface Water flood risk:**
Map 2 (Blockley) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. There is no local evidence of notable surface water flooding problems at Blockley, although a highway drain blockage led to flooding of properties in Mill Close in April/May 2013. The uFMfSW describes flow paths that follow the line of the Blockley Brook and its tributaries.

**Groundwater flood risk:**
Map 2 (Blockley) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Blockley) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register. No local evidence of foul sewer flooding

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the Blockley Brook, although the flood extent is not likely to increase significantly due to the confined topography.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Blockley - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Charmouth Mudstone Formation |
| **Superficial Deposits** | | Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Blockley - Implications for development**

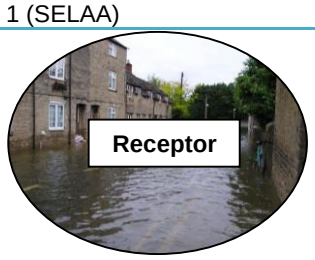
• Any site that falls within Flood Zone 2 or 3 will require an FRA in order to demonstrate how a potential development will mitigate against flood risk from all sources.
• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**
All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and 5-3 in the SFRA. The following sites will be required to pass an Exception Test in accordance with NPPF:
• BK_5, BK_14A, BK14B - All large sites with watercourse and Flood Zone 3b, 3a, 3a+CC, 2 running along borders. No model. More vulnerable development would not be permitted in Flood Zone 3b and sequential planning of the site to ensure that built development would be within Flood Zone 1 would be necessary.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.4 Bourton on the Water

| Potential Development in Bourton on the Water | | |
|---|---|---|
| **Total number of potential development sites within Bourton on the Water:** 5 | **Proposed use**<br>Housing and economic | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Bourton on the Water** | To view potential development sites, refer to Map 1, and select Bourton on the Water.<br>• Two potential development sites identified in the SHLAA<br>• Three potential development sites identified in the SELAA<br>• One potential development site is designated for use as a car park. | |

| Summary of flood risk to Bourton on the Water | | |
|---|---|---|
| **Main River** | River Dickler<br>River Eye (lower)<br>River Windrush | |
| **Ordinary Watercourse** | River Eye (upper)<br>Unnamed drains | |
| **Historic Flooding** | • July 2007 - Estimated 95- 100 properties flooded. Flooding was from extensive flooding from the River Windrush, rapid surface water runoff and overloaded sewers (2)<br>• November 2012 - One property on Rissington Road flooded from an overloaded sewer due to excess water running off the fields (3) | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>1 (SELAA) | **FZ3:**<br>1 (SELAA) |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance and floodplain flows.<br>• Urban drainage - sewers, drains and gullies.<br>• Roads and paths<br>• Surface water runoff e.g. Clapton Fields | • Domestic houses and commercial properties<br>• The Cotswold School<br>• Nethercote<br>• Landsdowne<br>• Birdland<br>• Conigers<br>• Roads such as:<br>- Sherbourne Street<br>- Sherbourne Terrace<br>- High Street<br>- Old Gloucester Road<br>- Letch Hill Drive<br>- Victoria Drive<br>- Rissington Road<br>- Roman Way |
| **Flood Warning** | Bourton on the Water is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | An ISIS-TUFLOW model of the River Windrush through Bourton on the Water was built by the Environment Agency for the purposes of updating the Flood Zones, and released in December 2015 (22). The Flood Zones of the River Dickler and River Eye are based on broadscale JFLOW modelling. | |
| **Flood Defences** | • The Environment Agency completed a flood alleviation scheme (in conjunction with GCC) 2009/10.<br>• CDC are planning a small scheme at Rissington Road to improve the existing | |

| | |
|---|---|
| | surface water (SW) issue, there is no final design yet (August 2013).<br>• Flood defences have been identified within the area. River Windrush benefits from bank protection along its course through Bourton on the Water (20)<br>• There are culverts present at Rissington Bridge and at the Mill House (20)<br>• There are raised defences between Bourton Bridge and Sherbourne Street. There is also a raised defence located on the Rissington Road (20)<br>• River control structures on the River Windrush are located D/S of Bourton Bridge; at Mill House; to the rear of the Motor Museum and U/S of Sherbourne Street (20) |

**Fluvial flood risk:**
Map 1 (Bourton on the Water) shows the fluvial flood risk in Bourton on the Water. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** No depth or hazard outputs were available from the River Windrush model. The fluvial floodplain of the River Windrush and Dikler Brook are relatively wide, and it is likely that depths and hazards could be moderate to significant in some locations.

**Surface Water flood risk:**
Map 2 (Bourton on the Water) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
Local evidence suggests that properties opposite Birdland are at risk from surface water runoff from fields. The uFMfSW follows the line of the existing floodplain of the local watercourses. There is some isolated ponding including a large area in the playing fields at Cotswold School, Roman Way, Pockhill Lane and the industrial parks along Bourton Link. Flow routes along roads are evident at Victoria Street and Moore Road.

**Groundwater flood risk:**
Map 2 (Bourton on the Water) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is mostly in the highest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Bourton on the Water) illustrates the incidents of sewer flooding recorded in CDC. There are known problems with sewer flooding. Reports from CDC describe there are with blockages and a pump in Lower Slaughter. Thames Water identified Bourton on the Water as an area where properties experienced internal sewer flooding in the 2007 event (2).

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the River Windrush and other watercourses. The River Windrush model shows a significant increase in outline particularly around the Sherbourne Street / Broadlands area for the +20% climate change scenario.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.
In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

**Bourton on the Water - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Charmouth Mudstone Formation |
| **Superficial Deposits** | | Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Bourton on the Water - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.

• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

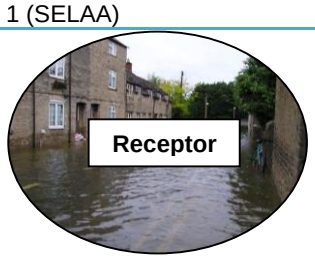
**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.5 Chipping Campden

| Potential Development in Chipping Campden | | |
|---|---|---|
| **Total number of potential development sites within Chipping Campden:** 15 | **Proposed use**<br>Housing and economic | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Chipping Campden** | To view potential development sites, refer to Map 1, and select Chipping Campden.<br>• Twelve potential development sites identified in the SHLAA<br>• Three potential development sites identified in the SELAA | |

| Summary of flood risk to Chipping Campden | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Knees Brook<br>The Cam<br>Unnamed Drains | |
| | • 1947 - Serious floods occurred across the region (3)<br>• In the 50s and 60s - Park Road has periodically suffered from lesser floods (3)<br>• July 1968 – Flooding occurred in Chipping Campden from the River Cam (2)<br>• June and July 1982- Flash flooding was reported, over 140 properties were affected (3)<br>• 1993 – Minor flooding on Park Road (3)<br>• July 2007 – Estimated 115 – 120 properties flooded. Sources were the River Cam, rapid surface water runoff and overloaded sewers/ drains (2)<br>• November 2012 - One garden at Catbrook was flooded. The road B4035 from Chipping Campden to Shipston on Stour was closed off Cider Mill Lane due to flooding (3)<br>Local evidence suggests that a lack of maintenance of watercourses and drains in the area has contributed to flooding in the past, and that blockage of culverts has increased flood risk in past events. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>1 (SELAA) | **FZ3:**<br>1 (SELAA) |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance and floodplain flows.<br>• Urban drainage - sewers, drains and gullies.<br>• Roads and paths | • Domestic houses and commercial properties<br>• Chipping Campden School<br>• Westingham Mill<br>• Littleworth<br>• Roads such as:<br>- Blind Lane<br>- Park Road<br>- Westend Terrace<br>- Lower High Street<br>- Sheep Street<br>- Calf's Lane<br>- Leysbourne<br>- Aston Road<br>- Rissington Road<br>- Roman Way |
| **Flood Warning** | No Environment Agency flood warning service within this area. | |
| **Available survey/detailed modeling** | A 1D/2D ESTRY-TUFLOW model of River Cam, Landgate Drain and the surface water network was built as part of the Chipping Campden Flood Risk | |

| | |
|---|---|
| | Management Study (MWH, 2009), commisioned by CDC after the 2007 floods to examine possible flood alleviation options. (15) The model does not cover any proposed sites. Because it includes surface water it is not possible to directly use the results to replace the Flood Zones, however information on flooded areas, depths, hazards and velocities has been included in the SFRA. |
| **Flood Defences** | • A CDC scheme was recently completed - a bund was built at the back of the mill at this junction helping attenuate water upstream at bathing pool (standard of protection approx 10 years)<br>• There are several structures which influence flow and levels, including the Blind Lane/Dyer's Lane culverts and the Guild Twin culvert. CDC and GCC have a maintenance regime for preventing and clearing critical structures from blockages. |

**Fluvial flood risk:**
Map 1 (Chipping Campden) shows the fluvial flood risk in Chipping Campden. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** The Flood Risk Management Study estimated that depths across the floodplain and overland flow paths are typically less than 0.2m at the peak of the 100 year + CC flood. However floodwater depths above this range occur in the worst affected areas, such as Sheep Street, Park Road and Blind Lane (15)

**Surface Water flood risk:**
Map 2 (Chipping Campden) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
Surface water has formed a major component of previous severe flood events (e.g. 2007), particularly ponding on Park Road, High Street and Calf's Lane, overland flow to Sheep Street from Conduit Hill and backing up of the surface water system during high levels in the River Cam. The uFMfSW follows the route of the existing drains and local watercourses within Chipping Campden. Roads such as Dyers Lane, Aston Road and Leysbourne are indicated as pathways along with some isolated ponding.

**Groundwater flood risk:**
Map 2 (Chipping Campden) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is mostly in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Chipping Campden) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register. No local evidence of foul sewer flooding

**Effects of climate change:**
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.
In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

**Chipping Campden - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Dyrham Formation |
| **Superficial Deposits** | | Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Chipping Campden - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood

Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, or where sewer flooding is a problem, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.6 Cirencester & Siddington

| Potential Development in Cirencester & Siddington | | |
|---|---|---|
| **Total number of potential development sites within Cirencester & Siddington:** 21 | **Proposed use**<br>Housing and economic | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Cirencester & Siddington** | To view potential development sites, refer to Map 1, and select Cirencester & Siddington.<br>• Twelve potential development sites identified in the SHLAA<br>• Nine potential development sites identified in the SELAA<br>• Eleven potential development sites are designated for use as car parks | |

| Summary of flood risk to Cirencester & Siddington | | |
|---|---|---|
| **Main River** | Churn,<br>Daglingworth Stream,<br>Gumstool Brook,<br>Abbey Ground Lake Channel | |
| **Ordinary Watercourse** | Barton Mill Channel | |
| **Historic Flooding** | • December 1929 – Nine streets flooded after prolonged wet autumn (5).<br>• March 1947 – Parts of Cirencester flooded in snowmelt flood that affected the whole Thames catchment (5).<br>• 1990 - River Churn – several residential properties affected at Watermoor (6)<br>• December 2000/Jan 2001- properties, roads and gardens affected in Cirencester and Siddington (6)<br>• Jan 2003 – One property flooded in the Watermoor area (6)<br>• July 2007 - Estimated 15-20 properties flooded in Chesterton area and 40-45 in Watermoor and other areas plus 1-5 in Siddington. Flooding was from the River Churn and rapid surface water runoff (2)<br>• November/December 2012 - Around 45-50 properties flooded due to high levels in River Churn causing urban drainage network to back up.<br>• Winter 2013/14 - Similar flooding problems with high levels in River Churn causing urban drainage network to back up. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>1 (SHLAA)<br>2 (SELAA) | **FZ3:**<br>1 (SHLAA)<br>2 (SELAA) |
|  |  |  |
| • Heavy rainfall<br>• Fluvial (predominantly driven by groundwater inputs, typically long duration events)<br>• Blockages in urban drainage<br>• Reservoir (The Lake) | • Channel exceedance and floodplain flows from the River Churn and tributaries.<br>• Urban drainage - sewers, drains and gullies.<br>• Surface water runoff e.g. fields on north side of Swindon Road | • Domestic houses and commercial properties (for e.g. Tesco)<br>• Mill Place<br>• Powell's School<br>• Abbey Grounds<br>• City Bank recreation ground.<br>• Kingsmead<br>In Cirencester, roads such as:<br>- Barton Lane<br>- Spitalgate Lane<br>- Trafalgar Road<br>- Hereward Road<br>- Hakeburn Road<br>- Beeches Road<br>- London Road<br>- Countess Lillias Road |

| | | |
|---|---|---|
| | | - Siddington Road<br>- Rose Way<br>- Cherry Tree Drive<br>- Cricklade Road<br>- Swindon Road<br>In Siddington, roads such as:<br>- South Cerney Road<br>- The Common<br>- Park Way |
| **Flood Warning** | Cirencester and Siddington are within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Cirencester and Siddington are within the area covered by the River Churn ISIS-TUFLOW model (Environment Agency, last updated 2011) (16) | |
| **Flood Defences** | • There are a number of control structures on the River Churn through Cirencester (Gloucester Road sluices, Barton Mill sluice, Gumstool Brook sluice and New Mill sluices). The Environment Agency have made improvements to formalise their operation for flood risk management.<br>• The first phase of the Churn Flood Risk Management Strategy, which included local improvements, has been completed. The next phase will focus on the maintenance and renewal of existing flood defence assets with the storage area a possible longer term option.The general standard of protection is 3.3% AEP (1 in 30) and up to 1.33% AEP (1 in 75) at Watermoor. A flood storage scheme has been proposed upstream of Cirencester as a longer term option if funding can be secured.<br>• Culverts under the Spitalgate Lane area are suspected to have been blocked in the 2012 event. This is currently under investigation by the Environment Agency.<br>• Culverts are present at Abbey Grounds/Park Street, at the end of Barton Lane, Hereward Road, Spitalgate Lane and The Plough. Gloucester Road.<br>• River Churn benefits from bank protection along its course through Cirencester, specifically at the Abbey Grounds to Corinium Gate; London Road Cirencester, at Mitsubishi Motors, Watermoor; The Willows, City Bank Lane; and at Riverside Walk off Thomas Street. | |

**Fluvial flood risk:**
Map 1 (Cirencester & Siddington) shows the fluvial flood risk in Cirencester & Siddington. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Map 1 shows the results of hydraulic modelling on the River Churn, including depth and hazard layers for the 100 year plus climate change event. Depths through the built areas of town are generally under 0.3m except in areas of ponding such as school fields and the Watermoor area. Hazards are generally low at the 5% AEP, low to moderate at the 1% AEP and moderate at the 0.1% AEP. The highest hazards are in open areas where water ponds to significant depths. Blockage of culverts on the River Churn in the Spitalgate Lane area may have contributed to fluvial flood risk.

**Surface Water flood risk:**
Map 2 (Cirencester & Siddington) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
Surface water runoff from the highways and urban area contributes to the exceedence of capacity in the surface water sewers, particularly in the Spitalgate area. The uFMfSW shows isolated areas of ponding and road flooding across Cirencester, and a distinct flow path through residential areas in the north east.

**Groundwater flood risk:**
Map 2 (Cirencester & Siddington) describes the Area Susceptible to Groundwater Flooding (AStGWF). The River Churn's catchment is highly permeable and its flows are predominantly driven by high groundwater levels. This was demonstrated in the November/December 2012 event, when river levels were maintained at a high level for a long period of time. The Environment Agency's log of groundwater related incidents has several entries in the Cirencester area where flooding of cellars and flooding from under floors has been reported. The AStGWF map suggests a varied risk (low to high risk) of groundwater flood emergence, with the highest risk indicated in Upper Siddington.

**Reservoir flood risk:**
The Environment Agency's Risk of Flooding from Reservoirs map (REF) suggests there is a risk of reservoir flooding from The Mansion Lake at Cirencester Park. If this failed, flooding would affect the area around the A419 junction, and flow across town roughly between Sheep Street/Trinity Road and Watermoor Road before joining the River Churn floodplain.

**Sewer flood risk:**
Map 2 (Cirencester & Siddington) illustrates the incidents of sewer flooding recorded in CDC. A significant pathway of flooding in November 2012 was surcharging of the surface water sewer network due to high river levels in the River Churn. This affected the Spitalgate/Trafalgar Road area. Some properties were also affected by foul sewer flooding. The Thames

Water sewer flooding register has aa total of 27 incidents in postcode area GL7 1 and 5 in GL7 2.

**Effects of climate change:**

Climate change is likely to increase the frequency and severity of fluvial flooding from the River Churn. Hydraulic modelling of the River Churn through Cirencester and Siddington (16) predicts an increase in the 100 year flood outline with climate change, particularly affecting the London Road and Purley Road areas.

Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

**Cirencester & Siddington - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Forest Marble Formation |
| **Superficial Deposits** | | Gravel; and Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Cirencester & Siddington - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• An FRA should include a full investigation of groundwater flood risk. For major developments, groundwater monitoring should be carried out for a suitable period.
• For major developments, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and 5-3 in the SFRA. The following sites will be required to pass an Exception Test in accordance with NPPF:

• C-89 - Falls within Flood Zone 3a, 3a+CC and 2. Highly Veulnerable development is not permitted in Flood Zone 3a. More Vulnerable development would be required to pass the Exception Test. Covered by River Churn model. Northern side of site is inundated in a 100+CC event. Depths are <0.2m in a 100+CC event, <0.5m in a 1000yr, hazard low in a 100+CC, low to medium in a 1000yr. It would be possible to provide safe access and egress at ground level to Victoria Road in a 1000 year event. Site design would need to be safe and not increase flood risk elsewhere to pass the Exception Test.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.7 Down Ampney

| Potential Development in Down Ampney | | |
|---|---|---|
| **Total number of potential development sites within Down Ampney:** 6 | **Proposed use**<br>Housing | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed). SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Down Ampney** | To view potential development sites, refer to Map 1, and select Down Ampney.<br>• Six potential development sites identified in the SHLAA | |

| Summary of flood risk to Down Ampney | | |
|---|---|---|
| **Main River** | Ampney Brook | |
| **Ordinary Watercourse** | Unnamed Drains, Poulton Brook | |
| **Historic Flooding** | • July 2007 – Estimated 5 – 10 properties flooded. Flooding may have been as a result of the Ampney Brook or the Poulton Brook; rapid surface water runoff and failure of the sewage pumping station. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance and floodplain flows from the River Churn and tributaries (Poulton Brook).<br>• Urban drainage - sewers, drains and gullies.<br>• Surface water runoff | • Domestic houses and commercial properties (for e.g. Manor House)<br>• Fields to west of the village Road such as<br>-Down Ampney Road |
| **Flood Warning** | Down Ampney is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Flood Zones are based on broad-scale JFLOW modelling. | |
| **Flood Defences** | No known flood defence or assets affecting flows or levels. | |

**Fluvial flood risk:**
Map 1 (Down Ampney) shows the fluvial flood risk in Down Ampney. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** The River Churn and Ampney Brook 2007 flood review (6) suggests that fluvial flooding may have been exacerbated by
• Poor ditch maintenance by Riparian owners.
• Lack of river maintenance.
• A pinch point in the watercourse near the village increases risk to the village.

**Surface Water flood risk:**
Map 2 (Down Ampney) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. Highway drainage is highlighted as a problem in the 2007 flood review, in particular an old stone highway culvert which surcharges and has caused road flooding in the past. The uFMfSW indicates a low risk of surface water flooding in Down Ampney.

**Groundwater flood risk:**
Map 2 (Down Ampney) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests that most of the area is identified as having a medium risk of groundwater flood emergence, probably due to its proximity to the River Thames alluvial gravels. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**

Map 2 (Down Ampney) illustrates the incidents of sewer flooding recorded in CDC. Thames Water records suggest there are issues with sewer flooding in the postcode sector (GL7 5) which includes Down Ampney. This does not necessarily mean there have been issues in Down Ampney. No local evidence of sewer flooding was found.

**Effects of climate change:**

Climate change is likely to increase the frequency and severity of flooding from the Ampney Brook, although the flood extent is not likely to increase significantly.

Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

| Down Ampney - Suitability of SuDS | | |
|---|---|---|
| **Bedrock Geology** | | Oxford Clay Formation |
| **Superficial Deposits** | | Sand and Gravel; and Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Down Ampney - Implications for development**

- Sites greater than 1ha in Flood Zone 1 require a full FRA.
- A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
- CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
- The effect of blockage of culverts should be considered as part of a FRA where appropriate.
- Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
- A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
- Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
- The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
- Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
- For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.8 Fairford

| Potential Development in Fairford | | |
|---|---|---|
| **Total number of potential development sites within Fairford:** 4 | **Proposed use**<br>Housing | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed). SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Fairford** | To view potential development sites, refer to Map 1, and select Fairford.<br>• Four potential development sites identified in the SHLAA | |

| Summary of flood risk to Fairford | | |
|---|---|---|
| **Main River** | River Coln, River Thames | |
| **Ordinary Watercourse** | Court Brook, Unnamed Drains | |
| **Historic Flooding** | • December 2000 - eight properties were flooded at the eastern end of Milton Street, 5 properties were flooded in Whitehart Court and gardens were flooded at Courtbrook (18)<br>• July 2007 - Estimated 60+ properties flooded (18). Flooding was as a result of flooding from the River Coln, rapid surface water runoff (RAF Fairford) and overloaded sewers. In addition there were concerns that the RAF air base had pumped a lot of water off the base (2) & (7).<br>. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance and floodplain flows.<br>• Urban drainage - sewers, drains and gullies.<br>• Surface water runoff<br>• Roads and paths | • Domestic houses and commercial properties<br>• Fairford Church of England Primary School<br>• Roads such as:<br>- Milton Street<br>- Coronation Street<br>- Bridge Street<br>- Lakeside<br>- Mill Lane<br>- Park Street<br>- London Street<br>- Lower Croft Road<br>- Aldsworth Close<br>- White Heart Court<br>- A417<br>- Back Lane<br>- Moor Lane<br>- East End<br>- Courtbrook<br>- Waterloo Meadows |
| **Flood Warning** | Fairford is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Flood Zone 3b, 3a and 3a+CC and 2 are based on a detailed 1D-2D ISIS-TUFLOW model of the Upper Thames (covering the Thames Main River Limit to St John's) which was completed in 2014 (18). Flood Zone 2 also incorporates historical flood outlines where these are more extensive than the modelled outlines. | |
| **Flood Defences** | • There are a series of measures on the River Windrush to prevent water | |

| | |
|---|---|
| | flooding property on Milton St, Back Lane, Court Brook; this involves the containment of high flows.<br>• There is Property Level Protection for nine properties at Court Brook.<br>• There is a bund upstream of Milton Street.<br>• The Environment Agency completed a scheme in Milton Street, the estimated Standard of Protection (SoP) is 1 in 100-year.<br>• Flood Action Plans have been prepared<br>• There are five control structures near Fairford Mill in order to mange local sluices. There are varying regimes within summer and winter. |

**Fluvial flood risk:**
Map 1 (Fairford) shows the fluvial flood risk in Fairford. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Map 1 shows the results of hydraulic modelling on the River Coln (18) including depth and hazard layers for the 100 year plus climate change event. Depths through the town are generally less than 0.3m and hazard is low, with small areas of moderate hazard.

**Surface Water flood risk:**
Map 2 (Fairford) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. Records of flooding from 2007 suggest that surface water flooding was a sigificant problem, particularly at RAF Fairford. The uFMfSW does not particularly reflect this historical evidence, showing low risk in most of Fairford. Overland flow routes indicate pathways which follow existing drains and certain roads including Coronation Street and Milton Street, and roads at East End.

**Groundwater flood risk:**
Map 2 (Fairford) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests that most of the area is identified as having a high risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Fairford) illustrates the incidents of sewer flooding recorded in CDC. There are known problems with foul sewer flooding. Residents reported repeated incidents of sewer flooding (2000, 2003 and 2007). Thames Water identified Fairford as an area where properties experienced internal sewer flooding in the 2007 event (2).

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of fluvial flooding from the River Coln. Hydraulic modelling of the River Coln through Fairford (18) predicts an increase in the 100 year flood outline with climate change, particularly in the Courtbrook area.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.
In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

**Fairford - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Kellaways Clay Member |
| **Superficial Deposits** | | Sand and Gravel; and Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Fairford - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.

| |
|---|
| • Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.<br>• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.<br>• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.<br>• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.<br>• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.<br>• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary. |
| **Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**<br>All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required. |

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.9 Kemble

| Potential Development in Kemble | | |
|---|---|---|
| **Total number of potential development sites within Kemble:** 3 | **Proposed use**<br>Housing | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed). SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Kemble** | To view potential development sites, refer to Map 1, and select Kemble.<br>• Three potential development sites identified in the SHLAA | |

| Summary of flood risk to Kemble | | |
|---|---|---|
| **Main River** | Thames | |
| **Ordinary Watercourse** | Unnamed drains | |
| **Historic Flooding** | • December 2012 - Minor flooding affected one property. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial<br>• Blockages in urban drainage | • Channel exceedance and floodplain flows of the Upper Thames and Unnamed Drains<br>• Urban drainage - sewers, drains and gullies.<br>• Roads and paths<br>• Surface water run off from fields | • Domestic houses and commercial properties<br>• Isolated ponding at Glebe Lane<br>• Roads such as:<br>-Windmill Road<br>-A429<br>-Parker's Bridge<br>-Glebe Lane |
| **Flood Warning** | Kemble is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Flood Zone 3b, 3a and 3a+CC and 2 for the River Thames are based on a detailed 1D-2D ISIS-TUFLOW model of the Upper Thames (covering the Thames Main River Limit to St John's) which was completed in 2014 (18). Flood Zone 2 also incorporates historical flood outlines where these are more extensive than the modelled outlines. Flood Zones for unnamed drains are based on broad-scale JFLOW modelling. | |
| **Flood Defences** | • Flood defence located at Parkers Bridge on the Upper Thames. | |

**Fluvial flood risk:**
Map 1 (Kemble) shows the fluvial flood risk in Kemble. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Map 1 shows the results of hydraulic modelling on the upper River Thames (18) including depth and hazard layers for the 100 year plus climate change event. Depths and hazards are low.

**Surface Water flood risk:**
Map 2 (Kemble) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. There is no local evidence of notable surface water flooding problems at Kemble. The uFMfSW indicates a low risk of surface water flooding, with small areas of ponding.

**Groundwater flood risk:**
Map 2 (Kemble) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Kemble) illustrates the incidents of sewer flooding recorded in CDC. Thames Water records suggest there are issues with sewer flooding in the postcode sector (GL7 6) which refers to Kemble. This does not necessarily mean there have been issues in Kemble, but there are records of sewer flooding within postcode sector GL7 6.

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of fluvial flooding from the River Thames and unnamed drains. Hydraulic modelling of the upper Thames (18) predicts an increase in the 100 year flood outline with climate change towards Ewan, but this does not impact any existing areas of Kemble.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.
In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

**Kemble - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Forest Marble Formation |
| **Superficial Deposits** | | Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Kemble - Implications for development**

• Any site that falls within Flood Zone 2 or 3 will require an FRA in order to demonstrate how a potential development will mitigate against flood risk from all sources.
• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**
All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.10 Lechlade

| Potential Development in Lechlade | | |
|---|---|---|
| **Total number of potential development sites within Lechlade:** 4 | **Proposed use** Housing and economic | **Flood risk vulnerability** More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Lechlade** | To view potential development sites, refer to Map 1, and select Lechlade.<br>• Two potential development sites identified in the SHLAA<br>• Two potential development sites identified in the SELAA | |

| Summary of flood risk to Lechlade | | |
|---|---|---|
| **Main River** | River Thames | |
| **Ordinary Watercourse** | Downington Ditch<br>Little Lemhill Drain | |
| **Historic Flooding** | • 1908 & 1935 - Rain and melted snow caused floods (2)<br>• 1998 to 2013 - Flooding on the A417 and adjacent land has occurred five times between 1998 and present; properties and gardens have been affected.<br>• July 2007 - Estimated 130-140 properties flooded (over one-third of the reports of property flooding in Lechlade relate to garden sheds). Flooding was caused by a combination of fluvial and surface water flooding (2).<br>• November 2012 - St Johns Priory Park was flooded; no property was reported as being affected. Reports describe that the sewage system was struggling to cope with the heavy rainfall and excess surface water. Lechlade Road (near Garden Centre) was flooded (3).<br>• Winter 2013/14 - further problems with sewer system. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>2 (SHLAA) | **FZ3:**<br>1 (SHLAA) |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance, floodplain flows and blocked culverts.<br>• Urban drainage - sewers, drains and gullies.<br>• Surface water runoff - from Warren's Cross and surrounding fields<br>• Roads and paths (particularly the A417) | • Domestic houses and commercial properties<br>• Riverside Marina<br>• Little London<br>• Roads such as:<br>- Thames Street<br>- Warren Cross |
| **Flood Warning** | Lechlade is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Flood Zone 3b, 3a and 3a+CC and 2 for the River Thames (and including the Little Lemhill Drain and Downington Ditch) are based on a detailed 1D-2D ISIS-TUFLOW model of the Upper Thames (covering the Thames Main River Limit to St John's) which was completed in 2014 (18). Flood Zone 2 also incorporates historical flood outlines where these are more extensive than the modelled outlines.<br>There is also a previous ISIS-TUFLOW model of Downington Ditch/Little Lemhill Drain available for information (Hyder, 2012) (17) | |
| **Flood Defences** | • A scheme to reduce surface water/ordinary watercourse risk (Phase 1) in the Downington area was recently completed by CDC. | |

| | |
|---|---|
| | • River Leach benefits from bank protection around Lechlade Mill and around St John's Lock.<br>• Gate settings are adjusted at St John's Lock on the River Thames in order to manage flood levels upstream and downstream.<br>• Culverts are located at "The Weather House" Downington; Downington Grange, Downington; Opposite Green Farm, Downington; Priory Mill , Lechlade; Orchard house to Tollgate House; and at Horseshoe Lake. (20) |

**Fluvial flood risk:**
Map 1 (Lechlade) shows the fluvial flood risk in Lechlade. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Map 1 shows the results of hydraulic modelling on the River Thames (18) including depth and hazard layers for the 100 year plus climate change event. Depths are generally less than 0.3m close to existing built up areas, with deeper water on the open floodplain. Similarly hazard is low, increasing to significant on the undeveloped Thames floodplain.

**Surface Water flood risk:**
Map 2 (Lechlade) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. The uFMfSW highlights the known surface water flow route down the A417 into Lechlade from the west. Other small areas of ponding are shown.

**Groundwater flood risk:**
Map 2 (Lechlade) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests that the area is in the highest category of risk of groundwater flood emergence. No historical record of groundwater flooding within the settlement area.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Lechlade) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register. Some reports of sewer flooding problems in 2012.

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of fluvial flooding from the River Thames, Lemhill Drain and Downington Ditch. Hydraulic modelling of the River Thames (18) predicts an increase in the 100 year flood outline with climate change affecting the Downington and Green Farm areas.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.
In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

**Lechlade - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Oxford Clay Formation |
| **Superficial Deposits** | | Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Lechlade - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage

strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and 5-3 in the SFRA. The following sites may be required to pass an Exception Test in accordance with NPPF:

• L_18B - A very small area falls within Flood Zone 2. Covered by the Upper Thames model. Depths and hazards in a 100 year + CC event are low. Will require an Exception Test if Highly Vulnerable development is proposed. Sequential planning of the site to ensure that built development would be within Flood Zone 1 would be recommended.

• L_19 - Small areas of the site fall within Flood Zone 3b and 3a, with nearly 20% in Flood Zone 2. Covered by the Upper Thames model. Depths and hazards in a 100 year + CC event are low. More Vulnerable development would not be permitted in Flood Zone 3b, Highly Vulnerable would not be permitted in Flood Zone 3a. The Exception Test would be required in Flood Zone 3a for More Vulnerable and Flood Zone 2 for Highly Vulnerable development. Sequential planning of the site to ensure that built development would be within Flood Zone 1 would be recommended.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.11 Mickleton

| Potential Development in Mickleton | | |
|---|---|---|
| **Total number of potential development sites within Mickleton:** 1 | **Proposed use** Housing | **Flood risk vulnerability** More Vulnerable (with the potential for Highly Vulnerable uses to be proposed). SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Mickleton** | To view potential development sites, refer to Map 1, and select Mickleton.<br>• One potential development site identified in the SHLAA | |

| Summary of flood risk to Mickleton | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Norton Brook, Gran Brook and unnamed drain | |
| **Historic Flooding** | • July 2007 - Estimated 5 to 10 properties flooded. Flooding was due to rapid surface water runoff and overloaded sewers (2). | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :** 0 | **FZ3:** 0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial (ordinary watercourses)<br>• Blockages in urban drainage | • Channel exceedance and floodplain flows of the Norton Brook, Unnamed Drain and Gran Brook<br>• Urban drainage - sewers, drains and gullies.<br>• Roads and paths<br>• Surface water runoff from fields | • Domestic houses and commercial properties<br>• Sewers<br>• Roads such as:<br>-Mill Lane<br>-High Street |
| **Flood Warning** | No Environment Agency flood warning service in this area. | |
| **Available survey/detailed modeling** | No Flood Zones in this area. | |
| **Flood Defences** | No known flood defence or assets affecting flows or levels. | |

**Fluvial flood risk:**
Map 1 (Mickleton) shows the fluvial flood risk in Mickleton. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Fluvial flood risk is limited to small ordinary watercourses which are not included in the Flood Zones. Hazard and risk to people is low.

**Surface Water flood risk:**
Map 2 (Mickleton) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. Local evidence suggests that surface water flooding problems have been experienced originating in the Meon Road area and flowing through the Meadow View area. The uFMfSW indicates that surface water flooding is the main risk in Mickleton. Flow pathways follow the ordinary watercourses and a number of roads in the village, including Meon Road, Chapel Lane, Cotswold Edge, Pound Lane, Arbour Close.

**Groundwater flood risk:**
Map 2 (Mickleton) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is mostly in the highest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Mickleton) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register. No local evidence of foul sewer flooding. Surface water inundated sewers in the 2007 flood event.

**Effects of climate change:**
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood

of incidents of surface water flooding.
In relation to groundwater, the effect is even less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this affect.

**Mickleton - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Blue Lias Formation and Charmouth Mudstone |
| **Superficial Deposits** | | Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Mickleton - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, or where sewer flooding is a problem, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified as requiring the Exception Test.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.12 Moreton-in-Marsh

| Potential Development in Moreton-in-Marsh | | |
|---|---|---|
| **Total number of potential development sites within Moreton-in-Marsh:** 19 | **Proposed use**<br>Housing and economic | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Moreton-in-Marsh** | To view potential development sites, refer to Map 1, and select Moreton-in-Marsh.<br>• Twelve potential development sites identified in the SHLAA<br>• Seven potential development site identified in the SELAA<br>• One potential development site is designated for use as a car park. | |

| Summary of flood risk to Moreton-in-Marsh | | |
|---|---|---|
| **Main River** | River Evenlode | |
| **Ordinary Watercourse** | Stow Brook and unnamed drains | |
| **Historic Flooding** | • July 2007 - Estimated 240-250 properties were flooded. Flooding was as a result of River Evenlode, rapid surface water runoff and overloaded sewers (2)<br>• November 2012 - Three houses on The Green, Moreton-in-Marsh were flooded following heavy rain (8). Three properties on Croft Holm were recorded as being affected by overloaded sewers and surface water runoff. Moreton Station flooded (3) | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>4 (SHLAA)<br>1 (SELAA) | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall.<br>• Fluvial<br>• Blockages in urban drainage<br>• Blockages/ constriction of culverts | • Channel exceedance and floodplain flows of the River Evenlode and Stow Brook.<br>• Urban drainage - sewers, drains and gullies.<br>• Railway line<br>• Surface water runoff from fields<br>• Roads and paths | • Domestic houses and commercial property<br>• Queen Victoria Garden<br>• Caravan Park<br>• Old Town,<br>• St David's Primary School<br>• Roads such as:<br>-Bourton Road<br>-High Street<br>-East Street<br>-Hospital Road<br>-Fosseway Avenue<br>-Croft Holm<br>-Primrose Court<br>-Stow Road<br>-Swans Close |
| **Flood Warning** | Moreton in Marsh is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Flood Zone 3 is based on broad-scale JFLOW modelling, Flood Zone 2 is mainly based on historical flood outlines. Flood Zone 3 is artificially cut off in the middle of the town and there is some uncertainty on the 100 year extent upstream of this and a precautionary approach should be taken. Moreton in Marsh Flood Risk Management Study includes a 1D/2D TUFLOW model of River Evenlode and the surface water network (MWH, 2009) (REF). Because it includes surface water it is not possible to directly use the results to replace the Flood Zones, however information on flooded areas, depths, hazards and velocities has been included in the SFRA. | |

| | |
|---|---|
| **Flood Defences** | There are several significant structures/culverts which may influence water levels and flow, including those at Queen Street, High Street, the A429, Budgens and the railway.<br>Since the 2007 event, measures have been undertaken by CDC to improve conveyance of water in Moreton in Marsh:<br>• Improved the maintenance schedules of watercourses; gullies and drains; and trash screens<br>• Installed a river level monitoring device at Primrose Court to provide early indications of flood risk during high flows<br>• Completed bank raising works on the Flood Relief Ditch in the verge of the A44 road, to prevent water spilling. Future plans include to lay a duplicate pipe below the A44 road, to prevent water spilling onto the road surface during storms<br>• A flood relief channel runs south of Fosseway Avenue, flowing in a west to easterly direction, underneath the railway line and joining with the River Evenlode. CDC have extended it to the north to catch water that previously would have entered the River Evenlode and gone into the Queen Street culvert. |

**Fluvial flood risk:**
Map 1 (Moreton-in-Marsh) shows the fluvial flood risk in Moreton-in-Marsh. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Hydraulic modelling has shown that in the 100 year + CC event the River Evenlode overtops its banks upstream of the Queen Street culvert and flows down the High Street. Flow along the ordinary watercourses entering the town (e.g. along East Street and Croft Holm) flood adjacent streets. Ponding upstream of restrictive culverts in the town can cause large depths (e.g. up to 1m at St Davids Primary School) and high hazards.

**Surface Water flood risk:**
Map 2 (Moreton-in-Marsh) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
Local evidence suggests that there is a major surface water flow component to flooding in Moreton-in-Marsh, with overland flow coming from farmland to the west and entering the town via the roads. There is also a flow route along the railway into the station, which cannot enter the river as it is culverted at that point. The uFMfSW reflects local knowledge, showing flow paths from higher ground into Bourton Road, High Street, East Street, Croft Holm, Stow Road and Fosseway Avenue and St David's Primary School. The railway embankment will act as a barrier to flow.

**Groundwater flood risk:**
Map 2 (Moreton-in-Marsh) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests that most of the area is in the highest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Moreton-in-Marsh) illustrates the incidents of sewer flooding recorded in CDC. CDC report that Croft Holm and Primrose Court suffer from ongoing sewer flooding which backs up from the pumping station when the river is high. The Thames Water sewer flooding register has a total of 8 incidents for postcode area GL56 0. Thames Water identified Moreton-in-Marsh as an area where properties experienced internal sewer flooding in the 2007 event (2).

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the River Evenlode and tributaries. Flood extent is likely to increase along out of bank flow paths such as High Street.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.
In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

| Moreton-in-Marsh - Suitability of SuDS | | |
|---|---|---|
| **Bedrock Geology** | | Charmouth Mudstone Formation |
| **Superficial Deposits** | | Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |

| | | |
|---|---|---|
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Moreton-in-Marsh - Implications for development**

• Flood Zone 2 covers a larger extent of the river than Flood Zone 3 and is based on recent flood events. CDC should consider treating Flood Zone 2 as Flood Zone 3a for planning purposes. Any site that falls within Flood Zone 2 or 3 will require an FRA in order to demonstrate how a potential development will mitigate against flood risk from all sources.
• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A FRA should include a full investigation of groundwater flood risk. For major developments, groundwater monitoring should be carried out for a suitable period.
• If the development is in an area of risk of flooding from reservoirs, developers should liaise with Emergency Planners.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and 5-3 in the SFRA. The following sites may be required to pass an Exception Test in accordance with NPPF:
• M_14C, M_19B, M_29, M_56 - All of these sites fall within Flood Zone 3a+CC and 2 and will require an Exception Test if Highly Vulnerable development is proposed.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.13 Naunton

| Potential Development in Naunton | | |
|---|---|---|
| **Total number of potential development sites within Naunton:** 0 | **Proposed use**<br>N/A | **Flood risk vulnerability**<br>N/A |
| **Potential development sites in Naunton** | N/A | |

| Summary of flood risk to Naunton | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | River Windrush (ordinary watercourse) | |
| **Historic Flooding** | • 1930s, 1947 and 1963 - severity and extent unknown (2) & (9).<br>• July 2007 - Estimated 20 -25 properties were flooded. Flooding was as a result of the Windrush, rapid surface water runoff and overloaded sewers (2) & (9).<br>• November 2012 - Properties were affected by sewer flooding (3).<br>• December 2012 - There were problems with the pumping station and blockage issues were recorded; a property was affected (10). | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance and floodplain flows.<br>• Roads and paths | • Domestic houses and commercial properties<br>• Guiting Power<br>• Dovecote<br>• Roads such as:<br>- Main Street<br>- Hill Close<br>- Lower Main Street<br>- Dale Street |
| **Flood Warning** | Naunton is within an Environment Agency flood alert area. | |
| **Available survey/detailed modeling** | A 1D HEC RAS model was completed as part of the Naunton Flood Study (Hyder, June 2009), commisioned by CDC after the 2007 floods to examine possible flood alleviation options. The model does not cover any proposed sites. The model was not considered fit for purpose to provide flood extents to replace the Flood Zones, but has been used to inform on flood mechanisms, depths and hazards.(9) | |
| **Flood Defences** | CDC funded a Property Level Protection scheme in 2012. There are several bridges and culverts which may influence flow and levels. | |

**Fluvial flood risk:**
Map 1 (Naunton) shows the fluvial flood risk in Naunton. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** The fluvial floodplain of the River Windrush is narrow and confined by topography. Hydraulic modelling has shown that the out of bank flow path down Main Street could be potentially hazardous to people.

**Surface Water flood risk:**
Map 2 (Naunton) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. The Naunton Flood Study report notes that surface water has contributed to flooding in past events. The uFMfSW indicates

possible flow routes down the roads to the north and into the River Windrush.

**Groundwater flood risk:**
Map 2 (Naunton) describes the Area Susceptible to Groundwater Flooding (AStGWF). The Naunton Flood Study Report notes that the majority of fluvial flood events in the Windrush (with the exception of 2007) have resulted from rising groundwater levels following sustained rainfall, suggesting that groundwater has an impact on fluvial flooding here. No other incidents of groundwater flooding unconnected from the river have been reported. The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Naunton) illustrates the incidents of sewer flooding recorded in CDC. There have been known problems with foul sewer flooding. CDC records describe problems with a pumping station and blockage issues. There are 6 incidents recorded on the Thames Water sewer flooding register in the postcode sector (GL54 3) which includes Naunton.

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the River Windrush, although the flood extent is not likely to increase significantly due to the topography.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Naunton - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Limestone |
| **Superficial Deposits** | | Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control |
| Infiltration |  | Mapping suggests permeability at this site, a site investigation should be carried out to assess potential for drainage by infiltration. |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Naunton - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**
There are currently no proposed sites in Naunton

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.14 Northleach

| Potential Development in Northleach | | |
|---|---|---|
| **Total number of potential development sites within Northleach:** 5 | **Proposed use** Housing and economic | **Flood risk vulnerability** More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Northleach** | To view potential development sites, refer to Map 1, and select Northleach.<br>• Four potential development sites identified in the SHLAA<br>• One potential development site identified in the SELAA | |

| Summary of flood risk to Northleach | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Unnamed Drains | |
| **Historic Flooding** | • July 2007 - Estimated 15 -20 properties were flooded. Flooding was as a result of local watercourses and rapid surface water runoff. (2) | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :** 0 | **FZ3:** 0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial<br>• Blockages in urban drainage | • Channel exceedance and floodplain flows.<br>• Exceedence of culvert capacity via manholes<br>• Roads and paths | • Domestic houses and commercial properties<br>• Mill End<br>Roads such as:<br>- West End<br>- High Street<br>- East End |
| **Flood Warning** | Northleach is within an Environment Agency flood alert area. | |
| **Available survey/detailed modeling** | The Flood Zone is based on broad-scale JFLOW modelling.There is no LIDAR available to improve the Flood Zone mapping. CCTV survey of culvert under West End carried out by CDC in May 2013. | |
| **Flood Defences** | No known flood defences. There is a major culvert on the River Leach, roughly following the course of West End road. The CCTV survey showed that the culvert is substantially blocked under the old prison, causing flood water to be stored upstream. | |

**Fluvial flood risk:**
Map 1 (Northleach) shows the fluvial flood risk in Northleach. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** The Flood Zone for the River Leach follows the natural topography through the village - the culvert capacity has not been taken into account when estimating flows. However local evidence shows that there is a genuine flood route above ground here. Although the culvert is substantially blocked, flow does drain into it from the north and along the road. Flooding occurs along the route of the culvert as far as Market Square - it flows overland and comes out of the manholes when surcharged.

**Surface Water flood risk:**
Map 2 (Northleach) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. There is no local evidence of notable surface water flooding problems at Northleach. The uFMfSW indicates a potential overland route through the village from the north and following the course of the tributary at Mill End.

**Groundwater flood risk:**
Map 2 (Northleach) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is mostly in the low category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Northleach) illustrates the incidents of sewer flooding recorded in CDC. There are 6 incidents recorded on the Thames Water sewer flooding register in the postcode sector (GL54 3) which includes Northleach. No local evidence of foul sewer flooding

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the River Leach and tributaries, although the flood extent is not likely to increase significantly.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Northleach - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Limestone |
| **Superficial Deposits** | | Clay, Silt, Sand and Gravel |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control |
| Infiltration |  | Mapping suggests permeability at this site, a site investigation should be carried out to assess potential for drainage by infiltration. |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Northleach - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• Modelling of the long culvert on the River Leach and the effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**
All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified as requiring the Exception Test.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.15 South Cerney

| Potential Development in South Cerney | | |
|---|---|---|
| **Total number of potential development sites within South Cerney:** 3 | **Proposed use**<br>Housing and economic | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in South Cerney** | To view potential development sites, refer to Map 1, and select South Cerney.<br>• One potential development sites identified in the SHLAA<br>• Two potential development sites identified in the SELAA | |

| Summary of flood risk to South Cerney | | |
|---|---|---|
| **Main River** | Cerneywick Brook<br>River Churn, River Thames | |
| **Ordinary Watercourse** | Unnamed Drains | |
| **Historic Flooding** | • 1990 - River Churn affected several residential properties at Watermoor, South Cerney and Cerney Wick (11)<br>• 2000/2001 - River Churn flooded properties, roads and gardens in Cirencester, South Cerney and Siddington (11)<br>• July 2007 - Estimated 1 to 5 properties flooded. Flooding was as a result of River Churn, rapid surface water runoff and overloaded sewers (2)<br>• December 2012 - Estimated 30 - 35 properties flooded. Flooding was as a result of the River Churn, fallen trees in the channel of the River Churn, overloaded sewers and surface water runoff (3)<br>• Winter 2013/14 - Similar problems with overloaded sewers experienced to 2012.<br>. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>1 (SHLAA)<br>2 (SELAA) | **FZ3:**<br>1 (SHLAA)<br>2 (SELAA) |
|  |  |  |
| • Heavy rainfall<br>• Fluvial<br>• Blockages in urban drainage<br>• Reservoir (The Lake) | • Channel exceedance and floodplain flows.<br>• Urban drainage - sewers, drains and gullies.<br>• Surface water runoff from fields<br>• Roads and paths | • Domestic houses and commercial properties<br>• Upper Up<br>Roads such as:<br>- School Lane<br>- Bow Wow<br>- Boxbrush Road<br>- Lakeside<br>- Robert Franklin Way<br>- Broadway Lane<br>- Robert Franklin Way |
| **Flood Warning** | South Cerney is within an Environment Agency flood warning and alert area. | |
| **Available survey/detailed modeling** | Flood Zone 3b, 3a and 3a+CC and 2 are based on a detailed 1D-2D ISIS-TUFLOW model of the Upper Thames (covering the Thames Main River Limit to St John's) including the lower Churn and Cerneywick Brook which was completed in 2014 (18). Flood Zone 2 also incorporates historical flood outlines where these are more extensive than the modelled outlines. | |
| **Flood Defences** | • The Lower Churn benefits from bank protection along its course through South Cerney specifically along School Lane and Bow Wow.<br>• Culverts are present at Lower Mill, Upper Mill and School Lane. | |

| | |
|---|---|
| | • Raised defences are located at the rear of The Close; Tallot House Drive; U/S of Clarks Hay Bridge; and at Upper Mill.<br>• After the flooding in 2012, residents enlarged the pipes through the disused railway embankment. These have been assessed by the EA as providing a small reduction in flood levels and extents in the Boxbush area of South Cerney without increased risk to properties downstream. |

**Fluvial flood risk:**
Map 1 (South Cerney) shows the fluvial flood risk in South Cerney. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Map 1 shows the results of hydraulic modelling on the River Thames (18) including depth and hazard layers for the 100 year plus climate change event. Depths are generally less than 0.3m close to existing built up areas, with deeper water in the Cotswold Water Park area. Similarly hazard is low, increasing to significant in the Cotswold Water Park.

**Surface Water flood risk:**
Map 2 (South Cerney) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. Surface water runoff was identified as a factor contributing to several past flooding events. Roads running from west to east such as High Street, Station Road and Bow Wow are identified as flow routes in the fluvial hydraulic modelling and the uFMfSW, with small areas of ponding in the town. A large area at risk of ponding is also shown to the north east.

**Groundwater flood risk:**
Map 2 (South Cerney) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is mostly in the highest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (South Cerney) illustrates the incidents of sewer flooding recorded in CDC. There are known problems with sewer flooding. Thames Water identified South Cerney as an area where properties experienced internal sewer flooding in the 2007 event (2). CDC have recorded issues with sewer flooding in South Cerney in December 2012. Since then, reports describe the Cirencester and South Cerney sewer system had been surveyed and cleared out at points where there were blockages and build-ups of debris (Wilts & Gloucestershire Standard July 2013). Thames Water is developing an Infiltration Reduction Plan to address sewer flooding issues.

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of fluvial flooding from the River Thames, lower Churn and Cerneywick Brook. Hydraulic modelling of the River Thames (18) predicts an increase in the 100 year flood outline with climate change particularly on the Churn upstream of South Cerney, and in industrial areas along the Cerneywick Brook. Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.
In relation to groundwater, the effect of climate change is less certain. Milder wetter winters may increase the frequency of groundwater flooding incidents but warmer drier summers may counteract this effect.

**South Cerney - Suitability of SuDS**

| | |
|---|---|
| **Bedrock Geology** | Kellaways Clay Member |
| **Superficial Deposits** | Sand and Gravel; and Clay, Silt, Sand and Gravel |

| SuDS Type | Potential Suitability | Comments |
|---|---|---|
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**South Cerney - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.

• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and 5-3 in the SFRA. The following sites may be required to pass an Exception Test in accordance with NPPF:

• SC_13A - A very small area (<1%) falls within Flood Zone 3a, 3a+CC and 2. Covered by the Upper Thames model. Depths and hazards in a 100 year + CC event are low. Would require an Exception Test for More Vulnerable development in FZ3a. Sequential planning of the site to ensure that built development would be within Flood Zone 1 would be recommended.

• RUR_E12 - >50% of the site is in Flood Zone 3a, 3a+CC and 2. Covered by the Upper Thames model. Depths in a 100 year + CC event increase across the site to around 0.6m at the eastern end, hazard is low. Less vulnerable development is permitted but will require a FRA to demonstrate that it is safe and will not increase flood risk downstream. Completely dry access at the 100 year + CC may be difficult but safe access to Broadway Lane should be possible.

• RUR_E13 - A very small area of the site (<2%) falls in Flood Zone 3b, 3a and 3a+CC along the edge of the lake. More than 50% of the site is in Flood Zone 2 (based on historical flood outline). Covered by the Upper Thames model. Depths and hazard in a 100 year + CC event are low. Less Vulnerable development is permitted outside of Flood Zone 3b but will require a FRA to demonstrate that it is safe and will not increase flood risk downstream. Dry access is possible to the B4696.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.16 Stow-on-the-Wold

| Potential Development in Stow-on-the-Wold | | |
|---|---|---|
| **Total number of potential development sites within Stow-on-the-Wold:** 10 | **Proposed use**<br>Housing and economic | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Stow-on-the-Wold** | To view potential development sites, refer to Map 1, and select Stow-on-the-Wold.<br>• Seven potential development sites identified in the SHLAA<br>• Three potential development sites identified in the SELAA<br>• Two potential development sites are designated for use as a car park. | |

| Summary of flood risk to Stow-on-the-Wold | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Tributaries of the River Dickler, Claudwell Brook and unnamed drain | |
| **Historic Flooding** | There are no reports of historical flooding identified for this settlement. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial (ordinary watercourses) | • Channel exceedance and floodplain flows from the ordinary watercourses<br>• Roads and paths<br>• Surface water run off from fields | • Isolated ponding on roads |
| **Flood Warning** | No Environment Agency flood warning service in this area. | |
| **Available survey/detailed modeling** | No Flood Zones in this area. | |
| **Flood Defences** | No known flood defences or assets. | |

**Fluvial flood risk:**
Map 1 (Stow-on-the-Wold) shows the fluvial flood risk in Stow-on-the-Wold. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Fluvial flood risk is limited to small ordinary watercourses which are not included in the Flood Zones. Hazard and risk to people is low.

**Surface Water flood risk:**
Map 2 (Stow-on-the-Wold) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
There is no local evidence of notable surface water flooding problems at Stow-on-the-Wold. The uFMfSW shows potential flow paths along Park Street and to the south of Oddington Road.

**Groundwater flood risk:**
Map 2 (Stow-on-the-Wold) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Stow-on-the-Wold) illustrates the incidents of sewer flooding recorded in CDC. There are 2 incidents recorded on the Thames Water sewer flooding register in the postcode sector (GL54 1) which includes Stow-on-the-Wold. No local evidence of foul sewer flooding.

**Effects of climate change:**
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Stow-on-the-Wold - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Chipping Norton Limestone Formation |
| **Superficial Deposits** | | none |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control |
| Infiltration |  | Mapping suggests permeability at this site, a site investigation should be carried out to assess potential for drainage by infiltration. |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature may be suitable, provided the slopes in the site are <0.4 |

**Stow-on-the-Wold - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified as requiring the Exception Test.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.17 Tetbury

| Potential Development in Tetbury | | |
|---|---|---|
| **Total number of potential development sites within Tetbury:** 8 | **Proposed use**<br>Housing and economic | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Tetbury** | To view potential development sites, refer to Map 1, and select Tetbury.<br>• Five potential development sites identified in the SHLAA<br>• Three potential development site identified in the SELAA<br>• Five potential development sites are designated for use as car parks. | |

| Summary of flood risk to Tetbury | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | River Avon (Tetbury branch) and unnamed tributary | |
| **Historic Flooding** | • July 2007 - Estimated 1 to 5 properties flooded. Flooding was due to local watercourses (2).<br>• November 2012 - London Road flooded from Cook's Pool (large pond) being overtopped by excessive surface water runoff (12). | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial (ordinary watercourses) | • Channel exceedance and floodplain flows from the ordinary watercourses.<br>• Roads and paths | • Domestic houses and commercial properties<br>• Police Station<br>• The Chipping<br>• Roads such as:<br>- Charlton Road<br>- New Church Street<br>- Long Street<br>- London Road<br>- Baybrook Close<br>- Fox Hill<br>- Church Street |
| **Flood Warning** | No Environment Agency flood warning service in this area. | |
| **Available survey/detailed modeling** | Flood Zones are based on broad-scale JFLOW modelling. | |
| **Flood Defences** | No known flood defences or assets. | |

**Fluvial flood risk:**
Map 1 (Tetbury) shows the fluvial flood risk in Tetbury. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** The fluvial floodplain of the River Avon (Tetbury branch) and its tributary are narrow and confined by topography. The Flood Zone is slightly misaligned in places but this does not affect any proposed sites. Flows are likely to be high velocity and therefore medium to high hazard depending on depths, but risk to people is minimal beyond the narrow confined floodplain.

**Surface Water flood risk:**
Map 2 (Tetbury) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas. There is no local evidence of notable surface water flooding problems at Tetbury. The uFMfSW indicates potential flow routes that follow the line of existing ordinary watercourses in the area. A flow route is also identified alongside London Road and from St Mary's Primary School south west towards The Splash.

**Groundwater flood risk:**
Map 2 (Tetbury) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Tetbury) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register. No local evidence of foul sewer flooding

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the River Avon (Tetbury branch) and tributaries, although the flood extent is not likely to increase significantly.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Tetbury - Suitability of SuDS**

| | |
|---|---|
| **Bedrock Geology** | Forest Marble Formation |
| **Superficial Deposits** | Clay, Silt, Sand and Gravel |

| SuDS Type | Potential Suitability | Comments |
|---|---|---|
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Tetbury - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**
All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.18 Upper Rissington

| Potential Development in Upper Rissington | | |
|---|---|---|
| **Total number of potential development sites within Upper Rissington:** 1 | **Proposed use**<br>Housing | **Flood risk vulnerability**<br>More Vulnerable (with the potential for Highly Vulnerable uses to be proposed). SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Upper Rissington** | To view potential development sites, refer to Map 1, and select Upper Rissington.<br>• One potential development site identified in the SHLAA | |

| Summary of flood risk to Upper Rissington | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Coombe Brook | |
| **Historic Flooding** | There are no reports of historical flooding identified for this settlement. | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial (ordinary watercourses) | • Channel exceedance and floodplain flows from the ordinary watercourses<br>• Roads and paths | • Ansell's Hill Coppice<br>• Bunting's Hill Copse<br>• Far Hill House<br>• Roads such as:<br>- Bleriot Grebe Square |
| **Flood Warning** | No Environment Agency flood warning service in this area. | |
| **Available survey/detailed modeling** | Flood Zones are based on broad-scale JFLOW modelling. | |
| **Flood Defences** | No known flood defences or assets. | |

**Fluvial flood risk:**
Map 1 (Upper Rissington) shows the fluvial flood risk in Upper Rissington. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** No fluvial flood risk

**Surface Water flood risk:**
Map 2 (Upper Rissington) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
There is no local evidence of notable surface water flooding problems at Upper Rissington. The uFMfSW reflects this, showing only a flow path which follows a tributary of the Coombe Brook.

**Groundwater flood risk:**
Map 2 (Upper Rissington) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Upper Rissington) illustrates the incidents of sewer flooding recorded in CDC. There are 4 incidents recorded on the Thames Water sewer flooding register in the postcode sector (GL54 2) which includes Upper Rissington. No local evidence of foul sewer flooding.

**Effects of climate change:**
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Upper Rissington - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Chipping Norton Limestone Formation and Salperton Limestone Formation |
| **Superficial Deposits** | | none |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control |
| Infiltration |  | Mapping suggests permeability at this site, a site investigation should be carried out to assess potential for drainage by infiltration. |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature may be suitable, provided the slopes in the site are <0.4 |

**Upper Rissington - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, and upstream of areas identified as experiencing sewer flooding problems, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**

All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified as requiring the Exception Test.

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.19 Weston Subedge

| Potential Development in Weston Subedge | | |
|---|---|---|
| **Total number of potential development sites within Weston Subedge:** 0 | **Proposed use**<br>N/A | **Flood risk vulnerability**<br>N/A |
| **Potential development sites in Weston Subedge** | N/A | |

| Summary of flood risk to Weston Subedge | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Coombe Brook and tributaries | |
| **Historic Flooding** | • June 1952, June 1968, July 1982, June 1986, Jan 1993, April 1998, April 2001, September 2001, April 2005 and July 2007 - Flooded 10 times in the 60 years (13).<br>• July 2007 - Estimated 15 to 20 properties flooded. Flooding was as a result of a combination of the River Coombe and rapid surface water runoff (2) & (13). | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :**<br>0 | **FZ3:**<br>0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial | • Channel exceedance and floodplain flows from the ordinary watercourses.<br>• Exceedence of culvert capacity<br>• Roads and paths | • Domestic houses and commercial properties<br>• Manor Farm<br>• Cidermill Orchard<br>• Roads such as:<br>- Parson's Lane<br>- Church Street<br>- Friday Street |
| **Flood Warning** | West Subedge is within an Environment Agency flood alert area | |
| **Available survey/detailed modeling** | Flood Zones are based on broad-scale JFLOW modelling. A 1D HEC-RAS model was completed as part of the Weston Subedge Stage 2 Flood Study (Hyder, January 2012), commisioned by CDC after the 2007 floods to examine possible flood alleviation options. (13) | |
| **Flood Defences** | No known flood defences. Various culverts through the village may affect flood risk. (e.g. Friday Street, Manor Farm and Parson Street culverts) | |

**Fluvial flood risk:**
Map 1 (Weston Subedge) shows the fluvial flood risk in Weston Subedge. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Hydraulic modelling has shown that depths on the floodplain are generally between 0.3 and 0.5m, with a deeper area close to Parsons Lane (up to 0.9m). Hazards are likely to be low to medium.

**Surface Water flood risk:**
Map 2 (Weston Subedge) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
The Weston Subedge Flood Study suggests that suface water and exceedence of urban drainage has contributed to previous flooding problems in the village. The uFMfSW indicate flow routes from south to north with flow converging on the village along the B4632 and the parallel road to the east, eventually joining Coombe Brook.

**Groundwater flood risk:**
Map 2 (Weston Subedge) describes the Area Susceptible to Groundwater Flooding (AStGWF). The Weston Subedge Flood Study indicates that exceptionally high groundwater levels may have increased the severity of the 2007 event. The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater

flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Weston Subedge) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register. No local evidence of foul sewer flooding

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the Coombe Brook and tributaries, although the flood extent is not likely to increase significantly.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Weston Subedge - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Blue Lias Formation and Charmouth Mudstone |
| **Superficial Deposits** | | none |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Weston Subedge - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.
• For major developments, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

**Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**
There are currently no proposed sites in Weston Subedge

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.20 Willersey

| Potential Development in Willersey | | |
|---|---|---|
| **Total number of potential development sites within Willersey:** 11 | **Proposed use** Housing and economic | **Flood risk vulnerability** More Vulnerable (with the potential for Highly Vulnerable uses to be proposed) on housing sites and Less Vulnerable on economic sites. SFRA users should consult the NPPF Planning Practice Guidance Table 2 for further information on permitted development. |
| **Potential development sites in Willersey** | To view potential development sites, refer to Map 1, and select Willersey.<br>• Ten potential development sites identified in the SHLAA<br>• One potential development site identified in the SELAA | |

| Summary of flood risk to Willersey | | |
|---|---|---|
| **Main River** | There are no designated 'Main Rivers' identified within the settlement. | |
| **Ordinary Watercourse** | Badsey Brook, East Stream and unnamed watercourses | |
| **Historic Flooding** | • January 1992 - One property and a number of roads were inundated (14).<br>• Summer 2000 - Blockages at a number of culverts were reported to exacerbate flooding problems during the flood, particularly at Timms Green. (14)<br>• July 2007 - Estimated 45 to 50 properties were flooded. Flooding was as a result of local watercourses and surface water runoff.(2)<br>• November 2012, flooding under the railway bridge Badsey Lane was reported (10).<br>• There have been reports of regular flooding in the Frampton Drive/Collin Lane area of Willersey. In 2010 an obstruction was removed from a culvert, which seems to have alleviated this issue (14). | |
| **No of sites in the Flood Map for Planning (Rivers and Sea)** | **FZ2 :** 0 | **FZ3:** 0 |
|  |  |  |
| • Heavy rainfall<br>• Fluvial (ordinary watercourses)<br>• Blockage of culverts or trash screens on watercourses | ●Channel exceedance and floodplain flows of the ordinary watercourses<br>• Roads and paths | • Domestic houses and commercial properties<br>• Roads such as:<br>-Frampton Drive/Collin Lane<br>-Fields Lane<br>-Broadway Road<br>-Collin Close/ Lane<br>-Recreation Ground<br>-Railway<br>-Badsey Lane<br>-Willow Road<br>-Timms Green |
| **Flood Warning** | No Environment Agency flood warning service in this area. | |
| **Available survey/detailed modeling** | No Flood Zones covering these watercourses. A 1D HEC-RAS model was completed as part of the Willersley Flood Study - Hydraulic and Hydrological Modelling Assessment (Hyder 2009), commisioned by CDC after the 2007 floods to examine possible flood alleviation options.(14) | |
| **Flood Defences** | No known flood defences. Several culverts have the potential to block (e.g. Timms Green), increasing water levels.<br>• In 2009, residents cleared 500 metres of ditch running from the village's recreation ground to a culvert under the disused Cheltenham-to-Stratford railway line. (REF Willersey Stream Team works to prevent flooding)<br>• A new drainage culvert was installed in 2010. (21) | |

**Fluvial flood risk:**
Map 1 (Willersey) shows the fluvial flood risk in Willersey. Select layer Flood Zone 3a to view the zone which comprises of land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) in any given year. Select layer Flood Zone 2 to view the zone which comprises of land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%) in any year.

**Depth, hazard and velocity:** Hydraulic modelling (14) has shown that flood depths along the east and west streams are likely to be low (<0.2m), although ponding to greater depths (~0.8m) may occur close to Timms Green in a 100 year plus climate change event. Blockage of the culvert at Timms Green would increase water levels by 1.13m (14).

**Surface Water flood risk:**
Map 2 (Willersey) shows the uFMfSW. The user can click to display the 1 in 30, 1 in 100 and 1 in 1000 year risk areas.
The area under the railway bridge is reported to flood from surface water regularly to depths of approximately 1m. It is also reported that since the railway was abandoned the drains under the road have not been maintained.
The uFMfSW highlights the channels and floodplains of existing ordinary watercourses. Flow paths along Main Street, Badsey Lane and Campden Lane are also evident.

**Groundwater flood risk:**
Map 2 (Willersey) describes the Area Susceptible to Groundwater Flooding (AStGWF). The AStGWF map suggests the area is in the lowest category of risk of groundwater flood emergence. No historical record of groundwater flooding.

**Reservoir flood risk:**
N/A

**Sewer flood risk:**
Map 2 (Willersey) illustrates the incidents of sewer flooding recorded in CDC. No incidents on the sewer flooding register.
No local evidence of foul sewer flooding

**Effects of climate change:**
Climate change is likely to increase the frequency and severity of flooding from the Badsey Brook and its tributaries, although the flood extent is not likely to increase significantly.
Climate change is predicted to result in more frequent occurrences of extreme/ heavy rainfall events, increasing the likelihood of incidents of surface water flooding.

**Willersey - Suitability of SuDS**

| | | |
|---|---|---|
| **Bedrock Geology** | | Blue Lias Formation and Charmouth Mudstone |
| **Superficial Deposits** | | none |
| **SuDS Type** | **Potential Suitability** | **Comments** |
| Source Control |  | All forms of source control excluding pervious pavements would be suitable |
| Infiltration |  | Mapping suggests low permeability at this settlement . |
| Detention |  | This option may be feasible provided site slopes are < 5%. Liner is required for permanent wet features in pervious soils. |
| Filtration |  | This feature is probably feasible. If the site has contaminated land issues; a liner will be required. |
| Conveyance |  | Mapping indicates that this feature is probably not suitable, due to the slopes in the settlement. (Slope <0.4) |

**Willersey - Implications for development**

• Sites greater than 1ha in Flood Zone 1 require a full FRA.
• A Flood Defence Consent is required from the Environment Agency for any development proposals within 8m of a designated Main River/Flood Defence.
• CDC should consider requesting an FRA where a site is close to an ordinary watercourse that is not included in the Flood Zones.
• The effect of blockage of culverts should be considered as part of a FRA where appropriate.
• Any site affected by the uFMfSW, or with a history of surface water flooding, should undertake an FRA including a comprehensive investigation into surface water flood risk. 'More vulnerable' development should be located in the areas of least flood risk through sequential design of the site. Mitigation of any surface water risk should be detailed in a drainage strategy.
• A drainage strategy should be submitted at an early stage to show how the impact of the development will be reduced through site design and SUDS techniques.
• Liaison with the appropriate SUDS Approving Body and CDC should be carried out in the early stages of the development.
• The strategy should demonstrate that surface water run-off rates are attenuated to greenfield run-off rates. Higher rates would need to be justified and the risks quantified. Developers should strive to reduce run-off rates for existing developed sites.
• Developers should consider the surface water catchment when looking at solutions for mitigation measures for surface water runoff from potential development. This may require developers to consider solutions outside of their site.

| |
|---|
| • For major developments, the relevant water company should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary. |
| **Comments on constraints to proposed sites (e.g. development not permitted/Exception Test required)**<br>All sites have been assessed with regard to key flood indicators, such as the Environment Agency Flood Zones, uFMfSW, local evidence and proximity to watercourses, see Table 5-2 and Table 5-3 in the SFRA for further details. No sites are identified where certain types of development would not be permitted or where the Exception Test is required. |

Note: Numbers in brackets refer to references given at the end of this Appendix

## B.21 References


1 Hyder (2009) Andoversford Flood Study Hydraulic and Hydrological Modelling Assessment

2 Hyder (2008) Review of the Summer 2007 floods in Cotswold District

3 CDC (2012) Flooded Homes and Businesses Nov 2012.xls

4 CDC (2007) The report on flooding in Chipping Campden, 20/21 July 2007)

5 Environment Agency (2006) River Churn - Final Flood Mapping Report

6 Environment Agency (2008) River Churn and Ampney Brook Floods Review 2007

7 Cotswold District Council (2008) Strategic Flood Risk Assessment for Local Development Framework Level 1 Volume 1 - FINAL

8 Wilts and Gloucestershire Standard (26th Nov 2012) "Only minimal flooding in the North Cotswolds"

9 Hyder (2009) Naunton Flood Study Hydraulic and Hydrological Modelling Assessment

10 GCC (2012) List for GCC re flooding Dec 2012.xls

11 Environment Agency (2008) River Churn and Ampney Brook Floods Review July 2007

12 www.s-t-e-p-s.co.uk/2012/11/flooding-on-london-road-tetbury/

13 Hyder (2009) Weston Subedge Flood Study Hydraulic and Hydrological Modelling Assessment

14 Hyder (2009) Willersey Flood Study Hydraulic and Hydrological Modelling Assessment

15 MWH (2009) Chipping Campden Flood Risk Management Study

16 Environment Agency (2011) River Churn ISIS-TUFLOW model

17 Hyder (2012) ISIS-TUFLOW model of Downington Ditch/Little Lemhill Drain

18 Halcrow (2014) Thames Main River Limit to St John's Modelling and Mapping: Final Report. Report on behalf of the Environment Agency.

19 MWH (December 2009) Moreton in Marsh Flood Risk Management Study

20 This flood defence data was taken from the Environment Agency's AIMS dataset

21 Cotswold District Online (2010) Keeping the threat of floods at bay in Willersey

22 CH2MHILL (2014) Post 2007 ABD - Bourton on the Water. Report on behalf of the Environment Agency.