Chichester District Council Level 1 Strategic Flood Risk Assessment

Final Report

December 2018

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Chichester District Council

JBA Project Manager

Ffion Wilson
JBA Consulting
35 Perrymount Road
HAYWARDS HEATH
West Sussex
RH16 3BW

Revision history

Revision Ref/Date	Amendments	Issued to
Version 1 / June 2018	Early Draft Report	Valerie Dobson (Chichester District Council)
Version 2 / October 2018	Draft Report – updated following initial comments from the Environment Agency, West Sussex County Council and Chichester District Council	Valerie Dobson (Chichester District Council)
Version 3 / December 2018	Final report – updated following further comments from the Environment Agency, West Sussex County Council and Chichester District Council	Vicky Owen (Chichester District Council)

This report describes work commissioned by Valerie Dobson of Chichester District Council, by an email dated 14 February 2018. Sophie Isaacs, Ffion Wilson, Ed Hartwell, Ben Gibson and Alastair Dale of JBA Consulting carried out this work.

Prepared by ..... Sophie Isaacs BA
Technician

..... Ffion Wilson BSc MSc PIEMA
Analyst

..... Ed Hartwell BSC MSc FRGS
Senior Analyst

..... Ben Gibson BSc MSc MCIWEM C.WEM
Chartered Senior Analyst

Reviewed by ..... Alastair Dale BSc PGDip MIAHR
Director

Purpose

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Acknowledgements

We would like to acknowledge the assistance of:

- Chichester District Council
- West Sussex County Council
- The Environment Agency
- Southern Water

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Executive summary

Introduction

This Strategic Flood Risk Assessment (SFRA) 2018 document supersedes the previous Level 1 SFRA (2008). The SFRA study area is the Chichester District Council area, excluding the South Downs National Park.

The report has been prepared to provide appropriate supporting evidence for the emerging Local Plan Review. The **Chichester Local Plan: Key Policies 2014-2029** was adopted in July 2015, and the Local Plan Review will revisit the adopted Local Plan so that sufficient housing is planned to meet the needs of the area.

This Level 1 SFRA provides the flood risk evidence and long-term strategy to support the management and planning of development, protect the environment, deliver infrastructure and promote sustainable communities within in the Local Plan area. It also supports the selection of site allocations in the Local Plan Review and provides information and guidance to be used in the preparation of Flood Risk Assessments (FRAs) in support of site-specific planning applications. The evidence in this SFRA shall also be used to formulate Neighbourhood Plans.

SFRA Objectives

The 2008 SFRA provided an initial baseline of the flood risk to the Local Plan area. Since 2008 there have been significant updates to flood modelling and policy and guidance. There have also been significant flood events since this time.

The key objectives of the 2018 SFRA are:

- To provide up to date information and guidance on flood risk for Chichester District Council, taking into account the latest flood risk information (including the probable impacts of climate change), the updated 2018 National Planning Policy Framework (NPPF) and legislation and relevant studies
- To provide the basis for applying the flood risk Sequential Test, and if necessary the Exception Test
- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as part of the evidence base for the Local Plan Review and to support the preparation of formulating Neighbourhood Plans.
- Identify the requirements for site-specific flood risk assessments and the application of Sustainable Drainage Systems

SFRA outputs

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- Level One: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the National Planning Policy Framework's (NPPF) Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This report fulfils the Level One SFRA requirements.

To meet the objectives, the following outputs have been prepared:

- Assessment of all potential sources of flooding

- Assessment of the potential impact of climate change on flood risk
- An assessment of surface water management issues and the application of Sustainable Drainage Systems (SuDS)
- A review and update of new and amended data sources (e.g. Catchment Flood Management Plans, Preliminary Flood Risk Assessment, Updated Flood Maps and modelling, etc)
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk
- Guidance for developers including requirements for site-specific flood risk assessments
- Mapping of location and extent of functional floodplain
- Mapping areas at risk from other sources including surface water, sewer, ground water, reservoir inundation
- Mapping areas covered by an existing flood alert / warning
- Identify opportunities to reduce flood risk
- High-level screening of proposed development sites against flood risk information
- Flood defence infrastructure.

Summary of Assessment

Flood risk

- There have been several substantive recorded flood incidents across the study area, from a combination of sources. The prominent source of flooding is fluvial with a significant influence from groundwater and tidal conditions. These sources of flooding can also occur in combination causing a cumulative effect. More recently surface water flooding at locations across the Local Plan area has also caused damage and disruption.
- More recent events have highlighted that flooding has often been associated with exceedance of the capacity of the sewer network and drainage systems.
- The most notable flooding incidents occurred in 1974, 1993/1994, 2000, 2012 and 2013/2014.
- There are several watercourses in the study area which contribute to fluvial flood risk. Fluvial flooding from the River Lavant poses a risk to Chichester and the characteristics of flooding are influenced by contributions from groundwater. Flood events influenced by groundwater flows are differentiated by the long duration of events. Elsewhere in the study area, settlements are at fluvial flood risk from other watercourses.
- As well as this, the study area is bounded to the south by the English Channel and as such there is a tidal flood risk along the coastline. Additionally, the combination of high tides and high river levels can result in tidal locking, particularly in the Rifes, as the rivers are unable to discharge effectively.
- The Risk of Flooding from Surface Water (RoFSW) dataset shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys, with some isolated ponding located in low lying areas.
- The JBA Groundwater Flood Map shows that a large proportion of the study area is at risk of groundwater flooding, particularly in the south.

- Historical incidents of sewer flooding are detailed by Southern Water. A total of 110 recorded flood incidents have been identified in the study area.
- There are no records of flooding from reservoirs impacting properties inside the study area.
- There are two canals located in the study area, the Chichester Canal and the Wey and Arun Canal. There are no recorded incidents of breach or overtopping of canals within the study area
- There are currently 12 Flood Alert Areas and 15 Flood Warning Areas in the study area.

Flood defences

There are several Environment Agency and council owned fluvial and coastal flood defences located within the study area. The standard of protection provided by these assets varies as does the condition. There are also tidal flood defences and coastal protection measures.

Development and flood risk

The Sequential and Exception Test procedures for both Local Plans and Flood Risk Assessments (FRAs) have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities such as the LLFA and the Environment Agency (EA).

Relevant studies

There are many relevant regional and local key studies which complement the SFRA and have been considered, such as the Shoreline Management Plans for Beachy Head to Selsey and North Solent, the Arun and Western Streams Catchment Flood Management Plan, River Basin Management Plan, the Preliminary Flood Risk Assessment, the South-East River Basin District Flood Risk Management Plan and the West Sussex Local Flood Risk Management Strategy. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

Policy Recommendations

The following policy recommendations are to be considered by Chichester District Council in the development of the Local Plan Review.

Development and planning considerations

Sequential approach to development

It is recommended that the sequential approach is adopted for all future developments within the study area where there is a flood risk.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site**.**

Sequential and Exception tests

The SFRA has identified areas that are at high risk of flooding from tidal, fluvial and surface water sources. Therefore, proposed development sites at such locations will be required to satisfy the Sequential and, where necessary, Exception Tests in accordance with the updated 2018 NPPF. Chichester District Council will use the information in this SFRA when deciding which development sites to take forward in the Local Plan Review.

Site-specific Flood Risk Assessments

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change

allowances which are expected to be updated in 2019), to inform development zoning within the site and prove, if required, whether the Sequential and Exception Tests are satisfied (for windfall sites not included in the plan, evidence on the Sequential Test must be submitted in FRAs). Where a site-specific FRA has produced modelling outlines which differ from the Flood Map for Planning then a full evidence-based review would be required. Where the watercourses are embanked, the effect of overtopping and breach must be considered and appropriately assessed.

All new development within the 1% AEP (Annual Exceedance Probability) flood extent including an allowance for climate change (for the lifetime of the development) must not normally result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage. Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water, and seek opportunities to provide floodplain betterment. Similarly, where ground levels are elevated to raise the development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain should normally be provided so the total volume of the floodplain storage is not reduced.

A **revised NPPF** was published on 24 July 2018 and sets out Government's planning policies for England and how these are expected to be applied. This revised Framework replaces the previous NPPF published in March 2012.

There are also several guidance documents which provide information on the requirements for site-specific FRAs:

- **Standing Advice on Flood Risk (Environment Agency)**
- **Flood Risk Assessment for Planning Applications (Environment Agency)**
- **Site-specific Flood Risk Assessment: CHECKLIST (NPPG, Defra)**

It should be noted that the **UK Climate Predictions 2018 (UKCP18)** was published on 26 November 2018. The UKCP18 projections replace the UKCP09 projections and is the official source of information on how the climate of the UK may change over the rest of this century. This may result in the Environment Agency climate change allowances being updated in 2019. When undertaking an FRA, please refer to the most up to date climate change allowances provided by the Environment Agency.

Developers should consult with Chichester District Council, West Sussex County Council, the Environment Agency and Southern Water at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design.

Surface water management and SuDS

- Planners should be aware of the conditions and local requirements set by West Sussex County Council for surface water management for major and minor developments and ensure development proposals and applications are compliant with the LLFAs policy.
- West Sussex County Council provide a **check list** for developers to assist in providing the correct information for planning applications.
- Chichester District published a document on **Surface Water and Drainage: Supplementary Planning Document** and expands on various policies in the adopted Local Plan relating to surface water and drainage, and how to address these.

Review of planning applications

Chichester District Council should consult the Environment Agency's '**Flood Risk Assessment: Local Planning Authorities**', last updated 28 February 2017, when reviewing planning applications for proposed developments at risk of flooding. The Council will consult

the relevant statutory consultees as part of the planning application assessment and they may, in some cases, also contact non-statutory consultees (e.g. Southern Water) that have an interest in the planning application

Infrastructure and safe access

Minimum finished floor levels for development should normally be above whichever is higher of the following:

- a minimum of 600mm above the 1% AEP fluvial event plus an allowance for climate change and an appropriate allowance for freeboard
- a minimum of 600mm above the 0.5% AEP tidal event plus an allowance for climate change and an appropriate allowance for freeboard
- 300mm above the general ground level of the site.

If it is not practical to raise floor levels to those specified above, consultation with the Environment Agency will be required to determine alternative approaches.

Safe access and egress will need to be demonstrated at all development sites. Emergency vehicular access should be possible during times of flood.

Where development is located behind, or in an area benefitting from, defences, consideration should be given to the potential safety of the development, finished floor levels and the potential for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning.

Resilience measures will be required if buildings are situated in the flood risk area, and opportunities to enhance green and blue infrastructure and reduce flood risk by making space for water should be sought.

Residual risk

Residual risk is the risk that remains after mitigation measures are considered. The residual risk includes the consideration of flood events that exceed the design thresholds of the flood defences or circumstances where there is a failure of the defences, e.g. flood banks collapse. Residual risks should be considered as part of site-specific Flood Risk Assessments.

Further, any developments located within an area protected by flood risk management measures, where the condition of those defences is 'fair' or 'poor', where the standard of protection is not of the required standard or where the failure of the intended level of service gives rise to unsafe conditions should be identified.

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage. They should seek to contact the reservoir owner to obtain information and should apply the sequential approach to locating development within the site. Developers should also consult with relevant authorities regarding emergency plans in case of reservoir breach.

Any development within the vicinity of either of the canals flowing through the borough should consider the residual risk from the canal, including the possibility of breach. Consideration should be given to the potential for safe access and egress in the event of rapid inundation of water due to a breach with little warning.

Future flood management

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. These are often waterside areas or areas along known flow routes. Development that may adversely affect green infrastructure assets should not be permitted.

The information provided in the SFRA should be used as a basis for investigating potential strategic flood risk solutions within the study area. Opportunities could consist of the following:

- Catchment and floodplain restoration;
- Flood storage areas;
- Opening up culverts, weir removal, and river restoration;
- The Environment Agency's Regional Habitat Creation Programme; and
- Green infrastructure

The Environment Agency has developed **Natural Flood Management (NFM) mapping** which displays opportunities for NFM.

It is recommended that local planning authorities continue with their catchment partnership working approach in tackling flood risk and environmental management.

Potential modelling improvements

The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. The Environment Agency has confirmed that the modelling for the Wey catchment is currently being updated and they should be approached if this materially affects an FRA in this area.

Use of Strategic Flood Risk Assessment data

SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. This SFRA has been developed using the best available information, supplied at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews its hydrology, hydraulic modelling and flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. It should be noted that the Environment Agency's Flood Zones, on their Flood Map for Planning website, may differ to the maps in the SFRA for a short period of time, whilst new modelling is incorporated into the Environment Agency's flood maps. Once the Environment Agency's Flood Map for Planning is updated to incorporate the latest modelling then this will provide the most up to date current day flood map. When using the SFRA to prepare FRAs it is important to check that the most up to date information is used, as is described in amendments to the flood mapping prepared and issued by the Environment Agency at regular intervals.

It should be noted that the UKCP18 was published on 26 November 2018 which may result in the Environment Agency climate change allowances changing in the future. If a Level 2 SFRA is required, any updated climate change allowances will be considered at that point. In addition, FRA's prepared following the issue of updated climate change data should use this for assessment (in accordance with Environment Agency guidance for implementation)

Other datasets used to inform this SFRA may also be periodically updated and following the publication of this SFRA, new information on flood risk may be provided by Risk Management Authorities.

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Abbreviations

	Definition
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
CDC	Chichester District Council
CFMP	Catchment Flood Management Plan
CLPHP	Chichester Local Plan: key policies 2014-2029
DEFRA	Department of the Environment, Food and Rural Affairs
DTM	Digital Terrain Model
EA	Environment Agency
FCRMGiA	Flood and Coastal Risk Management Grant in Aid
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FWMA	Flood and Water Management Act
FWA	Flood Warning Area
FWS	Flood Warning Service
FZ	Flood Zone
GIS	Geographic Information Service
JBA	Jeremy Benn Associates
LFRMS	Local Flood Risk Management Strategy
LiDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
OS	Ordnance Survey
PFRA	Preliminary Flood Risk Assessment
PFR	Property Flood Resilience
PPG	Planning Practice Guidance
RBMP	River Basin Management Plan
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
WFD	Water Framework Directive
WSCC	West Sussex County Council

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

> "Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards."
>
> (National Planning Policy Framework (2018), Section 14 paragraph 156)

This Strategic Flood Risk Assessment (SFRA) 2018 document supersedes the previous Level 1 SFRA (2008). The SFRA study area is shown in Figure 1-1 and excludes the South Downs National Park (SDNP) authoritative area. As the SDNP occupies a large area of the Chichester District, the mapping in this report has been divided into areas north and south of the SDNP. The mapping in the appendices provides both a district wide view and a 5km grid view. This report only considers Chichester District Council's Local Plan Area.

The main purpose of the SFRA update was to prepare a document that provides comprehensive and supporting evidence for the emerging Local Plan Review. The **Chichester Local Plan: Key Policies (CLPKP) 2014-2029** was adopted in July 2015, and the Local Plan Review will revisit the adopted Local Plan to make sure that sufficient housing will be planned to meet the needs of the area.

The SFRA update was also required to be compliant with the latest guidance described in the 2018 update to the National Planning Policy Framework (NPPF), support the selection of site allocations in the Local Plan Review and to provide information and guidance to be used in the preparation of Flood Risk Assessments (FRAs) in support of site specific planning applications. The evidence in this SFRA shall also be used to support the formulation of Neighbourhood Plans.

A **revised NPPF** was published on 24 July 2018 and sets out Government's planning policies for England and how these are expected to be applied. This revised Framework replaces the previous NPPF published in March 2012.

The key objectives of the 2018 SFRA are:

- To provide up to date information and guidance on flood risk for Chichester District Council, taking into account the latest flood risk information (including the probable impacts of climate change), the current state of national planning policy and legislation and relevant studies
- To provide the basis for applying the flood risk Sequential Test, and if necessary the Exception Test
- To provide a comprehensive set of maps presenting flood risk from all sources that can be used as part of the evidence base for the Local Plan Review and to support the preparation of Neighbourhood Plans.
- Identify the requirements for site-specific flood risk assessments and the application of Sustainable Drainage Systems

1.2 Levels of SFRA

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

1 Level One: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.

2 Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This report fulfils the Level One SFRA requirements.

1.3 SFRA outputs

To meet the objectives, the following outputs have been prepared:

- Assessment of all potential sources of flooding
- Assessment of the potential impact of climate change on flood risk
- An assessment of surface water management issues and the application of Sustainable Drainage Systems (SuDS)
- A review and update of new and amended data sources (e.g. Catchment Flood Management Plans, Preliminary Flood Risk Assessment, Updated Flood Maps and modelling, etc)
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk
- Guidance for developers including requirements for site-specific flood risk assessments
- Mapping of location and extent of functional floodplain
- Mapping areas at risk from other sources including surface water, sewer, ground water, reservoir inundation
- Mapping areas covered by an existing flood alert / warning
- Identify opportunities to reduce flood risk
- High-level screening of proposed development sites against flood risk information
- Flood defence infrastructure.

1.4 SFRA user guide

Table 1-1: SFRA report contents

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2. The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
3.The Sequential, risk-based approach	Describes the Sequential Approach and application of Sequential and Exception Tests. Outlines cross-boundary issues and considerations.

Section	Contents
4. Climate change	Outlines climate change guidance and the implications for Chichester.
5. Sources of information used in preparing the SFRA	Outlines what information has been used in the preparation of the SFRA.
6. Understanding flood risk in Chichester	Introduces the assessment of flood risk and provides an overview of the characteristics of flooding affecting the district. Provides a summary of responses that can be made to flood risk, together with policy and institutional issues that should be considered. Outlines the flood warning service in Chichester and provides advice for emergency planning, evacuation plans and safe access and egress.
7. Fluvial and coastal defences	Assessment of flood defences
8. FRA requirements and flood risk management guidance	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the LLFA that should be followed.
9. Surface water management and SuDS	Advice on managing surface water run-off and flooding and the application of SuDS.
10. Flood warning and emergency planning	Outlines the flood warning service in the joint SFRA area and provides advice for emergency planning, evacuation plans and safe access and egress.
11. Strategic flood risk solutions	Overview of possible strategies to reduce flood risk
12. Level 1 summary assessment of potential development locations	A summary of the information presents in the site screening table
13. Summary	Review of the Level 1 SFRA.
14. Recommendations	Identifies recommendations for the council to consider as part of Flood Risk Management policy.
Appendix A-J: Flood risk mapping	Maps showing flood risk information from all sources
Appendix K: Level 1 Site Screening table	Screening table showing the flood risking from all sources to the Level 1 development sites

1.5 Consultation

The following parties have been consulted during the preparation of this Level 1 SFRA:

- Chichester District Council
- Environment Agency
- West Sussex County Council

- Southern Water
- Neighbouring authorities: East Hampshire District, Havant District, Arun District, Horsham District, Waverley District and South Downs National Park
- The Chichester Harbour Conservancy
- Portsmouth Water
- Natural England

1.6 Use of SFRA data

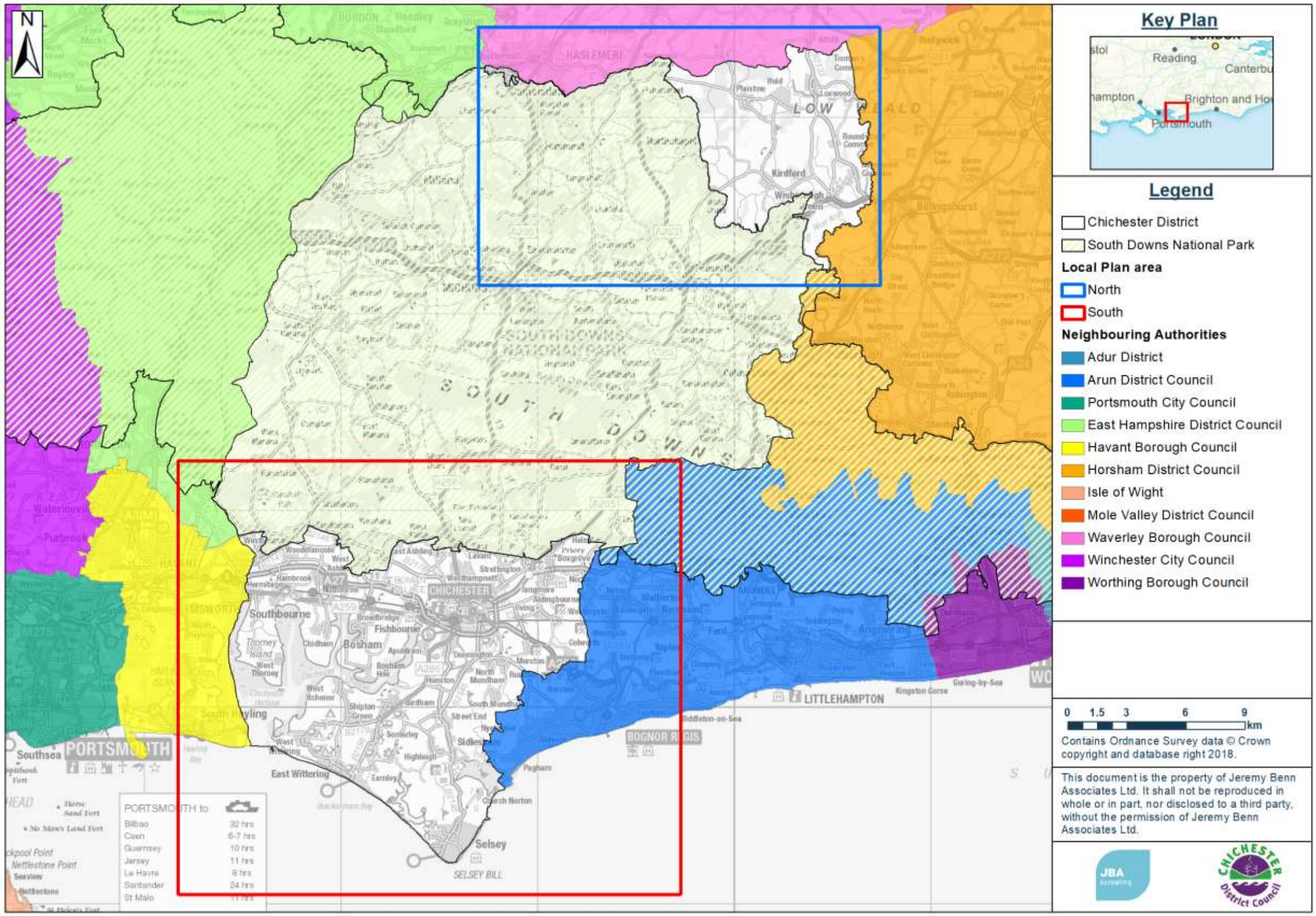
It is important to recognise that SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. The SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

SFRAs should be a **'living document'**, and as a result should be updated when new information on flood risk, new planning guidance or legislation becomes available. New information on flood risk may be provided by Chichester District Council, West Sussex County Council, the Environment Agency, Southern Water and the Harbour Conservancy. It is planned that Chichester District Council, West Sussex County Council, the Environment Agency, Southern Water and JBA Consulting will have annual meetings to discuss any updated information that should be included in the SFRA. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood defence schemes etc.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment. It is recommended that the SFRA is reviewed internally, in line with the Environment Agency's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information. Chichester District Council, West Sussex County Council, the Environment Agency, Southern Water and JBA Consulting plan to have annual meetings to discuss any updates that are needed to the Level 1 SFRA.

Figure 1-1: Chichester District Council's Local Plan area and neighbouring authorities



2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities.

2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

2.2.1 Flood Risk Regulations (2009)

The Flood Risk Regulations (2009) translate the current EU Floods Directive into UK law and place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage localised flood risk. Under the Regulations, the responsibility for flooding from rivers, the sea and reservoirs lies with the Environment Agency; however, responsibility for local and all other sources of flooding rests with LLFAs. In the instance of this SFRA, the LLFA is West Sussex County Council. Detail on the responsibilities of LLFAs is provided in Section 2.2.6.

Figure 2-1 illustrates the steps that have / are being taken to implement the requirements of the EU Directive in the UK via the Flood Risk Regulations. The Regulations require that the process described in Figure 2-1 is repeated on a 6-year cycle and thus the PFRA was updated last year (2017).

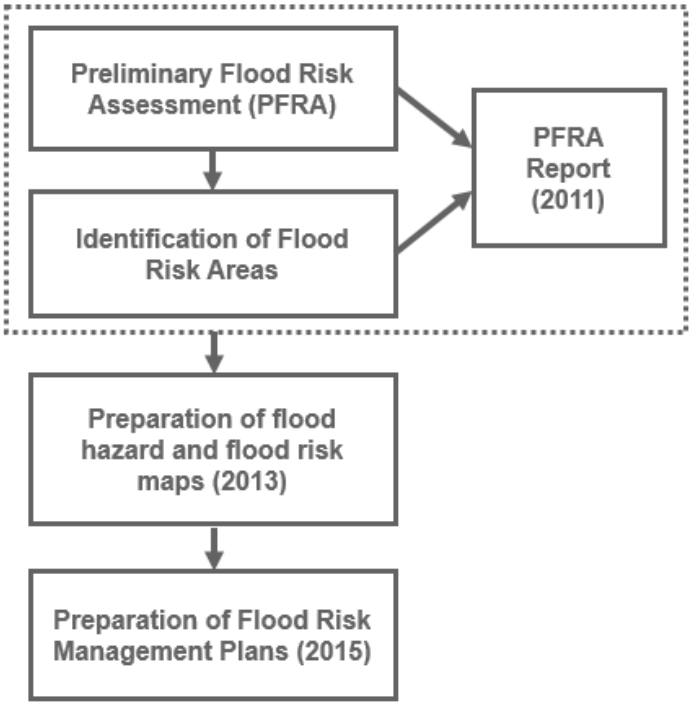


Figure 2-1: Flood Risk Regulation Requirements

2.2.2 Preliminary Flood Risk Assessments

Under this action plan and in accordance with the Flood Risk Regulations, LLFAs have the task of preparing a Preliminary Flood Risk Assessment (PFRA) report every 6 years. The **PFRA document** that covers the study area was first published by West Sussex

County Council in 2011. In 2017, West Sussex County Council prepared an **addendum** to the PFRA which updated the 2011 report.

The PFRA reports on significant past and future flooding from all sources except from Main Rivers and reservoirs, which are covered by the Environment Agency, and sub-standard performance of the adopted sewer network (in this instance, under the remit of Southern Water). PFRAs are a high-level screening exercise and consider floods which have significant harmful consequences for human health, economic activity, the environment and cultural heritage. The Regulations require the LLFA to identify significant Flood Risk Areas. The threshold for designating significant Flood Risk Areas is defined by DEFRA and the PRFA is the process by which these locations can be identified.

In 2011 ten indicative Flood Risk Areas were identified nationally by DEFRA / the Environment Agency, none encroached on the Chichester District Council's Local Plan area.

The exercise was repeated in 2017 and a further national study prepared to identify potential areas of significant flood risk ("Flood Risk Areas") – **'Review of preliminary flood risk assessments (Flood Risk Regulations 2009): guidance for lead local flood authorities in England – 25th Jan 2017'.** No additional Flood Risk Areas were identified within the Local Plan area.

2.2.3 Flood Risk Management Plans

Under the Regulations, the Environment Agency exercised an 'Exception' and did not prepare a PFRA for risk from rivers, reservoirs and the sea. This then made it a requirement for the Environment Agency to prepare and publish a Flood Risk Management Plan (FRMP). The FRMP process adopts the same catchments as used in the preparation of River Basin Management Plans, in accordance with the Water Framework Directive.

Accordingly, more detailed strategic information on proposed strategic measures and approaches can be found in the **South East River Basin District Flood Risk Management Plan** (FRMP) (2016) – Parts A, B and C. The FRMP draws on previous policies and actions identified in the Catchment Flood Management Plans and also incorporates information from Local Flood Risk Management Strategies.

There are ten catchments covered by the South East River Basin, and the Local Plan Area lies within the East Hampshire and Arun and Western Streams Catchment areas. The FRMP summarises the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations.

2.2.4 Flood and Water Management Act (FWMA), 2010

The **Flood and Water Management Act (2010)** aims to create a simpler and more effective means of managing both flood risk and coastal erosion and implements some of Sir Michael Pitt's recommendations following his review of the 2007 floods.

The FWMA established Lead Local Flood Authorities (LLFAs). West Sussex County Council is the LLFA for the study area. Further information on the LLFA role and responsibilities are provided in Section 2.12.2.

2.2.5 West Sussex Local Flood Risk Management Strategy (2013)

West Sussex County Council is responsible for developing, maintaining, applying and monitoring a LFRMS for West Sussex, which covers the Local Plan area. The **West Sussex Local Flood Risk Management Strategy** (2013) is used as a means by which the LLFA co-ordinates flood risk management on a day to day basis. The LFRMS also sets measures to manage local flood risk i.e. from surface water, groundwater and ordinary watercourses.

At the time of preparation of this SFRA West Sussex County Council are updating the LFRMS.

2.2.6 LLFAs, surface water and SuDS

On 18 December 2014 a **Written Ministerial Statement** laid by the Secretary of State for Communities and Local Government set out changes to the planning process that would apply for major development from 6 April 2015.

Major developments are defined as:

- Residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- Non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of 1 hectare or more.

When considering planning applications, Local Planning Authorities should consult the LLFA on the management of surface water so that:

- the proposed minimum standards of operation are appropriate
- there are clear arrangements for on-going maintenance over the development's lifetime, through the use of planning conditions or planning obligations.

As LLFA, WSCC is responsible for local flood risk, which involves flooding from surface water, groundwater and ordinary watercourses. The **West Sussex LLFA Policy for the Management of Surface Water** outlines the requirements that WSCC has for drainage strategies and surface water management provisions, relating to development applications.

2.2.7 Surface Water and Foul Drainage

Chichester District Council's **Surface Water and Foul Drainage – Supplementary Planning Document** (2016) expands on the objectives and policies of the Chichester Local Plan: Key Policies 2014-2029, and provides information on what is required by developers and planners in terms of new developments.

2.3 2018 National Planning Policy and Guidance

The **Revised National Planning Policy Framework** was published in July 2018, replacing the previous version published in March 2012. Key changes in the revised NPPF compared to the 2012 NPPF include:

- Strategic policies should also now consider the 'cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156), rather than just to or from individual development sites;
- Future risk from climate change- the 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158);
- Natural Flood Management - 'Using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques)' (para 157c);
- 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165); and
- Emergency planning. Emergency plans are required as part of an FRA that includes the inclusion of safe access and egress routes (para 163e).

The NPPF sets out Government's planning policies for England and how these are expected to be applied. The Framework is based on core principles of sustainability

and forms the national policy framework in England, also accompanied by a number of Planning Practice Guidance (PPG) notes. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions.

The PPG documents will, where necessary, be updated in due course to reflect the changes in the revised NPPF.

Sequential Test

"The aim of the sequential test is to steer new development to areas with the lowest risk of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding."

If it is not possible for development to be located in zones with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in national planning guidance.

(Revised National Planning Policy Framework, Section 14 paragraph 158 and 159)

Exception Test

"The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Both elements of the exception test should be satisfied for development to be allocated or permitted."

(Revised National Planning Policy Framework, Section 14 paragraph 160 and 161)

A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in Diagram 1 contained within the Planning Practice Guidance Figure 2-2.

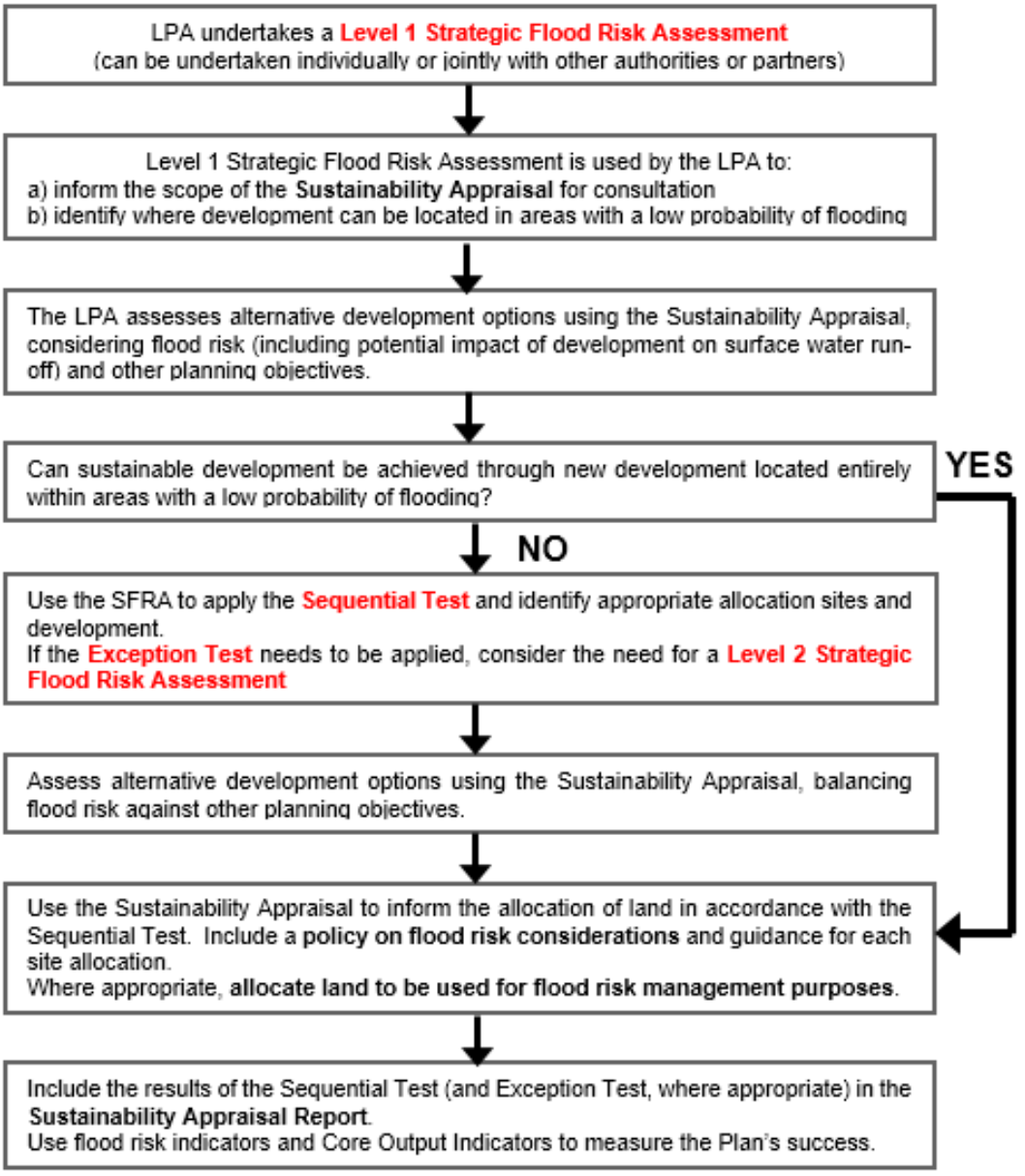


Figure 2-2: Flood risk and the preparation of Local Plans

† Diagram 1 of NPPG: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-005-20140306) March 2014

2.4 Water Quality

2.4.1 Water Quality and Strategic Growth for Chichester District Background Paper

The **Water Quality and Strategic Growth for Chichester District Background Paper** (2012) highlights problems with water quality in Chichester District and the subsequent impact on development. The two main aspects of the issue are the insufficient capacity in environmental permits to accommodate future development needs, and the high level of groundwater infiltration into the sewer network. This has led to the ongoing operation of storm overflow at Chichester (Apuldram) Wastewater Treatment Works. Key stakeholders, Chichester District Council, Southern Water, Environment Agency, Natural England and Chichester Harbour Conservancy, are looking at ways to solve these problems, which are summarised in this policy statement.

The Chichester District Council's Water Quality Assessment (2018) provides the evidence base for the Local Plan review by highlighting potential options for future wastewater treatment which would enable growth in the Local Plan area and support the council in their Habitats Regulations Assessment (HRA).

The Local Plan identifies a number of growth areas which are served by nine Wastewater Treatment Works. The assessment describes the outcomes of a water quality assessment and modelling work to estimate the potential impact of increased discharge volumes from these Wastewater Treatment Works on water quality and receiving waterbodies.

The assessments indicated that consideration might need to be given to upgrading all the Wastewater Treatment Works to provide increased capacity. The sewer networks for Chichester and Loxwood Wastewater Treatment Works will need upgrading and the further investigation is required at other locations so provision is made for sufficient capacity in the networks where necessary to reduce the volume and frequency of any storm related spills.

End of pipe solutions (e.g. improved treatment in the Wastewater Treatment Works) along with water efficiency measures and catchment solutions have also be recommended for consideration.

2.5 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

Surface Water Management Plans (SWMPs) applicable to the Local Plan area are summarised below. The outcomes and actions from these SWMPs should be considered in the context of proposed developments within the study area.

2.5.1 Manhood Peninsula Surface Water Management Plan

The **Manhood Peninsula** SWMP was developed as part of a commission by the WSCC, which involved producing SWMPs for five areas with a significant history of flooding in West Sussex. The plan was completed in 2015. It identifies the importance of short-term and long-term mitigation strategies in reducing flooding in the Manhood Peninsula. After identifying twelve priority locations (including those at high and moderate risk of flooding), the plan outlines short-term actions needed to reduce flooding. Ongoing and long-term mitigation measures are discussed and based around

four key themes: the importance of land drainage consents; controlling runoff from new developments; maintenance of watercourses, culverts and highway drainage on a cyclical basis; controlling runoff from glass houses.

2.5.2 West Chichester Surface Water Management Plan

Similar to the Manhood Peninsula, an SWMP was undertaken for West Chichester due to significant flooding in the past. The plan assesses flood risk within the area, which has been divided into three primary surface water flow catchments: Fishbourne Catchment, Fishbourne Road East Catchment and Parklands Estate Catchment. Following detailed analysis of the drainage systems, the SWMP discusses various options to mitigate flooding within each catchment. This includes localised mitigation measures, which are considered as small scale but high priority, and strategic measures, which address broader problems of capacity and exceedance flow of the drainage network.

The West Chichester SWMP is due to be published in Autumn 2018.

2.6 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are a high-level strategic plan providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other key-decision makers to identify and agree long-term policies for sustainable flood risk management.

There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long-term flood risk management options that can be applied to different locations in the catchment.

2.6.1 Arun and Western Streams CFMP (2009)

The Local Plan area is partially covered by the **Arun and Western Streams CFMP**. The primary policy units for the area are:

- **Policy 3 - Manhood Peninsula and Rural Chichester Harbour/Upper Chalk Stream**. Areas of low to moderate flood risk with generally effective flood risk management
- **Policy 4 - Coastal Plains and East Wittering/Chichester & Lower Chalk Streams.** Areas of low to moderate flood risk where further action is required to sustain the current level of flood risk (responding to the potential increases in risk from urban development, land use change and climate change)
- **Policy 6 – Rother Valley/Middle Arun/Weald**. Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.

The follow issues have been raised in each area.

<u>Manhood Peninsula and Rural Chichester Harbour/ Upper Chalk Streams</u>

This area is low lying and artificially drained by an old drainage network. High tides can prevent flood waters from entering the sea causing tide locking. There have been problems in this area where saturated ground fills septic tanks resulting in foul water discharge into streams and the local sewerage system has been overwhelmed.

The Chichester flood alleviation scheme drains into the Pagham Rife which runs through the area and there is an extensive network of drainage ditched which typically provides protection up to a 3% AEP event.

The CFMP states that the flood risk is being managed at an appropriate level. The emphasis to manage the flood risk in the area is on adaptation rather than prevention.

Coastal Plains and East Wittering

In these areas there is a risk of surface water flooding when groundwater is high, and surface water drains can be prevented from draining when tides are high causing tide locking. The Environment Agency are managing the flood risk in these areas, but further action is needed to keep pace with climate change. Sea level rise will cause an increase in tide locking and increases in rainfall will cause further flooding. It is proposed that methods to reduce run-off and SuDS are used where possible in these areas.

Chichester and Lower Chalk Streams

The rivers in this area are chalk fed streams and the River Lavant flows intermittently. High flows have caused flooding in the past however the Lavant Alleviation Scheme has been in place since 2003 and diverts excess floes into the Pagham Rife.

Groundwater flooding is also an issue in this area and can last for several weeks. High tides can cause tide locking in drainage channels and run-off from the A27 can exacerbate flooding.

Rother Valley/Middle Arun/The Weald

This area has opportunities for changing land use and possible flood storage. The policy in this area supports increased flooding, or at least keeping water on the land for longer. There are large areas of existing wet woodlands which would benefit or be increased in area through increased flooding.

2.7 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assess the pressure facing the water environment in River Basin Districts. The Local Plan area falls within the **South East RBMP.**

The plan provides a summary of programmes of measures that help prevent deterioration to protect and improve the beneficial use of the water environment in the river basin district. An assessment of whether deterioration has occurred from the 2015 classification baseline will be carried out in 2021.

Measures are presented for each significant water management issue in the river basin district which are:

- Physical modifications
- Managing pollution from waste water
- Managing pollution from towns, cities and transport
- Changes to natural flow and levels of water
- Managing invasive non-native species
- Managing pollution from rural areas

The plan provides an example of how Portsmouth Water are working towards making improvements to the operation of the River Ems augmentation scheme and restoration. The improvements will mitigate the low flows which are exacerbated by its abstractions for public water supply. The measures are predicted to get the overall water body status to good ecological potential by 2021.

2.8 Shoreline Management Plan

The Shoreline Management Plan (SMP) forms part of Defra's strategy for flood and coastal defence. It provides a large-scale assessment of risks associated with coastal evolution and presents the policy framework to address these risks in a sustainable manner. The SMP policies defined by DEFRA are:

- **Hold the line** – maintain or upgrade the level of protection provided by defences.
- **Advance the line** – build new defences seaward of the existing defence line.
- **Managed realignment** – allowing retreat of the shoreline, with management to control or limit the movement.
- **No active intervention** – a decision not to invest in providing or maintaining defences.

Not all policies are guaranteed funding and over time the Environment Agency along with other partners will identify the cost. The SMPs are currently undergoing a refresh

2.8.1 Beachy Head to Selsey Bill Shoreline Management Plan (2006)

The **Beachy Head to Selsey Bill Shoreline Management Plan** (2006) covers part of the Local Plan coastline. Between Pagham Harbour and Selsey Bill, the long-term policy is Managed Realignment of the shoreline.

2.8.2 North Solent Shoreline Management Plan (2010)

The **North Solent Shoreline Management Plan** covers the study area from Selsey West Beach to Emsworth Yacht Harbour. The majority of the coastline within this area requires 'Hold the Line' management, both in the short and long term. However, although the majority of the coastline had a hold the line policy, this is on the proviso that there is "No Public Funding Available" within the harbour.

2.9 Coastal Defence Strategies

Coastal defence strategies provide recommendations for managing flood and erosion risks along the coastline.

2.9.1 Pagham to East Head Coastal Defence Strategy (2009)

The Environment Agency, Chichester District Council and Arun District Council worked together to produce the **Pagham to East Head Coastal Defence Strategy**. The strategy identifies ways to manage the risk of flooding and erosion at the main population centres around Pagham, Selsey and the Witterings. The Environment Agency has now begun to implement the recommended options.

2.9.2 Arun to Pagham Risk Management Strategy (2015)

The **Arun to Pagham Flood and Coastal Erosion Risk Management Strategy** outlines recommendations for managing flood and erosion risk along the coastline between the River Arun and Pagham over the next 100 years. The area is divided into a number of strategy units. Part of the SFRA study area, in the south east of the district, is located in the Bognor Regis and Felpham strategy unit.

2.10 Local Plan policies on flood risk and drainage

The **Chichester Local Plan: Key Policies 2014-2029** provides the policy framework and long-term strategy manage development, protect the environment, deliver infrastructure and promote sustainable communities within in the Local Plan area. The policies relating to flood risk and drainage are:

- **Policy 40** – Sustainable Design and Construction

- **Policy 42** - Flood Risk and Water Management

2.11 Natural Flood Management (NFM) Plans

The Environment Agency has developed **Natural Flood Management (NFM) mapping** which displays opportunities for NFM. These maps are to be used as a guide and supplemented with local knowledge to provide a starting point for discussions about NFM. NFM aims to protect, restore and emulate the natural functions of catchments, floodplains, rivers and the coast. NFM should be used on a catchment wide scale and is the linking of blue and green infrastructure.

The maps identify NFM opportunities on different catchment scales:

- National River Basin Districts
- River Basin Districts showing Management Catchments
- Management Catchments showing Water Body Catchments
- Water Body Catchments

These catchments in the Local Plan area cross boundaries with the South Downs National Park Authority and other neighbouring authorities. Discussions about NFM should be had with catchment stakeholders in combination with local knowledge. West Sussex County Council as the LLFA have an NFM lead officer and it is recommended that they are contacted to promote collaborative working.

2.12 Roles and responsibilities of Risk Management Authorities in the Chichester District Council's Local Plan area

The roles and responsibilities of Risk Management Authorities (RMAs) in the Chichester District are summarised below.

2.12.1 Chichester District Council

As a Local Planning Authority, Chichester District Council assess, consult on and determine whether development proposals are acceptable, ensuring that flooding and other, similar, risks are effectively managed.

The council will consult relevant statutory consultees as part of planning application assessments and may, in some cases, also contact non-statutory consultees, such as Southern Water, that have an interest in the planning application.

Chichester District Council are also the Coast Protection Authority, primarily managing coastal erosion through defences. These defences are dual purpose and often serve to manage the coastal flood risk.

2.12.2 West Sussex County Council

As the Lead Local Flood Authority (LLFA) for the area, West Sussex County Council's duties include:

- Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor a LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood Investigations: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.

- Designation of Features: LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Consenting: When appropriate LLFAs will perform consenting of works on ordinary watercourses.
- Enforcement: The LLFA has enforcement powers under the Land Drainage Act 1991 and FWMA 2010.

West Sussex County Council is also the Local Highway Authority and manages highway drainage, carrying out maintenance and improvement works on an on-going basis, as necessary, to maintain existing standards of flood protection for highways, making appropriate allowances for climate change. It also has the responsibility to ensure road projects to no increase flood risk.

2.12.3 Environment Agency

The Environment Agency is responsible for protecting and enhancing the environment and contributing to the government's aim of achieving sustainable development in England and Wales. The Environment Agency has powers to work on Main Rivers to manage flood risk. These powers are permissive, which means they are not a duty, and they allow the Environment Agency to carry out flood and coastal risk management work and to regulate the actions of other flood risk management authorities on main rivers and the coast.

The Environment Agency also has powers to regulate and consent works to Main Rivers. Prior written consent is required from the Environment Agency for any work in, under, over or within nine metres of a Main River or between the high water line and the secondary line of defence e.g. earth embankment. The Environment Agency also has a strategic overview role across all types of flooding as well as other types of water management matters.

2.12.4 Water and wastewater providers

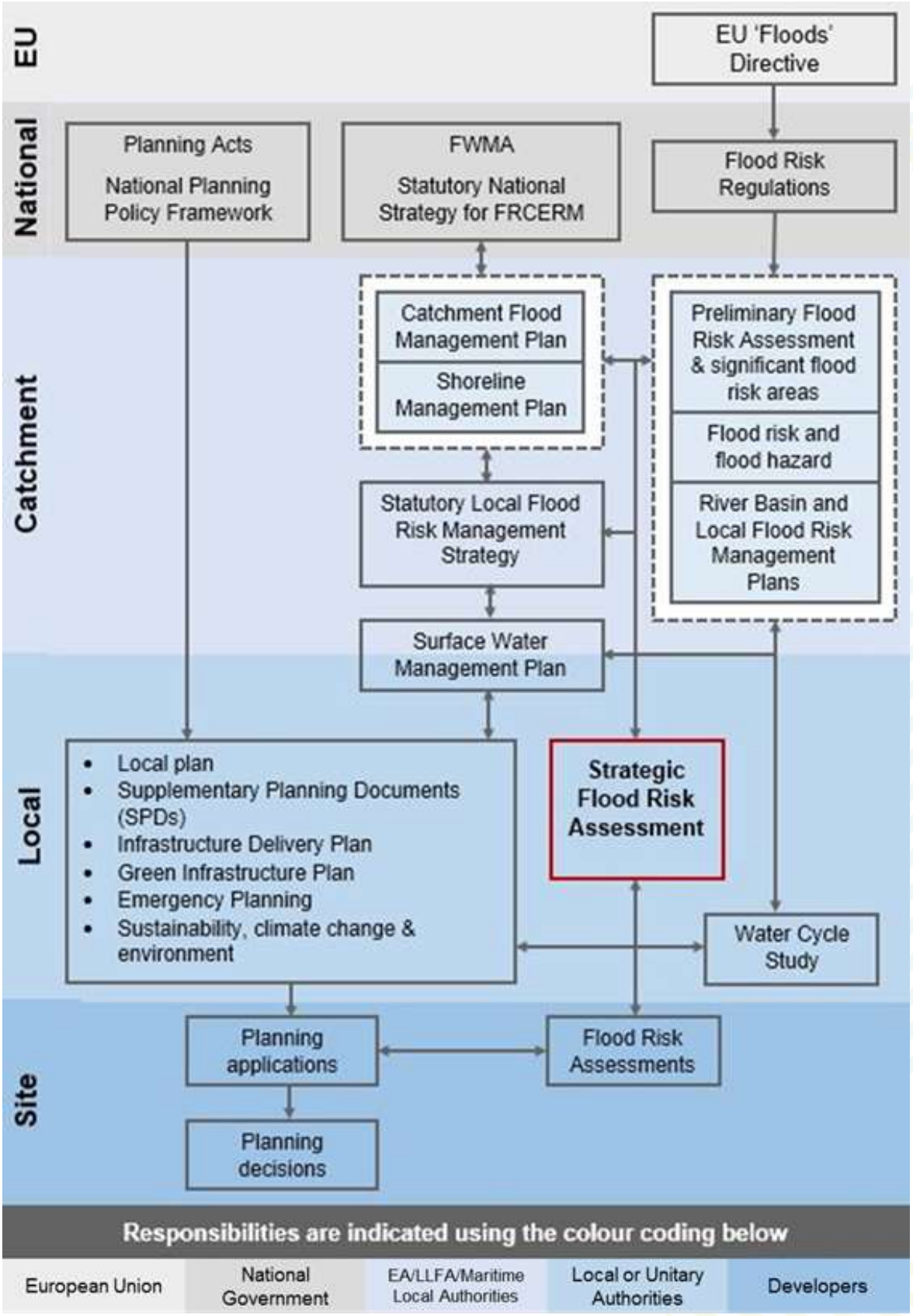
Southern Water is the sewerage undertaker for the Local Plan area. They have the responsibility to maintain surface, foul and combined public sewers to ensure the area is effectively drained. When flows (foul or surface water) are proposed to enter public sewers, Southern Water will assess whether the public system has the capacity to accept these flows as part of their pre-application service. If there is not available capacity, they will provide a solution that identifies the necessary mitigation. Southern Water also comments on the available capacity of foul and surface water sewers as part of the planning application process. Further information can be found on their **website**.

Portsmouth Water and Southern Water provide potable water to the Local Plan area. Consent, prior to commencing work, is required from the relevant provider if installing water systems, or altering existing systems, is intended.

2.13 Key strategic planning links

Figure 2-3 outlines the key strategic planning links for flood risk management and associated documents. It shows how the Flood Risk Regulations and Flood and Water Management Act, have introduced a wider requirement for the mutual exchange of information and the preparation of strategies and management plans. There is a duty to cooperate which is a legal requirement between local planning authorities and other public bodies which serves to maximise the effectiveness of policies for strategic matters in Local Plans.

Figure 2-3: Strategic planning links and key documents for flood risk



3 The sequential, risk-based approach

3.1 The sequential, risk-based approach

This approach is designed to ensure areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible. In the long term this will strategically reduce the reliance on flood risk management measures and avoid commitment to the long term investment required so the measures maintain appropriate standards of safety under climate change conditions.

When drawing up a Local Plan Review, it is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances the Flood Zone maps, which show the extent of inundation without the presence of defences, are too simplistic. Thus, a greater understanding of the scale and nature of the actual flood risks is required as the Flood zones do not take account of the effect of flood risk management measures.

3.1.1 Flood Zones

Maps of Flood Zones are used in this SFRA to illustrate the land at risk of flooding if there were no defences present. The NPPF Flood Risk and Coastal Change Guidance identifies four main Flood Zones, which apply to both Main River and Ordinary Watercourses. These are summarised in Table 3-1.

Table 3-1: Flood Zone descriptions

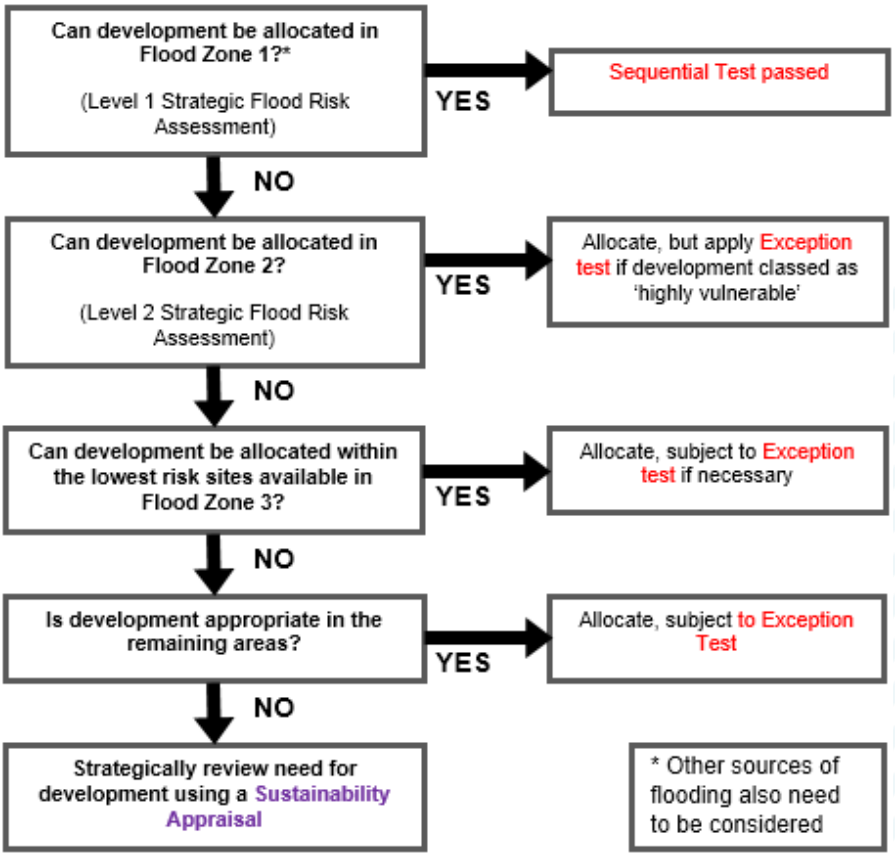
Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1% AEP).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1% - 1% AEP) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5% AEP) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) are appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0% AEP) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5% AEP) in any year. Developers and the local authorities should seek to reduce the overall level of flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify, in their SFRA, areas of functional floodplain, in agreement with the Environment Agency. The identification of functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. They must also be safe for users and not increase flood risk elsewhere. Essential Infrastructure will only be permitted if it passes the Exception Test.
		All developments in this zone require an FRA.

3.2 Applying the Sequential Test and Exception Test in the preparation of the Local Plan Review

When preparing a Local Plan or review, the Local Planning Authority should demonstrate it has considered a range of site allocations, using SFRAs to apply the Sequential and Exception Tests where necessary.

The Sequential Test should be applied to the whole Local Planning Authority area to increase the likelihood of allocating development in areas not at risk of flooding. It is recommended that the Council gives consideration to the climate change maps to understand how the flood zones are predicted to change over the lifetime of the development. In accordance with the NPPF guidance the Sequential Test should use the present-day flood zones for the consideration of site allocations and windfall sites. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the **Sequential Test should be applied in the preparation of the Local Plan Review** (see Figure 3-1).

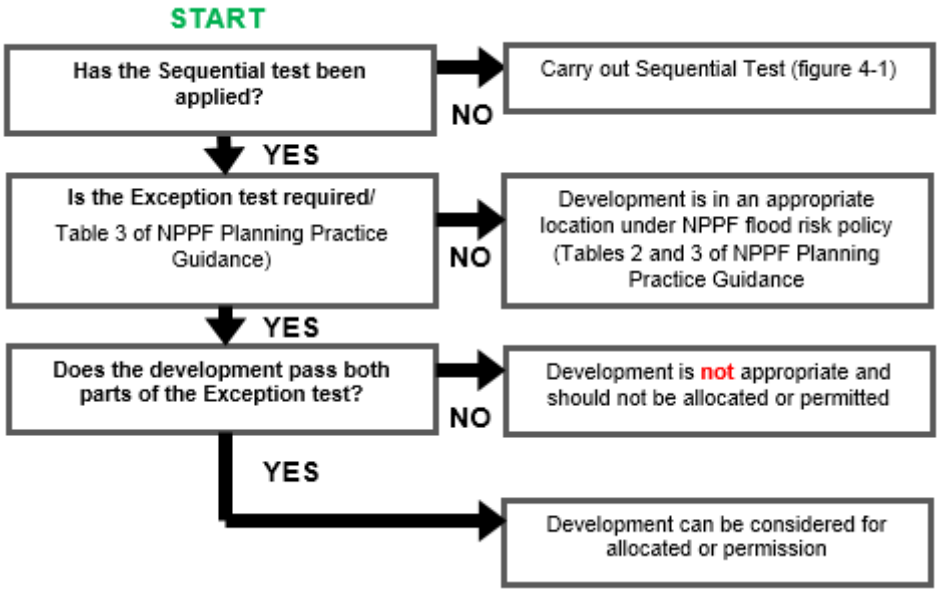
Figure 3-1: Applying the Sequential Test in the preparation of the Local Plan Review



† Diagram 2 of NPPG: Flood Risk and Coastal Change (paragraph 021, Reference ID: 7-021-20140306) March 2014

The Exception Test should only be applied following the application of the Sequential Test and as set out in Table 3 of the 2014 NPPF Planning Practice Guidance: Flood Risk and Coastal Change. The NPPF Guidance describes **how the Exception Test should be applied in the preparation of a Local Plan** († Diagram 3 of NPPG: Flood Risk and Coastal Change (paragraph 028, Reference ID: 7-028-20140306) March 2014).

Figure 3-2: Applying the Exception Test in the preparation of a local plan review



† Diagram 3 of NPPG: Flood Risk and Coastal Change (paragraph 028, Reference ID: 7-028-20140306) March 2014

3.3 Applying the Sequential Test and Exception Test to individual planning applications

The NPPF Planning Practice Guidance sets out how developers and planners need to consider flood risk to, and from, the development site, following the broad approach of assessing, avoiding, managing and mitigating flood risk. A checklist for site-specific Flood Risk Assessments is provided in Paragraph 68 of the Guidance.

A site-specific Flood Risk Assessment should be carried out to assess flood risk to, and from, a development. The assessment should demonstrate how flood risk will be managed over a development's lifetime, taking climate change and the user vulnerability into account. Flood Risk Assessment should also consider the cumulative impact of the development, so flood risk is not exacerbated.

The NPPF Planning Practice Guidance sets out the following objectives for a site-specific Flood Risk Assessment (FRA) and st1ates it should establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- the evidence for the local planning authority to apply (if required) the Sequential Test; and
- whether the development will be safe and pass the Exception Test (where applicable).

3.3.1 Sequential Test

The Sequential Test must be performed when considering the placement of future development and for planning application proposals. The sequential approach to locating development should be followed for all sources of flooding. The Flooding and Coastal Change Planning Practice Guidance to the NPPF gives detailed instructions on how to perform the test.

The Sequential Test does not need to be applied for individual developments under the following circumstances:

- The site has been identified in development plans through the Sequential Test
- Applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site)

It is normally reasonable to presume and state that individual sites that lie in Zone 1 satisfy the requirements of the Sequential Test. However, consideration should be given to risks from all sources, areas with critical drainage problems and critical drainage areas. Also in some circumstances the zone mapping might not have been prepared for small local watercourses making it appear as if land is in Zone 1, when in fact the presence of such features introduces the risk of flooding. At such locations an FRA should be prepared to establish the extent of the Zones, based on site specific local modelling and included in the FRA. The outputs can then be used, as necessary to perform the sequential and exception tests.

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. Whilst for some sites this may be clear, in other cases it may be identified by other local plan policies. A pragmatic approach should be taken when applying the Sequential Test and should be agreed with the Council.

Chichester District Council, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere.

3.3.2 Exception Test

If, following application of the Sequential Test it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied if deemed appropriate. The aim of the Exception Test is to ensure that more vulnerable uses, such as residential development can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the test to be satisfied, the following two elements have to be accepted for development to be allocated or permitted:

1. **It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared.**

Local Planning Authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied, and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused[1].

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1 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 037, Reference ID: 7-056-20140306) March 2014

2. A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The site-specific Flood Risk Assessment should demonstrate that the site will be safe and the people will not be exposed to hazardous flooding from any source. The following should be considered[2]:

- The design of any flood defence infrastructure
- Access and egress
- Operation and maintenance
- Design of the development to manage and reduce flood risk wherever possible
- Resident awareness
- Flood warning and evacuation procedures
- Any funding arrangements required for implementing measures

The NPPF provides detailed information on how the Test can be applied

3.4 Actual flood risk

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the "actual risk" of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- residential development should be protected against flooding with an annual probability of river flooding of 1% AEP (1 in 100-year chance of flooding); and
- residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% AEP (1 in 200-year chance of flooding) in any year.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for the Flood Risk Management Strategy to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change may reduce the standard of protection afforded by defences, due to increased river flows and levels, and so commitment is needed to invest in the maintenance and upgrade of defences if the present-day levels of protection are to be

2 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 038, Reference ID: 7-056-20140306) March 2014

maintained and where necessary land secured that is required for affordable future flood risk management measures.

- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset, rate of rise and duration of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where a) the consequences of flooding need to be mitigated or b) where it is proposed to place lower vulnerability development in areas of flood risk.

3.5 Residual flood risk

Residual risk refers to the risks that remain after measures have been taken to alleviate flooding (such as flood defences). It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- the effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges; and/or
- failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner, or failure of pumping stations.

3.6 Impact of additional development on flood risk

When allocating land for development, consideration must be given to the potential cumulative impact of development on flood risk. The increase in impermeable surfaces and resulting increase in runoff increases the chances of surface water flooding if suitable mitigation measures, such as SuDS, are not put in place. Additionally, the increase in runoff may result in more flow entering watercourses, increasing the risk of fluvial flooding downstream.

Consideration must also be given to the potential cumulative impact of the loss of floodplain as a result of development. The effect of the loss of floodplain storage should be assessed, at both the development and elsewhere within the catchment and, if required, the scale and scope of appropriate mitigation should be identified.

Whilst the increase in runoff, or loss in floodplain storage, from individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe without appropriate mitigation measures.

For windfall sites which have not yet been allocated, the NPPF requires that the cumulative impact of development should be considered at the application stage and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk.

4 Climate change

4.1 Climate change and the NPPF

The 2018 NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

The updated 2018 NPPF also states that the 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158).

4.2 Revised climate change guidance

The Environment Agency published **updated climate change guidance** on 19 February 2016 (further updated on 3 February 2017), which supports the NPPF and must now be considered in all new developments and planning applications. The document contains guidance on how climate change should be taken into account when considering development, specifically how allowances for climate change should be included with FRAs. The Environment Agency can give a free preliminary opinion to applicants on their proposals at pre-application stage. There is a charge for more detailed pre-application planning advice

4.3 Climate change allowances

By making an allowance for climate change it will help reduce the vulnerability of the development and provide resilience to flooding in the future.

The 2016 climate change guidance includes climate change predictions of anticipated change for peak river flow and peak rainfall intensity. These allowances are based on climate change projections and different scenarios of carbon dioxide emissions to the atmosphere.

Due to the complexity of projecting the effects of climate change, there are uncertainties attributed to climate change allowances. As a result, the guidance presents a range of possibilities to reflect the potential variation in the impact of climate change over three periods.

The UK Climate Predictions 2018 (UKCP18) were published on 26 November 2018. The UKCP18 projections replace the UKCP09 projections and is the official source of information on how the climate of the UK may change over the rest of this century. The Environment Agency have confirmed that this may result in changes to the climate change allowances in the future. Please refer to the most up to date climate change allowances provided by the Environment Agency.

For the purposes of the 2018 Level 1 SFRA the 2016 allowances have been considered. Any changes which impact on this SFRA will be added as an addendum after the release of the updated predictions. If a Level 2 SFRA is required, any changes to the climate change allowances will be considered at that stage.

4.4 Peak river flows

Climate change is expected to increase the frequency, extent and impact of flooding, reflected in peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising river levels may also increase flood risk.

The peak river flow allowances provided in the guidance show the anticipated changes to peak flow for the river basin district within which the subject watercourse is located. Once the river basin district has been identified, guidance on uplift in peak flows are provided for three allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 90th percentiles respectively. The allowance category

to be used is based on the vulnerability classification of the development and the flood zones within which it is located.

These allowances (increases) are provided, in the form of figures for the total potential change anticipated, for three climate change periods:

- The '2020s' (2015 to 2039)
- The '2050s' (2040 to 2069)
- The '2080s' (2070 to 2115)

The time period used in the assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development. Further information on what is considered to be the lifetime of development is provided in the **NPPG**.

Land within the Local Plan area is located within the South East River Basin District. Maps showing the extent of River Basins are **published by the Environment Agency**. The allowances for the South East River Basin District are provided in Table 4-1.

Table 4-1: Peak river flow allowances for the South East River Basin District

Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Upper end	25%	50%	105%
Higher central	15%	30%	45%
Central	10%	20%	35%

4.4.1 High++ allowances

High++ allowances only apply in assessments for developments that are very sensitive to flood risk, for example large scale energy generating infrastructure, and that have lifetimes beyond the end of the century. H++ estimates represent the upper limit of plausible climate projections and would not normally be expected for schemes of plans to be designed to or incorporate resilience for the H++ estimate. Further information is provided in the Environment Agency publication, **Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities**.

4.4.2 Which peak river flow allowance to use?

The flood zone and flood risk vulnerability classification should be considered when deciding which allowances apply to the development or the plan. Vulnerability classifications are found in the **NPPG**. The Environment Agency guidance states the following:

Flood Zone 2

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure		✓	✓

Vulnerability classification	Central	Higher Central	Upper end
Highly vulnerable		✓	✓
More vulnerable	✓	✓	
Less vulnerable	✓		
Water compatible	None		

Flood Zone 3a

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure			✓
Highly vulnerable	Development not permitted		
More vulnerable		✓	✓
Less vulnerable	✓	✓	
Water compatible	✓		

Flood Zone 3b

Vulnerability classification	Central	Higher Central	Upper end
Essential infrastructure			✓
Highly vulnerable	Development not permitted		
More vulnerable			
Less vulnerable			
Water compatible	✓		

4.5 Peak rainfall intensity allowance

Climate change is predicted to result in wetter winters and increased summer storm intensity in the future. This increased rainfall intensity will affect land and urban drainage systems, resulting in surface water flooding, due to the increased volume of water entering the systems. The Table 4-2 shows anticipated changes in extreme rainfall intensity in small and urban catchments. These allowances should be used for

small catchments and urban drainage sites. For catchments, larger than 5km^2, the guidance suggests the peak river flow allowances should be used.

For Flood Risk Assessments, both the central and upper end allowances should be assessed to understand the range of impact.

Table 4-2: Peak rainfall intensity allowance in small and urban catchments

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

4.6 Tidal/coastal change

Sea level allowances have been used in the preparation of this report and should be considered for use in FRAs. Additionally, offshore wind speed and extreme wave height allowances should be considered as part of tidal/coast climate change assessment. The Environment Agency guidance and allowances can be found on their **website**.

4.7 Using climate change allowances

To help decide which allowances should be selected to inform the flood levels in flood risk assessments and management strategies for a development or development plan allocation, the following should be considered:

- likely depth, speed and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s)
- vulnerability of the proposed development types or land use allocations to flooding
- 'built in' resilience measures used, for example, raised floor levels
- capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach

4.8 Groundwater

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows, is much more uncertain. Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months. The effect of climate change on groundwater levels for sites in areas where groundwater is known to be an issue should be considered at the planning application stage.

4.9 The impact of climate change in the Local Plan area

4.9.1 Previous studies

The **UK Climate Projections (UKCP18)** provides a number of future projections for different variables across the UK.

South East England

- Increased mean summer temperatures of over 8ºC by 2099.
- Increased mean winter temperatures of up to 7ºC or a decrease of up to 1ºC by 2099.
- Summer rainfall could decrease by over 80% or it could increase up to 10% by 2099.
- Winter rainfall could decrease by up to 10% or it could increase over 60% by 2099.

Whilst changes in trends and mean values is important, the more influential effect of climate change with respect to flood risk and drought is to increase the chance of occurrence and severity of more extreme wet and dry events.

4.9.2 Adapting to climate change

NPPG Climate Change contains information and guidance for how to identify suitable mitigation and adaptation measure in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses

Chichester District Council is part of **Your Energy Sussex**, a partnership led by West Sussex County Council. The scheme works with residents and businesses to lower carbon emissions, as well as investing in energy saving and renewable energy. As well as this, Chichester District Council have produced a **Climate Change Action Plan.** This outlines numerous projects and initiatives being undertaken across its services to reduce carbon emissions and assist the District in adapting to the effects of climate change.

West Sussex County Council has adopted a **Sustainability Strategy** for the period 2015 to 2019. The strategy prioritises corporate and environmental sustainability, valuing and protecting West Sussex, resource efficiency and collaborating with and influencing others in order to achieve maximum sustainability benefits.

West Sussex Life is a report published annually by WSCC, and provides a range of statistics and information about West Sussex. A chapter in the 2014 report focused on **the Environment**, including carbon emissions, energy consumption, waste, flood risk, natural environment and geology.

4.9.3 SFRA climate change modelling

As part of the Level 1 SFRA, the River Ems (2006) ISIS model and the East Wittering (2015) InfoWorks models were re-run to reflect the 2016 peak river flow allowances for the South East River Basin District.

The East Wittering model was run for the 1% AEP plus 35%,45% and 105% increases in peak flows.

Due to the age of the River Ems ISIS model, the 105% increase in flow was beyond what the original model was developed for without significant re-working. Therefore,

the existing model was re-run for the for the 1% AEP plus 35% and 45% events only. The Flood Zone 2 (0.1%AEP) extent has also been used to provide an indicative climate change flood outline. If any sites are considered in this area, then further detailed assessment/modelling should be undertaken using the appropriate, available version of the model.

The 1% AEP plus 35%, 45% and 105% climate change mapping has been provided by the Environment Agency for the following watercourses:

- Aldingbourne
- Bosham Stream
- River Lavant
- Upper Arun

Where there is no fluvial model available, Flood Zone 2 has been used to provide indicative information on climate change. This level of assessment is suitable for a SFRA, However, detailed hydraulic modelling using topographic survey would be required at a site-specific level to confirm the flood risk to these sites.

The East Head to Littlehampton flood risk coastal modelling study (2016) has been provided by the Environment Agency and used to understand the tidal and coastal flood risk along the Local Plan area. The climate change events for the years 2070 and 2115 have also been provided.

Climate change mapping can be found in Appendix E.

5 Sources of information used in preparing the SFRA

5.1 Historic flood risk

The historic flood risk in the Local Plan area has been assessed using point information of recorded incidents provided by West Sussex County Council and on the Environment Agency's recorded flood outline dataset. This has supplemented with other information collected during the course of preparing the assessment. The key considerations from these sources are outlined in Section 6.1.

5.2 Fluvial flood risk models used in this SFRA

Table 5-1 lists the fluvial flood risk modelling used to inform the SFRA.

It should be noted that generalised modelling has been used for the River Wey in this SFRA. At the time of preparing this SFRA, the Environment Agency were in the process of updating flood maps in the Wey Catchment. The Environment Agency should be consulted to obtain the most up to date modelling in preparation of any FRAs in this area.

Table 5-1: Fluvial flood risk models used in the Level 1 SFRA

Model name	Year	Software (type)
East Wittering	2015	InfoWorks
River Ems	2006	ISIS (Flood Modeller)
The Lavant	2018	Flood Modeller/TUFLOW
Upper Arun	2003	ISIS (Flood Modeller)
Aldingbourne Rife	2016	InfoWorks
Bosham Stream	2012	ISIS-TUFLOW
Generalised main river and ordinary watercourse modelling	2004 and 2009	JFlow (2D)

5.3 Fluvial flooding

Flood Zones 2, 3a and 3b have been compiled for the study area as part of this SFRA. Flood Zones are based on the undefended scenario with the exception of Flood Zone 3b, which includes the presence of defences on the basis that land behind existing defences is not functional floodplain. The Flood Zones presented in this SFRA should be used for the basis for decision making in the Local Plan review. This will update the existing Environment Agency Flood Zones.

The following categories have been used to define each Flood Zone:

- **Flood Zone 1:** Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1% AEP)
- **Flood Zone 2:** Comprised of land having between a 1 in 100 (1% AEP) and 1 in 1,000 annual probability of river flooding or 1 in 200 (0.5% AEP) and 1 in 1,000 (0.1% AEP) annual probability of sea flooding.
- **Flood Zone 3a:** This zone comprises land assessed as having a greater than 1 in 100 (>1% AEP) annual probability of river flooding or Land having a 1 in 200 or greater annual probability of sea flooding.
- **Flood Zone 3b:** This zone comprises land where water has to flow or be stored in times of flood (the functional floodplain).

Flood Zone 3b, unlike other Zones, does show flood risk that takes account of the presence of existing flood risk management features and flood defences, as land afforded this standard of protection is not appropriately included as functional flood plain. The mapping in the SFRA identifies this Flood Zone as land which would flood with a 5% chance in each and every year (a 1 in 20-year annual exceedance probability (AEP)), where detailed modelling exists. Where the 5% AEP outputs are not available, the precautionary approach has been taken, surrogate return periods have been used (e.g. 1 in 25-year (4% AEP), if available). Where this was not available, then the 1 in 100-year (1% AEP) defended scenario has been used. If a proposed development is shown to be in Flood Zone 3, further investigation should be undertaken as part of a detailed site-specific FRA to define and confirm the extent of Flood Zone 3b.

The effect of wave overtopping along the coastline has been included in the Flood Zone 3b delineation.

If existing development or infrastructure is shown in Flood Zone 3b, additional consideration should be given to whether the specific location is appropriate for designation as 'Functional' with respect to the storage or flow of water in time of flood.

Flood Zone mapping for the Local Plan area can be found in Appendix D. The map highlights where a precautionary approach has been used to identify Flood Zone 3b.

5.3.1 Climate change

Hydraulic modelling has been undertaken to provide updated climate change flood mapping for the River Ems and East Wittering models. This modelling follows the latest guidance for climate change in FRAs/SFRAs released by the Environment Agency in February 2016 (and updated in April 2016).

Climate change for fluvial events has been prepared for the Central, Higher Central and Upper End estimates for the 2080s epoch (2070-2115).

Care must be taken with respect to using the predicted change in Zone 3b as an increase in the extent of the zone at locations where there are existing defences might reflect that the requirement for future improvements in the standard of protection afforded by flood risk management measures rather than in increase in the extent of functional flood plain.

Climate change mapping for the Local Plan area can be found in Appendix E.

5.4 Tidal/Coastal

The East Head to Littlehampton flood risk coastal modelling study (2016) has been used to understand the tidal and coastal flood risk along the Local Plan area. The tidal mapping provides information for present day Flood Zone 3b, 3a and 2 (Appendix D) and for the for the climate change event for the years 2070 and 2115 (Appendix E).

5.5 Surface Water

Mapping of surface water flood risk in Chichester District Council's Local Plan area has been taken from the Risk of Flooding from Surface Water (RoFSW) published online by the Environment Agency. These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The RoFSW is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different levels of surface water flood risk

depending on the annual probability of the land in question being inundated by surface water.

Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in chance in any given year (3.3% AEP)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1% AEP) and 1 in 30 (3.3% AEP) chance in any given year.
Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1% AEP) and 1 in 100 (1% AEP) chance in any given year.
Very Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1% AEP) and 1 in 100 (1% AEP) chance in any given year.

Although the RoFSW offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site-specific scale. Such an assessment will use the RoFSW in partnership with other sources of local flooding information, to confirm the presence of a surface water risk at that particular location.

The RoFSW map for the Local Plan area can be found in Appendix F.

A **Flood Investigation report** prepared by West Sussex County Council reviewed the major flood event of June 2012. This report has been referred to in the preparation of this SFRA.

5.6 Groundwater

JBA has developed a range of Groundwater Flood Map products at national scale. The 5m resolution JBA Groundwater map has been used within the SFRA. The modelling involves simulating groundwater levels for a range of return periods (including 75, 100 and 200-years). Groundwater levels are then compared to ground surface levels to determine the head difference in metres. The JBA Groundwater Map categorises the head difference (m) into five feature classes based on the 100-year model outputs.

It should be noted that the JBA Groundwater Flood Map is suitable for general broad-scale assessment of the groundwater flood hazard in an area, but is not explicitly designed for the assessment of flood hazard at the scale of a single property. In high risk areas a site-specific risk assessment for groundwater flooding is recommended to fully inform on the likelihood of flooding.

The JBA Groundwater Map for the Local Plan area can be found in Appendix G.

5.7 Sewers

Historical incidents of flooding are detailed by Southern Water through their Sewer Incident Report Form (SIRF) Data. This database records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding.

The SIRF for the Local Plan area can be found in Table 6-3.

5.8 Reservoirs

The risk of inundation due to reservoir breach or failure of reservoirs within the area has been mapped using the outlines available from the Risk of Flooding from Reservoirs dataset made available by the Environment Agency.

The Risk of Flooding from Reservoirs mapping for the Local Plan area can be found in Appendix H. An Environment Agency programme for updating and improving this mapping is in progress and is due to be completed by 2020.

5.9 Suite of maps

All of the mapping can be found in the appendices to this SFRA and is presented in the following structure:

- Appendix A: SFRA appendix grid map
- Appendix B: Historic flood risk records
- Appendix C: Watercourses
- Appendix D: Fluvial and tidal Flood Zones
- Appendix E: Fluvial and tidal climate change flood risk mapping
- Appendix F: Surface water flood risk mapping
- Appendix G: JBA Groundwater Flood Map
- Appendix H: Reservoir inundation map
- Appendix I: Flood Defences
- Appendix J: Flood Alert and Flood Warning Areas

5.10 Other relevant flood risk information

Users of this SFRA should also refer to other relevant information on flood risk where available and appropriate. This information includes:

- **Arun and Western Streams CFMP (2009)**

Provides information on the catchment-wide strategy for flood risk management. It should be ensured that any flood risk management measures are consistent with the plan.

- **West Sussex Local Flood Risk Management Strategy (2013)**

Provides information on local flooding issues and the plan for managing risk. It should be ensured that development and any flood risk management measures are consistent with the strategy. The LFRMS is currently being updated by West Sussex County Council.

- **South East River Basin District Flood Risk Management Plan (2016)**

Provides information on the catchment-wide strategy for flood risk management. It should be ensured that any flood risk management measures are consistent with the strategy.

- **Beachy Head to Selsey Bill Shoreline Management Plan (2006)**
- **North Solent Shoreline Management Plan (2010)**

These provide large-scale assessments of the risks associated with coastal evolution and presents the policy framework to address these risks in a sustainable manner. It should be ensured that any coastline development and flood risk management measures are consistent with the plan. The SMPs are currently undergoing a refresh.

- **Chichester District Council Surface Water and Drainage Supplementary Planning Document (SPD)**

This document provides useful advice to developers and consultants when preparing a planning application so that the development fully considers the water environment and how it should be managed. The document covers areas served by the wastewater treatment catchments: Apuldram (Chichester), Bosham, Thornham, Sidlesham, Pagham, Tangmere, Kirdford, Loxwood and Wisborough Green

6 Understanding flood risk in the Local Plan area

6.1 Historical flooding

The Local Plan area has a long history of recorded flood events, with multiple sources of flooding. The most notable flooding incidents occurred in 1974, 1993/1994, 2000, 2012 and 2013/2014, during which widespread flooding was observed across the study area.

Information collated from the Environment Agency's flood outline and West Sussex County Council recorded flood incidents data sets, were assessed to understand the historic flooding in the Local Plan area. The data shows that there have been a number of fluvial floods in the area including along the River Lavant, the Earnley Rife, River Ems, the Ham Brook, River Lox and River Kird.

Selsey and East Wittering have been susceptible to tidal flooding in the past and surface water flooding has been recorded throughout the Local Plan area.

Groundwater flooding has been recorded in Chichester, Emsworth, Wisborough Green and Woodmancote.

This information was supplemented by information collected from the 2008 Chichester SFRA, West Sussex County Council Flood Investigation reports and an online search.

The key historical incidents of flooding identified is summarised as follows:

- **September 1968:** A fluvial flood in Wisborough Green caused damage to the river bank, a road and to a cottage. The maximum recorded flood level was 11.18m AOD. There are also several records which show that Loxwood was subject to flooding during this event, which affected roads, properties and gardens.
- **November 1974**: Heavy rainfall resulted in widespread fluvial and tidal flooding across the Local Plan area. Among the areas affected were Chidham, Bosham and Southbourne. The main impacts of the flood were minor road flooding and damage to property.
- **1974, 1979 and 1981:** The Environment Agency flood records identify that Wisborough Green has been affected by several flood events. According to the WSCC records, areas frequently affected by flooding include Durham Road, the public house and the local green. During the 1981 flooding incident, several gardens and properties flooded.
- **June 1991**: Chidham was affected by flooding due to drainage.
- **December 1993/January 1994:** Heavy rain at the end of December led to burst banks along the River Lavant and subsequent flooding in the City of Chichester and surrounding areas. The A27, 3 miles west of Chichester was closed due to serious flooding for a lengthy period.
- **January 1996:** Fluvial flooding in East Wittering resulted in the flooding of several properties.
- **January 1998; November and December 2005; March 2008:** According to the historic flood records, Selsey has been affected by flooding on at least three different occasions. The main causes of these floods are tidal/coastal or overtopping of defences.
- **October 2000 and January 2003:** Bosham has also flooded on separate occasions, mainly due to drainage problems. Flooding was particularly bad in October 2000, as road drainage systems and sewer networks became congested, which led to ditches and sewer chambers overflowing onto roads.

- **November 2000:** Overtopping of the River Ems led to flooding on Lumley Road in Southbourne. The same road was flooded again in December 2013.
- **June 2012:** Heavy rainfall led to widespread surface water flooding, with 138 properties affected within the study area. The A27 was closed in both directions due to serious flooding[3]. To reduce flood damage, the Environment Agency used high volume pumps to lower river levels on Aldingbourne Rife[4].
- **Winter 2013/14:** Widespread flooding across the study area.

Appendix B shows the recorded historic flood points and historic flood extents provided by WSCC and the Environment Agency respectively. Not all of the historic data provided had a source of flooding and was therefore classified as 'Unknown'. Also, not all of the data provided had dates or a description of flooding recorded.

6.1.1 West Sussex County Council June 2012 Flood Event Report

West Sussex County Council produced a **Flood Investigation report** in November 2012 reviewing the major flood event of June 2012. The report identifies the event as a 1 in 200-year event (0.5% AEP) that overwhelmed the drainage network and led to widespread flooding across West Sussex. 110 properties were recorded as flooded in the Manhood Peninsula and 28 properties in West Chichester.

6.2 Topography, geology and soils

Chichester District, the largest district in West Sussex, covers an area of approximately 800km^2 and has a total population of 113,800. A substantial proportion of the district (544km^2) falls within the South Downs National Park which is excluded from the Local Plan area. There are 33 Parish Councils in the Local Plan area. The main settlement is the city of Chichester, with a population of around 26,000. Other sizeable towns include Selsey, Southbourne and Tangmere[5].

6.2.1 Topography

As shown in Figure 6-1 and Figure 6-2, the topography of the Local Plan area comprises of low-lying grounds in the south, associated with Chichester Harbour and Pagham Harbour, and further north, with the 'Low Weald' arable landscape[6]. The South Downs runs through the centre of the district, wherein the highest elevation is approximately 277m AOD. The majority of the Local Plan area is just above sea level, with the highest elevation located in the north-eastern corner at approximately 85m AOD.

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[3] Travel warning after roads flood in Chichester area, BBC News, June 2012, available: https://www.bbc.co.uk/news/uk-england-sussex-18392059

[4] Flood water pumped out as West Sussex rain alert issued, BBC News June 2012, available: https://www.bbc.co.uk/news/uk-england-sussex-18451257

5 Chichester District Council, Adopted Chichester Local Plan: Key Policies 2014-2029

6 Chichester District Council, Adopted Chichester Local Plan: Key Policies 2014-2029

Figure 6-1 Topography of the northern Local Plan area

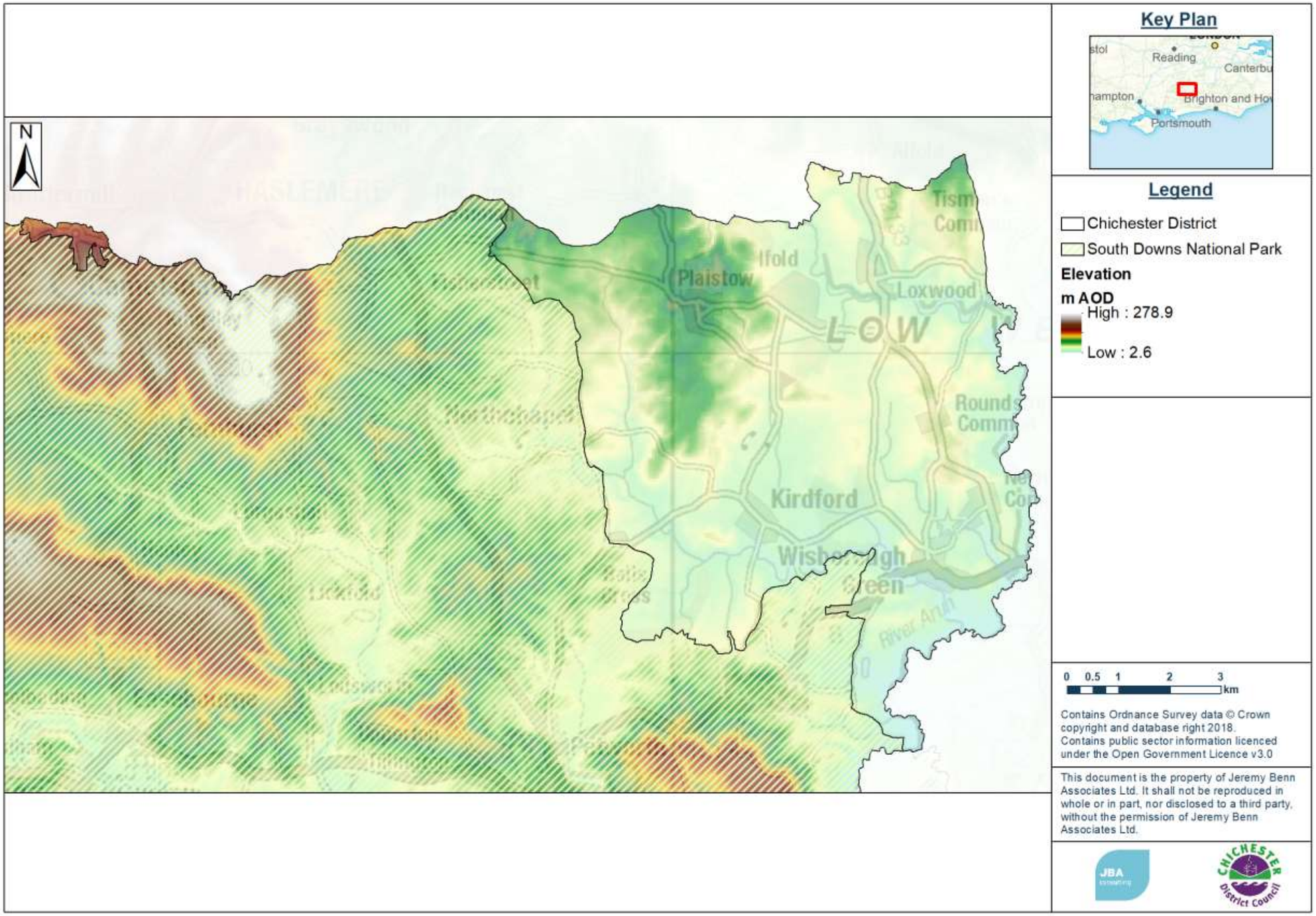
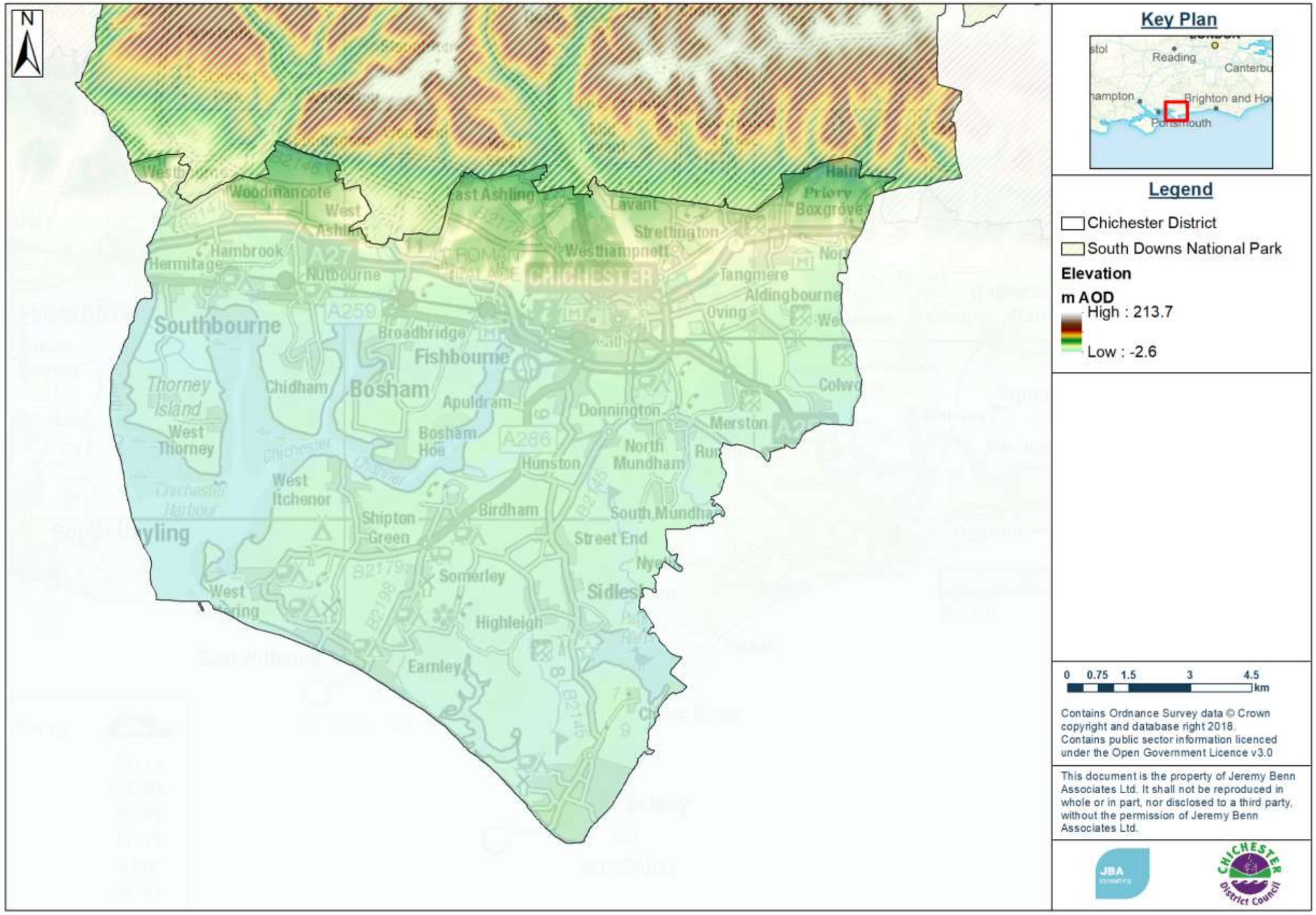


Figure 6-2: Topography of the southern Local Plan area



6.2.2 Geology and soils

The geology of the catchment can be an important influencing factor on the way that water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy.

Figure 6-3 and Figure 6-4 show the bedrock (solid permeable) formations in the Local Plan area and Figure 6-5 and Figure 6-6 show the superficial deposits (permeable, unconsolidated).

The bedrock layers and superficial deposits are classified as the following aquifers and are shown in Figure 6-7, Figure 6-8, Figure 6-9 and Figure 6-10.

- **Principal**: layers of rock or drift deposits with high permeability and, therefore, provide a high level of water storage
- **Secondary A**: rock layers or drift deposits capable of supporting water supplies at a local level and, in some cases, forming an important source of base flow to rivers
- **Secondary B**: lower permeability layers of rock or drift deposits which may store and yield limited amounts of groundwater
- **Secondary undifferentiated**: rock types which do not fit into either category A or B.
- **Unproductive Strata**: rock layers and drift deposits with low permeability and, therefore, have a negligible impact on water supply or river base flow.

The bedrock geology in the study area is classified as a mixture of Principal and Secondary A aquifers and unproductive strata.

The superficial deposits in the study are primarily classified as Secondary A aquifers, which are associated with areas of sand and gravel, and Secondary (undifferentiated) aquifers are also located through the area.

Figure 6-3: Bedrock Geology in the northern Local Plan area

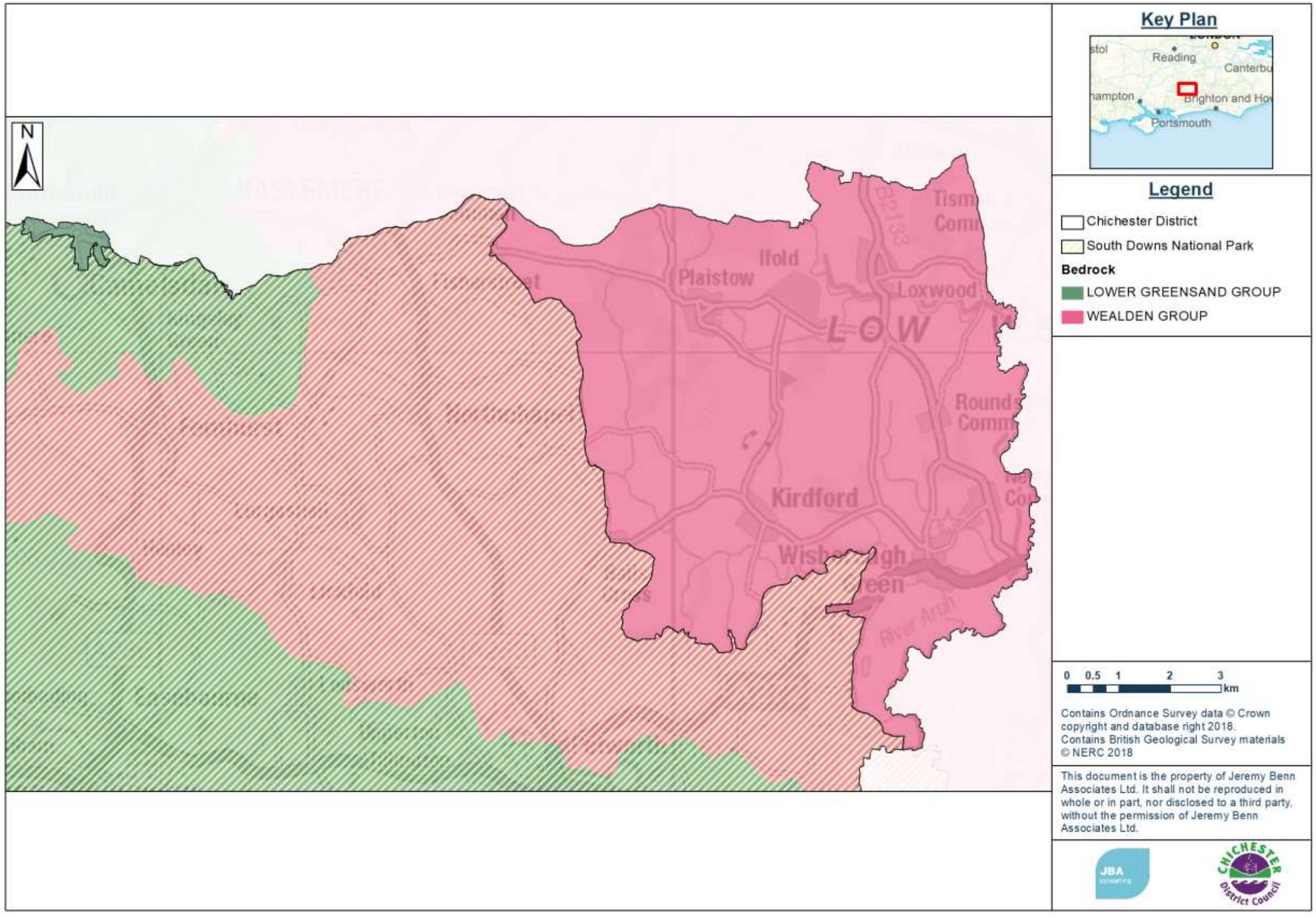


Figure 6-4: Bedrock Geology in the southern Local Plan area

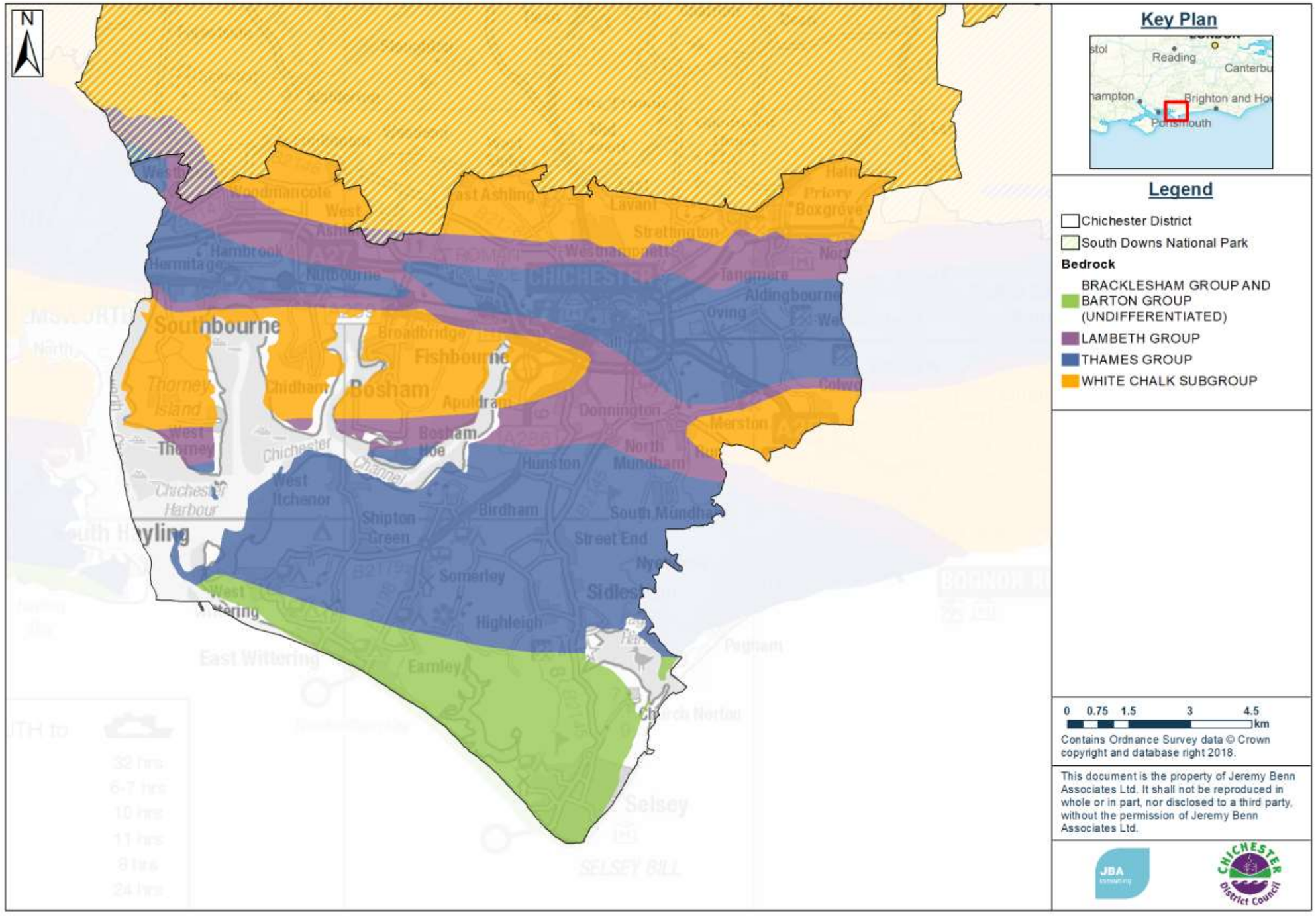


Figure 6-5: Superficial deposits in the northern Local Plan area

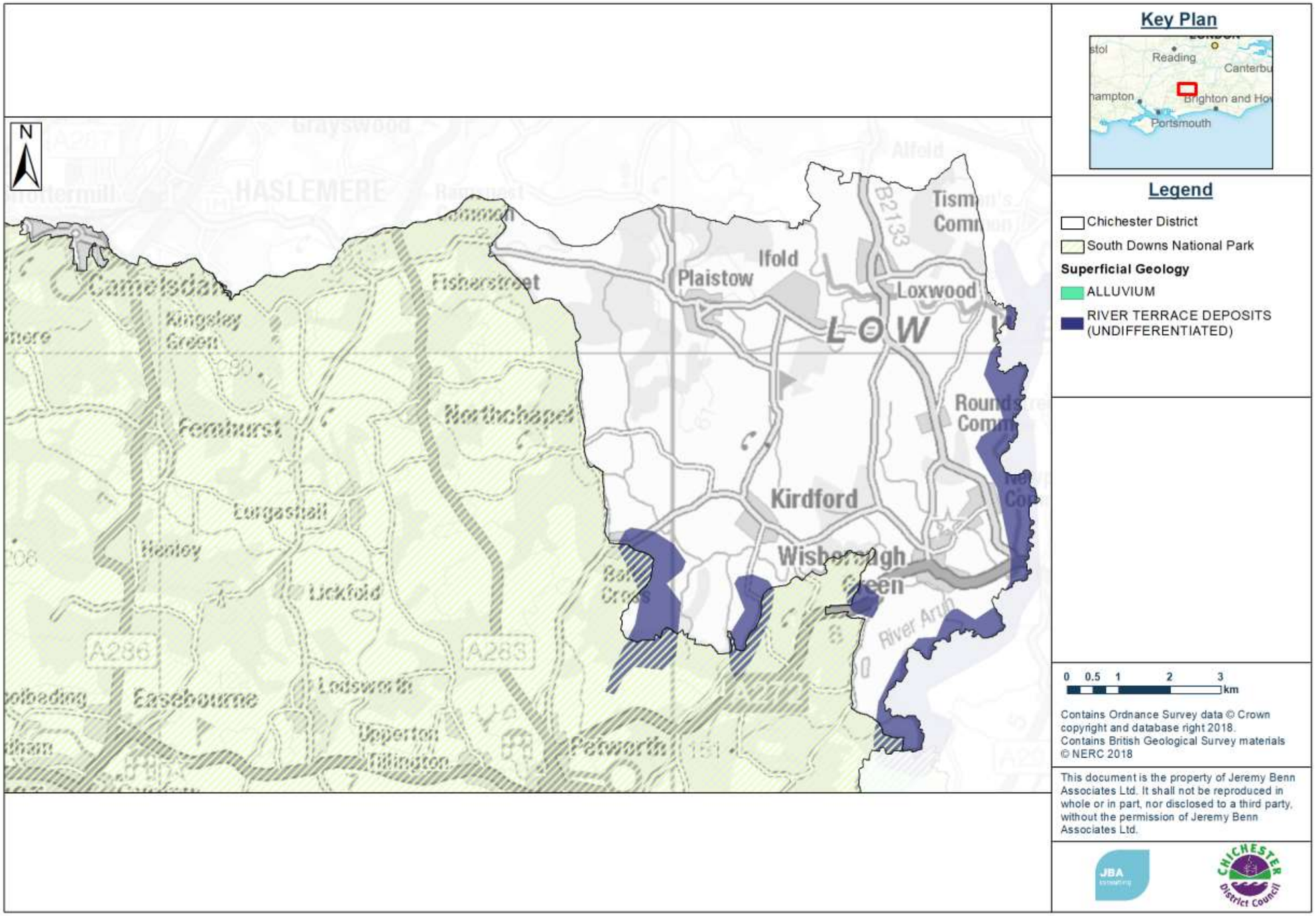


Figure 6-6: Superficial deposits in the southern Local Plan area

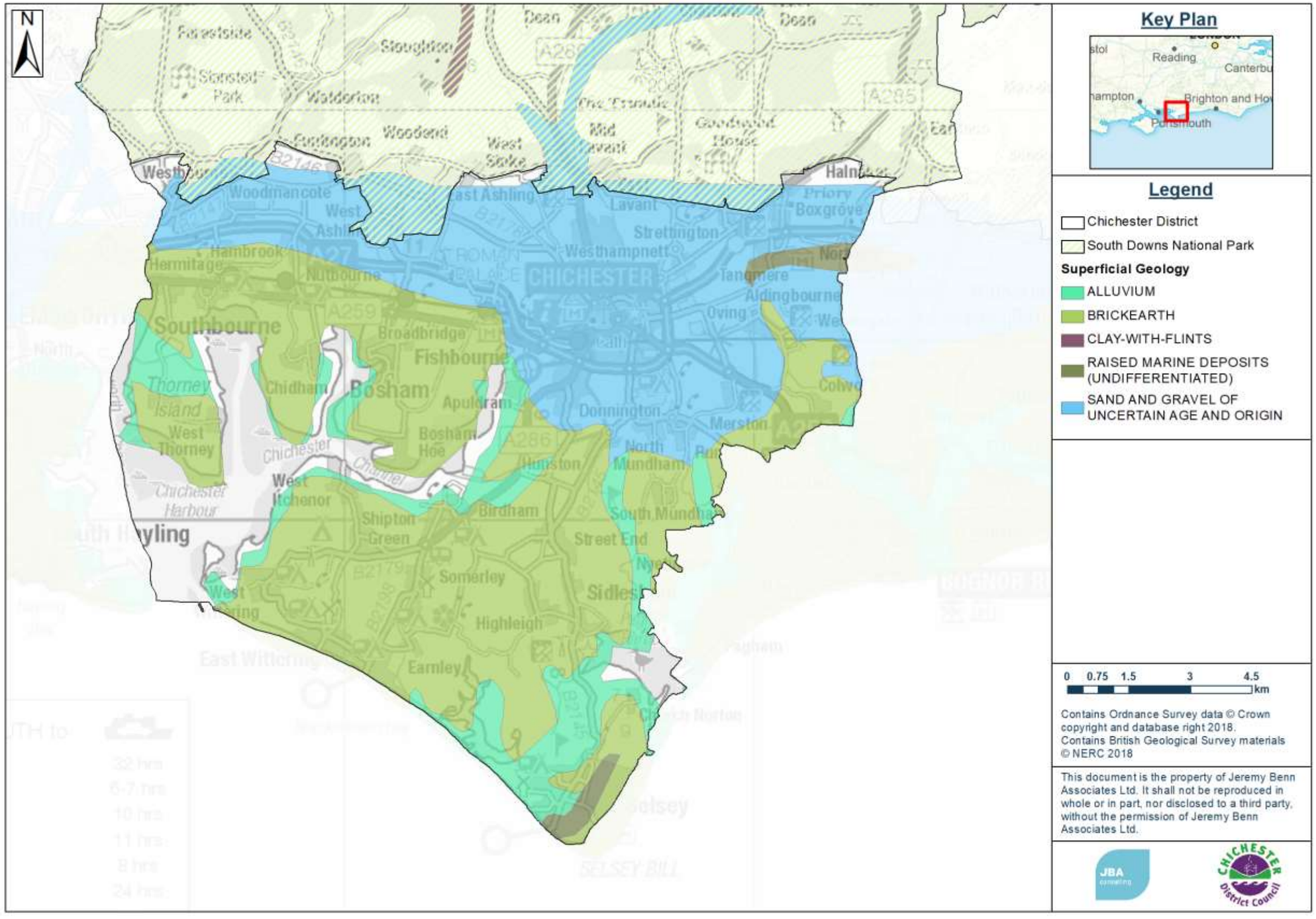


Figure 6-7: Bedrock aquifer designation in the northern Local Plan area

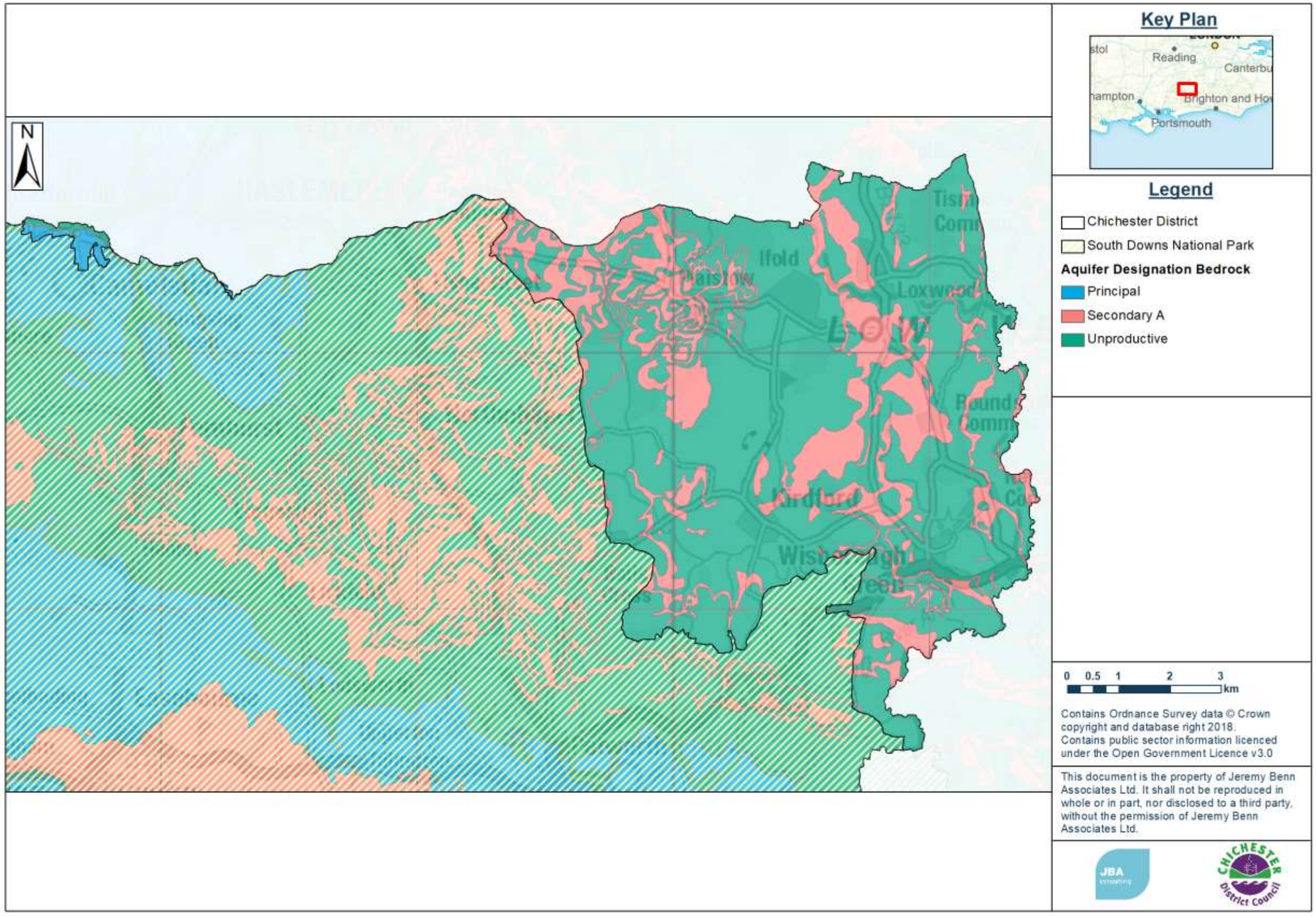


Figure 6-8: Bedrock aquifer designation in the southern Local Plan area

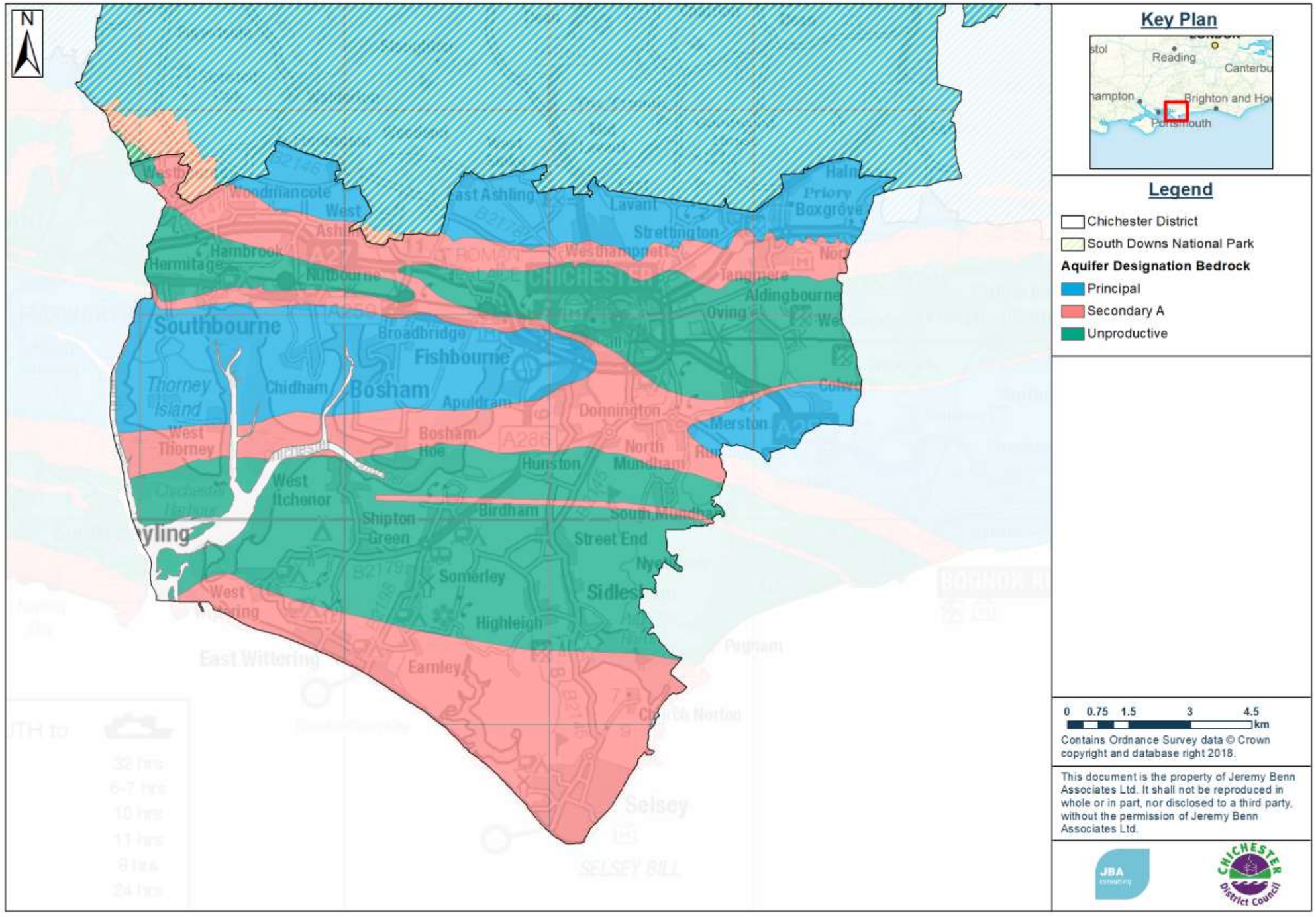


Figure 6-9: Superficial aquifer designation in the northern Local Plan area

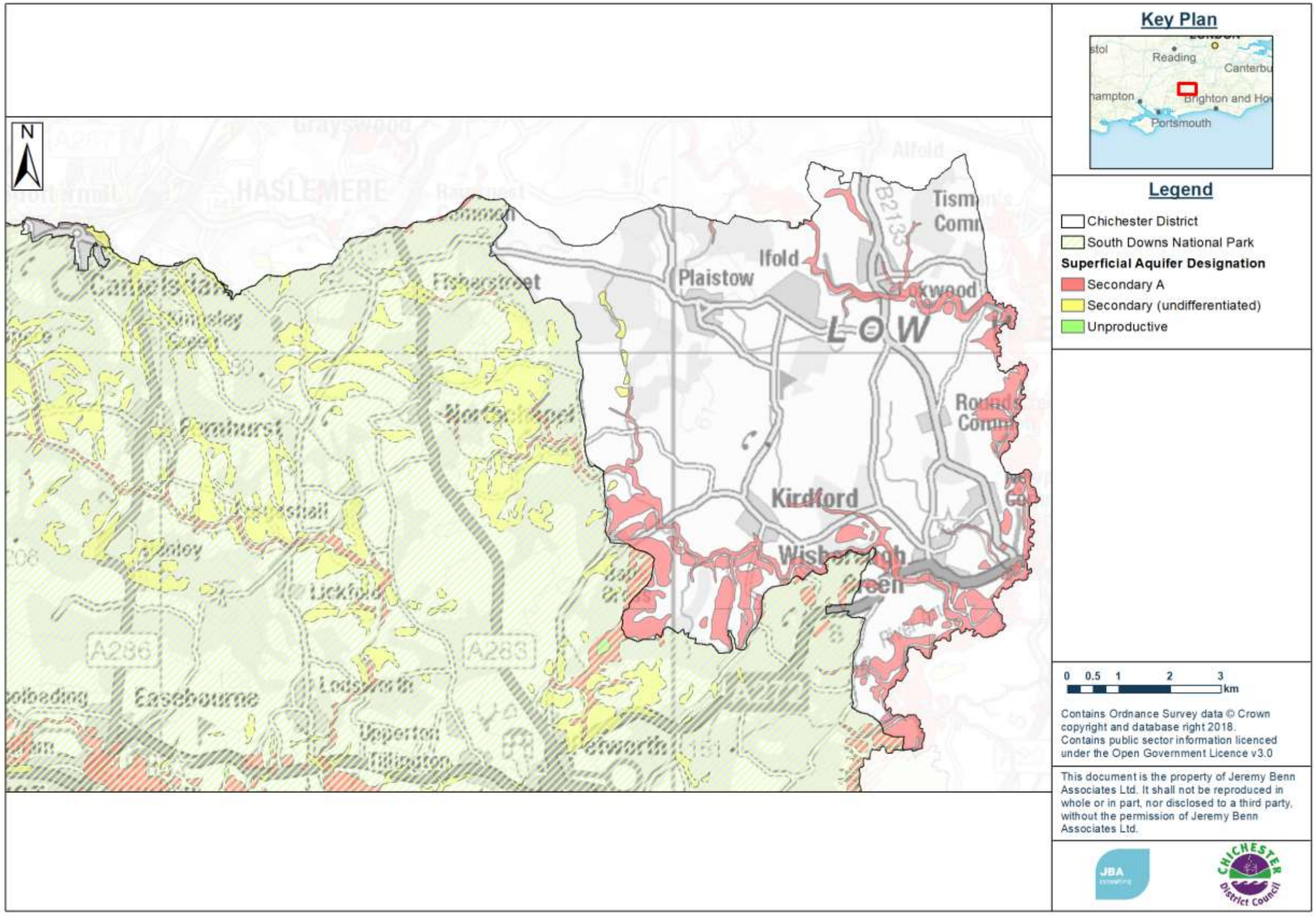
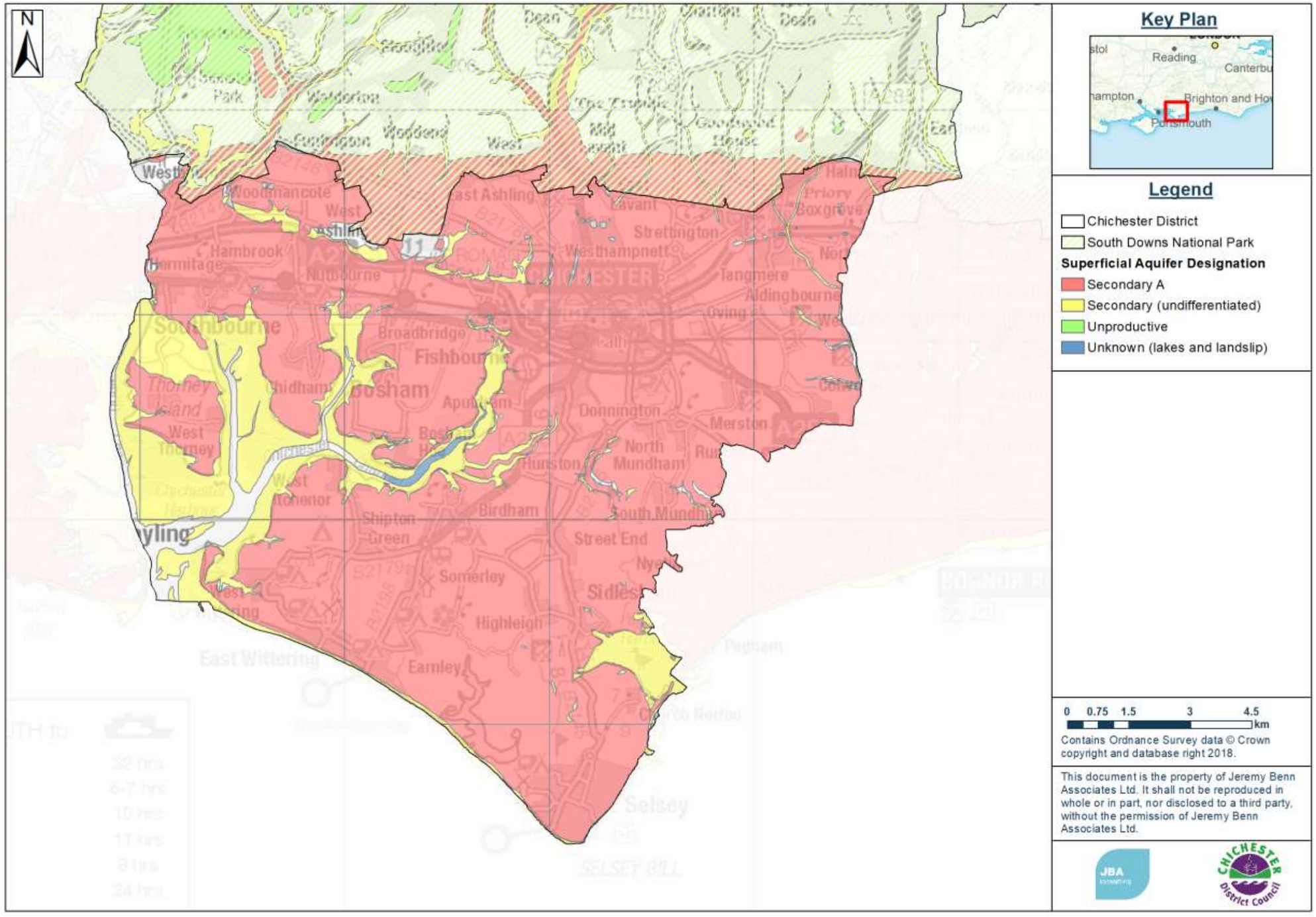


Figure 6-10: Superficial aquifer designation in the southern Local Plan area



6.2.3 Watercourses

The principal watercourses flowing through the Local Plan area are the River Lavant and its tributaries to the south, and tributaries of the River Arun to the north. Whilst the River Arun flows just outside the eastern boundary of the SFRA area, its main tributaries within the study area are the River Lox and the River Kird. The River Lavant flows through the city of Chichester and on towards the Chichester Channel, with several tributaries draining the coastal parts of the Local Plan area.

Pagham Harbour and Chichester Harbour are fed by a number of small streams from the South Downs and are of international importance and are protected. Many of these streams are groundwater fed and provide public water supply for the area.

A summary of the principal watercourses in the SFRA is provided below in Table 6-1. Mapping indicating the location of the principal watercourses can be found in Appendix C.

Table 6-1: Watercourses in the study area

Watercourse	Description
River Lox	River Lox flows easterly across the top north-eastern corner of the SFRA area, through Loxwood village, before joining the River Arun.
Wey and Arun Canal	A small portion of this canal flows through the north-eastern corner of the SFRA area, alongside the River Lox.
River Wey	The River Wey runs long the border of the SFRA study area boundary in the north-west through Hammer and Camelsdale.
River Kird	A tributary of the River Arun. Flows easterly from its source in the South Downs National Park across the SFRA area through Wisborough Green, before joining the River Arun at the edge of the SFRA area.
River Ems	River Ems flows southwest from its source in Stoughton, in the South Downs National Park and briefly enters the SFRA area north of Emsworth, before exiting again and continuing south to Emsworth Harbour.
River Lavant	River Lavant flows south into the SFRA area from its source in East Dean, in the South Downs National Park. The River Lavant flows through Chichester, before continuing south-west and discharging into the Chichester Channel.
Chichester Ship Canal	A 4-mile long waterway linking historic Chichester to the Harbour at Birdham.
Ham Brook	A tributary of the River Lavant, flowing south from Hambrook before flowing into Chichester Harbour.
Bosham Stream	A tributary of the River Lavant, which starts at the edge of the South Downs National Park boundary and flows south through Bosham towards the Chichester Channel.
Earnley Rife	A tributary of Broad Rife. Flows from its source in Earnley before joining Broad Rife near Bracklesham Bay.
Easton Rife	A tributary which flows in a southerly direction towards its confluence with Broad Rife.
Broad Rife	A tributary of Pagham Rife. Flows southwest from its confluence with Pagham Rife and continues northwest along Bracklesham Bay, where it is joined by Earnley Rife.

Watercourse	Description
Selsey Rife	A tributary of Broad Rife. Flows southeast towards Selsey from its confluence with Broad Rife.
Keynor Rife	A tributary of Broad Rife, which flows southerly through Highleigh village.
Bremerie Rife	A tributary of Pagham Rife. Flows southerly from its source near Hunston village before reaching its confluence with Pagham Rife.
Pagham Rife	A tributary of the River Lavant. Flows southerly from its confluence with the River Lavant in Westhampnett. The tributary exits the SFRA area around the town of Pagham, and enters again at Pagham Harbour.

6.3 Fluvial flood risk

One of the main sources of flooding in the Local Plan area is from rivers with an influence from tidal conditions. Tide locking is also likely to be an issue where high tides prevent watercourses, such as The Rifes, from discharging effectively, raising levels in the lower reaches of the watercourses[5].

The River Ems, Bosham Stream and Lavant are chalk-fed and their flows can vary seasonally depending on groundwater levels[7]. The characteristics of flooding differ for watercourses influenced by groundwater flows and thus flood events and can be associated with flood events where high flows occur for significant durations, such as affected Chichester and the A27 in the early 1990's.

Although much of the Local Plan area is rural, fluvial flooding from the River Lavant poses a risk to Chichester. The River Lavant flows through the centre of Chichester and has been the source of fluvial flooding in the city in the past. Notable flood events were in December 1993/ January 1994 and in 2000. The River Lavant Flood Alleviation Scheme is designed to reduce the flood risk to Chichester and surrounding area.

In addition to Chichester, there are several further urban areas where there is potential for watercourse to flow out of banks and cause flooding to property. The key settlements at fluvial flood risk, and the source, are summarised in Table 6-2.

Table 6-2: Settlements at risk of fluvial flooding

Settlement	Source of fluvial flood risk
Chichester	River Lavant
Loxwood	River Lox
Westbourne	River Ems
Broadridge	Bosham Stream
Bosham	Bosham Stream
Earnley	Earnley Rife
Almodington	Easton Rife
Highleigh	Keynor Rife
Hunston	Beremere Rife
Runcton	Pagham Rife

[7] Environment Agency (2009) Arun and Western Streams CFMP

Settlement	Source of fluvial flood risk
Merston	Pagham Rife
Oving	Aldingbourne Rife

It should be noted that flood risk management measures (defences) are present within the Local Plan area which act to reduce the risk of flooding. Such defences inhibit the function of the river floodplain as during flood events they prevent water being stored on the land adjacent to the river channel. This may be particularly important when considering the functional floodplain (Flood Zone 3b) for development. Further details on the defence in Chichester District are presented in Section 7.

The extents of the fluvial Flood Zones are shown in Appendix D. Consideration of how climate change may influence the fluvial flood risk is presented in Appendix E.

In addition to flood risk shown by the flood risk mapping, there are a number of small watercourse and field drains which may pose a risk to development. Generalised Flood Zone mapping (where more detailed modelling investigations are not available) has only been prepared for watercourses with a catchment greater than 3km^2. Therefore, whilst these smaller watercourses may not be shown as having flood risk on the flood risk mapping, it does not necessarily mean that there is no flood risk. As part of a site-specific flood risk assessment the potential flood risk and extent of flood zones should be determined for these smaller watercourses and this information used as appropriate to perform the Sequential and Exception tests.

6.4 Tidal flood risk

Tidal flooding is caused by extreme tide levels exceeding ground and/or defence levels. The tidal flood risk to the Local Plan area has been based on the East Head to Littlehampton flood risk coastal modelling study. Flood Zone mapping can be found in Appendix D and the effects of climate change can be found in Appendix E

The Local Plan area coast is bounded by the English Channel. As such the coastline is at risk of tidal flooding. In addition, the lower reaches of the flowing watercourse are affected by tide levels:

- River Ems
- Ham Brook
- Bosham Stream
- River Lavant
- Earnely Rife
- Broad Rife
- Easton Rife
- Selsey Rife
- Keynor Rife
- Bremere Rife
- Pagham Rife

The Manhood Peninsula is at particularly high risk of flooding as it is less than 5m above sea level[8]. The risk is from a combination of fluvial, coastal and groundwater sources along with inadequate existing ditches. The influence of the change to mean

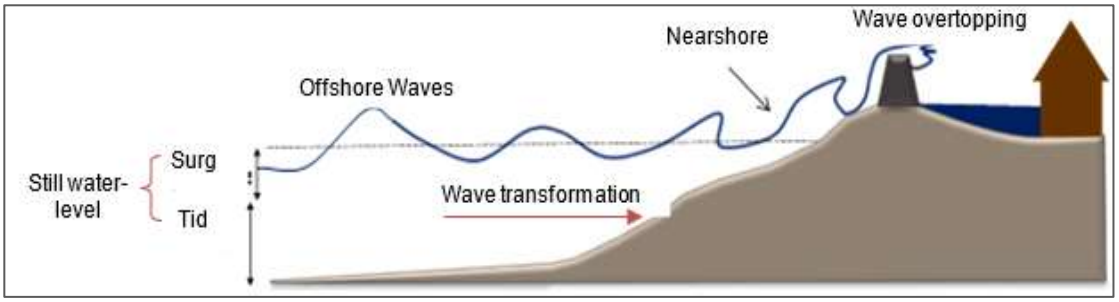
[8] Manhood Peninsula Partnership, Coastal Management available at http://peninsulapartnership.org.uk/environment/coastal-management/

sea level as a consequence of climate change effects is particularly important for these watercourses in their lower reaches, as this will contribute significantly to the height of predicted flood water levels. The predicted change in mean sea levels will also potentially have a material effect on the performance of local drainage systems at coastal locations since the discharge rates and 'emptying times' will be affected (reduced).

6.4.1 Wave overtopping

Tidal flooding along much of the south coast is characterised by the presence of risk associated with wave overtopping. In exposed locations along the coast, landward flooding is more likely to occur as a consequence of wave overtopping than inundation. Wave overtopping is a term, which encompasses a number of complex physical processes, which result in the transfer of water from the sea onto the coastal floodplain. The amount of wave overtopping that occurs during an extreme event is dependent on the local water depth, the properties of incoming waves and the geometry of local flood defences. Figure 6-11 outlines the process of wave overtopping in relation to the Extreme Still Water Sea-level.

Figure 6-11: Illustration of residual risk associated with wave overtopping



Wave overtopping is one of the principal mechanisms of flooding for the coastal frontage. The effect of wave overtopping has been included in the Flood Zone 3b delineation

6.5 Coastal flood risk

In coastal locations the risk of flooding is linked to the stability of the coastline. If the coast is eroding, then the potential effect is that tidal flood defences near to the sea will be lost and flood risk will increase. To maintain an appropriate standard of safety from flooding it is sometimes necessary to implement works to slow down or stop the rate of coastal erosion and so maintain the integrity of the tidal defences.

The **Beachy Head to Selsey Bill Shoreline Management Plan** and the **North Solent Shoreline Management Plan** describe the arrangements and strategy for managing coastal erosion and the influential measures.

The Environment Agency, Chichester District Council and Arun District Council worked together to prepare the **Pagham to East Head coastal defence strategy (2009)**. The strategy provides further details about ways to manage the risk of flooding and erosion to 5,300 properties at risk between Pagham Beach and West Wittering. The main areas at risk are Pagham, Selsey and the Witterings with 20,000 permanent residents, and thousands of visitors each year.

The Environment Agency has prepared a draft Portchester Castle to Emsworth Coastal Flood and Erosion Risk Management Strategy which is relevant to a small section of the coastline near Slipper Close in Emsworth.

The coastline between East Head and Emsworth does not currently have a coastal defence strategy, but the Environment Agency are currently promoting its production.

6.6 Surface water flood risk

Flooding from surface water runoff (or 'pluvial' flooding) is caused by intense short periods of rainfall and usually affects lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding.

Tide locking is also an issue where high tides prevent surface water from draining from gravity outfalls along the defended coastal plain.

The Risk of Flooding from Surface Water (RoFSW) map shows predicted flood extents that predominantly follow topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas. Mapping of the RoFSW throughout the Local Plan area is provided in Appendix F.

6.6.1 Surface water management plans

In response to the WSCC's June 2012 Flood Event report, Surface Water Management Plans (SMWPs) have been and are currently being developed for five key areas in West Sussex which have suffered from significant flooding in the past. Among these are the Manhood Peninsula and West Chichester.

The Manhood Peninsula SMWP was produced in July 2015. The area is known to have long standing flooding problems. In the past, extreme rainfall events (e.g. June 2012) and long wet periods (e.g. Winter 2013/14) have resulted in significant flooding across the area, mainly because the Rifes, local ditch networks and the highway drainage system do not have sufficient capacity to drain large amounts of water away. The Manhood Peninsula is also prone to regular flooding due to its low-lying nature, and this is often caused by poor maintenance or collapses/blockages of culverts and ditches.

The emerging West Chichester SWMP focuses on the Fishbourne and Parklands Estates, which were first identified as prone to flood risk by the June 2012 report. The area has suffered from flooding problems in the past and there have already been many actions taken to alleviate flooding. The SWMP has identified three primary surface water flow catchments: Parklands Catchment, Fishbourne Road East Catchment and the Fishbourne Catchment. Similar to the Manhood Peninsula, the main cause of surface water flooding in this area is the exceedance of drainage systems and culverts, because they do not have the capacity to cope with large amounts of water.

6.6.2 WSCC's Local Flood Risk Management Strategy

The WSCC's Local Flood Risk Management Strategy covers flood risk in West Sussex, from all sources of flooding, including surface water flooding. In relation to the Chichester District Local Plan area, the report has identified Bosham, Selsey, Birdham and Ifold as the residential areas that are most susceptible to surface water flooding.

6.6.3 Chichester District Council's Surface Water and Drainage Supplementary Planning Document

Chichester District Council's **Surface Water and Drainage Supplementary Planning Document** (SPD) explains that in the south of the district, as the land is low-lying, there is a risk of fluvial and tidal flooding. As well as this, there is a lack of capacity and infiltration into the sewer network which causes surface water and foul water flooding. It highlights that new development should not exacerbate existing problems and increase the flood risk.

6.7 Groundwater flood risk

Groundwater flooding is the term used to describe flooding caused by unusually high groundwater levels. It occurs as excess water emerging at the ground surface or within manmade underground structures such as basements. Groundwater flooding tends to be more persistent than surface water flooding, in some cases lasting for weeks or months, and it can result in significant damage to property.

JBA has developed a range of Groundwater Flood Map products at national scale. The 5m resolution JBA Groundwater map for the Local Plan area can be found in Appendix G. The modelling involves simulating groundwater levels for a range of return periods (including 75, 100 and 200-years). Groundwater levels are then compared to ground surface levels to determine the head difference in metres. The JBA Groundwater Map categorises the head difference (m) into five feature classes based on the 100-year model outputs. The JBA Groundwater map for the Local Plan area can be found in Appendix G.

It should be noted that the JBA Groundwater Flood Map is suitable for general broad-scale assessment of the groundwater flood hazard in an area, but is not explicitly designed for the assessment of flood hazard at the scale of a single property. In high risk areas a site-specific risk assessment for groundwater flooding is recommended to fully inform on the likelihood of flooding.

As illustrated in the map, a large proportion of the Chichester District Local Plan area is at risk from groundwater flooding. The southern part of the Local Plan area is particularly vulnerable to groundwater flooding, with the city of Chichester and surrounding towns being the most vulnerable areas.

The West Sussex Groundwater Management Study was produced in October 2017 by WSP, commissioned by WSCC. This project was initially undertaken with the purpose of improving the WSCC's level of understanding of groundwater flood risk across West Sussex. Results of the study will be used to inform the specification of groundwater monitoring pilot study sites. Use of a Flood Risk Grading Tool (FRGT) identified the key areas at risk from flooding. Findings of this analysis predicted that coastal areas such as Southbourne, West Ashling/Nutbourne and Chichester are more vulnerable to groundwater flooding than areas in the mid or northern regions of West Sussex.

The south of the Local Plan area is at particularly high risk due to the chalk valleys feeding from the South Downs. Rain can infiltrate the chalk through large fissures into the underlying aquifers and is released slowly though springs further downstream in the Local Plan area.

The River Ems and Bosham Stream are particularly sensitive to groundwater levels and have high winter baseflows as their headwaters are fed by the chalk springs to the south of the South Downs. When there are prolonged wet winters periods, high groundwater levels result in saturated ground and surface water flooding. This leads to an immediate response to additional rainfall and high flow velocities due to the steep stream gradients at the foot of the Downs. Groundwater processes are an important contributor to flooding in these areas.

6.8 Flooding from sewers

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment (such as pumps) failure occur in the sewerage system. Surface water inundation of manhole openings, entry of soil or groundwater, and may cause high flows for prolonged periods of time.

Since 1980, the Sewers for Adoption guidelines have meant that most new surface water sewers have been designed to have capacity for a rainfall event with a 1 in 30 chance of occurring in any given year (3.33% AEP), although until recently this did not

apply to smaller private systems. This means that, even where sewers are built to current specifications, they can still be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding (e.g. a 1 in 100 chance of occurring in any given year 1% AEP). Existing sewers can also become overloaded as new development adds to their catchment, even with restrictions in place on permitted discharge, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

Historical incidents of flooding are detailed by Southern Water in their DG5 register. This database records incidents of flooding relating to public foul, combined or surface water sewers and identifies which properties suffered flooding. For confidentiality reasons, this data has been supplied on a postcode basis from the Sewer Incident Report Form (SIRF) hydraulic overload database. Data covers all reported incidents between August 2013 and February 2017. The information from the SIRF database is shown in Table 6-3.

The DG5 register indicates a total of 110 recorded flood incidents in the Local Plan area, (excluding properties located within the South Downs National Park). The most frequently flooded postcodes are: PO20 7 (21 incidents), PO20 8 (17 incidents) and PO10 8 (14 incidents). It is important to recognise that the information does not indicate the cause of the sewer flooding incidents. Also, the register represents a snap shot in time and may become outdated following future rainfall events, when new properties are added. Risk of flooding may be reduced in some locations by capital investment to increase of the capacity of the network. As such, the sewer flooding flood risk register is not a comprehensive 'at risk register' and updated information should be sought to enhance understanding of flood risk from sewers at a given location.

Studies and assessments performed by the Chichester Water Quality Group (**Water Quality and Strategic Growth for Chichester District Background Paper November 2012**) indicate that the capacity of sewers and drains is adversely affected by infiltration of groundwater.

The 2018 Chichester District Council's Water Quality Assessment states that areas around west Chichester, east Chichester and Tangmere are at medium risk of groundwater flooding and there is the potential for increased infiltration into the sewer network which can impact on capacity in these areas.

Additionally, West Sussex County Council has confirmed that when groundwater levels have been high over recent winters, exceptional discharges of surcharged sewers were regularly permitted by the Environment Agency to be discharged into the River Lavant.

Thus, the groundwater flooding not only has a direct effect on flood risk, but also an indirect effect as poorly designed, constructed and maintained drainage systems will permit ingress of flows that reduces the capacity of drainage systems. Accordingly proposed development should seek to deploy designs and be implemented such that the risk of groundwater ingress is minimised.

Table 6-3 Sewer Incident Report Form database for Chichester SFRA area

Post Code	Recorded Flood Incidents	Post Code	Recorded Flood Incidents
PO10 8	14	PO20 0	5
PO18 0	11	PO20 1	5
PO18 8	5	PO20 2	4

Post Code	Recorded Flood Incidents	Post Code	Recorded Flood Incidents
PO19 3	9	PO20 7	21
PO19 6	1	PO20 8	17
PO19 7	1	PO20 9	1
PO19 8	5	RH14 0	11
Total: 110			

6.9 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low. Recent changes to legislation under the Flood and Water Management Act require the Environment agency to designate the risk of flooding from these reservoirs. The Environment agency is currently progressing a 'Risk Designation' process so that the risk is formally determined.

Outlines from the Risk of Flooding from Reservoirs dataset (informed from the National Reservoir Inundation Mapping (NRIM) study) show worst case inundation extents of five reservoirs impacting the Local Plan area, as detailed in Table 6-4. The Environment Agency are currently engaged on a programme to improve the quality of the reservoir flood mapping and this is due to be completed and available for use by 2020.

Table 6-4 Reservoirs in the Chichester District Local Plan area

Reservoir	Location (grid ref)	Reservoir owner	Environment Agency area	Local authority
Park Mill Pond	497167, 130789	Haslemere Angling Society	Solent and South Downs	West Sussex
Upper North Pond	496227, 132153	Wakefield	Solent and South Downs	West Sussex
Hunston Reservoir	486578, 100971	Ashmarden Ltd	Solent and South Downs	West Sussex
Southend Farm No.2	484710, 100446	Fleming	Solent and South Downs	West Sussex
Park Mill Pond	497167, 130789	Haslemere Angling Society	Solent and South Downs	West Sussex

Reservoir flooding is very different from other forms of flooding. It may happen with little or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate, but it is very much less likely than flooding from rivers or surface water. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The Environment Agency maps represent a credible worst case scenario. In these circumstances, it is the time to inundation, the depth of inundation, the duration of

flooding and the velocity of flood flows that will be most influential. The Environment Agency Risk of Flood from Reservoir Map for Chichester is shown in Appendix H.

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage:

- Developers should seek to contact the reservoir owner to obtain information which may include
  - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
  - operation: discharge rates / maximum discharge;
  - discharge during emergency drawdown; and
  - inspection / maintenance regime.
- Developers should apply the sequential approach to locating development within the site. The following questions should be considered
  - can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?
  - can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
  - can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?
- Consult with relevant authorities regarding emergency plans in case of reservoir breach
- In addition to the risk of inundation those considering development in areas affected by breach events should also assess the potential hydraulic forces imposed by the rapid flood event and check that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

6.10 Flooding from canals

Canal water flow is controlled by artificial structures (such as locks) so that water levels remain below adjacent ground. Therefore, such watercourses rarely flood as they are generally designed to retain a controlled volume of water rather than collect and convey water running off from adjacent land. However, intense rainfall can increase the risk of flooding from canals through increased artificial conveyance between catchments or interaction of this watercourse within another which may cause water to back up and spill out of the channel. The other potential source of flooding is from a failure in the structure of the canal channel that results in a sudden cascade of water onto adjacent land.

There are two canals located in the Local Plan area, the Chichester Canal and the Wey and Arun Canal. The flood risk from these sources should be considered for individual developments.

The Chichester Canal is partially navigable (for recreation). Road culverts connect the upper, middle and lower sections so the canal is theoretically connected to the sea. The upper section from the Chichester Basin to the B2201 is open for recreational use (approximately (3km). The lower section from the BB2201 to the Chichester Marina is used for the stationing of houseboats, but is not navigable. There is a lock at Chichester Marina. The maintenance of the canal is the responsibility of the Chichester Ship Canal Trust, who lease the canal from West Sussex County Council[9].

[9] Chichester Ship Canal, About: Chichester Ship Canal, available at https://chichestercanal.org.uk/about-chichester-canal/

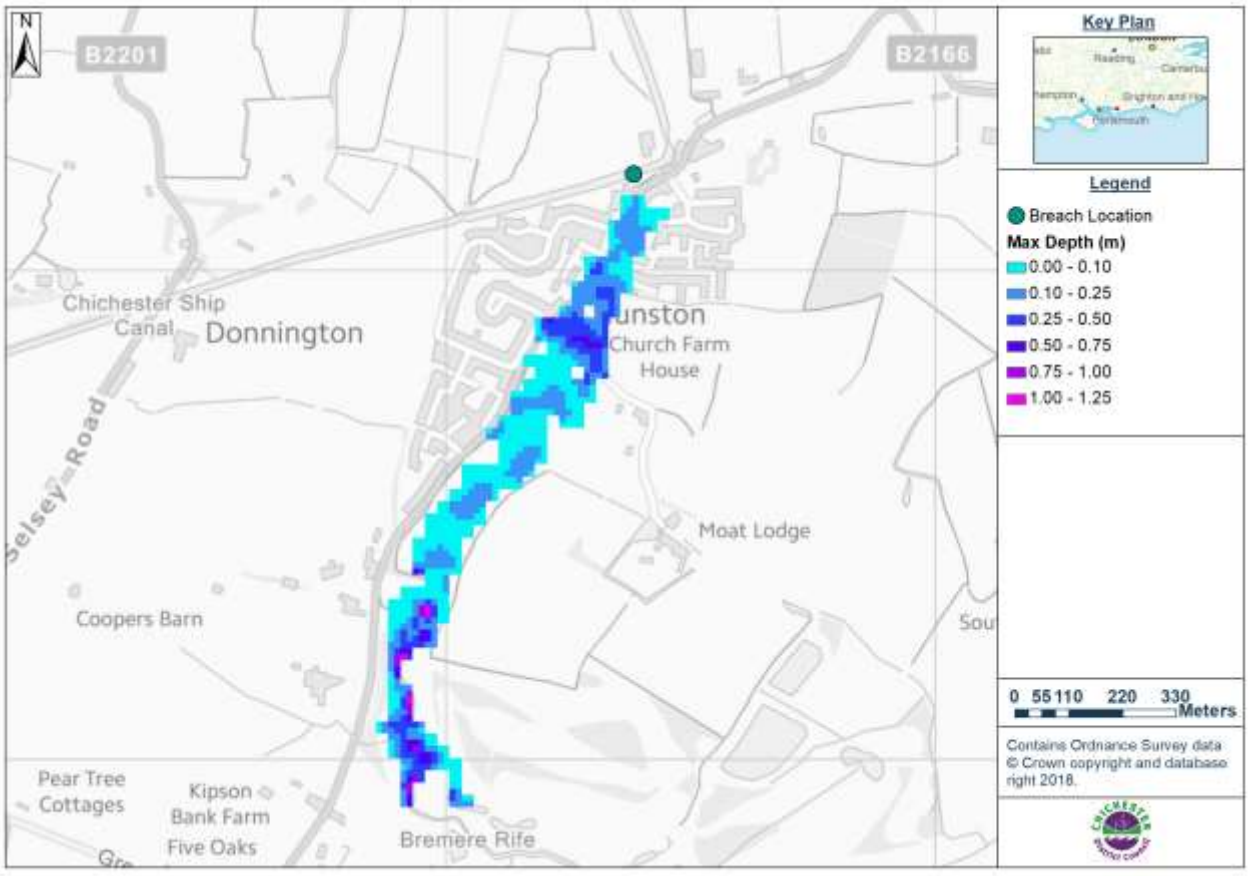
The Wey and Arun Canal runs through a small part of the north-east of the study area. The canal is currently being restored with some parts which are navigable through Loxwood. The Wey and Arun Canal Trust are currently restoring the canal. Part of the aim is to create a 23 mile 'green corridor' through the West Sussex and Surrey countryside[10].

The main flood risk from the canals is from a breach, leakage or overtopping.

There are no recorded incidents of breach or overtopping of canals within the study are and there is no evidence to suggest the risk posed by canal flooding warrants a detailed assessment in the Level 1 SFRA.

The 2008 SFRA undertook breach modelling of one possible scenario in the Chichester Canal at Hunston. The modelled flood depths are shown in Figure 6-12. The modelling shows that flood depths of over 1m could be experienced during a breach scenario.

Figure 6-12: Breach modelling of the Chichester Ship Canal



6.11 Summary of flood risk to key settlements

A high-level review of the flood risk to key settlements in Chichester District Local Plan area has been undertaken. Table 6-5 summarises the flood risk to the main settlements in the Chichester District outside of the South Downs National Park authoritative area.

[10] West Sussex County Council, The Wey and Arun Canal, available at https://www.westsussex.gov.uk/leisure-recreation-and-community/places-to-visit-and-explore/the-wey-and-arun-canal/

Table 6-5: Summary of flood risk to the key settlements in the study area

Settlement	Fluvial/tidal/coastal flood risk	Formal flood defences	Surface water flood risk	Susceptibility to groundwater flooding, according to JBA map					Reservoir inundation
				No risk	5m below surface	0.5m to 5m below surface	0.025m to 0.5m below surface	Within 0.025m of surface	
Loxwood	The River Lox and the Wey and Arun Canal flow to the south of Loxwood, and a stream flows through the town, close to the B2133. Flood Zones 2 and 3 surround these watercourses. Several properties in the south of Loxwood are located in Flood Zones 2 and 3. The Environment Agency historic flood outline dataset shows that there has been a history of fluvial flooding at the settlement.	See Section 7	Mapping shows that surface water flood risk generally follows similar paths to the watercourses and roads. The roads at most risk of surface water flooding are Pond Copse Lane, B2133 Guildford Road, Pond Close and Station Road.	✓		✓	✓		None
Plaistow / Ifold	The River Lox flows east of Ifold, and a stream flows east of Plaistow. Flood Zone mapping shows that the eastern side of Ifold is vulnerable to fluvial flooding, The Environment Agency historic flood outline dataset shows that there has been no previous history of flooding in the area.	None	Mapping shows that surface water flood risk generally follows similar paths to the watercourses. In Plaistow, Rickmans Lane and several settlements along this road are at risk of surface water flooding. In Ifold, mapping shows that roads and residential areas close to Loxwoodhills Pond are at risk of surface water flooding, particularly The Drive. Other roads at risk include Plaistow Road and The Lane.	✓	✓	✓	✓	✓	None
Kirdford	The River Kird passes south of the settlement, flowing from west to east. Several streams also flow through Kirdford. A small proportion of Kirdford is located within Flood Zones 2 and 3. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Kirdford.	None	Mapping shows that surface water flood risk generally follows routes of the watercourses. Away from the watercourses, the mapping shows ponding of residential gardens and risk to multiple roads, including Kirdford Road and Glasshouse Lane.	✓			✓	✓	Inundation from two ponds, Upper North Pond and Park Mill Pond, may affect areas of Kirdford where the River Kird passes through.
Wisborough Green	The River Kird and several small streams flow through Wisborough Green. Flood Zones 2 and 3 surround these watercourses. Several properties lie close to these Flood Zones. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Wisborough Green.	None	Mapping shows that surface water flood risk generally follows the main watercourses and roads. The roads at most risk are the A272, Newpound Lane, Durbans Road, and Kirdford Road. The mapping also shows surface water ponding in open spaces and residential gardens.	✓	✓	✓	✓	✓	Inundation from two ponds, Upper North Pond and Park Mill Pond, may affect areas of Wisborough Green where the River Kird passes through.
Westbourne	The main watercourse flowing through Westbourne is the River Ems. Flood Zone mapping shows that most of Westbourne is located in Zone 2 or 3. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Westbourne.	See Section 7	Mapping shows that surface water flood risk generally follows the route of the River Ems and runs onto roads. Several roads are at a high risk of flooding, particularly North Road, River Road and East Street. Houses and residential gardens along these roads are also at risk of flooding.	✓			✓	✓	None
Southbourne	The path of Ham Brook flows through Southbourne on route to Chichester Harbour. Not located in Flood Zones The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Southbourne.	See Section 7	Mapping shows that surface water flood risk generally follows similar paths to the roads and open spaces in Southbourne. Roads at risk include the main road A259 and Stein Road running through the town centre, particularly by the train station, as well as Cooks Lane and Priors Leaze Lane.				✓	✓	None
Hambrook / Nutbourne	Not located in Flood Zones; apart from an area that stretches from the A259 (Main Road) up to Priors Leaze Lane. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Hambrook and Nutbourne.	See Section 7	Mapping shows that surface water flood risk in Hambrook and Nutbourne is relatively low, but it generally follows similar paths to the Ham Brook watercourse, roads and open spaces.	✓			✓	✓	None
Bosham / Broadbridge	The main watercourse passing through these two settlements is Bosham Stream, which flows southwards to Chichester Channel. Flood Zone mapping shows that Bosham and Broadbridge are susceptible to fluvial flooding from Bosham Stream and coastal flooding from Chichester Channel. Those at highest risk of flooding are residential areas located close to the shoreline in Bosham, particularly along Shore Road. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Bosham and Broadbridge.	See Section 7	Mapping shows that surface water flood risk generally follows similar paths to the roads in Bosham, including Bosham Lane, Walton Lane, Taylor's Lane and Chequer's Lane. In Broadbridge, surface water follows the watercourse alongside the town. The A27 just north of the town has a high risk of flooding.	✓		✓	✓	✓	None
Fishbourne	The River Lavant flows through Fishbourne, into the Chichester Channel. Southern parts of Fishbourne near Fishbourne Road are located in Flood Zones and are at risk of coastal flooding from the channel. Parts of Apuldram, especially along Appledram Lane (South) are also at risk of flooding. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Fisbourne.	See Section 7	Mapping shows that surface water flood risk generally follows similar routes to roads and open spaces in Fishbourne. The A27 north of the town has a high risk of surface water flooding. Other roads at risk include Blackboy Lane and Salthill Road. Fishbourne Train Station and surrounding buildings are at risk of surface water flooding.	✓		✓	✓	✓	None

Settlement	Fluvial/tidal/coastal flood risk	Formal flood defences	Surface water flood risk	Susceptibility to groundwater flooding, according to JBA map					Reservoir inundation
				No risk	5m below surface	0.5m to 5m below surface	0.025m to 0.5m below surface	Within 0.025m of surface	
Birdham	Chichester Ship Canal and the River Lavant lie north of Birdham. Birdham is not located in Flood Zones. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Birdham.	See Section 7	Mapping shows that surface water flood risk is fairly limited in Birdham, but generally follow routes of roads and open spaces.				✓		None
West Wittering	West Wittering is located very close to Chichester Harbour. Flood Zone mapping shows that this settlement is prone to coastal flooding. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in West Wittering.	See Section 7	Mapping shows that surface water flood risk generally follows similar paths to the watercourse and roads, including Rookwood Lane.			✓	✓	✓	None
East Wittering / Bracklesham	Earnley and Easton Rifes flow through East Wittering and Bracklesham. According to Flood Zone mapping, there is limited flood risk in these settlements. Areas at risk include buildings located closest to the coastline and those located close to Earnley Rife. Earnley Beach Centre is at high risk of flooding. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in East Wittering and Bracklesham.	See Section 7	Mapping shows that surface water flood risk generally follows roads, open spaces and residential gardens. In East Wittering, Church Road and Shore Road are at risk of flooding, as well as several pockets of residential areas. In Bracklesham, surface water follows Earnley Rife and several roads.	✓		✓	✓	✓	None
Selsey	Selsey is at risk of flooding from several rifes and the coastline. Flood Zone mapping shows that some parts of Selsey are at risk of coastal and fluvial flooding. To the north-west of Selsey, holiday parks, including Bunns Leisure, and Selsey Country Club are located in Flood Zones 2 and 3. To the east, a large area is located in the flood zones, including Kingsway and East Beach Road. Areas directly on the coastline are also in the flood zones. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Selsey.	See Section 7	Mapping shows that surface water flood risk follows roads and also appears in open spaces around the town.	✓		✓	✓	✓	None
Hunston	Not in Flood Zones	See Section 7	Mapping shows that surface water flood risk mainly follows the B2145 Selsey Road through the centre of Hunston and spreads to open spaces near the road.	✓			✓	✓	Inundation may affect Sidlesham Common, south of Hunston. Affected area spreads from Manhood End Farm to Hoe Farm.
North Mundham / Runcton	Pagham Rife flows southerly through Runcton. Runcton Lane and Saltham Lane are at high risk of flooding. There are no main watercourses flowing through North Mundham. A few houses located on Lagness Road in North Mundham are located in Flood Zone 2. There has been a limited history of recorded flooding in North Mundham and Runcton.	See Section 7	Mapping shows that surface water flood risk mainly follows roads. In North Mundham, roads prone to surface water flooding include Church Road and Post Office Lane. In Runcton, surface water follows the watercourse, particularly impacting the intersection of the watercourse and Lagness Road. Other roads affected include Marsh Lane and Vinnetrow Lane.				✓	✓	None
Chichester	The River Lavant passes through the centre of Chichester, and continues towards Chichester Harbour. Flood Zone mapping shows that Chichester is located in both Zones 2 and 3, and is prone to fluvial flooding. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Chichester.	See Section 7	Mapping shows that surface water flood risk mainly follows roads. A large number of roads in Chichester are at risk of flooding, including St Paul's Road (B2178) and several roads near Sherbourne Road. Surface water also accumulates in open spaces and residential gardens. .				✓	✓	None
Westhampnett	The River Lavant also passes directly through Westhampnett. Flood Zone mapping shows that Westhampnett is prone to fluvial flooding from the River Lavant. Areas most at risk include parts of Madgwick Lane, Stane Street and Maudlin Farm. The Environment Agency historic flood outline dataset shows that there has been a history of flooding in Westhampnett.	See Section 7	Mapping shows that surface water flood risk on some roads near Westhampnett, including Stane Street, and also some risk of flooding near the local school and residential area.			✓	✓	✓	None
Boxgrove	Not in Flood Zones	None	Mapping shows that surface water flood risk mainly follows the roads in Boxgrove, particularly Crouch Cross Lane and The Street, with substantial flooding at the A27 roundabout.				✓		None
Tangmere	Not in Flood Zones	None	Mapping shows that surface water flood risk mainly follows roads. Roads most at risk of flooding include Tangmere Road.				✓	✓	None

7 Fluvial and coastal defences

A high-level review of flood defences was carried out for this SFRA and this involved an interrogation of existing information on asset condition and standard of protection. Defences are categorised as either raised flood defences (e.g. walls/embankments) or flood storage areas (FSAs). The assessment has considered defences with a standard of protection which is against a 5% AEP event or more. Man-made and natural defences which may arise for instance due to the presence of naturally high ground adjacent to a settlement have been considered. The defences and their locations are summarised in the following sections.

7.1 Defence standard of protection and residual risk

One of the principal aims of the SFRA is to outline the present risk of flooding across Chichester District Local Plan area including consideration of the effect of flood risk management measures (including flood banks and defences). The modelling that informs the understanding of flood risk within the Local Plan area is typically of a catchment wide nature, suitable for preparing evidence on possible site options for development. In cases where a specific site risk assessment is required, detailed studies should seek to refine the results used to provide a strategic understanding of flood risk from all sources.

Consideration of the residual risk behind flood defences has been undertaken as part of this study. Residual risk includes the consideration of flood events that exceed the design thresholds of the flood defences or circumstances where there is a failure of the defences, e.g. flood banks collapse. Developers should also consider the standard of protection provided by defences and residual risk when preparing detailed Flood Risk Assessments.

Standard of Protection

Flood defences are designed to give a specific standard of protection, reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with a 1% AEP standard of protection means that the flood risk in the defended area is reduced to a 1% chance of flooding in any given year.

Although flood defences are designed to a standard or protection it should be noted that, over time, the actual standard of protection provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change

7.2 Defence condition

Formal structural defences are given a rating by the Environment Agency based on a grading system for their condition[11]. A summary of the grading system used by the Environment Agency for condition is provided in Table 7-1.

[11] Condition Assessment Manual, Environment Agency (2012)

Table 7-1: Defence asset condition rating

Grade	Rating	Description
1	Very Good	Cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the asset.
3	Fair	Defects that could reduce the performance of the asset.
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation required.
5	Very Poor	Severe defects resulting in complete performance failure.

The condition of existing flood defences and whether they are planned to be maintained and/or improved in the future must be considered with respect to the safety and sustainability of development over its intended life and also with respect to the financial and economic commitment to the long-term provision of appropriate standards of protection. In some cases, the relevant strategy may suggest that it is not appropriate to maintain the condition of the assets, which may prove influential for the development over its intended life. In addition, detailed FRAs undertaken by developers (if a defence is influential to the proposed development) will need to thoroughly explore the condition of defences, especially where these defences are informal and demonstrate a wide variation of condition grades. It is important that all of these assets are maintained to a good condition and their function remains unimpaired in accordance with the policy and strategy for Flood Risk Management.

Key defences across Local Plan area are displayed in the 5km grid maps in Appendix I including their condition and standard of protection, using spatial defence data provided by the Environment Agency.

7.3 Fluvial defences in the Local Plan area

The key fluvial defences in the Local Plan area are raised barriers such as walls or embankments. The maps shown in Appendix I provide a summary of the fluvial defences in Chichester District provided by the Environment Agency

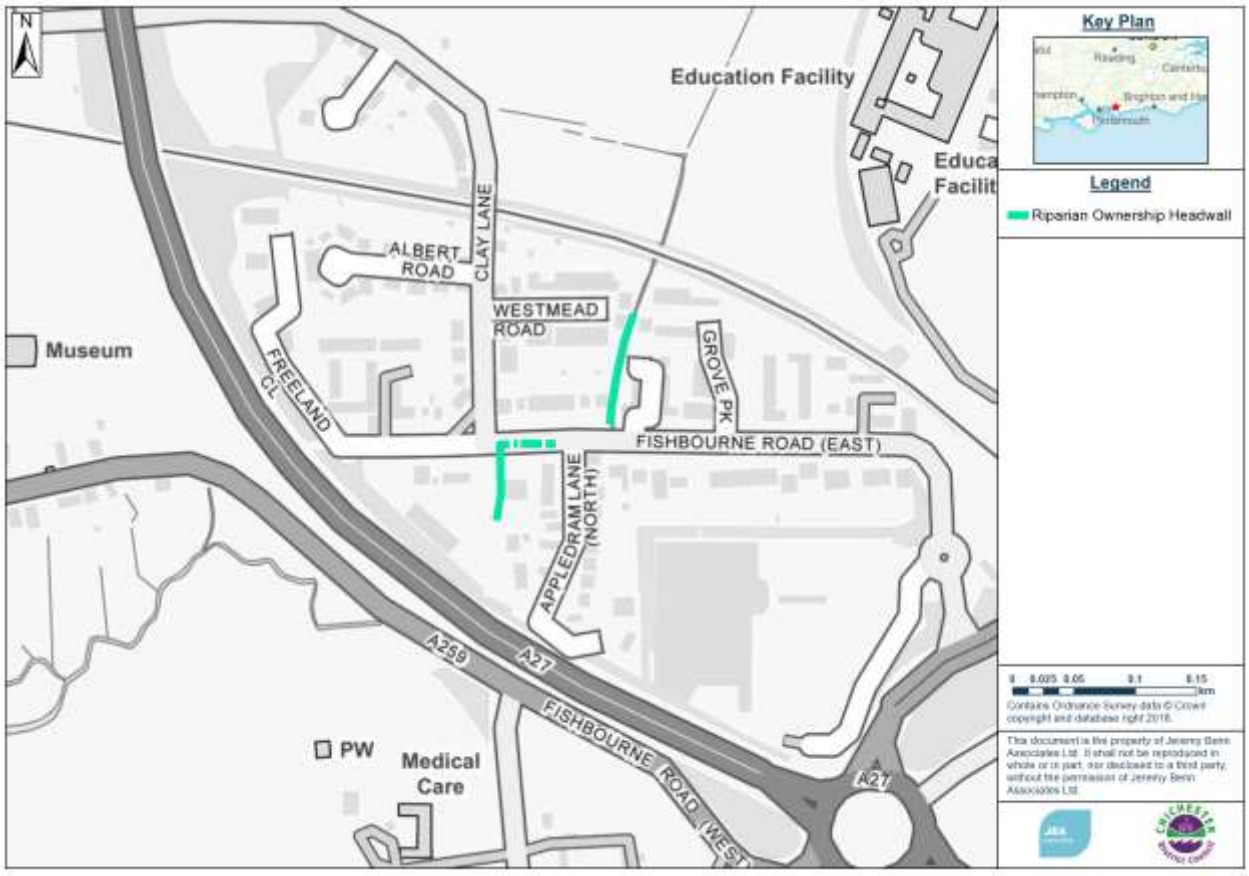
7.3.1 Chichester

Fluvial defences along the River Lavant in the city of Chichester mainly consist of high ground and embankments. The majority of these defences provide a standard of protection against a 1.25% AEP event and are categorised as being in fair condition. There is an embankment close to Westhampnett which provides a standard of protection against a 0.5% AEP flood event.

These fluvial defences are designed to operate in conjunction with measures implemented under the wider River Lavant Flood Alleviation Scheme (Section 7.4.1)

Chichester also benefits from a new headwall along the River Lavant which runs south to and under Fishbourne Road. The headwall remains in Riparian Ownership and responsibility. However, West Sussex County Council have confirmed that as far as they are aware, a full land charges or an ownership report has not been undertaken to formally identify the owners. The location of the headwall shown in Figure 7-1.

Figure 7-1: Riparian owned headwall



7.3.2 Runcton and Hunston

The flood defences in Runcton and Hunston are both classified as high ground and have a standard of protection against a 4% AEP flood event. Most of the defences are in fair condition.

7.3.3 South of Loxwood

Alongside the River Kird and the Wey and Arun Canal is a fluvial defence in fair condition in the form of high ground, providing protection at a standard against a 4% AEP event.

7.3.4 River Ems

The flood defences along the River Ems are predominately masonry, concrete and brick walls, and earth embankments. Nearly all of these defences have a standard of protection against less than a 5% AEP event and are therefore not shown in Appendix I. There is a brick wall in Emsworth which offers protection against a 1.25% AEP but it is in poor condition.

7.4 Alleviation Schemes

Whilst there are limited fluvial defences on the Chichester District Local Plan watercourses with a significant standard of protection (protect against a 5% AEP flood event or greater), schemes have been introduced to reduce flooding from the River Lavant.

7.4.1 River Lavant Flood Alleviation Scheme

The River Lavant Flood Alleviation Scheme was introduced by the Environment Agency to reduce the risk of flooding in Chichester and the surrounding areas. The scheme involves the construction of a new flood flow route, which diverts high flows away from the culverted watercourse through Chichester town centre and towards Pagham Harbour.

There are also several Flood Alleviation Schemes in the pipeline. These include the Environment Agency's Siddlesham Inland Banks Project and Loxwood Flood Alleviation Scheme.

7.5 Coastal and tidal defences in the Local Plan area

Coastal defences in the Local Plan area consist of a combination of soft and hard engineering solutions. The area is mainly protected by soft engineering methods, in the form of shingle defences. There are large shingle banks which dominate Pagham Beach, Pagham Harbour and Church Norton. Environment Agency asset maps are also shown in Appendix I.

Hard engineering methods are also incorporated along the coast and these are in the form of seawalls, groynes, gabions, revetments and embankments. These hard engineering methods often support the soft engineering methods.

When considering defences along the coastline, it is important to differentiate between those which are constructed to protect the coastal frontage from erosion and those which are designed to protect the coast from flood risk from the sea e.g. still water levels exceeding the defence crest, or waves overtopping the defence. Each of these types of defence are present in the Local Plan area but are not designed to necessarily fulfil the dual purpose of managing flood risk and coastal protection.

The defences which are identified by the Environment Agency as coastal and tidal are shown in Appendix I. Many of the defences around the coastline are coastal defences. With climate change, it is likely that many of the coastal defences will need to become tidal defences in the future.

The majority of coastal and tidal defences provide a standard of protection against an event with an annual probability of 5% AEP or 4% AEP, with the exception of defences at Pagham Harbour, which provide a standard of protection against a 1% AEP flood event. The asset data provided by the Environment Agency shows that the most of these defences are in 'fair' condition.

The Environment Agency, Chichester District Council and Arun District Council worked together to prepare the **Pagham to East Head coastal defence strategy (2014)**. The strategy provides further details about ways to manage the risk of flooding and erosion to 5,300 properties at risk between Pagham Beach and West Wittering. The main areas at risk are Pagham, Selsey and the Witterings with 20,000 permanent residents, and thousands of visitors each year.

The Environment Agency has prepared a draft Portchester Castle to Emsworth Coastal Flood and Erosion Risk Management Strategy which is relevant to a small section of the coastline near Slipper Close in Emsworth.

The coastline between East Head and Emsworth does not currently have a coastal defence strategy, but the Environment Agency are currently promoting its production.

7.5.1 Selsey East and West Beach

The **Pagham to East Head coastal defence strategy** recommends the option for the coastline along Selsey is hold the line – sustain. Selsey has been hit by some of the worst storms in the area. Coastal protection schemes have been carried out by Chichester District Council along Selsey East and West beach. These include:

- 2010 - 2011 Selsey West Beach Coast Protection Beach Recharge;
- 2009 - 2010 Selsey West Beach Permanent Repairs to Sea Wall;
- 2009 - 2010 Selsey East Beach Groyne Refurbishment

In 2012, further beach and sea defence work was completed[12]. The scheme was privately funded by the holiday village Bunn Leisure and took six months to complete. The scheme used granite rocks, sand and shingle.

7.5.2 Selsey

During the first phase of the **Selsey and Wittering Beach Management Plan** (2011-2016), beach recharges were undertaken in 2014 and 2016 (6,500 tonnes and 8,500 tonnes). These bolstering exercises were performed to address depleting beach levels to maintain the existing level of protection while extending the life of existing hard defences.

7.5.3 Medmerry managed realignment scheme

The **Pagham to East Head coastal defence strategy** states that for Medmerry the recommended option is managed realignment. The managed realignment scheme at Medmerry was completed in 2013 by the EA[13], in partnership with the RSPB, and has resulted in major improvements in flood protection along the shoreline from Selsey to Bracklesham. Previously, the flood defence along this part of the coast was a 3km shingle bank, which was prone to regular breaching and was very costly to maintain. The new flood defence scheme protects 348 properties, as well as sewage works, caravan parks and Selsey's main road route, to a standard of protection in excess of 0.5% AEP. Furthermore, the site is an RSPB Nature Reserve and an intertidal habitat for a range of wildlife[14].

7.5.4 West Wittering Flood Defence 2012

Following recommendations from the **North Solent Shoreline Management Plan** and the Pagham to East Head Coastal Defence Strategy to improve flood defences in West Wittering, the Environment Agency finished building a new defence in 2012. Located close to Chichester Harbour, West Wittering has long been at significant risk of flooding from high tides. The newly built flood defence provides improved flood protection to 55 properties, the local school and Southern Water's sewage pumping station[15].

7.5.5 East Head

In 2009, Chichester District Council undertook a beach recycling scheme at East Head[16]. In 2016, additional shingle was recycled from the spit and placed behind the hinge. This work supports the policy for the frontage of "adaptive management" where hard defences are removed as they fail.

7.5.6 East Wittering / Bracklesham

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12 Selsey £17 million flood defence scheme completed, Chichester Observer, available at https://www.chichester.co.uk/news/environment/selsey-17-million-flood-defence-scheme-completed-1-4343967
13 Medmerry coastal flood defence scheme, EA, available: https://www.gov.uk/government/publications/medmerry-coastal-flood-defence-scheme/medmerry-coastal-flood-defence-scheme
14 Managed realignment at Medmerry, West Sussex, ICE, available: https://www.ice.org.uk/knowledge-and-resources/case-studies/managed-realignment-at-medmerry-sussex
15 West Wittering Tidal Flood Defences, available: https://www.gov.uk/government/publications/west-wittering-tidal-flood-defences/west-wittering-tidal-flood-defences
16 Chichester District Council, Planning the Management of our Coastline, available at http://www.chichester.gov.uk/article/25457/Planning-the-management-of-our-coastline

During the first phase of the **Selsey and Wittering Beach Management Plan** (2011-2016), a number of defences were upgraded. In 2012, groynes in East Wittering were raised, 8,500 m^3 of shingle was recycled from the western end of the frontage in 2014 and 8,000 tonnes of course shingle was imported at Jolliffe Road in 2015. These works bolstered and more evenly distributed the beach levels, better absorbing wave energy and extending the life of existing hard defences.

7.6 Future schemes

Chichester District Council plans to promote the following schemes in the future:

- The second phase of the Selsey and Wittering Beach Management Plan (2016-2021) which will involve annual shingle recharges on the west side of Selsey.
- Adaptive Management on the East Head Frontage
- Surface water outfall to be replaced at Selsey East Beach 2018

7.7 Residual flood risk

Residual risks are those remaining after applying the sequential approach and taking mitigating actions. It is the responsibility of the developer to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed.

This SFRA does not assess the probability of failure other than noting that such events are very rare. However, in accordance with NPPF, all sources of flooding need to be considered. If a breach or overtopping event were to occur, then the consequences to people and property could be high. Developers should be aware that any site that is at or below defence level may be subject to flooding if an event occurs that exceeds the design capacity of the defences, or the defences fail and this should be taken into account when building resilience into low level properties.

7.7.1 Overtopping

Overtopping conditions occur when a wave meets a structure lower than the maximum wave height or when the mean sea level exceeds the top of the defences. The risk from overtopping of defences is based on the relative heights of property or defence, the distance from the defence level and the height of water above the crest level of the defence. During these conditions there is a regular intermittent discharge of sea water over the defences which can cause flooding. The Defra and Environment Agency **Flood Risks to People** guidance document provides standard flood hazard ratings based on the distance from the defence and the level of overtopping.

The risk of violent waves overtopping sea walls in particular can lead to a significant flood hazard. Therefore, as part of this SFRA, the risk of overtopping is included in the production of the Flood Zones within the Local Plan area.

7.7.2 Defence breach

A breach of a defence occurs when there is a failure in the structure and a subsequent ingress of flood water.

Breach modelling was prepared for the 2008 SFRA but does not cover all possible breach locations. It is important to consider the type of breach that would be most likely to occur, ground levels and tidal conditions when it comes to breach modelling. Where defences are present, risk of breach events should be considered as part of the site-specific flood risk assessment. Flood flows from breach events can be associated with significant depths and flow velocities in the immediate vicinity of the breach location and so FRAs must include assessment of the hazards that might be present so that the safety of people and structural stability of properties and infrastructure can be

appropriately taken into account. Whilst the area in the immediate vicinity of a breach can be subject to high flows, the whole flood risk area associated with a breach must also be considered as there may be areas remote from the breach that might, due to topography, involve increased depth hazards.

8 FRA requirements and flood risk management guidance

8.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within Chichester District Local Plan area. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk at a site are fully addressed. Some sites may additionally require the application of the Exception Test following the Sequential Test if the Sequential Test indicates that there are safety and sustainability issues to be addressed. At these locations further work will need to be carried out to inform a detailed Flood Risk Assessment (FRA). Any site that does not pass the Exception Test should not be allocated for development. It is the responsibility of the developer to provide an FRA with an application.

It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. Where the FRA shows that a site is not appropriate for a particular use, a lower vulnerability classification may be appropriate.

8.2 Requirements for site-specific flood risk assessments

8.2.1 What are site specific FRAs?

Site specific FRAs are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with planning applications and should demonstrate how flood risk will be managed over the development's lifetime, taking into account climate change and vulnerability of users.

Paragraph 068 of the NPPG Flood Risk and Coastal Change Planning Practice Guidance sets out a checklist for developers to assist with site specific flood risk assessments.

Site specific FRAs are required in the following circumstances:

- Proposals for new development (including minor development and change of use) in Flood Zones 2 and 3
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency)
- Proposals of 1 hectare or greater in Flood Zone 1
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding
- Proposals of less than one hectare in Flood Zone 1 where they could be affected by sources of flooding other than rivers and the sea (e.g. surface water)

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)
- Where the site is intended to discharge to the catchment or assets of a water management authority which requires a site-specific FRA
- Where evidence of historical or recent flood events have been passed to the LPA

8.2.2 Objectives of site specific FRAs

The aim of an FRA is to demonstrate that the development is protected to the 1% AEP fluvial and 0.5% AEP tidal flood scenario and is safe for its intended life span

during the 'design' flood event, including an allowance for climate change. This includes assessment of mitigation measures required to safely manage flood risk. Development proposals requiring FRAs should establish:

- Whether a proposed development is likely to be affected by current or future flooding from any source;
- Whether a proposed development will increase flood risk elsewhere;
- Whether the measures proposed to deal with the effects and risks are appropriate;
- Assess the potential cumulative impact of development on flood risk;
- The evidence, if necessary, for the Local Planning Authority to apply the Sequential Test; and
- Whether, if applicable, the development will be safe and pass the Exception Test, if applicable.

FRAs for sites located in the Local Plan area should follow the approach recommended by the 2018 NPPF (and associated guidance) and guidance provided by the Environment Agency and West Sussex County Council. This includes:

- **Site-specific Flood Risk Assessment: CHECKLIST** (NPPF PPG, Defra)
- **Standing Advice on Flood Risk** (Environment Agency)
- **Flood Risk Assessment for Planning Applications** (Environment Agency)
- **West Sussex County Council LLFA Policy for the Management of Surface Water**

The **UKCP18** was published on 26 November 2018. The UKCP18 projections replace the UKCP09 projections and is the official source of information on how the climate of the UK may change over the rest of this century. This may result in the Environment Agency climate change allowances being updated in 2019. When undertaking an FRA, please refer to the most up to date climate change allowances provided by the Environment Agency.

Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – **Flood Risk Assessment: Local Planning Authorities.**

8.3 Mitigation measures

Mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered.

Often the determining factor in deciding whether a particular development is appropriate is the practical feasibility, financially viability and long-term maintenance implications of flood risk mitigation rather than technical limitations. Detailed technical assessments are required in the FRA to assess the practical feasibility, together with a commercial review by the developer of the cost of the mitigation works and how contributions will be made for their long-term maintenance. At the SFRA stage, broad assumptions must be made regarding the feasibility of flood risk mitigation to highlight sites with greater development potential. The formulation of measures that not only provides an appropriate standard of protection to new development, but also reduces the risk to existing communities will be an important consideration.

Attention must also be paid to the provision of safe access and egress during flood events, including climate change, and how this is linked to flood warning and

emergency evacuation where necessary. The Emergency Services and local authority should be consulted on the evacuation and rescue capabilities and any advice or requirements included. Consideration should also be given to residual risk to understand the safety implications during events where the design capacity is exceeded or there is a failure.

There should be no interruption to flood flows or loss of flood storage as a result of any proposed development. Flood storage compensation may be appropriate for sites on the edge of the existing floodplain or within a flood cell.

Whilst it might be possible to identify appropriate flood mitigation measures for some sites, it is worth noting that in some instances the findings of individual FRAs may determine that the risk of flooding to a proposed development is too great and mitigation measures are not feasible or appropriate. In these instances, the development is likely to be subject to an objection by the Environment Agency.

The minimum acceptable standard of protection against flooding for new residential property within flood risk areas is the 1% AEP event for fluvial flooding, 0.5% AEP event for tidal flooding, and 1% AEP storm for surface water flooding. Developments susceptible to flood risk resulting from blockage or exceedance of structures should be protected beyond the 1% AEP plus climate change scenario. An allowance for climate change over the lifetime of the development must be made when assessing each of these scenarios and be conducted in line with latest guidance for climate change.

8.4 Reducing flood risk

8.4.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from flood zones, to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. However, vehicular parking in floodplains should be based on the nature of parking, flood depths and hazard including evacuation procedures and flood warning. The nature of risk to water quality also needs to be considered and mitigated for to ensure that accumulated hydrocarbons and other vehicle related pollutants are not released to the aquatic environment. Particular consideration should be given to designing drainage systems that reduce the risk of groundwater ingress, as this is a known existing problem.

Waterside areas, or areas along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise.

8.4.2 Raised floor levels

The raising of internal floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood.

If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable, finished flood levels should normally be set to whichever is higher of the following:

- a minimum of 600mm above the 1% AEP fluvial event plus an allowance for climate change and an appropriate allowance for freeboard

- a minimum of 600mm above the 0.5% AEP tidal event plus an allowance for climate change and an appropriate allowance for freeboard
- 300mm above the general ground level of the site.

If it is not practical to raise floor levels to those specified above, consultation with the Environment Agency will be required to determine alternative approaches.

The additional height that the floor level is raised above the maximum water level is referred to as the "freeboard". Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels.

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress would still be an issue, particularly when flood duration covers many days.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

8.4.3 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain if they are overtopped or breached. Compensatory storage must be provided where raised defences remove storage from the floodplain. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate.

8.4.4 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property.

In most areas of fluvial flood risk, raising land above the floodplain would reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary.

Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

Any proposal for modification of ground levels will need to be assessed as part of a detailed flood risk assessment.

8.4.5 Developer contributions

In some cases, and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

DEFRA's Flood and Coastal Risk Management Grant in Aid (FCRMGiA)[17] can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCRMGiA and therefore any shortfall in funds will need to be found from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer.

However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior to the granting of planning permission and in partnership with the Council and the Environment Agency.

The appropriate route for the consideration of strategic measures to address flood risk issues is the Local Flood Risk Management Strategy (LFRMS) prepared by the Lead Local Flood Authority. The LFRMS should describe the priorities with respect to local flood risk management, the measures to be taken, the timing and how they will be funded. It will be preferable to be able to demonstrate that strategic provisions are in accordance with the LFRMS, can be afforded and have an appropriate priority.

The Environment Agency is also committed to working in partnership with developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the Environment Agency request that developers contact them to discuss potential solutions.

8.5 Buffer strips

The provision of a buffer strip to 'make space for water', allows additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes.

It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult.

8.6 Resistance and Resilience measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised

17 Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)

but there is still a risk at the 0.1% AEP scenario. In these cases, (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not normally be relied on for new development as an appropriate mitigation method.

Resistance measures aim to reduce the amount of floodwater entering the building and resilience measures aim to reduce the damage caused by flood water which has enter the property.

8.6.1 Resistance measures

Most of the resistance measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sand bags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The effectiveness of these forms of measures is often dependant on the availability of a reliable forecasting and warning system, so the measures are deployed in advance of an event. The following resistance measures are often deployed:

Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

Temporary barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

8.6.2 Resilience measures

Interior design measures to reduce damage caused by flooding. For example:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level
- Water-resistant materials for floors, walls and fixtures
- If redeveloping existing basements for non-residential purposes, new electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to minimise damage if the development floods

Resistance and Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA. Further guidance relating to appropriate resistance and resilience measures can be found on the Environment Agency's **Flood risk assessment in flood zones 2 and 3** webpage

8.6.3 Community resistance measures

These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

8.6.4 Emergency planning

Safe access and egress from the site should be provided to reduce the residual risks to a development. The developer should seek to incorporate an emergency plan and a safe refuge point if the development site has been identified to be at risk of flooding.

The local authority and Emergency Services should be consulted when designing an emergency plan. For further details on emergency planning, see Section 10.

8.7 Making space for water

The **PPG** sets out a clear aim in Flood Zone 3 to create space for flooding by restoring functional floodplain and generally development should be directed away from these areas

All new development close to rivers should consider the opportunity presented to improve and enhance the river environment. Developments should look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

Consideration for making space for water should also be applied to surface water generated by impermeable surfaces. All new developments should aim to incorporate SuDS to minimise the amount of surface water that is generated. Through a sequential design, known areas of flood risk from surface water can be set aside as open space to ensure flow routes are not blocked, preventing water from building up to potentially dangerous depths. The provision of SuDS also allows water related features to become part of the landscape, offering improved aesthetics to a development and removing the need for underground storage or culverting.

8.8 Reducing flood risk from other sources

8.8.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1% AEP plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off of the site. Developers should provide evidence and ensure that this will not be a significant risk.

When redeveloping existing buildings, it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an appropriate solution.

8.8.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. The development must improve the drainage infrastructure to reduce flood risk on site and the wider area. It is important that a drainage impact assessment shows that this will not increase flood risk elsewhere, and that the drainage requirements regarding runoff rates and SuDS for new development are met.

If residual surface water flood risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk.

When redeveloping existing buildings, the installation of some permanent or temporary flood-proofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains

and sewers. These can be installed within gravity sewers or drains in a property's private sewer upstream of the public sewerage system. They need to be carefully installed and must be regularly maintained. Consideration must also be given to attenuation and flow ensuring that flows during the 1%AEP plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques. Particular consideration should be given to designing drainage systems that reduce the risk of groundwater ingress, as this is a known existing problem.

8.8.3 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of greenfield surface water drainage by encouraging water to flow along natural flow routes and thereby reduce runoff rates and volumes during storm events while providing some water treatment benefits. SuDS also have the advantage of providing effective blue and green infrastructure and ecological and public amenity benefits when designed and maintained properly.

The inclusion of SuDS within developments should be seen as an opportunity to enhance ecological and amenity value, and promote green infrastructure, incorporating above ground facilities into the development landscape strategy. SuDS must be considered at the outset, during preparation of the initial site conceptual layout to ensure that enough land is given to design spaces that will be an asset to the development rather than an after-thought. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA).

More detailed guidance on the use of SuDS is providing in Section 9.3.

9 Surface water management and SuDS

9.1 What is meant by surface water flooding?

Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall.

Surface water flooding includes

- **pluvial flooding**: flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (overland surface runoff) before it either enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity;
- **sewer flooding**: flooding that occurs when the capacity of underground water conveyance systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters which may cause water to back up and flood around buildings or in built up areas. Sewer flooding can also arise from operational issues such as blockages or collapses of parts of the sewer network; and
- **overland flows entering the built-up area from the rural/urban fringe**: includes overland flows originating from groundwater springs.

9.2 Role of the LLFA and Local Planning Authority in surface water management

From April 2015 local planning policies and decisions on planning applications relating to major development or major commercial development should make provision for sustainable drainage systems to manage run-off, where major developments are defined as:

- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of one hectare or more.

The Local Planning Authority must satisfy themselves that clear arrangements are in place for future management of the maintenance arrangements and the LLFA (West Sussex County Council), as statutory consultee is required to review the drainage and Sustainable Urban Drainage (SuDS) proposals to confirm they are appropriate.

When considering planning applications, local planning authorities should seek advice from the relevant flood risk management bodies, principally the LLFA on the management of surface water (including what sort of SuDS they would consider to be reasonably practicable), satisfy themselves that the proposed minimum standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the development's lifetime. Judgement on what SuDS system would be reasonably practicable should be through reference to Defra's **'Non-statutory technical standards for SuDS' document** and should take into account design and construction costs.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. Proposals should also comply with the key SuDS principles regarding solutions that deliver multiple long-term benefits. These principles are:

- **Quantity:** should be able to cope with the quantity of water generated by the development at the agreed rate with due consideration for climate change via a micro-catchment based approach
- **Quality:** should utilise SuDS features in a "treatment train" that will have the effect of treating the water before infiltration or passing it on to a subsequent water body
- **Amenity/Biodiversity:** should be incorporated within "open space" or "green corridors" within the site and designed with a view to performing a multifunctional purpose

West Sussex County Council and Chichester District Council:

- promote the use of SuDS for the management of run off;
- ensure their policies and decisions on applications support and compliment the building regulations on sustainable rainwater drainage, giving priority to infiltration over watercourses and then sewer conveyance;
- incorporate favourable policies within development plans;
- adopt policies for incorporating SuDS requirements into Local Plans;
- encourage developers to utilise SuDS whenever practical, if necessary, through the use of appropriate planning conditions; and
- develop joint strategies with sewerage undertakers to further encourage the use of SuDS.

Chichester District Council's **'Surface Water and Drainage: Supplementary Planning Document'** investigates surface water management in the Chichester District (excluding the South Downs National Park) and describes how development should be managed in order to fully enhance and protect the water environment. This document should be referred to by developers and consultants when preparing planning applications.

9.3 Sustainable Drainage Systems (SuDS)

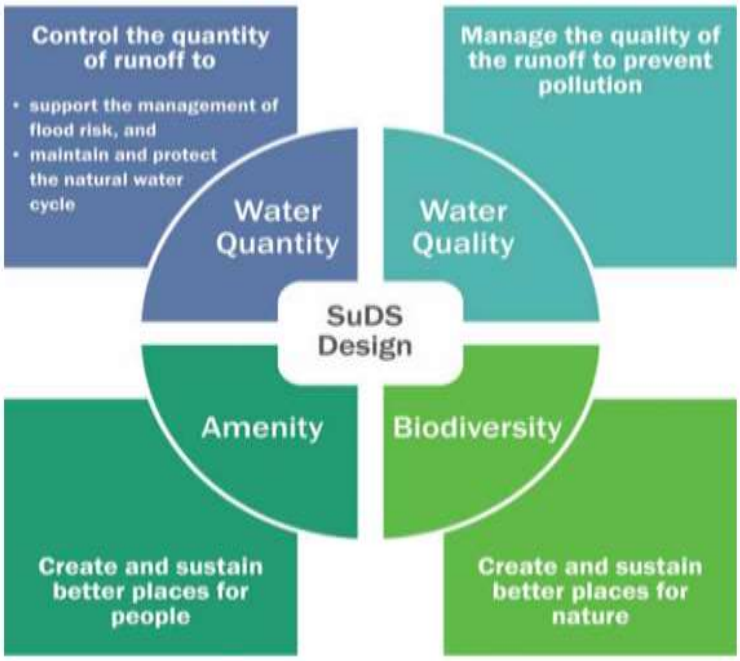
Sustainable Drainage Systems are water management practices which aim to enable surface water to be drained in a way that mimics (as closely as possible) the run-off and drainage prior to site development. The primary benefits of SuDS can be categorised under four distinct themes. These are highlighted in Figure 9-1 and are referred to as the four pillars of SuDS design.

There are a number of ways in which SuDS can be designed to meet surface water quantity, water quality, biodiversity and amenity goals. Given this flexibility, SuDS are generally capable of overcoming or working alongside various constraints affecting a site, such as restrictions on infiltration, without detriment to achieving these goals.

The inclusion of SuDS within developments should also be seen as an opportunity to enhance ecological and amenity value as well as promote Green Infrastructure by incorporating above ground facilities into the landscape development strategy. SuDS must be considered at the outset and during preparation of the initial conceptual site layout to ensure that enough land is given to design spaces that will be an asset to the development as opposed to an ineffective afterthought. For SuDS trains to work effectively it needs to be ensured that appropriate techniques are selected based on the objectives for drainage and the site-specific constraints. It is recommended that on all developments source control is implemented as the first stage of a management

train allowing for improvements in water quality and reducing or eliminating runoff from smaller, more frequent, rainfall events.

Figure 9-1: Four pillars of SuDS design



Source: The SuDS Manual C753 (2015)

All new major development proposals should ensure that sustainable drainage systems for management of run-off are put in place. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

9.4 Types of SuDS System

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (Table 9-1). Techniques can include soakaways, infiltration trenches, permeable pavements, grassed swales, green roofs, ponds and wetlands and these do not necessarily need to take up a lot of space. The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA) e.g. the **CIRIA SuDS Manual C753 (2015)**.

Table 9-1: Examples of SuDS techniques and potential benefits

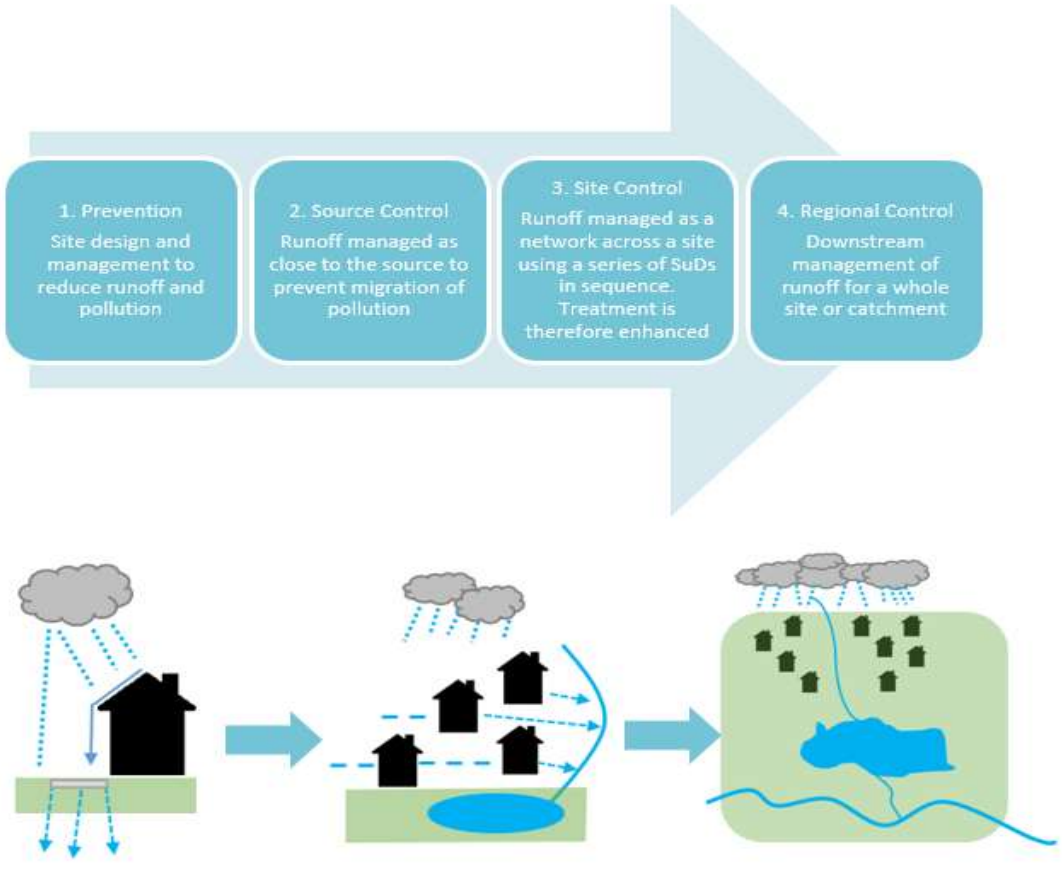
SuDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

9.4.1 SuDS Management

SuDS should not be used individually but as a series of features in an interconnected system designed to capture water at the source and convey it to a discharge location. Collectively this concept is described as a SuDS Management Train (see Figure 9-2). The number of treatment stages required within the Management Train depends primarily on the source of the runoff and the sensitivity of the receiving waterbody or groundwater. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered.

SuDS components should be selected based on design criteria and how surface water management is to be integrated within the development and landscaping setting. By using a number of SuDS features in series it is possible to reduce the flow and volume of runoff as it passes through the system as well as minimising pollutants which may be generated by a development.

Figure 9-2: SuDS Management Train



9.4.2 Treatment

A key part of the four pillars of SuDS is to provide the maximum improvement to water quality through the use of the "SuDS management train". To maximise the treatment within SuDS, CIRIA recommends[18] the following good practice is implemented in the treatment process:

1. **Manage surface water runoff close to source:** This makes treatment easier due to the slower velocities and also helps isolate incidents rather than transport pollutants over a large area.
2. **Treat surface water runoff on the surface:** This allows treatment performance to be more easily inspected and managed. Sources of pollution and potential flood risk is also more easily identified. It also helps with future maintenance work and identifying damaged or failed components.
3. **Treat a range of contaminants:** SuDS should be chosen and designed to deal with the likely contaminants from a development and be able to reduce them to acceptably low levels.
4. **Minimise the risk of sediment remobilisation:** SuDS should be designed to prevent sediments being washed into receiving water bodies or systems during events greater than what the component may have been designed.

18 C753 CIRIA SuDS Manual (2015)

5. **Minimise the impact of spill:** Designing SuDS to be able to trap spills close to the source or provide robust treatment along several components in series.

The number of treatment stages required depends primarily on the source of the runoff. A drainage strategy will need to demonstrate that an appropriate number of treatment stages are delivered. This involves determining a pollutant hazard score for each pollutant type. An index is then used to determine the treatment potential of different SuDS features for different pollutant types. This is known as the mitigation index. The Total SuDS mitigation index should be equal or greater than the pollution hazard score to deliver adequate treatment.

9.4.3 Overcoming SuDS constraints

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design. Table 9-2details some possible constraints and how they may be overcome.

Table 9-2: Example SuDS design constraints and possible solutions

Considerations	Solution
Land availability	SuDS can be designed to fit into small areas by utilising different systems. For example, features such as permeable paving and green roofs can be used in urban areas where space may be limited.
Contaminated soil or groundwater below site	SuDS can be placed and designed to overcome issues with contaminated groundwater or soil. Shallow surface SuDS can be used to minimise disturbance to the underlying soil. The use of infiltration should also be investigated as it may be possible in some locations within the site. If infiltration is not possible linings can be used with features to prevent infiltration.
High groundwater levels	Non-infiltrating features can be used. Features can be lined with an impermeable line or clay to prevent the egress of water into the feature. Additional, shallow features can be utilised which are above the groundwater table.
Steep slopes	Check dams can be used to slow flows. Additionally, features can form a terraced system with additional SuDS components such as ponds used to slow flows.
Shallow slopes	Use of shallow surface features to allow a sufficient gradient. If the gradient is still too shallow pumped systems can be considered as a last resort.
Ground instability	Geotechnical site investigation should be done to determine the extent of unstable soil and dictate whether infiltration would be suitable or not.
Sites with deep backfill	Infiltration should be avoided unless the soil can be demonstrated to be sufficiently compacted. Some features such as swales are more adaptable to potential surface settlement.
Open space in floodplain zones	Design decisions should be done to take into consideration the likely high groundwater table and possible high flows and water levels. Features should also seek to not reduce the capacity of the floodplain and take into consideration the influence that a watercourse may have on a system. Facts such as siltation after a flood event should also be taken into account during the design phase.
Future adoption and maintenance	Local Planning Authority should ensure development proposals, through the use of planning conditions or planning obligations, have clear arrangements for on-going maintenance over the development's lifetime.

For SuDS techniques that are designed to encourage infiltration, it is imperative that the water table is low enough and a site-specific infiltration test is conducted early on as part of the design of the development. Infiltration should be considered with caution within areas of possible subsidence or sinkholes. Where sites lie within or close to groundwater protection zones (GSPZs) or aquifers, further restrictions may be applicable and guidance should be sought from the LLFA and the Environment Agency.

9.5 Sources of SuDS guidance

West Sussex County Council and partner LLFAs produced a document on SuDS design and guidance, aimed at developers and planners involved in designing small and large developments in the South East of England. This document is called **'Water, People, Places: A guide for master planning sustainable drainage into developments'**.

West Sussex County Council also produced a document called **West Sussex County Council LLFA Policy for the Management of Surface Water**. This policy statement should be used by developers, professionals and local authorities involved in the development of new or brownfield sites; drainage schemes for major developments; and local planning and land-use policy.

Chichester District Council's **'Surface Water and Drainage: Supplementary Planning Document'** should also be referred to by developers if the site is within a wastewater treatment catchment. More information and guidance on SuDS is available on the **Susdrain** website.

The **C753 CIRIA SuDS Manual (2015)** replaces and updates the previous version (C697) providing up to date guidance on planning, design, construction and maintenance of SuDS. The document is designed to help the implementation of these features into new and existing developments, whilst maximising the key benefits regarding flood risk and water quality. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document. It is recommended that developers and the LPA utilise the information within the manual to help design SuDS which are appropriate for a development.

9.5.1 Surface Water Advice Note – Using SuDS on new developments (June 2015)

When considering SuDS as part of a major planning application, local planning authorities need to satisfy themselves that the minimum standard of operation is appropriate for SuDS and ensure through the use of planning conditions that clear arrangements are in place for their ongoing maintenance over the lifetime of the development.

The NPPF expects local planning authorities to give priority to the use of SuDS in determining planning applications. Where SuDS are used, it must be established that these options are feasible, can be adopted and properly maintained and would not lead to any other environmental problems. This is a material planning consideration for all major applications as of the 6 April 2015 and should therefore be given full consideration in an application.

9.5.2 Non-Statutory Technical Guidance, Defra (March 2015)

Non-Statutory Technical Guidance has been developed by Defra to sit alongside PPG to provide non-statutory standards as to the expected design and performance for SuDS.

In March 2015, the latest guidance was released providing amendments as to what is expected by the LPA to meet the National standards. The guidance provides a valuable resource for developers and designers outlining peak flow control, volume control,

structural integrity of the SuDS, and flood considerations both within and outside the development as well as maintenance and construction considerations. It considers the following: flood risk inside and outside the development, peak flow, volume control, structural integrity, designing for maintenance considerations and construction.

The LPA will make reference to these standards when determining whether proposed SuDS are considered reasonably practicable.

9.5.3 Groundwater Vulnerability Zones

The Environment Agency have published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise the underlying bedrock. The maps show the vulnerability of groundwater at a location based on the hydrological, hydrogeological and soil properties within a one-kilometre grid square.

Two maps are available

- **Basic groundwater vulnerability map:** this shows the likelihood of a pollutant discharged at ground level (above the soil zone) reaching groundwater for superficial and bedrock aquifers and is expressed as high, medium and low vulnerability
- **Combined groundwater vulnerability map:** this map displays both the vulnerability and aquifer designation status (principal or secondary). The aquifer designation status is an indication of the importance of the aquifer for drinking water supply.

The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas.

9.5.4 Groundwater Source Protection Zones (GSPZ)

In addition to the AStGWF data the Environment Agency also defines Groundwater Source Protection Zones in the vicinity of groundwater abstraction points. These areas are defined to protect areas of groundwater that are used for potable supply, including public/private potable supply, (including mineral and bottled water) or for use in the production of commercial food and drinks. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. The definition of each zone is shown below:

- **Zone 1 (Inner Protection Zone)** – Most sensitive zone: defined as the 50-day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres
- **Zone 2 (Outer Protection Zone)** – Also sensitive to contamination: defined by a 400-day travel time from a point below the water table. This zone has a minimum radius around the source, depending on the size of the abstraction
- **Zone 3 (Total Catchment)** - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. Individual source protection areas will still be assigned to assist operators in catchment management
- **Zone 4 (Zone of special** interest) – A fourth zone SPZ4 or 'Zone of Special Interest' usually represents a surface water catchment which drains into the

aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one of the other zones, SPZ 1, 2 or 3, whichever is appropriate in the particular case, or become a safeguard zone

GSPZs in the Local Plan area

Three locations have been identified to be within a Groundwater Source Protection Zone (GSPZ) in the Chichester District Local Plan area. These locations are shown in Figure 9-3 and provided below:

- Woodmancote and West Ashling (Zone 1c, 2 and 3)
- East Ashling and Fishbourne (Zone 1c, 2 and 3)
- Boxgrove and East Hampnett (Zone 1c, 2, 2c and 3)

There are no Groundwater Source Protection Zones in the north of the Local Plan area.

Portsmouth Water relies on groundwater abstractions for public water supply. Developers should refer to **Portsmouth Water's Groundwater Protection Guide** which provides guidance on Protsmouth Water's preferred approach to development relating the groundwater quality and quantity for their catchments.

9.5.5 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies.

The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The definition of each NVZ is as follows:

- **Groundwater NVZ** – an area of land where groundwater supplies are at risk from containing nitrate concentrations exceeding the 50mg/l level dictated by the EU's Surface Water Abstraction Directive (1975) and Nitrates Directive (1991).
- **Surface Water NVZ** – an area of land where surface waters (in particular those used or intended for the abstraction of drinking water) are at risk from containing nitrate concentrations exceeding the 50 mg/l dictated by the EU's Surface Water Abstraction Directive (1975) and Nitrate Directive (1991).
- **Eutrophic NVZ** – an area of land where nitrate concentrations are such that they could/will trigger the eutrophication of freshwater bodies, estuaries, coastal waters and marine waters.

The locations of the Nitrate Vulnerable Zones in the Local Plan area are shown in Figure 9-4.

Figure 9-3: Groundwater Source Protection Zones in the south Local Plan area

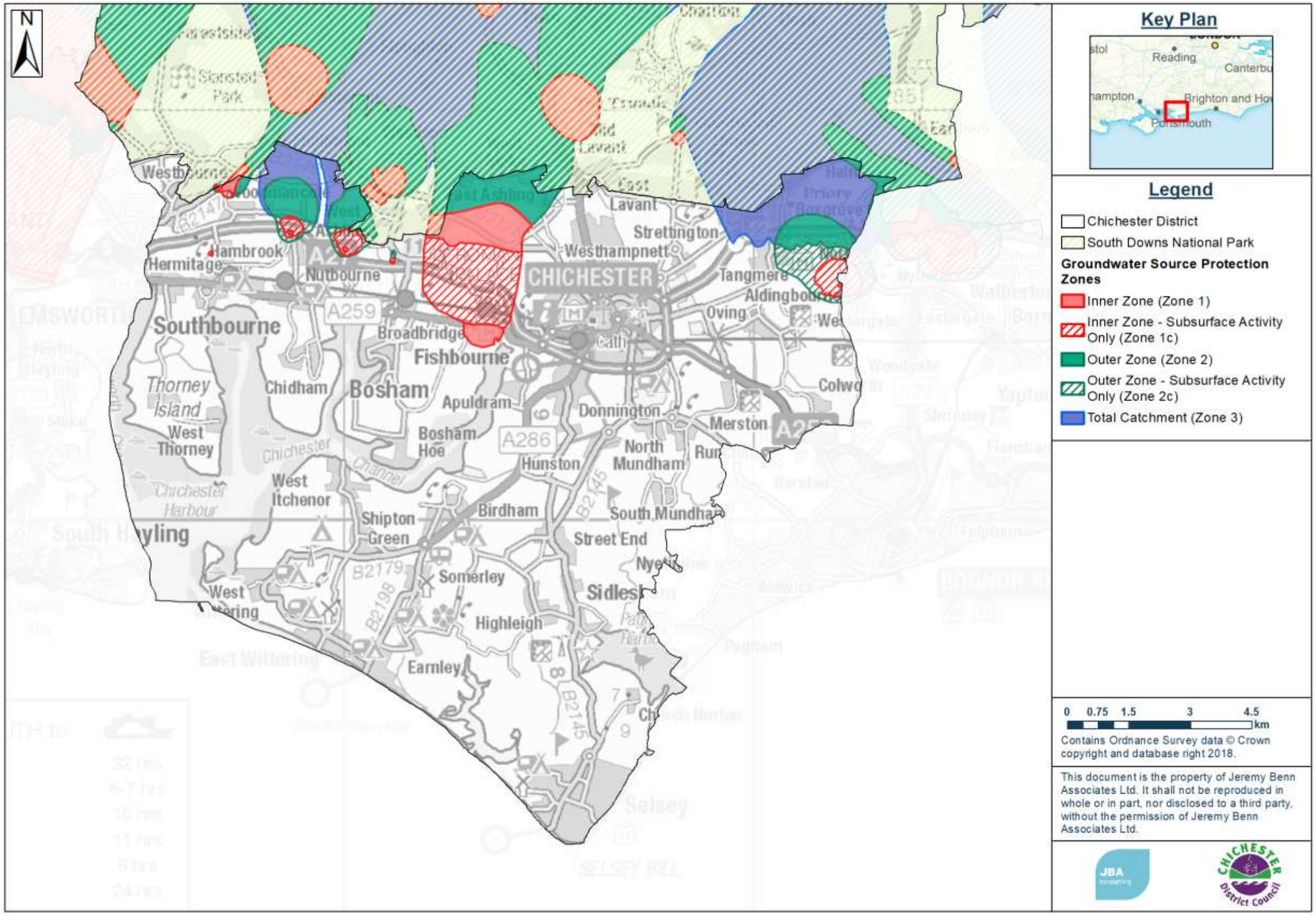


Figure 9-4: Nitrate Vulnerability Zones in the north Local Plan area

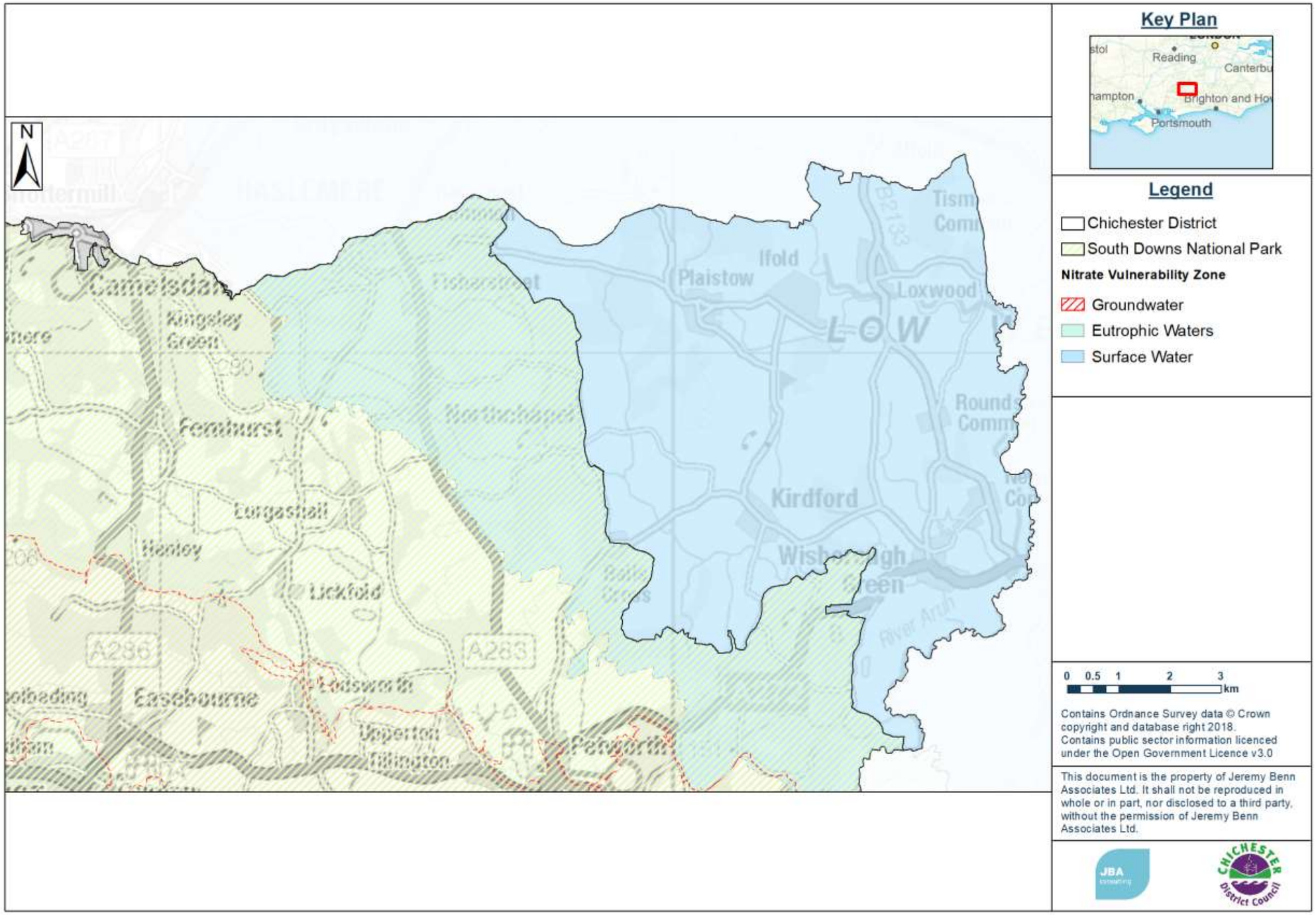
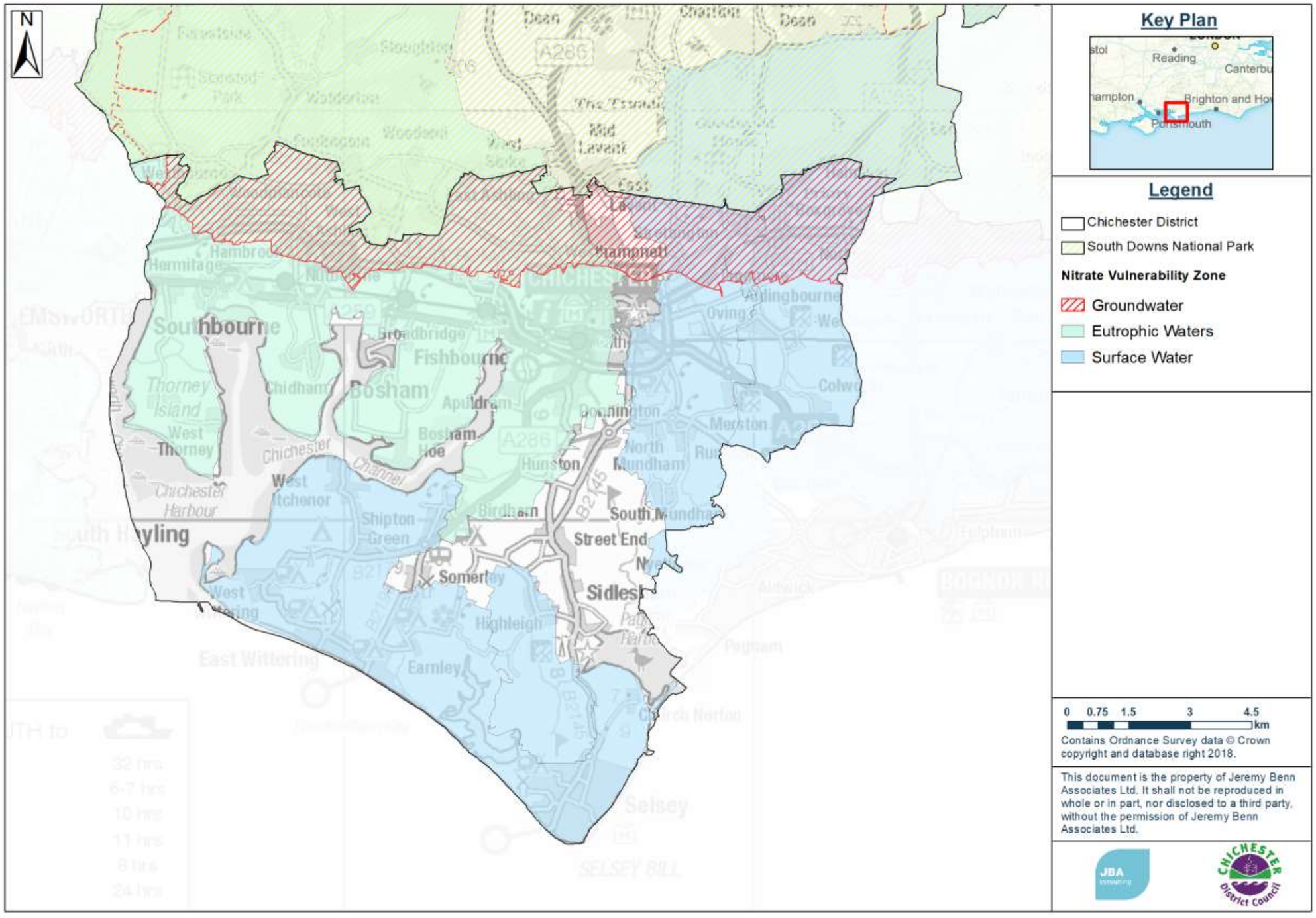


Figure 9-5: Nitrate Vulnerability Zones in the north Local Plan area



10 Flood warning and emergency planning

10.1 Emergency planning

Emergency planning is one option to help manage flood related incidents. From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding.

In development planning, a number of emergency planning activities are already **integrated** in national building control and planning policies e.g. the NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. Flood warning and emergency planning is a last resort after using this SFRA to undertake the Sequential Test appropriately first.

However; safety is a key consideration for any new development and includes residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures.

The **NPPF Planning Practice Guidance** outlines how developers can ensure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test. As part of an FRA, the developer should review the acceptability of the proposed access in consultation with the LPA (where appropriate) and the Environment Agency.

There are circumstances where a flood warning and evacuation plan[19] is required and / or advised:

- It is a **requirement under the 2018 NPPF** that safe access and escape routes are included in an FRA where appropriate, as part of an agreed emergency plan
- The **Environment Agency and DEFRAs standing advice** for undertaking flood risk assessments for planning applications states that details of emergency escape plans will be required for any parts of the building that are below the estimate flood level.

It is recommended that Emergency Planners at Chichester District Council (where appropriate) are consulted prior to the production of any emergency flood plan.

In addition to the **flood warning and evacuation plan considerations listed in the NPPF / PPG**, it is advisable that developers also acknowledge the following:

- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- Proposed new development that places additional burden on the existing response capacity of the Councils will not normally be considered to be appropriate.
- Developers should encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.
- The vulnerability of site occupants.

19 Flood warning and evacuation plans may also be referred to as an emergency flood plan or flood response plan.

- Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop emergency plans.

Further emergency planning information links:

- **2004 Civil Contingencies Act**
- **DEFRA (2014) National Flood Emergency Framework for England**
- **Sign up for Flood Warnings with the Environment Agency**
- **National Flood Forum**
- **GOV.UK Make a Flood Plan guidance and templates**
- **FloodRe**

10.2 Flood warning systems

Flood warnings can be derived and, along with evacuation plans, can inform emergency flood plans or flood response plans. The Environment Agency is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as Main Rivers) and coastal flooding in England. Flood Warnings are supplied via the Flood Warning Service (FWS), to homes and business within Flood Zones 2 and 3. The different levels of warnings are shown in Table 10-1.

Table 10-1: Environment Agency Warnings

Flood Warning Symbol	What it means	What to do
	Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advance notice of the possibility of flooding, but before there is full confidence that flooding in Flood Warning Areas is expected.	Be prepared to act on your flood plan Prepare a flood kit of essential items Monitor local water levels and the flood forecast on the Environment Agency website Stay tuned to local radio or TV Alert your neighbours Check pets and livestock Reconsider travel plans
	Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.	Move family, pets and valuables to a safe place Turn off gas, electricity and water supplies if safe to do so Seal up ventilation system if safe to do so Put flood protection equipment in place

Flood Warning Symbol	What it means	What to do
		Be ready should you need to evacuate from your home 'Go In, Stay In, Tune In'
	Severe Flood Warnings warn people of expected severe flooding where there is a significant threat to life.	Stay in a safe place with a means of escape Co-operate with the emergency services and local authorities Call 999 if you are in immediate danger
Warnings no longer in force	Informs people that river or sea conditions begin to return to normal and no further flooding is expected in the area. People should remain careful as flood water may still be around for several days.	Be careful. Flood water may still be around for several days If you've been flooded, ring your insurance company as soon as possible

It is the responsibility of individuals to sign-up to this service in order to receive the flood warnings via FWS. Registration and the service is free and publicly available. It is recommended that any household considered at risk of flooding signs-up. Developers should also encourage those owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.

10.2.1 Flood Alert and Warning Areas in the Local Plan area

There are currently 15 Flood Warning Areas (FWAs) and 12 Flood Alert Areas (FAAs). These are displayed in Appendix J. A list of the FAAs in the study area are shown in Table 10-2 and a list of FWAs are shown in Table 10-3.

Table 10-2: Flood Alert Areas within Chichester District Local Plan area

Flood Alert Code	Flood Alert Name	Watercourse	Description
065WAF411	River Ems	Ems	The River Ems and tributaries from Stoughton to Emsworth Harbour including Westbourne
065WAC402	Coastal areas of Medmerry	English Channel	Earnley Beach Centre, West Sands, Selsey Country Club and Ferry, Oakhurst, Greenwood and Easton Farm

Flood Alert Code	Flood Alert Name	Watercourse	Description
065WAF422	Loxwood Stream	Loxwood Stream	The Loxwood Stream in West Sussex from Chiddingfold to Drungewick
065WAC162	Langstone to Emsworth Harbour	Langstone Harbour, Emsworth Harbour	Coastal area from Langstone to Emsworth Harbour
065WAC401	Thorney Island to Bracklesham	English Channel	Coastal areas between Thorney Island and Bracklesham, including Bosham, West Itchenor and West Wittering
065WAC403	Selsey Bill to Elmer	English Channel	Coastal areas between Selsey Bill and Elmer, including Pagham, Sidlesham and Bognor
065WAF413	River Lavant	Lavant	The River Lavant from Mid Lavant to Shopwhyke including Chichester
065WAF415	Aldingbourne and Barnham Rifes	Aldingbourne and Barnham Rifes	Elbridge, Lidsey, Aldingbourne, Barnham, Yapton and Ryebank Rifes
065WAF412	Bosham Stream	Bosham Stream	Bosham Stream from West Ashling to Bosham including Churchfield Stream
065FAG015	Groundwater flooding in Finchdean, Dean Lane End and Rowlands Castle	Groundwater	Areas at risk of groundwater flooding in Finchdean, Dean Lane End, Idsworth and Rowlands Castle
061WAF30UpperWey	Upper River Wey	River Wey	Upper River Wey including Alton, Farnham, Bordon, Frensham, Tilford, Godalming, Guildford and Peasmarsh
065WAF423	Upper Arun	Arun	The Rivers Arun and Kird, Boldings Brook, North River and Par Brook

Table 10-3: Flood Warning Areas within Chichester District Local Plan area

Flood Warning Code	Flood Warning Name	Watercourse	Description
065FWC1801	Thorney Island, Southbourne and Nutbourne	The Solent	Coastal areas of Thorney Island, Southbourne and Nutbourne
065FWC1901	Bosham and West Itchenor	The Solent	Coastal areas of Bosham and West Itchenor, including Chidham, Broadbridge, and Bosham Hoe
065FWC2001	West Wittering	The Solent	Coastal areas of West Wittering
065FWC1401	Langstone and Emsworth	Langstone Harbour	Tidal areas at Langstone and Emsworth
065FWC2002	Bracklesham	The Solent	Coastal areas of Bracklesham
065FWC2101	Medmerry	The Solent	Coastal areas of Medmerry beach, including the West Sands caravan park
065FWC2201	Selsey East Beach	English Channel	Coastal areas of Selsey Bill, including Church Norton, and East Beach
065FWC2302	Sidlesham	English Channel	Coastal areas of Sidlesham
065FWF4602	Mid and East Lavant	River Lavant	The River Lavant at Mid Lavant and East Lavant
065FWF4501	Westbourne on the River Ems	Ems	The River Ems at Westbourne, including Commonside, and the B2147 at Racton House
065FWF4603	Westhampnett on the River Lavant	River Lavant	The River Lavant at Westhampnett, including Church Farm pit, the A27, and the Supermarket retail park at Portfield Way
065FWF5201	The Loxwood Stream	Loxwood Stream	The Loxwood Stream at Loxwood, including Loxwood Village, and Brewhurst Mill
065FWF4604	Chichester on the River Lavant	River Lavant	The River Lavant within Chichester City Centre, including Whyke, the A285, A286, and Chichester College
065FWF4702	Bosham on the Bosham Stream	Bosham Stream	The Bosham Stream at Bosham, including the Old Bosham Ditch,

Flood Warning Code	Flood Warning Name	Watercourse	Description
			Shore Road, and Churchfield Stream
065FWF5002	Broadbridge Heath to Pallingham Quay on the River Arun	River Arun	The River Arun from Broadbridge Heath to Pallingham Quay, including Broadbridge Heath, Slinfold, Wanford Mill, Gibbons Mill, Newbridge, and Pallingham Lock

10.2.2 Local arrangements for managing flood risk

The Chichester District Council's **website** provides information on local flood risk, how to protect your property from flooding and useful contacts in case of a flood incident.

10.2.3 Selsey Flood Plan

This **Multi-Agency Flood Plan** (MAFP) is written as a Part 2 to the Sussex Adverse Weather Response Framework: Chapter 2 Multi-Agency Flood Plan. It provides detailed information on flood management for the high-risk communities of Selsey, Sidlesham and Church Norton (the Selsey area). The plan is owned by Chichester District Council and will be reviewed every two years.

The aim of the MAFP is to set out a framework for the response to flooding in the Selsey area. It also considers site-specific logistical challenges to evacuating or supporting people of Selsey, and establishes effective flood warning mechanisms.

The MAFP outlines the evacuation process for the Selsey area and has also allocated emergency rest centres to provide temporary accommodation to those made homeless in the event of an extreme event. The three designated rest centres are:

- The Selsey Centre
- Selsey Town Hall
- Westgate Leisure
- The Bournes

Alternative rest centre locations may be considered in the event of Selsey being cut off by flooding.

The plan also highlights key infrastructure in the Selsey area, including B2145 Selsey Road, various utilities and West Beach and Medmerry sea defences. It is considered that responders to a flood event will not need to defend these sites, because they are either at low risk or the flooding would be too extensive for temporary defences.

As well as this, the MAFP gives information and guidance on various problems which arise following a flood event and how to respond to them.

10.3 Emergency planning and development

10.3.1 NPPF

The NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. It is essential that any development which will be required to remain operational during a flood event is located in the lowest flood risk zones to ensure that, in an emergency, operations

are not impacted on by flood water or that such infrastructure is resistant to the effects of flooding such that it remains serviceable/operational during 'upper end' events, as defined in the Environment Agency's Climate Change allowances (February, 2016). For example, the NPPF classifies police, ambulance and fire stations and command centres that are required to be operational during flooding as Highly Vulnerable development, which is not permitted in Flood Zones 3a and 3b and only permitted in Flood Zone 2 providing the Exception Test is passed. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process. All flood sources such as fluvial, surface, groundwater, sewers and artificial sources (such as canals and reservoirs) should be considered. In particular sites should be considered in relation to the areas of drainage critical problems highlighted in the relevant SWMPs.

The outputs of this SFRA should be compared and reviewed against any emergency plans and continuity arrangements. This includes the nominated rest and reception centres (and perspective ones), so that evacuees are outside of the high-risk Flood Zones and will be safe during a flood event.

10.3.2 Safe access and egress

The NPPF Planning Practice Guidance outlines how developers can secure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test[20]. Access considerations should include the voluntary and free movement of people during a 'design flood' as well as for the potential of evacuation before a more extreme flood. The access and egress must be functional for changing circumstances over the lifetime of the development. The NPPF Planning Practice Guidance sets out that:

- Access routes should allow occupants to safely access and exit their dwellings in design flood conditions. In addition, vehicular access for emergency services to safely reach development in design flood conditions is normally required; and
- Where possible, safe access routes should be located above design flood levels and avoid flow paths including those caused by exceedance and blockage. Where this is unavoidable, limited depths of flooding may be acceptable providing the proposed access is designed with appropriate signage etc. to make it safe. The acceptable flood depth for safe access will vary as this will be dependent on flood velocities and risk of debris in the flood water. Even low levels of flooding can pose a risk to people in situ (because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention).

The depth, velocity and hazard mapping from hydraulic modelling should help inform the provision of safe access and egress routes.

As part of an FRA, the developer should review the acceptability of the proposed access in consultation with Chichester District Council and the Environment Agency. Site and plot specific velocity and depth of flows should be assessed against standard hazard criteria to ensure safe access and egress can be achieved.

10.3.3 Potential evacuations

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20 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 039, Reference ID: 7-056-20140306) March 2014

During flood incidents, evacuation may be considered necessary. The NPPF Planning Guidance states practicality of safe evacuation from an area will depend on[21]:

1. the type of flood risk present, and the extent to which advance warning can be given in a flood event;
2. the number of people that would require evacuation from the area potentially at risk;
3. the adequacy of both evacuation routes and identified places that people could be evacuated to (and taking into account the length of time that the evacuation may need to last); and
4. sufficiently detailed and up to date evacuation plans being in place for the locality that address these and related issues.

The vulnerability of the occupants is also a key consideration. The NPPF and application of the Sequential Test aims to avoid inappropriate development in flood risk areas. However, developments may contain proposals for mixed use on the same site. In this instance, the NPPF Planning Practice Guidance states that layouts should be designed so that the most vulnerable uses are restricted to higher ground at lower risk of flooding, with development which has a lower vulnerability (parking, open space etc.) in the highest risk areas, unless there are overriding reasons to prefer a different location[22]. Where the overriding reasons cannot be avoided, safe and practical evacuation routes must be identified.

The Environment Agency and DEFRA provide standing advice for undertaking flood risk assessments for planning applications. Please refer to **the government website** for the criteria on when to following the standing advice. Under these criteria, you will need to provide details of emergency escape plans for any parts of the building that are below the estimated flood level. The plans should show:

- single storey buildings or ground floors that do not have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- basement rooms have clear internal access to an upper level, e.g. a staircase; and
- occupants can leave the building if there is a flood and there is enough time for them to leave after flood warnings[23].

Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. developments located immediately behind a defence and at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop appropriate emergency plans.

10.3.4 Flood warning and evacuation plans

Flood warning and evacuation plans are potentially mitigation measures to manage the residual risk, as stated in the NPPF Planning Practice Guidance. It is a requirement under the NPPF that a flood warning and evacuation plan is prepared for sites at risk

21 NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 057, Reference ID: 7-057-20140306) March 2014
22 NPPF Planning Practice Guidance, Reducing the causes and impacts of flooding Paragraph: 053 Reference ID: 7-053-20140306
23 Environment Agency and DEFRA (2012) Flood Risk Assessment: Standing Advice: https://www.gov.uk/flood-risk-assessment-standing-advice

of flooding used for holiday or short-let caravans and camping and are important at any site that has transient occupants (e.g. hostels and hotels).

A flood warning and evacuation plan should detail arrangements for site occupants on what to do before, during and after a flood as this will help to lessen its impact, improve flood response and speed up the recovery process. The Environment Agency provides practical advice and templates on how to prepare a flood plans for individuals, communities and businesses (see text box for useful links).

It is recommended that emergency planners at Chichester District Council are consulted prior to the production of any emergency flood plan. The council will provide guidance to help local communities to protect their home and valuables and understand what to do before, during and after a flood.

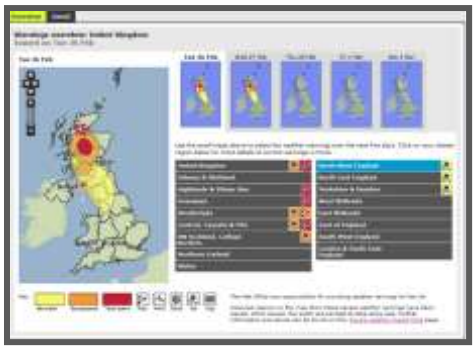
Once the emergency flood plan is prepared, it is recommended that it is distributed to emergency planners at Chichester District Council and the emergency services. When developing a flood warning and evacuation plan, it is recommended that it links in with any existing parish / community level plan.

Guidance documents for preparation of flood response plans

- **Environment Agency (2012) Flooding – minimising the risk, flood plan guidance for communities and groups**
- **Environment Agency (2014) Community Flood Plan template**
- **Environment Agency Personal flood plans**
- **Flood Plan UK 'Dry Run' - A Community Flood Planning Guide**

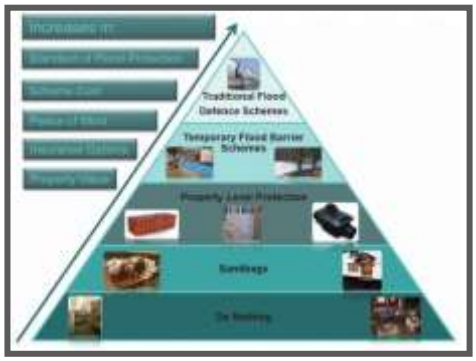
10.3.5 Other sources of information

As well as being a statutory consultee for new development at risk of flooding, the Environment Agency can offer independent technical advice. The Environment Agency website contains a breadth of information on flood risk and there are numerous publications and guidance available. For example, the **"flooding from groundwater"** guide has been produced by the Environment Agency and Local Government Association to offer practice advice to reduce the impact of flooding from groundwater.



The Met Office provides a **National Severe Weather Warning Service** about rain, snow, wind, fog and ice. The severity of warning is dependent upon the combination of the **likelihood** of the event happening and the **impact** the conditions may have. In simplistic terms, the warnings mean: Yellow: Be Aware, Amber: Be Prepared, Red: Take Action. This service does not provide flood warnings. The Met Office provide many other services and products. For further information, please visit their **website**.

The **National Flood Forum** (NFF) is a **national charity**, set up in 2002 to support those at risk and affected by flooding. The NFF helps people to prepare and recover from flooding as well as campaigning on behalf of flood risk communities, including providing advice on matters such as insurance.



Individual property flood resilience protection (PFR) measures are design to help protect homes and businesses from flooding. These include a combination of **flood resistance measures** - trying to prevent water ingress – and **flood resilience measures** - trying to limit the damage and reduce the impact of flooding, should water enter the building. It is important that any measures have the **BSI Kitemark**. This shows that the measure has been tested and ensures that it meets industry standards. Please visit the **Government website: "Prepare for flooding"** for more information.

11 Strategic flood risk solutions

11.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in the Local Plan area. The following sections outline different options which could be considered for strategic flood risk solutions. Any strategic solutions should ensure they are consistent with wider catchment policy and the local policies. It is important that the ability to deliver strategic solutions in the future is not compromised by the location of proposed development. When assessing the extent and location of proposed development consideration should be given to the requirement to secure land for flood risk management measures that provide wider benefits.

11.2 Flood storage schemes

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. Methods to provide these schemes include[24]:

- enlarging the river channel;
- raising the riverbanks; and/or
- constructing flood banks set back from the river.

Flood storage schemes have the advantage that they generally benefit areas downstream, not just the local area.

11.2.1 Promotion of SuDS

Surface water flood risk is present in the area. By considering SuDS at an early stage in the development of a site, the risk from surface water can be mitigated to a certain extent within the site as well as reduce the risk that the site poses to third party land. Regionally SuDS should be promoted on all new developments to ensure the quantity and quality of surface water is dealt with sustainably to reduce flood risk. Given the various policies and guidance available on SuDS, developers should use this information to produce technically proficient and sustainable drainage solutions that conform with the non-statutory standards for SuDS (2015).

11.3 Catchment and Floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state, and by creating space for naturally functioning floodplains working with natural processes.

Although the restoration of floodplain is difficult in previously developed areas where development cannot be rolled back, the following measures should be adopted:

- Promoting existing and future brownfield sites that are adjacent to watercourses to naturalise banks as much as possible. Buffer areas around watercourses provide an opportunity to restore parts of the floodplain
- Removal of redundant structures to reconnect the river and the floodplain.
- Apply the Sequential Approach to avoid new development within the floodplain.

24 http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

For those sites considered within the Local Plan Review and / or put forward by developers, that also have watercourses flowing through or past them, the sequential approach should be used to locate development away from these watercourses. This will ensure the watercourses retain their connectivity to the floodplain. Loss of floodplain connectivity could potentially increase flooding.

11.3.1 River Ems Restoration

In 2015, Portsmouth Water proposed the restoration of the Deepsprings to Racton Park Dell reach of the River Ems. The project formed part of the National Environment Programme (NEP) and was supported by the Environment Agency. The works were delivered by the Arun & Rothers Rivers Trust (ARRT) and the Wild Trout Trust (WTT). The aim of the project was to create a sinuous channel over a 300m chalk stream, in order to increase the biodiversity of flora and fauna[25].

11.3.2 Structure Removal and/ or modification (e.g. Weirs)

Structures, both within watercourses and adjacent to them can have significant impacts upon rivers including alterations to the geomorphology and hydraulics of the channel through water impoundment and altering sediment transfer regime, which over time can significantly impact the channel profile including bed and bank levels, alterations to flow regime and interruption of biological connectivity, including the passage of fish and invertebrates.

Many artificial in-channel structures (examples include weirs and culverts) are often redundant and / or serve little purpose and opportunities exist to remove them where feasible. The need to do this is heightened by climate change, for which restoring natural river processes, habitats and connectivity are vital adaptation measures. However, it also must be recognised that some artificial structures may have important functions or historical/cultural associations, which need to be considered carefully when planning and designing restoration work.

In the case of weirs, whilst weir removal should be investigated in the first instance, in some cases it may be necessary to modify a weir rather than remove it. For example, by lowering the weir crest level or adding a fish pass. This will allow more natural water level variations upstream of the weir and remove a barrier to fish migration.

11.3.3 Bank Stabilisation

Bank erosion should be avoided and landowners encouraged to avoid using machinery and vehicles close to or within the watercourse.

There are several techniques that can be employed to restrict the erosion of the banks of a watercourse. In an area where bankside erosion is particularly bad and/or vegetation is unable to properly establish, ecologically sensitive bank stabilisation techniques, such as willow spiling, can be particularly effective. Live willow stakes thrive in the moist environment and protect the soils from further erosion allowing other vegetation to establish and protect the soils.

11.3.4 Re-naturalisation

There is potential to re-naturalise a watercourse by re-profiling the channel, removing hard defences, re-connecting the channel with its floodplain and introducing a more natural morphology (particularly in instances where a watercourse has historically been modified through hard bed modification). Detailed assessments and planning would need to be undertaken to gain a greater understanding of the response to any proposed channel modification.

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25 River Ems Restoration, Arun & Rothers River Trust (2015): http://arrt.org.uk/river-ems-restoration/

11.4 Natural Flood management

Developments provide opportunities to work with natural processes to reduce flood and erosion risk, benefit the natural environment and reduce costs of schemes. Natural flood management requires integrated catchment management and involves those who use and shape the land. It also requires partnership working with neighbouring authorities, organisations and water management bodies. The Environment Agency has developed **Natural Flood Management (NFM) mapping** which displays opportunities for NFM.

Conventional flood prevention schemes may be preferred, but consideration of 're-wilding' rivers upstream could provide cost efficiencies as well as considering multiple sources of flood risk; for example, reducing peak flows upstream such as through felling trees into streams or building earth banks to capture runoff, could be cheaper and smaller-scale measures than implementing flood walls for example. With flood prevention schemes, consideration needs to be given to the impact that flood prevention has on the WFD status of watercourses. It is important that any potential schemes do not have a negative impact on the ecological and chemical status of waterbodies.

11.5 Habitat creation

There are also opportunities to deliver sites through the Environment Agency's Regional Habitat Creation Programme which seeks to replace intertidal habitats that are lost through coastal squeeze. Potential sites highlighted include locations at Chidham and Thorney Island.

11.6 Flood defences

There are a number of formal flood and coastal defences present within the study area (see Section 7 for further information).

Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas. If defences are constructed to protect a development site, it will need be demonstrated that the defences will not have a resulting negative impact on flood risk elsewhere, and that there is no net loss in floodplain storage.

11.7 Green Infrastructure

Green Infrastructure (GI) is a planned and managed network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and rural fringe and consist of:

- Open spaces – parks, woodland, nature reserves, lakes
- Linkages – River corridors and canals, and pathways, cycle routes and greenways
- Networks of "urban green" – private gardens, street trees, verges and green roofs.

The identification and planning of Green Infrastructure is critical to sustainable growth. It merits forward planning and investment as much as other socio-economic priorities such as health, transport, education and economic development. GI is also central to climate change action and is a recurring theme in planning policy. With regards to flood risk, green spaces can be used to manage storm flows and free up water storage capacity in existing infrastructure to reduce risk of damage to urban property, particularly in city centres and vulnerable urban regeneration areas. Green infrastructure can also improve accessibility to waterways and improve water quality, supporting regeneration and improving opportunity for leisure, economic activity and biodiversity.

A **Green Infrastructure Delivery Document (2016)** has been prepared by Chichester County Council as a guidance note to help developers incorporate green infrastructure into their development.

12 Level 1 summary assessment of potential development locations

12.1 Introduction

A total of 310 of potential development sites were provided by Chichester District Council, as shown in Figure 12-1 and Figure 12-2. These sites were identified from the Housing and Land Availability Assessment (HELAA) and Horticultural Development Areas (HDAs).

These sites were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site (see Appendix K).

Information considered includes the flood risk datasets listed below.

- Environment Agency Flood Zones 2 and 3
- Flood Zone 3b
- Fluvial and coastal climate change allowances
- Environment Agency Risk of Flooding from Surface Water
- Environment Agency Risk of Flooding from Reservoirs
- JBA Groundwater map
- Environment Agency and Chichester District Councils historic Flood Map
- Southern Water's SIRF dataset

A summary has been prepared on the proportion of a given site affected by levels and types of flood risk, along with whether historic incidences of flooding have occurred, watercourses flowing through the site and if the site is located within areas that receive Flood Alerts and Flood Warnings.

The information provided is intended to enable a more informed consideration of the sites when applying the sequential approach, which will be used to determine whether more detailed assessment of sites is required to further identify those that should be taken forward as potential development allocations.

Figure 12-1: Northern sites screened

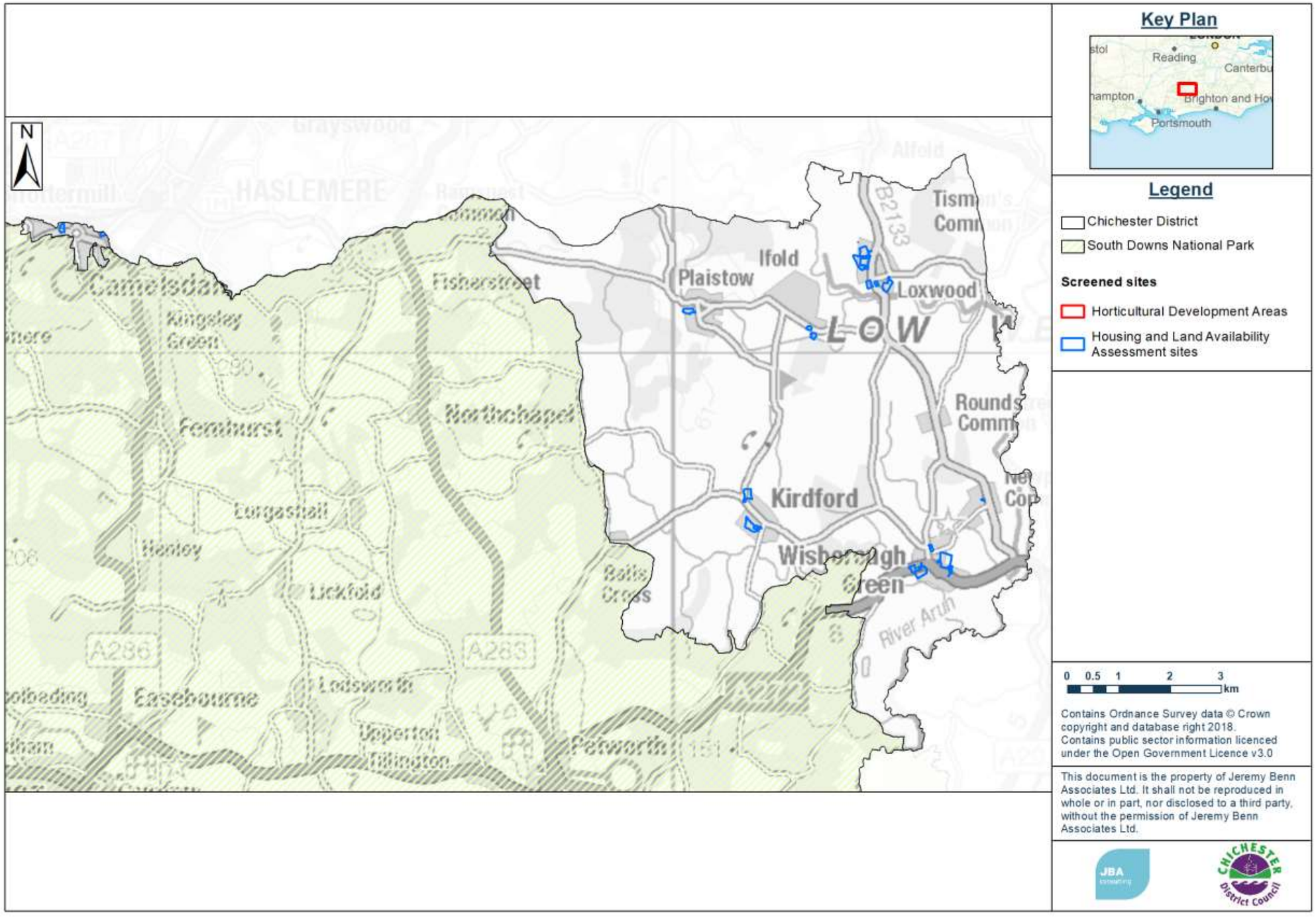
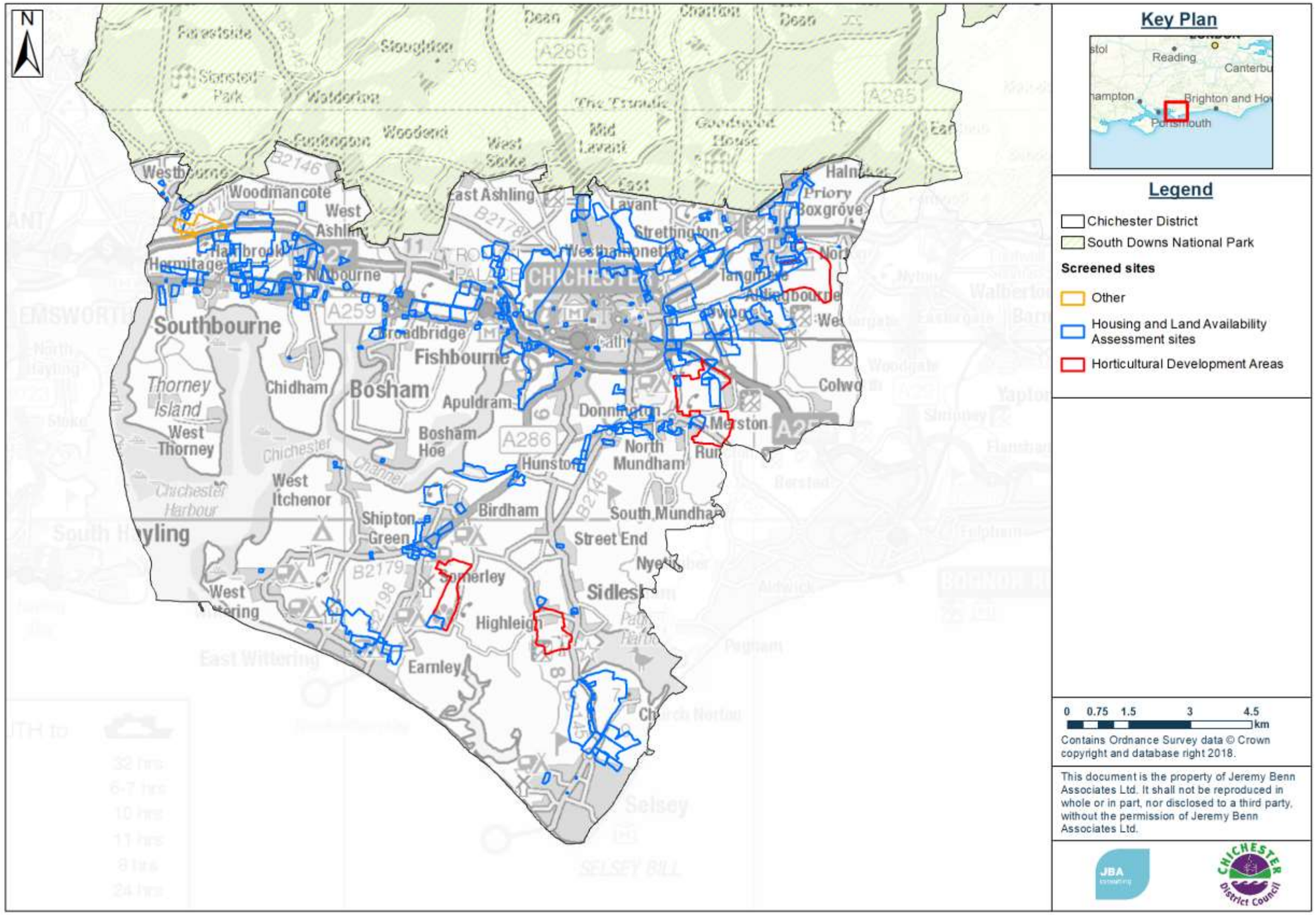


Figure 12-2: Southern sites screened



12.2 Overview of risk at identified sites

A summary of flood risk at each of the sites in light of the screening above is provided below:

- Flood Zone composition is varied across the sites. However, the majority of the sites have Flood Zone 1 comprising the largest proportion of the study area.
- 66 sites are partially located within Flood Zone 2
- 37 sites are partially located within Flood Zone 3a
- 31 sites are partially located within Flood Zone 3b
- 54 sites are predicted to be at risk from fluvial flooding in the future due to climate change
- 33 sites are predicted to be at risk from tidal flooding in the future due to climate change
- 20 sites intersect the Environment Agency's historic flood outlines.
- 216 sites are predicted to be at risk of surface water flooding
- 2 sites are predicted to be at risk from reservoir inundation
- 158 sites are predicted to have groundwater level which are either at or very near (0.025m of) the ground surface.

12.3 Sequential Testing

The SFRA does not include the Sequential Test of potential development sites, as this is described under separate cover. However, Appendix K summarises the flood risk to the potential development sites and provides evidence for usein the completion of the Sequential Test.

Inclusion of HELAA and HDA sites in the SFRA does not imply that development can be permitted without further consideration of the Sequential Test. The required evidence should be prepared as part of a Local Plan Review Sustainability Appraisal or alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan Review. The assessments undertaken for this SFRA will assist the Council in the preparation of the Sequential Test.

13 Summary

13.1 Overview

This Level 1 SFRA delivers a strategic assessment of all sources of flooding in the Local Plan area. It also provides an overview of policy and provides guidance or planners and developers.

The study area comprises the administration area of Chichester District, excluding the area covered by the South Downs National Park.

13.2 Sources of flood risk

13.2.1 Historic flooding

There have been several recorded flood incidents across the study area, from a combination of sources. The most notable flooding incidents occurred in 1974, 1993/1994, 2000, 2012 and 2013/2014.

Based on the West Sussex County Council historic incidents database and the Environment Agency's flood outline database there have been a number of fluvial floods in the Local Plan area including along the River Lavant, the Earnley Rife, River Ems, the Ham Brook, River Lox and River Kird.

Selsey and East Wittering have been susceptible to tidal flooding in the past and surface water flooding has been recorded throughout the Local Plan area.

Groundwater flooding has been recorded in Chichester, Emsworth, Wisbourough Green and Woodmancote.

13.2.2 Fluvial flood risk

There are several watercourses throughout the study area which are identified to contribute to fluvial flood risk. Flood Zone mapping and climate change mapping of the fluvial flood risk in the Local Plan area has been prepared as part of the Level 1 SFRA.

13.2.3 Tidal flood risk

The study area is bound by the English Channel to the south and as such there is a tidal flood risk. In addition, many of the river networks are tidally influenced. The combination of high tides and high river levels, can result in the tidal locking as the rivers are unable to discharge. There is also the possibility that tidal defences can fail or overtopped. The assessment of the 'residual' risk of defence failure should be considered on a site by site basis.

13.2.4 Coastal flood risk

Coastal erosion is a prominent process along much of the study area's coastline. Defences form an important aspect of the control of the physical coastline

13.2.5 Surface water flood risk

The Risk of Flooding from Surface Water (RoFSW) dataset shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas.

13.2.6 Groundwater flood risk

The JBA Groundwater Flood Map shows that a large proportion of the Chichester Local Plan area is at risk of groundwater flooding. The southern part of the study area is particularly vulnerable to groundwater flooding, with the city of Chichester and surrounding towns being the most vulnerable areas.

The south of the Local Plan area is at particularly high risk due to the chalk valleys feeding from the South Downs. Rain can infiltrate the chalk through large fissures into the underlying aquifers and is released slowly though springs further downstream in the Local Plan area. The River Ems and Bosham Stream are particularly sensitive to groundwater levels as they are fed by the chalk springs to the south of the South Downs.

13.2.7 Sewer flood risk

Historical incidents of sewer flooding are detailed by the Southern Water SIRF. This database records incidents of flooding relating to public foul, combined or surface water sewers and identifies which postcode areas have suffered from flooding. A total of 110 incidents have been recorded.

The sewer flood risk in the Local Plan area is exacerbated by groundwater infiltrating into the sewer network and outfalls are constrained by the tide which can result in tide locking. In the coastal plains the sewer network relies upon pumping because of the very low relief.

13.2.8 Flooding from reservoirs

Outlines from the Risk of Flooding from Reservoirs dataset (informed from the National Reservoir Inundation Mapping (NRIM) study) show worst case inundation extents of five reservoirs impacting the Local Plan area.

13.3 Flooding from canals

There are two canals located in the Local Plan area, the Chichester Canal and the Wey and Arun Canal. There are no recorded incidents of breach or overtopping of canals within the study area

13.4 Flood defences

A high-level review of formal flood defences was carried out using existing information to provide an indication of their condition and standard of protection. Details of the flood defence locations and condition were provided by the Environment Agency for the purpose of preparing this assessment.

13.5 Key policies

There are many relevant regional and local key policies which have been considered within the SFRA, such as the CFMPs, RBMPs, the PFRA and LFRMS. Other policy considerations have also been incorporated, such as sustainable development principles, climate change and flood risk management.

13.6 Development and flood risk

The Sequential and Exception Test procedures for both Local Plan Reviews and FRAs have been documented, along with guidance for planners and developers. Links have been provided for various guidance documents and policies published by other Risk Management Authorities such as the LLFA and the Environment Agency.

14 Recommendations

A review of national and local policies has been conducted against the information collated on flood risk in this SFRA. Following this, several recommendations have been made for Chichester District Council to consider as part of Flood Risk Management in the study area.

14.1 Development management

14.1.1 Sequential approach to development

The NPPF supports a risk-based and sequential approach to development and flood risk in England, so that development is located in the lowest flood risk areas where possible; it is recommended that this approach is adopted for all future developments within the borough.

New development and re-development of land should wherever possible seek opportunities to reduce overall level of flood risk at the site, for example by:

- Reducing volume and rate of runoff through the use of SuDS, as informed by the **'Water, People, Places: A guide for master planning sustainable drainage into developments'** and Chichester District Council's **Surface Water and Drainage Supplementary Planning Document** (SPD) in the relevant wastewater treatment catchments.
- Relocating development to zones with lower flood risk
- Creating space for flooding
- GI should be considered within the mitigation measures for surface water runoff from potential development and consider using Flood Zones 2 and 3 as public open space
- Consideration must be given to the potential cumulative impact of development on flood risk.

14.1.2 Site-specific flood risk assessments

Site specific FRAs are required by developers to provide a greater level of detail on flood risk and any protection provided by defences and, where necessary, demonstrate the development passes part b of the Exception Test.

Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), inform development zoning within the site and prove, if required, whether the Exception Test can be passed. The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk. Any flood risk management measures should be consistent with the wider catchment policies set out in the CFMP, FRMPs and LFRMS.

It should be noted that the **UKCP18** was published on 26 November 2018. The UKCP18 projections replace the UKCP09 projections and is the official source of information on how the climate of the UK may change over the rest of this century. This may result in the Environment Agency climate change allowances being updated in 2019. When undertaking an FRA, please refer to the most up to date climate change allowances provided by the Environment Agency.

Developers should consult with Chichester District Council, West Sussex County Council, the Environment Agency and Southern Water at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling, and drainage assessment and design.

14.1.3 Sequential and Exception tests

The SFRA has identified that areas of the study area are at high risk of flooding from both fluvial and surface water sources. Therefore, it is expected that several proposed development sites will be required to pass the Sequential and, where necessary, Exception Tests in accordance with the NPPF. Chichester District Council should use the information in this SFRA when deciding which development sites to take forward in the Local Plan Review. It is the responsibility of Chichester District Council to be satisfied that the Sequential Test has been passed.

14.1.4 Council review of planning applications

The Council should consult the Environment Agency's '**Flood Risk Assessment: Local Planning Authorities**', last updated 15 April 2015, when reviewing planning applications for proposed developments at risk of flooding.

The Council will consult the relevant statutory consultees as part of the planning application assessment and they may, in some cases, also contact non-statutory consultees (e.g. Southern Water) that have an interest in the planning application.

14.1.5 Drainage strategies and SuDS

Planners should be aware of the conditions set by the LLFA for surface water management and ensure development proposals and applications are compliant with the Council's **Surface Water and Drainage Supplementary Planning Document** (SPD) for the relevant wastewater treatment catchment.

14.1.6 Cumulative impact of development and cross-boundary issues

The cumulative impact of development should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk

14.1.7 Residual risk

Residual risk is the risk that remains after mitigation measures are considered. The residual risk includes the consideration of flood events that exceed the design thresholds of the flood defences or circumstances where there is a failure of the defences, e.g. flood banks collapse. Residual risks should be considered as part of site-specific Flood Risk Assessments

Further, any developments located within an area protected by flood risk management measures, where the condition of those defences is 'fair' or 'poor', where the standard of protection is not of the required standard or where the failure of the intended level of service gives rise to unsafe conditions should be identified.

The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage. They should seek to contact the reservoir owner to obtain information and should apply the sequential approach to locating development within the site. Developers should also consult with relevant authorities regarding emergency plans in case of reservoir breach.

Any development within the vicinity of either of the canals flowing through the borough should consider the residual risk from the canal, including the possibility of breach. Consideration should be given to the potential for safe access and egress in the event of rapid inundation of water due to a breach with little warning.

14.1.8 Safe access and egress

Minimum finished floor levels for development should be above whichever is higher of the following:

- a minimum of 600mm above the 1% AEP fluvial event plus an allowance for climate change and an appropriate allowance for freeboard
- a minimum of 600mm above the 0.5% AEP tidal event plus an allowance for climate change and an appropriate allowance for freeboard
- 300mm above the general ground level of the site.

If it is not practical to raise floor levels to those specified above, consultation with the Environment Agency will be required to determine alternative approaches.

Safe access and egress will need to be demonstrated at all development sites. Emergency vehicular access should be possible during times of flood.

Where development is located behind, or in an area benefitting from, defences, consideration should be given to the potential safety of the development, finished floor levels and for safe access and egress in the event of rapid inundation of water due to a defence breach with little warning.

Resilience measures will be required if buildings are situated in the flood risk area, and opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought.

14.1.9 Future flood management

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted.

The information provided in the SFRA should be used as a basis for investigating potential strategic flood risk solutions within the study area. Opportunities could consist of the following:

- Catchment and floodplain restoration;
- Flood storage areas;
- Opening up culverts, weir removal, and river restoration;
- The Regional Habitat Creation Programme; and
- Green infrastructure.

For successful future flood risk management, it is recommended that local planning authorities adopt a catchment partnership working approach in tackling flood risk and environmental management.

14.2 Requirements for Level 2

This report fulfils Level One SFRA requirement. Following the application of the Sequential Test, where sites cannot be appropriately accommodated in Flood Zone 1, Chichester District Council may need to apply the NPPF's Exception Test. In these circumstances, a Level Two SFRA may be required, to consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

If a Level 2 Assessment is required, any updates to the Environment Agency's climate change allowances will be considered when preparing more detailed assessments of hazards and actual risks.

14.3 Technical recommendations

14.3.1 Potential modelling improvements

The Environment Agency regularly reviews its flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. The Environment Agency have confirmed that they are currently updating the Wey catchment and they should be approached if this will impact on an FRA.

14.3.2 Updates to SFRA

SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. This SFRA has been developed using the best available information, supplied at the time of preparation.

This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews its hydrology, hydraulic modelling and flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a site-specific FRA. It should be noted that the Environment Agency's Flood Zones, on their Flood Map for Planning website, may differ to the maps in the SFRA for a short period of time, whilst new modelling is incorporated into the Environment Agency's flood maps. Additionally, in time, the Flood Map for Planning website may be the most up to date for current day Flood Zones as the Environment Agency will update when any further modelling is undertaken in the Plan area and this may be before the SFRA is updated.

Other datasets used to inform this SFRA may also be periodically and following the publication of this SFRA, new information on flood risk may be provided by Risk Management Authorities.

APPENDICES

A SFRA appendix grid map

B Historic flooding

C Watercourses

D Fluvial and tidal Flood Zones

E Fluvial and tidal climate change flood risk map

F Surface water flood risk map

G JBA Groundwater Flood Map

H Reservoir inundation map

I Flood defences

J Flood Alert and Flood Warning Areas

K Level 1 site screening table

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SKIPTON
North Yorkshire
BD23 3AE
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
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Registered in England 3246693

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