Chichester District Council Level 2 Interim Strategic Flood Risk Assessment

Final Report

December 2022

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Chichester District Council

JBA Project Manager

Ffion Wilson BSc MSc PIEMA
35 Perrymount Road
Haywards Heath
RH16 3BW

Revision History

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Contract

This report describes work commissioned by Andrew Rushmer of Chichester District Council in an email dated July 2022, Abigail Betts, Amy Atkins, Emma Elwood, Ffion Wilson, Harriet Freestone, Libby Raines, Alastair Dale and Alexander Jones and of JBA Consulting carried out this work.

Prepared by ..... Abigail Betts BSc MSc
Analyst

..... Amy Atkins BSc MSc PhD AMIEnvSc
Analyst

..... Emma Elwood BSc (Hons) FdSc MCIWEM
Senior Analyst

..... Ffion Wilson BSc MSc PIEMA
Senior Analyst

..... Harriet Freestone BSc (Hons)
Senior Analyst

..... Libby Raines BSc
Technical Assistant

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

..... Alexander Jones BSc MSc CGeol FGS

Principal Analyst

Purpose

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Acknowledgements

We would like to acknowledge the assistance of:

- Chichester District Council
- Environment Agency
- Southern Water
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Executive summary

Introduction and context

This Level 2 Interim Strategic Flood Risk Assessment (SFRA) document was prepared with the purpose of providing part of the evidence base for the Local Plan. It follows on from the Chichester District Council Level 1 Interim SFRA update, completed in December 2022.

This report should be read alongside the Level 1 Interim SFRA published for Chichester District Council.

The 2022 Level 2 SFRA involves the assessment of six proposed development sites and contains updated details regarding flood data, legislation changes since the previous iteration of this report completed in 2018 and has recommendations for the cumulative impact of development.

On 25 August 2022 an updated Planning Practice Guidance (PPG) was published. In response to the substantive recent changes to the PPG Chichester District Council has resolved that an interim Level 2 SFRA report should be prepared to support the preparation of the Exception Test to inform the draft Local Plan and then produce a PPG compliant SFRA prior to the examination. This report is the interim Level 2 SFRA and PPG updates have been included where possible to support the application of the Exception Test. However, further modelling is required to be fully compliant with the PPG requirements. It is the intention that a final version of the Level 2 SFRA will be prepared and any necessary adjustments included so the latest PPG information is addressed.

SFRA Objectives

The Government's PPG on Flood Risk and Coastal Change advocates a tiered approach to risk assessment and identifies the Level 1 and Level 2 assessments.

The aim of the Level 2 assessment is to build on identified risks from Level 1 for proposed development sites, to provide a greater understanding of fluvial, surface water, groundwater, and reservoir related flooding risks to the sites. From this the Local Council and Developers can make more informed decisions and pursue development in an effective and efficient manner. The Level 2 assessment also identifies sites for further risk analysis at the site-specific Flood Risk Assessment (FRA) stage.

Level 2 SFRA outputs

The Level 2 assessment includes detailed assessments of the proposed site options. These include:

- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increase in fluvial and surface water flood risk due to climate change.
- Reporting on current conditions of flood defence infrastructure, where applicable.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff.
- Advice on whether the sites are likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA.

Summary of the Level 2 SFRA

Chichester District Council provided six sites for further assessment. These sites were screened against flood risk datasets to assess the potential viability and provide flood risk recommendations.

Summary tables were prepared for five of the sites where multiple sources of flood risk were assessed. For the sixth site, groundwater only was considered. The summary tables set out the flood risk to the site taking into account the potential benefit and residual risks from flood defences. Maps of extent, depth and velocity of flooding as well as hazard mapping have been produced where modelled outputs were available. The Risk of Flooding from Surface Water (RoFSW) mapping has also been used as an indication of flood risk for smaller watercourses where site-specific modelling does not exist.

Each table sets out the National Planning Policy Framework (NPPF) requirements for the site, as well as guidance for site-specific FRAs. A broadscale assessment of suitable SuDS options has been provided to give an indication of potential constraints to surface water drainage and where additional information may be required.

Groundwater is not covered within these summary tables. There is generally a potential risk of groundwater flooding across the study area, but there is no existing mapping or data that describes the magnitude of the risk. As such, a high-level overview of the risk of groundwater flooding has been carried out for each of the sites and this is described in Appendix C.

Site AL3- Land East of Chichester

- This site is partially within flood zone 2, but is afforded an appropriate standard of protection from risk of fluvial or coastal flooding in the design flood (1% plus climate change) when flood defences are taken into account.
- The Risk of Flooding from Surface Water mapping does not represent existing watercourses within the site boundary. Existing flow paths (ditches) should be retained and integrated into blue-green infrastructure and public open space.
- This initial assessment indicates that it is feasible to design a drainage system to suppress groundwater flooding. Such a design should be based on:
  - Groundwater monitoring,
  - Groundwater modelling to determine the spacing and sizing of drainage requirements,
  - Potential zoning of the site limit development in the lowest lying parts of the site.
  - A long term commitment to control water levels in the lake to the south of the allocation so groundwater flood risk is appropriately addressed.
- This assessment does not consider underground structures such as basements.
- On the basis of the assessment it is considered that the principle of development can be supported at the site, taking a sequential approach to flood risk and developing in the areas at the lowest risk of flooding. To address potential climate change effects an evaluation should be performed of how long term changes in mean sea level could affect the performance of local watercourse systems so consideration can be given to the arrangements and commitment to water level management in local watercourses.

Site AL5-Southern Gateway

- The site is situated in the centre of the City of Chichester and consists of mixed previously developed and undeveloped land. The proposed development is more and less vulnerable development.
- The site is shown within flood zones 2 and 3 on the Flood Map for Planning due to the risk of flooding from the River Lavant in the undefended scenario. Part two of the Exception Test will therefore need to be considered if the requirements of the Sequential Test can be met.

- The site is defended from fluvial flooding by the River Lavant Flood alleviation Scheme, which diverts flows from the River Lavant into the Flood Relief Channel. The scheme provides a 100-year present day Standard of Protection to the site
- The site is at risk of flooding in all modelled climate change scenarios (25% (central), 36% (higher central) and 64% (upper end)).
- For a 1% AEP plus 25% climate change defended scenario, the south-east portion of the site is flooded to a shallow depth up to 0.3m, with hazard mainly classed as 'low hazard,' with small areas as 'danger for some' and 'danger for most.'
- For a 1% AEP plus 35% climate change defended scenario, the south-east portion of the site is also flooded, although this is to a deeper 0.4m, with hazard mainly classed as 'low hazard,' with small areas as 'danger for some' and 'danger for most.'
- Finally, for a 1% AEP plus 64% climate change defended scenario, the south-east portion of the site is also flooded to a 0.6m depth, with hazard mainly classed as 'low hazard,' with small areas as 'danger for some' and 'danger for most.'
- The site is therefore not considered to be flood free in the design event. A sequential approach to development should be taken, concentrating the most vulnerable usage categories in the west of the site where the risk of fluvial flooding is lower. To maintain the existing standard of protection an appropriate commitment will have to be made to the maintenance and management of the River Lavant FAS or alternative provision made so the development is safe for the intended life.
- Blockage scenarios were modelled on the River Lavant at Market Avenue culvert and Needlemakers culvert. Flooding in the 1% present day flood with a 40% blockage did not show flooding to the site, however a 70% blockage at the Needlemakers culvert resulted in flooding to the north of the site which is not present in any other modelled scenarios.
- Measures to reduce the future risk of flooding should be considered at the strategic and individual property level to reduce the risk of flooding in the future due to climate change.
- This initial assessment indicates that overall, the risk of groundwater flooding on site is negligible. It should be noted that this assessment does not consider underground structures such as basements, which may disrupt groundwater flow on a localised scale.
- SuDS techniques should be utilised with a reduction in peak runoff rates to greenfield rates wherever possible or 50% of existing brownfield rates.
- In view of the topographic elevation and location of the site it is unlikely that local groundwater flow or flood risk will be affected by long term changes in mean sea level. However, it is possible that long term changes in mean sea level could affect the performance of local watercourse systems and so consideration will need to be given to the arrangements for water level management as affects local watercourses.
- On the basis of the assessment it is considered that the principle of development can be supported at the site, taking a sequential approach to flood risk and developing in the areas at the lowest risk of flooding.

- **Site HWH0014-Land north of Maudlin Farm**
- This site is entirely in flood zone 1 and therefore is considered to be at very low actual risk of flooding from Main rivers or the sea.
- Areas to the south and north east of the site are shown to be at risk of flooding in the 30-year surface water flood. This corresponds to the location of a pond to the south of the site and a watercourse adjacent to the north east corner of the site.

- The generalised modelling methodology used for the Risk of Flooding from Surface Water mapping means that the channel and the culverts under Stane Street and the A27 are not well defined. Site specific modelling of the watercourse is recommended to determine the extents of flood zone 2 and 3 within the site boundary and to set appropriate finished floor levels.
- Safe access and egress from the site is likely to be possible for the 100-year fluvial event, however flooding is possible on roads into Chichester from the site.
- Over 80% of the site is considered to be at very low risk of fluvial or surface water flood risk. The position and extent of the potential flooding is not likely to impact on the overall viability of the site.
- This initial assessment indicates that it is feasible to design a drainage system to suppress groundwater flooding. Such a design should be based on:
  - Groundwater monitoring,
  - Groundwater modelling to determine the spacing and sizing of drainage requirements,
  - Potential zoning of the site limit development in the lowest lying parts of the site (i.e. close to the existing pond).
  - A long term commitment to controlling water levels in the pond.
  - This assessment does not consider underground structures such as basements.
- On the basis of the assessment it is considered that the principle of development can be supported at the site, taking a sequential approach to flood risk and developing in the areas at the lowest risk of flooding.

Site AL6- Land south of Bognor Road

- This site is entirely in flood zone 1 and therefore is considered to be at very low actual risk of flooding from Main rivers or the sea.
- A flow route is shown within the boundary of the site within the 1000-year surface water modelled flood in the south west corner of the site. It is unclear from the available data whether the flow route corresponds to an existing ditch. Flood depths are predicted to be less than 600mm at any location within the site boundary.
- Over 90% of the site is considered to be at very low risk of fluvial or surface water flood risk. The position and extent of the potential flooding is not likely to impact on the overall viability of the site.
- This initial assessment indicates that it is feasible to design a drainage system to suppress groundwater flooding. Such a design should be based on:
  - Groundwater monitoring
  - Groundwater modelling to determine the spacing and sizing of drainage requirements
  - Potential zoning of the site limit development in the lowest-lying parts of the site.
  - This assessment does not consider underground structures sure as basements.
- On the basis of the assessment it is considered that the principle of development can be supported at the site, taking a sequential approach to flood risk and developing in the areas at the lowest risk of flooding.

Site HSY0010B- Land West of Park Farm, Selsey

- This site is entirely in flood zone 1 and therefore is considered to be at very low actual risk of flooding from Main rivers or the sea.

- Less than 10% of the site is at risk of flooding in the 1000-year surface water modelled flood. The mapping shows isolated areas of ponding and does not show any flow routes through the site
- The wider area is considered to be a dry island, as the main road from Selsey (B2145) is at risk from flooding at Pagham Harbour. Depths of flooding in the 200-year present day event of the B2145 is considered as hazardous for some.
- This initial assessment indicates that overall, the risk of groundwater flooding on site is negligible. It should be noted that this assessment does not consider underground structures such as basements. However, as this is a low lying location on the coastal flood plain the potential effects of rise in mean sea level could be influential with respect to the performance of local drainage systems, water level management and groundwater flood levels. Accordingly, it would be appropriate that these matters were addressed when assessing flood risk at the site.

Site AL7 – Highgrove Farm

The main flood risk to the site is considered to be from groundwater. Therefore, only a groundwater assessment was undertaken for this site.

- There is an area of high and moderate groundwater flood risk in the south of the site is underlain by chalk, that receives flow from a large groundwater catchment. Simple on-site mitigation may not be possible to mitigate groundwater flood risk in this area. The area to the north has negligible groundwater flood risk due to the underlying geology. The site could be zoned to avoid development in the high-risk area, however ongoing monitoring and site investigation would be required to confirm the boundaries of these zones.
- To address the requirements with respect to drainage and control of water levels the following matters should be addressed:
  - Groundwater monitoring
  - Groundwater modelling to determine the spacing and sizing of drainage requirements
  - Potential zoning of the site limit development in the lowest-lying parts of the site.
  - A long term commitment to control water levels in the adjacent lakes so groundwater flood risk is appropriately addressed.
- This assessment does not consider underground structures sure as basements.
- To address potential climate change effects an evaluation should be performed of how long term changes in mean sea level could affect the performance of local watercourse systems so consideration can be given to the arrangements and commitment to water level management in local watercourses.
- On the basis of the assessment, it is considered that the principle of development can be supported at the site, taking a sequential approach to flood risk and developing in the areas at the lowest risk of flooding.

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Abbreviations and Definitions

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability – The probability (expressed as a percentage) of a flood event occurring in any given year.
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CIA	Cumulative Impact Assessment
CIRIA	Construction Industry Research and Information Association
Defra	Department for Environment, Food and Rural Affairs
Design Flood	The flood scenario which is used to determine whether internal flooding to development would occur. It is also used to set design criteria for flood resilience and resistance measures such as Finished Floor Levels.
Dry Island	An area which does not flood in the design event, but is surrounded by flood water.
EA	Environment Agency
EU	European Union
Exception Test	The method set out in the NPPF used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; designed to a specific standard of protection (design standard).
Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea)

	is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
FWA	Flood Warning Area
FWMA	Flood and Water Management Act: Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a River
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
Greenfield	Undeveloped parcel of land
Ha	Hectare
JBA	Jeremy Benn Associates
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
m AOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRD	National Receptor Database
NVZs	Nitrate Vulnerability Zones
Ordinary Watercourse	All watercourses that are not designated as Main River on the statutory main river map.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
RBMP	River Basin Management Plan
ReFH	Revitalised Flood Hydrograph
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and

	businesses; could include flood guards for example.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
Riparian owner	A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
RMA	Risk Management Authority - Operating authorities who's remit and responsibilities concern flood and/or coastal risk management.
RoFSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW)
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SPZ	(Groundwater) Source Protection Zone
Stakeholder	A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
SWDS	Surface Water Drainage Strategy
SWMP	Surface Water Management Plan - The SWMP outlines the preferred surface water management strategy and identifies the actions, timescales and responsibilities of partner organisations.
WFD	Water Framework Directive
Winterbourne	A groundwater fed watercourse which may only run at times when the groundwater table is high.

1 Introduction

Chichester District covers an area of approximately 811km² comprising of 58 parish or town council areas. and has an estimated population of 121,000. The city of Chichester is the largest settlement in the district with a population of circa 23,700. Other sizeable towns include Selsey, Midhurst and Petworth.

Two major river catchments characterise Chichester District Council's area:

- The River Rother flows through from west to east near the towns of Midhurst, Petworth and Fittleworth before joining the River Arun. The River Arun then flows in a southerly direction, forming the eastern border of the district in some areas.
- The River Lavant, a winterbourne stream, flows through Chichester into the Fishbourne channel. The River Lavant Flood Alleviation Scheme (FAS) diverts water at Westhampnett Mill into the relief channel to the east of the city, before discharging into the Pagham Rife.

1.1 Purpose of the Strategic Flood Risk Assessment

The following text has been taken from the National Planning Policy Framework, paragraph 160:

"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."

This Interim SFRA report provides a Level 2 assessment of strategic sites identified for potential allocation within the Chichester District and was prepared in accordance with the 2021 National Planning Policy Framework (NPPF) and as far as practically possible the 2022 Planning Practice Guidance (PPG).

This report should read alongside the Interim Level 1 SFRA published for Chichester District Council in 2022. The content of the Interim Level 2 SFRA builds on the information presented in the 2022 Level 1 SFRA.

1.2 Levels of SFRA, Planning Policy Guidance

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 in relation to potential development sites and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- Level Two: where land outside of flood risk areas 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 risk area and should include all sources of flooding.

1.3 SFRA objectives

The objectives of this 2022 Level 2 SFRA are to:

- Assess the flood risk to proposed sites using the latest available flood risk data and climate change uplifts where available
- Provide information and mapping to show flood risk from all sources for each site option.
- Provide recommendations for making the site safe from flooding throughout its lifetime where the Exception Test is required
- Take into account, as far as practically possible the most recent policy and legislation in the NPPF, PPG and LLFA SuDS guidance.

- Provide further assessment of cumulative development impacts on high risk catchments as indicated in the Level 1 SFRA.

1.4 Consultation

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to Chichester District Council) have been consulted during the preparation of this SFRA:

- Adur and Worthing Council
- Arun District Council
- Chichester Harbour Conservancy
- East Hampshire Council
- Environment Agency
- Hampshire County Council
- Havant Borough Council
- Horsham District Council
- Natural England
- South Downs National Park Authority
- Southern Water
- Surrey County Council
- Waverley Council
- West Sussex County Council

1.5 National Plan Policy and Guidance

The Revised National Planning Policy Framework (NPPF) was updated in July 2021. 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.

1.6 Flood Risk and Coastal Change (PPG)

An updated version of the PPG guidance was published in August 2022. This advises on 'how to take account of and address the risks associated with flooding and coastal change in the planning process'. The guidance outlines the steps required when preparing strategic policies. Further details regarding the PPG can be found in the Level 1 SFRA.

1.7 The Sequential Test

The Sequential Test aims to ensure that areas of little or no flood risk are prioritised for development over areas at a higher risk of flooding. This means areas at a medium or high risk of flooding from any source, now or on the future should be avoided for development where possible.

1.8 The Exception Test

It may not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required.

The Exception Test should only be applied following the application of the Sequential Test. It applies in the following instances, where it is not possible for development to be located in areas with a lower risk of flooding:

- More vulnerable in Flood Zone 3a
- Essential infrastructure in Flood Zone 3a or 3b
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)
- Locations where surface, groundwater, sewer or reservoir flood risk materially affect the safety of proposed development or where development proposals potentially affect existing land or property.

1.9 Use of SFRA data

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, the sea, surface water and groundwater and, where available, the potential effects of future climate change.

Datasets used to inform this SFRA may be updated following the publication of this SFRA and new information on flood risk may be produced by Risk Management Authorities. This new information (such as updated mapping and modelling) may supersede the information included in this SFRA. Guidance should be sought from West Sussex County Council, the Environment Agency and Chichester District Council as appropriate to check the most up to date source of information is used for future flood risk assessment.

2 Data sources

The main aim of the Level 2 SFRA is to provide an overview of the actual flood risk affecting development included in the Local Plan Review. In this context, actual flood risk is defined as the predicted flooding expected including with the effect of flood defences and other flood risk management measures in place. The following section outlines sources of data used and categorisation criteria for different sources of flood risk. Mapping of all flood risks is included in Appendix B of this report.

Defended scenarios from hydraulic modelling of rivers and the sea are used for the determination of actual risk to sites and therefore form the basis of the detailed Level 2 assessment for flood depth, velocities and hazard. This includes the River Lavant modelling for the city of Chichester, and tidal modelling for Selsey.

For areas that are partially affected by flood risk it is possible that development can be implemented in line with guidance by using a sequential approach. This involves incorporating the less vulnerable aspects of the development (according to the Environment Agency's flood risk vulnerability classification) in the areas at risk of flooding.

2.1 Flood Zones

Flood Zones 2 3a and 3b (functional floodplain) have been taken from the Flood Zones derived in the Level 1 SFRA, which incorporated the Environment Agency's Flood Map for Planning. These undefended scenarios are used to determine whether the site would be Sequentially acceptable and in circumstances where there are no defences they also describe the actual flood risk. The exception to this approach is where the defended and undefended Arun to East Head coastal model extents have been combined to delineate the flood zones. Please see the Level 1 SFRA for more details.

2.2 Flood defences

For sites where existing flood defences provide a reduction in the flood risk to the site, it is important to understand the standard of protection these structures and measures provide. It is also necessary to understand how this level of protection changes over time, considering the implications of climate change.

If flood defences are required to protect a development site, evidence will be required to show that the new development does not adversely impact and increase flood risk to other areas, for example that there is no net loss in floodplain storage in circumstances where this is a material consideration. It will need to be established that these defences can be appropriately managed and maintained during the lifetime of the development. In some cases it will be a requirement to demonstrate that there is an appropriate level of commitment to the maintenance of the standard of protection afforded by existing defences, where reliance is placed on the standard they provide.

Current flood defences have been taken from the Environment Agency's Asset Information Management System (AIMS) Spatial Defences data set. Their current condition and standard of protection are based on those recorded in the tabulated shapefile data. The Council's asset register was also obtained in the Level 1 SFRA.

2.3 Flooding from rivers

The JBA 2018 1D-2D Chichester Lavant Model Update was commissioned by the Environment Agency to update the Chichester Hazard and ABD Mapping Study (2010) and includes the River Lavant Flood Alleviation Scheme.

It is noted that this modelling study focuses on the Lavant and therefore does not necessarily schematise smaller channels. For smaller channels, the Risk of Flooding from Surface Water mapping can provide an indication of the flood risk, but this is not exhaustive or site-specific enough to be used for site specific FRAs where site layouts will need to be considered. Additional information requirements have been outlined in the site summary tables where this is the case.

Structure blockage scenarios were completed at two locations for 40%, 60% and 70% blockage which forms the basis for fluvial residual risk scenarios in this area.

Results from the River Lavant modelling study have been used in the assessment of the following sites.

- AL3- Land East of Chichester
- AL6- Land south of Bognor Road
- AL5-Southern Gateway
- HWH0014-Land north of Maudlin Farm

2.3.1 River Lavant FAS

The River Lavant FAS is an important consideration for the sites affected by drainage and flood risk along the River Lavant and Pagham Rife. The FAS was completed in 2000 in response to the flood of 1993-1994 and includes a diversion which takes excess flows out of the river at Westhampnett, via a series of tunnels and gravel pits into a diversion channel that discharges into Forebridge Rife and then Pagham Rife. A schematic of part of the scheme is shown in Figure 2-1.

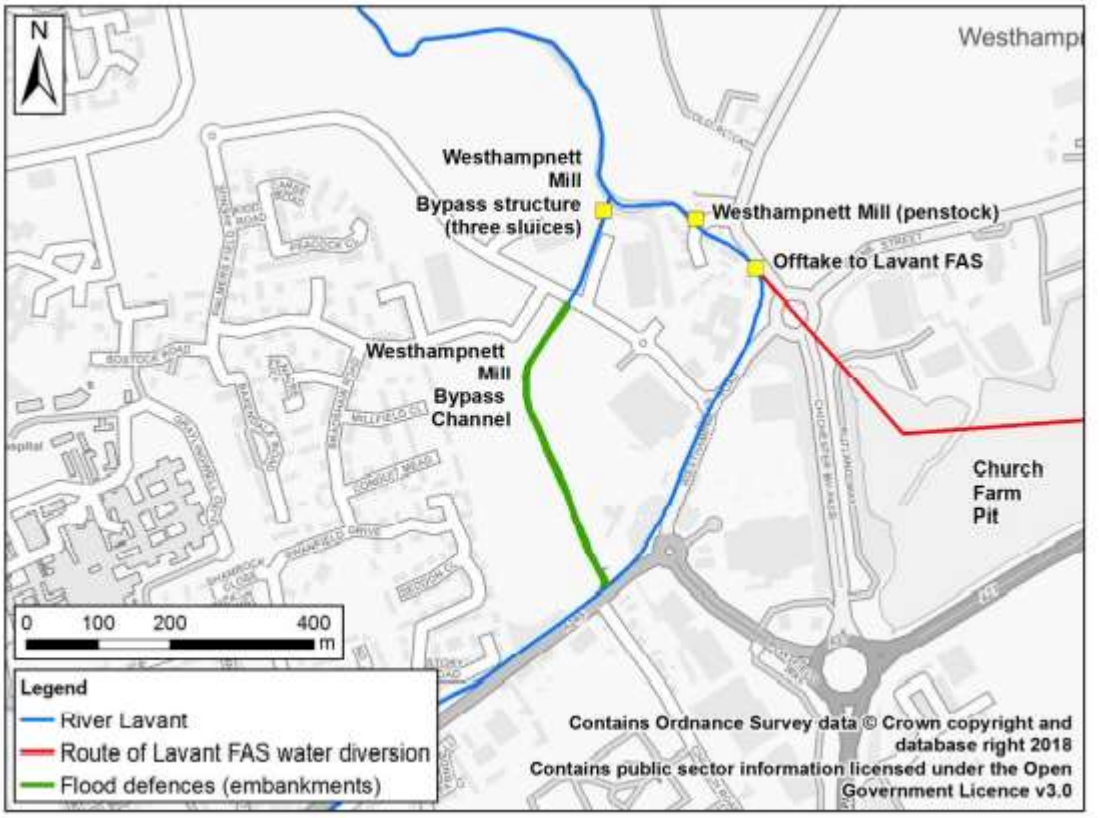

Figure 2-1: Schematic of the modelled FAS (JBA River Lavant Modelling Update Study 2018)

The Westhampnett Mill Bypass Control Structure comprises of three sluice gate which are open during flood events and control the flow going through the loop channel around the Mill (Figure 2-2). A single penstock at Westhampnett Mill is operated during periods of raised flow to manage the distribution of water through the system (Figure 2-3).

Figure 2-2: Westhampnett Mill Bypass Control Structure

Figure 2-3: Penstock at Westhampnett Mill

The modelling shows that diversion of flood water to the FAS occurs in the 20% AEP (5-year) event and above and diverts up to 4m3/s into Church Farm Pit.

2.3.2 Impact of climate change on fluvial flooding

Climate change is expected to increase the peak flows of rivers, meaning that flows which were previously thought to be extreme will now be considered far more possible. Areas benefiting from flood defences will find the standard of protection changes over time, overtopping of defences more likely unless they are upgraded.

Peak river flow climate change allowances for the Chichester District (Arun and Western Streams Management Catchment) are displayed in

Table 2-1.

Table 2-1: 2021 Peak river flow allowances for the Arun and Western Streams Management Catchments

Allowance category	Total potential change anticipated for '2020s' (2015-2039)	Total potential change anticipated for '2070s' (2040-2069)	Total potential change anticipated for '2070s' (2061-2115)
Upper End	27%	36%	64%
Higher Central	16%	19%	36%
Central	11%	13%	25%

The increased risk of flooding due to climate change has also been included in the assessment. For the River Lavant, modelling of the 1% AEP (100-year) plus 25%, 35% and 64% climate change allowances form the basis of fluvial climate change estimates.

2.4 Flooding from the sea

Whilst most of the sites considered in this Level 2 SFRA are upstream of the tidal extent and therefore not at risk of flooding from the sea, site HSY0010B- Land West of Park Farm is situated in Selsey on the Manhood Peninsula. Generally, the land on the Manhood Peninsula is potentially at high risk of flooding as it is less than 5m above sea level[1], although the site levels at HSY0010B are generally above this level. The risk is also potentially from a combination of fluvial, coastal and groundwater sources along with inadequate existing ditches.

The base model used for coastal modelling is the SWAN wave transformation model developed for the Environment Agency Emsworth to Littlehampton West Bank Coastal Modelling which was updated by JBA in 2022. The coastal and tidal flood risk was assessed using a 2D hydrodynamic 2D TUFLOW model.

The model uses defended schematisations created for the base model to update the model with coastline changes such as new walls and embankments from the Environment Agency's AIMS database (August 2021). For the undefended scenarios the following changes were made:

- Raised walls and defences were lowered
- Roughness coefficients were adjusted to represent the removal of stepped revetments and rock armour
- Slope angles were lowered to represent the removal of vertical slopes following the removal of structures.
- Tidal boundaries were updated to use the extreme still water level estimates from the latest Coastal Flood Boundary Dataset (2018) which provide a baseline year of 2017.

2.4.1 Impact of climate change on sea levels

The influence of the change to mean sea level as a consequence of climate change effects is particularly important for these watercourses in their lower reaches, as this will contribute

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

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).

The **Environment Agency's sea level allowances**[2] have been used in the preparation of this report as confirmed by the Environment Agency (Table 2-2). In situations where it is appropriate to apply the credible maximum scenario, the H++ allowance for sea level rise to 2100 should be used, this represents an increase of 1.9m plus 2mm of surge per year from 2017 to 2100.

Table 2-2: Peak sea level allowances for South East (1981 to 2000 baseline)

Allowance category	Annual sea level rise allowance 2000 to 2035	Annual sea level rise allowance 2036 to 2065	Annual sea level rise allowance 2066 to 2095	Annual sea level rise allowance 2096 to 2125	Cumulative rise 2000 to 2125
Higher central	200mm	261mm	348mm	393mm	1.20m
Upper end	242mm	339mm	474mm	546mm	1.60m

Sea levels were updated in the Emsworth to Littlehampton model update (2022) to account for sea level rise to the years 2021, 2091, 2100 and 2121. The sea level rise for each epoch are outlined in Table 2-3.

Table 2-3: Modelled sea level rise (JBA Emsworth to Littlehampton model update 2022- 2017 baseline)

UKCP18 Grid square	2021	70th Percentile		95th Percentile		H++
		2091	2121	2091	2121	
714	0.026	0.648	0.852	1.039	1.397	2.07
713	0.026	0.648	0.853	1.039	1.397	2.07
712	0.026	0.648	0.853	1.039	1.397	2.07
711	0.026	0.648	0.853	1.039	1.397	2.07

The coastal modelling studies were updated with the latest climate change allowances for the years 2091 and 2121. The following scenarios have been run for climate change:

- 0.5% AEP event for 2091 with the Higher Central allowance
- 0.5% AEP event for 2091 with the Upper End allowance
- 0.5% AEP event for 2121 with the Higher Central allowance
- 0.5% AEP event for 2121 with the Upper End allowance
- 0.5% AEP event for 2121 with the H++ allowance

2 Flood risk assessments: climate change allowances – sea level allowances. Environment Agency. (2016, updated 2020) https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#sea-level-allowances

In the defended scenarios, the presence of the defences reduces the volume of floodwater that can flow back to sea and the increased volumes behind the defences result in more extensive inland inundation.

2.4.2 Coastal and tidal defences

The **Pagham to East Head coastal defence strategy** recommends the option for the coastline along Selsey is hold the line – sustain. 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

The majority of coastal and tidal defences provide a standard of protection against an event with an annual probability of at least 5% AEP. The defences at Pagham Harbour, provide a standard of protection against a 1% AEP and 0.5% AEP flood event. These defences are important for the consideration of safe access and egress from Selsey.

Defences to the east of Selsey are noted to not currently provide a standard of protection according to the EA's dataset. Defences to the west of Selsey do not provide any protection against flood events with the exception of a section of the beach noted to provide protection against a 0.1% AEP event and the Medmerry Scheme on this section of coastline providing protection against a 0.33% AEP event.

2.5 Surface Water

The Risk of Flooding from Surface Water (RoFSW) mapping dataset shows potential extent, depth and flooding hazard for the 30-year, 100-year and 1000-year events. The mapping uses generalised assumptions on the performance of local drainage systems and no particular no flood defences for surface water flooding have been identified or included in the consideration of the protection to any of the sites assessed in this Level 2 SFRA.

2.5.1 Impact of climate change on surface water flooding

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 potential impacts of surface water plus climate change may need to be considered at site-specific assessment stage.

For the Level 1 Interim SFRA, mapping for both the 1% AEP and 3.3% AEP events for the 2070s epoch were produced. Values for the 2070s epoch for the Arun and Western Streams as shown in Table 2-4 were applied as these values are higher than those for the Wey and tributaries catchment.

Table 2-4: Peak rainfall intensity allowance for the Arun and Western Streams management catchments

	Allowance category	Total potential change anticipated for '2050s' (up to 2060)	Total potential change anticipated for '2070s' (2061-2125)
3.3% annual exceedance rainfall event	Upper End	35%	40%
	Central	20%	25%
1% annual exceedance rainfall event	Upper End	45%	45%
	Central	20%	25%

The Environment Agency's Risk of Flooding from surface water model was re-run by JBA for the Level 1 Interim SFRA with the following climate change allowances:

- 3.3% AEP (30-year) plus 40%
- 1% AEP (100-year) plus 45%

2.6 Groundwater

Large areas of the Chichester District are potentially at risk of groundwater flooding. Areas in the south of the district are 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 and therefore needs close consideration for sites close to the South Downs chalk escarpment. Other mechanisms that can increase risk include the flooding induced in alluvial strata during periods when there are high water levels in the watercourses and the groundwater flows in coastal flood plain alluvial during high tide periods. It is understood from Southern Water that high groundwater levels in the district are of concern as they contribute to the risk of pollution, even from new developments, as infiltration to the sewerage network potentially overloads the system could affect designated conservation sites. As such, a high-level overview of the risk of groundwater flooding has been performed for each site as described in Appendix C. The datasets used are outlined in each assessment.

2.6.1 Impact of climate change on groundwater flood risk

The impact of climate change is more uncertain for groundwater flooding associated with rivers and land catchments and those watercourses where groundwater has a large influence on winter flood flows than other channels and surface water. Changes would depend on the flooding mechanism, historic evidence of known flooding and geological characteristics.

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.

In the coastal flood plain it is possible that the rise in mean sea level could affect the influence of groundwater and affect the capacity of watercourse and drainage systems. Accordingly in circumstances where such effects could be material over the lifetime of development more detailed assessment should be performed to identify and address any matters that could affect the normal use of proposed development.

2.7 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been identified from the Environment Agency's **Long Term Flood Risk Information website**.

The EA online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975).

None of the sites assessed in this Level 2 SFRA are shown to be at residual risk of flooding from reservoirs included in the Environment Agency mapping.

2.8 Flood warning

Flood Warning Areas and Flood Alert Areas are represented by the Environment Agency's Flood Warning Area GIS dataset.

2.9 Residual risk

The residual flood risk to sites is identified as where potential blockages or overtopping/ breach of defences could result in the inundation of a site, with the sudden release of water with little warning.

Residual risk from breaches to flood defences, whilst rare, needs to be considered in Flood Risk Assessments. Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches.

There are a number of formal fluvial and coastal defences located within the study area. The flood risk at several potential sites identified within the Local Plan area could be influenced by the presence of these defences, particularly sites in Selsey and those located near to the River Lavant in Chichester. At these locations it will be important to understand the benefit that defences can have on reducing flooding, and consequences if their design standard is exceeded or they fail. Residual risk of these defences should be understood and managed. Maintenance arrangements, including funding mechanisms, for the defences will need to be evidenced for the lifetime of development.

2.10 Depth, velocity and hazard to people

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people during the defended fluvial 100-year (1% AEP) plus climate change (Central/ Higher Central) flood event, because the Level 2 assessment helps inform the Exception Test and usually flood mitigation measures and access/ egress requirements focus on flood events lower than the 1,000-year event (0.1% AEP) (e.g. the 100-year plus climate change event).

Where detailed model outputs were available, i.e. for the river Lavant, the 100-year plus climate change depth, velocity and hazard data has been used. This data is only present where models have a 2D element, representing the floodplain in detail.

In the absence of detailed hydraulic models (or models with detailed 1D-2D outputs), the Risk of Flooding from Rivers and Sea dataset has been used, as well as the Risk of Flooding from Surface Water datasets. The depth, hazard, and velocity of the 100-year surface water flood event has also been mapped and considered in this assessment

Hazard to people has been calculated using the below formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in Table 2-5. Developers should also test the impact of climate change depths, velocities, and hazard on the site, at Flood Risk Assessment stage.

Table 2-5: Defra FD2321/TR2 Flood Risks to People classifications

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Very Low Hazard	< 0.75	Flood zone with shallow flowing water or deep standing water"
Danger for some (i.e. children)	0.75 - 1.25	"Danger: flood zone with deep or fast flowing water"
Danger for most	1.25 - 2.00	Danger: flood zone with deep fast flowing water"
Danger for all	>2.00	"Extreme danger: flood zone with deep fast flowing water"

As part of a site-specific FRA, developers will need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood depth, velocity and hazard based on the relevant 100-year plus climate change event, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all this information is known at the strategic scale.

2.11 SuDS suitability

The hydraulic and geological characteristics of each site were assessed to determine the constraining factors for surface water management. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

The assessment is based on catchment characteristics, British Geological Survey (BGS) mapping and onshore borehole data available online. LIDAR data was used as a basis for determining the topography and average slope across each development site. Other datasets were used to determine factors such as potential water quality and flood constraints, including:

- Historic landfill sites
- Groundwater Source Protection Zones
- Nitrate Vulnerable Zones
- Detailed River Network
- Risk of Flooding from Surface Water mapping
- Flood Map for Planning- flood zones

SuDS in Chichester District should be designed in accordance with the **West Sussex Lead Local Flood Authority (LLFA) policy for the management of surface water** and guidance **Water, People, Places- A guide for master planning sustainable drainage into developments**

3 Level 2 site assessment

3.1 Site summary tables

Site summary tables are included for five sites in Appendix A including recommendations for further evaluation and management of flood risk at each of the sites. An overview of the flood risk and recommendations for management of flooding when development is brought forward is included as follows.

Notwithstanding the recommendations of this Level 2 SFRA, site-specific assessments will need to be undertaken in accordance with the latest policy, guidance and flood risk, defence information and information in the SFRA. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), to inform the sequential approach within the site and demonstrate, as required that the Exception Test is satisfied.

The site summary tables have not included an assessment of groundwater flood risk as this has been performed separately and can be found in Appendix C and a short summary can be found in Section 3.2. The following summarises the results of the assessment for river and sea flooding

Site AL3- Land East of Chichester

- This site is partially within flood zone 2, but is not considered to be at risk of fluvial or coastal flooding in the design flood (1% plus climate change for rivers and 0.5% plus climate change for the sea) when flood defences are taken into account
- The Risk of Flooding from Surface Water mapping does not represent existing watercourses within the site boundary. Existing flow paths (ditches) should be retained and integrated into blue-green infrastructure and public open space.
- On the basis of the assessment the principle of development is supported at the site, taking a sequential approach to flood risk and developing in the areas at the lowest risk of flooding
- As it is possible that long term changes in mean sea level could affect the performance of local watercourse systems consideration will need to be given to the arrangements for water level management as affects local watercourses and water features.

Site AL5-Southern Gateway

- The site is situated in the centre of the City of Chichester and consists of mixed previously developed and undeveloped land. The proposed development is more and less vulnerable development.
- The site is shown within flood zones 2 and 3 on the Flood Map for Planning due to the risk of flooding from the River Lavant in the undefended scenario. Part two of the Exception Test will therefore need to be considered if the requirements of the Sequential Test can be met.
- The site is afforded protection from fluvial flooding by the River Lavant Flood alleviation Scheme, which diverts flows from the River Lavant into the Flood Relief Channel. The scheme provides a 100-year present day Standard of Protection to the site.
- The site is at risk of flooding in all modelled climate change scenarios (25% (central), 36% (higher) and 64% (upper)).
- In the 25% climate change scenario maximum flood depths within the site are in the Low Row Lane area, with flooded depths up to 1m. with no flooding in the western half of the site. As a result, the flood hazard is highest in this area with danger for most recorded in this area, which is currently undeveloped and Chichester High School.

- In the 65% climate change scenario, the extent of flooding is marginally increased compared to other climate change scenarios The maximum hazard rating within the site is danger for most, with a greater area of the site up to Kingsham Road included within this category.
- Consideration must be given to the measures required so that the development is safe for the intended life. A sequential approach to development should be taken, concentrating the most vulnerable usage categories in the west of the site where the risk of fluvial flooding is lower. The commitment required to contribute to improve the existing general standard of defence should be secured when development proposals are brought forward.
- Blockage scenarios were modelled on the River Lavant at Market Avenue culvert and Needlemakers culvert. Flooding in the 1% present day flood with a 40% blockage did not show flooding to the site, however a 70% blockage at the Needlemakers culvert resulted in flooding to the north of the site which is not present in any other modelled scenarios. SuDS techniques should be utilised with a reduction in peak runoff rates to greenfield rates wherever possible or 50% of existing brownfield rates.As it is possible that long term changes in mean sea level could affect the performance of local watercourse systems consideration will need to be given to the arrangements for water level management as affects local watercourses and water features.

Site HWH0014-Land north of Maudlin Farm

- This site is entirely in flood zone 1 and therefore is considered to be at very low risk of flooding from rivers or the sea.
- Areas to the south and north east of the site are shown to be at risk of flooding in the undefended 30-year surface water flood. This corresponds to the location of a pond to the south of the site and a watercourse adjacent to the north east corner of the site.
- The generalised modelling methodology used for the Risk of Flooding from Surface Water mapping means that the channel and the culverts under Stane Street and the A27 are not well defined. Site specific modelling of the watercourse is recommended to determine the extents of flood zone 2 and 3 within the site boundary and to set appropriate finished floor levels.
- Safe access and egress from the site is likely to be possible for the 100-year fluvial event, however flooding is possible on roads into Chichester from the site.
- Over 80% of the site is considered to be at very low risk of fluvial or surface water flood risk. The position and extent of the potential flooding indicates that the principle of development is supported at the site.

Site AL6- Land south of Bognor Road

- This site is entirely in flood zone 1 and therefore is considered to be at very low risk of flooding from rivers or the sea.
- A flow route is shown within the boundary of the site within the 1000-year surface water modelled flood in the south west corner of the site. It is unclear from the available data whether the flow route corresponds to an existing ditch. Flooded depths are predicted to be less than 600mm at any location within the site boundary.
- Over 90% of the site is considered to be at very low risk of fluvial or surface water flood risk. The position and extent of the potential flooding indicates that the principle of development tis supported at the site.
- As it is possible that long term changes in mean sea level could affect the performance of local watercourse systems consideration will need to be given to the arrangements for water level management as affects local watercourses and water features.

Site HSY0010B- Land West of Park Farm, Selsey

- This site is entirely in flood zone 1 and therefore can be considered to be at very low risk of flooding from Main rivers or the sea.
- Less than 10% of the site is at risk of flooding in the 1000-year surface water modelled flood. The mapping shows isolated areas of ponding and does not show any flow routes through the site
- The low lying nature of the land surrounding the site means that the site is a "dry island. As the main road from Selsey (B2145) is at risk from flooding at Pagham Harbour safe access and egress to the site is a material consideration. Predicted depths of flooding in the 200-year present day flooding of the B2145 is considered as hazardous for some and under future climate change conditions the route would be classified as "danger for all".
- Less than 10% of the site is at risk of flooding in the 1000-year surface water modelled flood. The mapping shows isolated areas of ponding and does not show any flow routes through the site.
- The commitment to the long term management and maintenance of the existing defences is a material consideration together with the appropriate provisions to address the residual risk in circumstances where the defences failed or were overtopped.

3.2 Groundwater flood risk assessment

The site summary tables have not included an assessment of groundwater flood risk as this has been performed separately and can be found in Appendix C. A summary is outlined below.

Site AL3- Land East of Chichester

The area is underlain by permeable superficial deposits and has been highlighted as have a potential clearwater flooding risk. Groundwater within these deposits likely discharge to the drains and lakes on site and the lake to the southern boundary. The groundwater catchment outside of allocation is relatively small and the drains will only be subjected to limited surface water flooding and no fluvial flooding so it is expected that a drainage design could be incorporated in the future development of the site that could supress the water table. This would however be reliant on the lakes on site and to the south being maintained at a low level.

This initial assessment indicates that it is feasible to design a drainage system to suppress groundwater flooding. Such a design should be based on:

- Groundwater monitoring,
- Groundwater modelling to determine the spacing and sizing of drainage requirements,
- Potential zoning of the site limit development in the lowest lying parts of the site.
- A long term commitment to control water levels in the lake to the south of the allocation so groundwater flood risk is appropriately addressed.
- This assessment does not consider underground structures such as basements.

Site AL5-Southern Gateway

This initial assessment indicates that overall, the risk of groundwater flooding on site is negligible. It should be noted that this assessment does not consider underground structures such as basements, which may disrupt groundwater flow on a localised scale.

Site HWH0014-Land north of Maudlin Farm

The area is underlain by permeable superficial deposits and has been highlighted as have a potential clearwater flooding risk. Groundwater within these deposits likely discharge to the drains and the pond on site and the lake to the southern boundary. The groundwater catchment outside of proposed allocation is relatively small and the drains will only be subjected to limited surface water flooding and no fluvial flooding. As such, it is expected that a drainage design could be incorporated in the future development of the site that could supress the water table. This would however be reliant on the pond on site being maintained at a low level.

This initial assessment indicates that it is feasible to design a drainage system to suppress groundwater flooding. Such a design should be based on:

- Groundwater monitoring,
- Groundwater modelling to determine the spacing and sizing of drainage requirements,
- Potential zoning of the site limit development in the lowest lying parts of the site (i.e. close to the existing pond).
- Controlling water levels in the pond.
- This assessment does not consider underground structures such as basements.

Site AL6- Land south of Bognor Road

The area is underlain by permeable superficial deposits and has been highlighted as having a potential clearwater flooding risk. Groundwater within these deposits likely discharges to the lakes surrounding the site. The groundwater catchment outside of allocation is relatively small so it is expected that a drainage design could be incorporated that could suppress the water table. This would however be reliant on the lakes being maintained at a low level.

This initial assessment indicates that it is feasible to design a drainage system to suppress groundwater flooding. Such a design should be based on:

- Groundwater monitoring
- Groundwater modelling to determine the spacing and sizing of drainage requirements
- Potential zoning of the site limit development in the lowest-lying parts of the site.
- A long term commitment to control water levels in the adjacent lakes so groundwater flood risk is appropriately addressed.
- This assessment does not consider underground structures sure as basements.

Site HSY0010B- Land West of Park Farm, Selsey

This initial assessment indicates that overall, the present day risk of groundwater flooding on site is negligible. It should be noted that this assessment does not consider underground structures such as basements.

Site AL7 – Highgrove Farm

There is an area of high and moderate groundwater flood risk in the south of the site is underlain by chalk, that receives flow from a large groundwater catchment. Simple on site mitigation may not be possible to mitigate groundwater flood risk in this area. The area to the north has negligible groundwater flood risk due to the underlying geology. The site could be zoned to avoid development in the high-risk area, however ongoing monitoring and site investigation would be

required to confirm the boundaries of these zones. The following measures should be addressed when formulating site proposals:

- Groundwater monitoring
- Potential zoning of the site limit development in the lowest-lying parts of the site.
- Evaluation of the capacity of local drainage systems to appropriately accommodate and control groundwater flow and level.

3.3 Cumulative Impact Assessment

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume and potential effects of increased volumes of runoff from proposed development. Whilst the loss of storage or potential increase in flow volume for individual developments may only have minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.

Future development sites within the study area were provided by Chichester District Council. Predicted flood risk was assessed in the Interim Level 1 SFRA using a variety of datasets and the catchments were then ranked to allow the categorisation of the catchment dependent on the sensitivity of the catchment to proposed level of growth, historic flood risk and properties sensitive to growth.

The five highest ranked catchments are:

- Aldingbourne Rife
- Kird
- Lavant (Sussex)
- Pagham Rife
- Arun (U/S Pallingham)

A detailed analysis was undertaken for these catchments also taking wider factors such as topography and location within the wider river drainage network, to determine policy recommendations for development in those catchments.

A detailed description of the methodology and Cumulative Impact Assessment for high-risk catchments are included as Appendix D .

A Cumulative Impact Assessment for high-risk catchments identified in the Level 1 SFRA is included as Appendix D.

4 Summary

4.1 Overview

This Interim Level 2 SFRA delivers site specific guidance and recommendations for a number of sites highlighted in the Local Plan for the Chichester District. It should be read in conjunction with the Interim Level 1 SFRA which delivers a strategic assessment of all sources of flooding in the area.

4.2 Recommendations

Recommendations from this report should be considered in addition to recommendation from the Level 1 interim SFRA. Recommendations in the Level 1 Interim SFRA were made regarding (but not limited to):

- Considering flood resilience measures for new development.
- Combining infiltration (e.g. permeable surfaces) and attenuation (e.g. balancing ponds and flood storage reservoirs) SuDS techniques to overcome constraints to the area of a site set aside for infiltration systems caused by development pressures.
- Seeking opportunities for betterment where possible, where surface water flooding issues are present.
- Encouraging the use of permeable surfacing in gardens and use measures to optimise drainage and reduce runoff.
- Considering opportunities for water conservation through rainwater harvesting and water butts where appropriate for new and existing development.
- Promoting land management practices where appropriate to attenuate runoff and alleviate potential issues downstream.

4.3 Guidance for proposed development including windfall sites

- For sites not represented in the Environment Agency's Flood Zones, or where Flood Zones do exist, but no detailed hydraulic modelling is present, it is recommended that developers construct detailed hydraulic models at these sites as part of a site-specific FRA using channel, structure and topographic survey, to confirm flood risk. This representation may be absent as Flood Zones do not extend into a watercourse any further than the point where the upstream catchment is less than 3km^2.
- Where the site either include or borders a Main River (including a culverted reach of Main River), an easement of 8m is required from either bank for access and maintenance. Any future development will require a flood risk permit from any activity within 8m of a Main River.
- If an ordinary watercourse is within or immediately adjacent to the site area, consultation with the Lead Local Flood Authority should be undertaken. If alterations or discharges are proposed to the watercourse, a land drainage consent will be required.
- Where necessary, blockages of nearby culverts may need to be simulated in a hydraulic model to confirm residual risk to the site.
- Surface water risk should be considered in terms of the proportion of the site at risk in the 30-year, 100-year or 1,000-year events, whether the risk is due to isolated minor ponding or deeper pooling of water, or whether the risk is due to a wider overland flow route.
- Surface water risk and mitigation should be considered as part of a detailed site-specific Flood Risk Assessment and Surface Water Drainage Strategy.
- Access and egress should be considered at the site, but also in the vicinity of the site, for example, a site may have low surface water risk, but in the immediate locality, access/ egress to and from the site could be restricted for vehicles and/ or people.

- Sites where there is a canal within or immediately adjacent to the site area, developers should consult the Canal and Rivers Trust. Any proposed alterations to the canal or discharges must be agreed with the Canal and Rivers Trust.
- If a site is located within 250m of a landfill site, there could be amenity, dirt and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment.
- High groundwater is likely to be a major consideration for all sites around the city of Chichester due to the underlying geology. The potential effects on the capacity of watercourse and drainage systems potentially affected by future increases in groundwater levels should be assessed and appropriately addressed.
- In locations where reliance is placed on water levels in watercourses and water bodies consideration must be given to the arrangements required for long term water level management, particularly with respect to the potential effects of sea level rise. These arrangements require a strategic understanding of the risk and the commitment to long term management by the appropriate authorities.
- Surface water drainage routes must be preserved in perpetuity, including both flow routes shown in surface water modelling and existing drainage ditches and smaller watercourses.
- Where flow routes are altered due to changes in ground levels on the site, it is important that the site-specific FCA includes an assessment of the impact on and offsite, with suitable mitigation provided.
- The ability for emergency vehicles to access and exit the site must be maintained. This is particularly important for development in Selsey and the Manhood peninsula, where the site may remain dry but the wider area is considered to be a dry island.

4.4 Use of SFRA data and future updates

It is important to recognise that 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 all sources and the potential impacts of future climate change.

The SFRA should be a 'living document', and as a result should be updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. Additional guidance should be sought from WSCC, EA and CDC Flooding and Drainage teams to ensure the most up to date information is considered within any new assessments. Such information may be in the form of:

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

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed Flood Risk Assessment.

It is recommended that the SFRA is reviewed 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.

4.5 Neighbourhood Plans

Flood risk should be fully addressed in development plan preparation and in bringing forward policies for the allocation of land and therefore the SFRA findings should be used in the production of Neighbourhood Plans.

Neighbourhood planners can use the information in the Interim Level 1 and Level 2 SFRA on the sources of flood risk across the CDC area and the flood risk mapping, to assess the risk of flooding to sites within their community. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas.

Appendices

JBA consulting

Offices at

Coleshill
Doncaster
Dublin
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Registered Office
1 Broughton Park
Old Lane North
Broughton
SKIPTON
North Yorkshire
BD23 3FD
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
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