



HAMPSHIRE DEVELOPMENTS LTD

LAND EAST OF WESTERGATE ALDINGBOURNE

Flood Risk Assessment





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ALDINGBOURNE**

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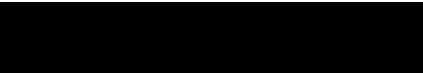
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LAND EAST OF WESTERGATE ALDINGBOURNE

Flood Risk Assessment

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APPENDICES

APPENDIX A - TOPOGRAPHIC SURVEY

List of Abbreviations

FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
PPG	Planning practice guidance
CIRIA	Construction industry research and information association
DEFRA	Department Environment Food & Rural Affairs
SuDS	Sustainable Drainage Systems
LLFA	Lead Local Flood Authority
SMP	Shoreline Management Plan
WSCC	West Sussex County Council
SSWMS	Strategic Surface Water Management Strategy
SWMP	Surface Water Management Plan
LiDAR	Light Detection and Ranging
BGS	British Geological Survey
IDB	Internal Drainage Board
NEAP	Neighbourhood area of play
LEAP	Local equipped area of play
LAP	Local area of play
uFMfSW	Updated Flood Maps for Surface Water
AEP	Annual Exceedance Probability
ADC	Arun District Council

EXECUTIVE SUMMARY

WSP has been commissioned by Hampshire Developments to prepare a site-specific Flood Risk Assessment and supporting Surface Water Drainage Strategy for the Land East of Westergate Aldingbourne, West Sussex. This Flood Risk Assessment (FRA) forms part of a hybrid planning application for 'up to 400 dwellings', with only the East West Link Road and the Pine Close access in detail.



The aim of this National Planning Policy Framework (NPPF) compliant FRA was to identify flood risks to the proposed site (the site) and those that may arise as a result of the development proposals. Where risks are identified, mitigation measures are proposed to effectively manage the risks over the lifetime of the development, accounting for the effects of climate change. This includes the design of a robust Surface Water Drainage Strategy.

This FRA has investigated all sources of potential flood risk within and in the vicinity of the existing undeveloped site. These are fluvial flood risk, surface water flood risk and residual flood risks. The main residual flood risks are climate change uncertainties for the 1 in 100 year design storm, a partial blockage of the railway culvert at the southern boundary of the site and foul flooding as a result of groundwater intrusion.

Table 2 in the Sequential and Exception Tests (2014) for the Arun Local Plan (2011 to 2031), indicates that the sites in Barnham/Eastergate/Westergate can allocate employment and housing without the need for the Exception Test. No residential dwellings are placed within the modelled Flood Zone 3 and therefore it is confirmed that the Exception Test is not required for this site.

The East-West Link Road which will provide safe access/egress to and from the site, where the flood hazard is sufficiently low to allow emergency vehicles reaching the site. There is also the potential access to the North via St Richard's Road and to Nyton Road where the flood hazard is sufficiently low to allow access from emergency services.

The sequential approach within the site has been achieved by allocating vulnerable land uses as far away as possible from all sources of flood risk, including the 1 in 100 year climate change flood extent. This principle of avoidance has been applied, by ensuring the residential plots, development runoff storage basins, and compensation storage do not encroach the 1 in 100 year plus the higher estimate climate change flood extents.

Compensation storage has been estimated using the 1 in 100 year plus upper estimate climate change event, for the proposed bridge over the Lidsey Rife.

The application of the principle of avoidance ensures the resilience of the development and together with the following measures, it has resulted in acceptable levels of residual flood risk: a) setting finished floor levels 0.20m above existing ground levels, b) setting the foundations for developing a

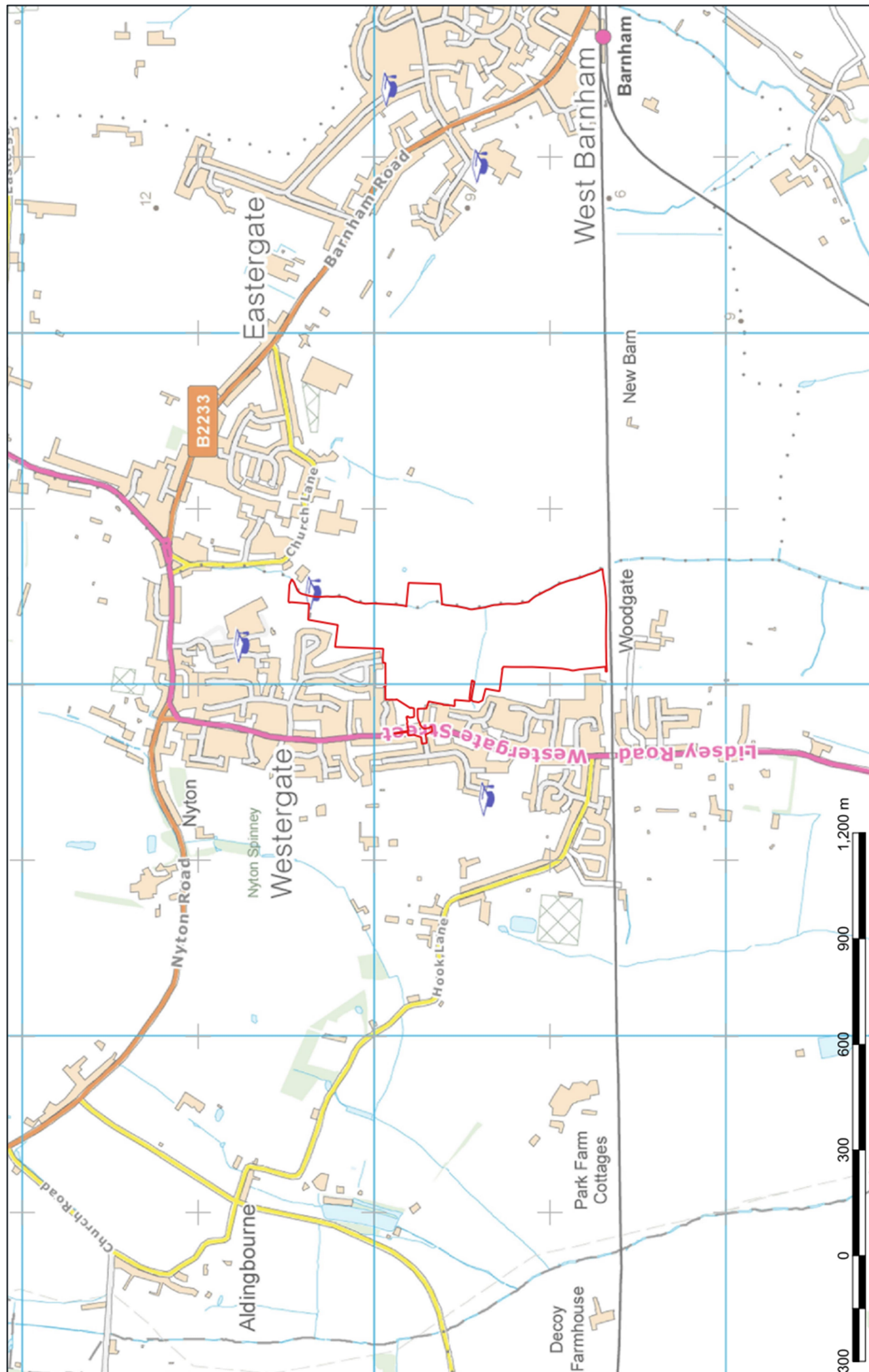


full Evacuation Plan and a Maintenance Manual for watercourses within the site, and c) developing a robust Surface Water Drainage Strategy (a document written separately to this FRA).

Contact name Bruno Venturini



Figure 1 - Site Location Map



INTRODUCTION

1.1 APPOINTMENT AND BRIEF

- 1.1.1. WSP has been commissioned by Hampshire Developments to prepare a site-specific Flood Risk Assessment and supporting Surface Water Drainage Strategy for the site - the Land East of Westergate Aldingbourne, West Sussex (refer to Site Location Map in the Executive Summary).
- 1.1.2. This Flood Risk Assessment (FRA) forms part of a hybrid planning application for 'up to 400 dwellings', with only the East West Link Road and the Pine Close access in detail.

1.2 AIM AND OBJECTIVES

- 1.2.1. The aim of this National Planning Policy Framework (NPPF) compliant FRA is to identify flood risks to the site and those that may arise as a result of the development proposals. Where risks are identified mitigation measures are proposed to effectively manage the risks over the lifetime of the development, accounting for the effects of climate change. This includes presentation of a Surface Water Drainage Strategy to support the development proposals for the site, without restricting the future drainage strategy for the remainder of the BEW Strategic Allocation to the east.
- 1.2.2. To achieve this, aim the following relevant documents in **Table 1** have been reviewed to inform this assessment:

Table 1 – List of Relevant Documents

Ref.	Document/Source
1	NPPF (20 July 2021)
2	Preparing a flood risk assessment: standing advice (Gov.UK, 8 Feb 2022)
3	Development and Flood Risk – Guidance for the Construction Industry (C624), CIRIA 2004
4	Non-statutory technical standards for sustainable drainage systems, DEFRA 2015
5	The SuDS Manual (CIRIA C753), CIRIA 2015
6	SuDS design guidance for LLFAs of the South East of England (Sep 2013)
7	Arun and Western Streams Catchment Flood Management Plan, 2009
8	Head to Selsey Bill Shoreline Management Plan, May 2006
9	West Sussex Local Flood Risk Management Strategy, 2013
10	Lidsey Surface Water Management Plan, October 2014
11	WSCC Preliminary Flood Risk Assessment (PFRA), May 2011
12	Arun Level 1 Strategic Flood Risk Assessment Update, August 2016

13	Arun Strategic Surface Water Management Strategy (SSWMS), Stage 1 and Stage 2 reports, July 2016
14	The Sequential and Exception Tests (2014) for the Arun Local Plan (2011 to 2031)

1.2.3. In addition to the documents listed above, data from regulatory bodies and third parties has been collected and reviewed to inform this assessment, as listed in the summary **Table 2** below.

Table 2 – List of Information Collected

Ref	Details	Source	Comments
15	2015 Infoworks Aldingbourne Model CaVID data (defined for the purpose of this study as the Environment Agency model)	Environment Agency	Latest model which includes the main watercourses crossing and adjacent to the site. It includes drainage networks with pipe diameters larger than 0.3m. The Environment Agency model has been modified to produce a cut version model for the Westergate area (defined as the Westergate model for the purpose of this study – refer to Chapter 4).
16	Manhole locations in the Westergate Street area	Arun District Council	Useful information for the understanding of the pipe network along Westergate Street.
17	Supplementary requirements for surface water drainage proposals	Arun District Council	Indicates the need to produce a Maintenance Manual prior to building the development.
18	Manhole and pipe data in the Westergate Street area	West Sussex County Council	Pipe sizes included.
19	LiDAR data from the environment.data.gov.uk open data website	Open Government Licence	Used for comparing the topographic survey for the site against the LiDAR data that was used to create the Infoworks model (Ref 15). As there were some discrepancies between the two datasets, the model was updated with the topographic survey of the site.
20	Full topographic survey of the site area	Cala Homes (South Home Counties) Ltd	Includes 3d contours at 0.1m vertical interval.

21	Private drainage infiltration prevention	Southern Water (John Challoner)	A summary of practical drainage measures, as a guidance for potential developers in the Barnham area.
22	Flood map for planning	GOV.UK	Live Document
23	Groundwater monitoring report	Bingham Hall Associates	Supplementary document to assess groundwater conditions for the site.
24	Detailed map of ordinary watercourses and IDBs	Arun District Council	Meeting on site with Arun District Council (ADC) in 2017 to discuss maintenance issues and bridge crossing details over ordinary watercourses.

2 THE EXISTING SITE

2.1 THE SURROUNDING AREA AND SITE LOCATION

- 2.1.1. The three villages of Barnham, Eastergate and Westergate are in Arun District between the A27 and the south coast, north of Bognor Regis in West Sussex. The existing site is an undeveloped greenfield site, and it is located to the east of Westergate (refer to Site Location Map in the Executive Summary).

2.2 EXISTING TOPOGRAPHY

- 2.2.1. A detailed topographic survey covering the existing site has been undertaken and the output is provided in **Appendix A**.
- 2.2.2. **Figure 2** provides an overview of the ground terrain levels. The general fall of the land is from west to east, towards the Lidsey Rife. This watercourse forms the eastern boundary of the existing site. The blue lines represent 1m interval contours (from 2m to 10m) and the red lines represent 0.1m interval contours. The key spot levels identified in this figure do not include depressions in the terrain; therefore, along the Lidsey Rife the spot levels represent bank levels (not bed levels). There is only a small strip of land that has levels lower than 3m AOD (green highlighted area).

2.3 WATERCOURSES

- 2.3.1. The existing site is located in an area of agricultural land. The Lidsey Rife is a main river that flows in a north to south direction, and it is culverted underneath the railway embankment (refer to **Figure 3**).
- 2.3.2. An unnamed watercourse crosses the middle of the existing site in a west to east direction, towards its confluence with the Lidsey Rife. For the purpose of this FRA the unnamed watercourse is identified as the Westergate Stream. Within the site boundary, the Westergate Stream was partly an Ordinary Watercourse and partly an Internal Drainage Board (IDB) watercourse in 2018, as shown in **Figure 3**. The current live IDB map, however, does not show this watercourse and therefore it is assumed that the entire length of the Westergate Stream is now an Ordinary Watercourse.
- 2.3.3. Main River, IDB and Ordinary Watercourse designations gives legal powers respectively to the Environment Agency, the IDB and ADC (ADC acts on behalf of WSCC) respectively.

2.4 HYDROGEOLOGY

- 2.4.1. The information provided in the following **Sections 2.5 to 2.7** has been extracted from the Groundwater Monitoring report (**Ref 23** in **Table 2**) from Bingham Hall Associates.

2.5 GEOLOGY

- 2.5.1. The British Geological Survey (BGS) 1:50,000 map for Chichester/Bognor (sheet 317/332) indicates the existing site lies on bedrock of the London Clay Formation. This is largely masked by superficial deposits of Head (Gravel, Sand Silt & Clay) in the northern part and River Terrace Deposits (Sand, Silt & Clay) in the southern part, of the existing site. The river valley of the Lidsey Rife comprises of Alluvium (Clay, Silt, Sand & Gravel) and Raised Beach Deposits (Sand and Gravel).

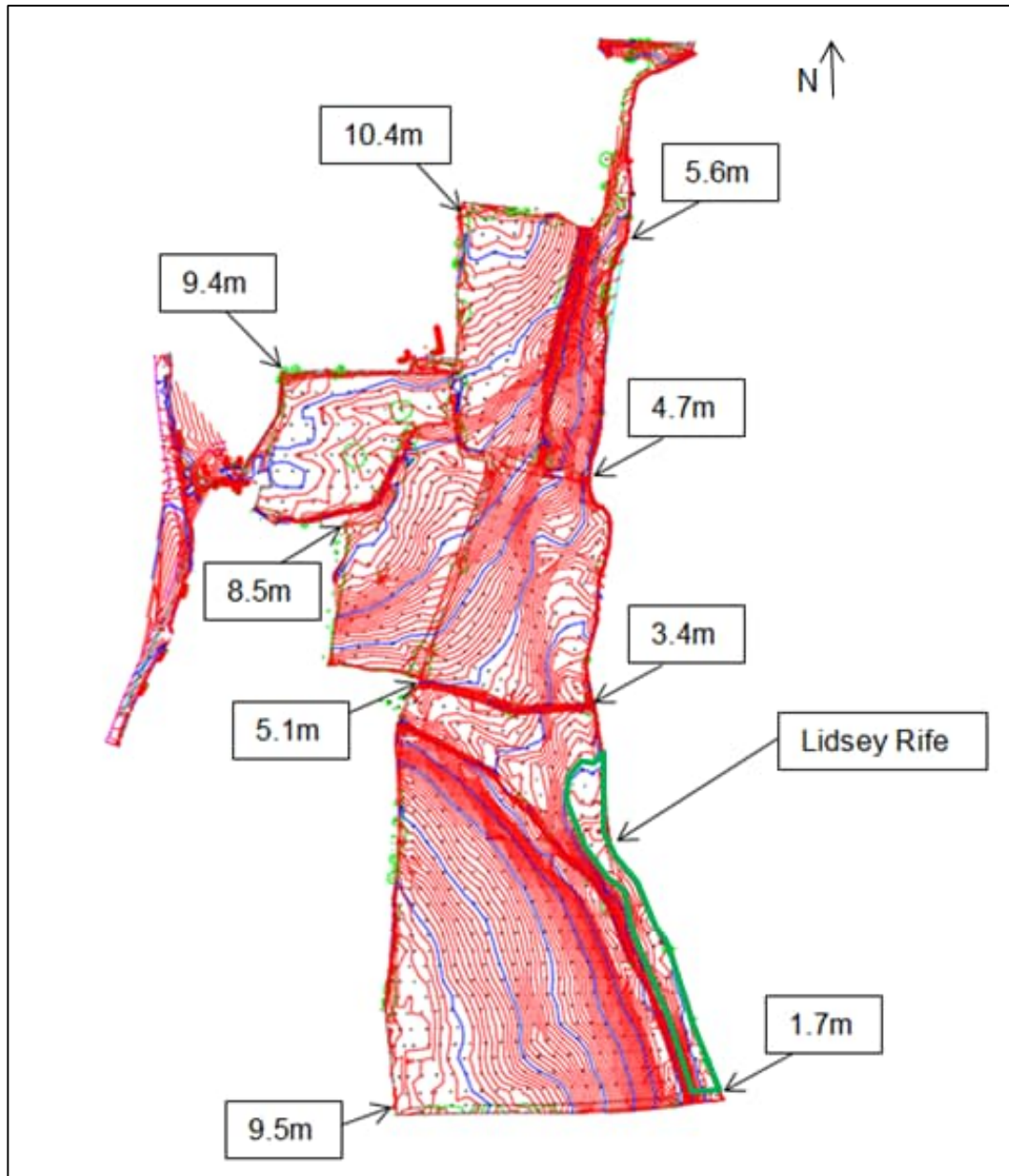
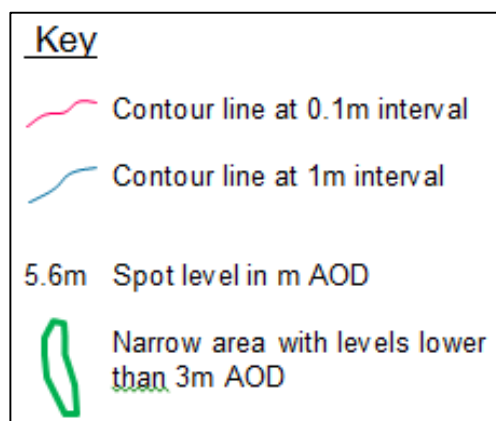


Figure 2 – Overview of the Ground Topography



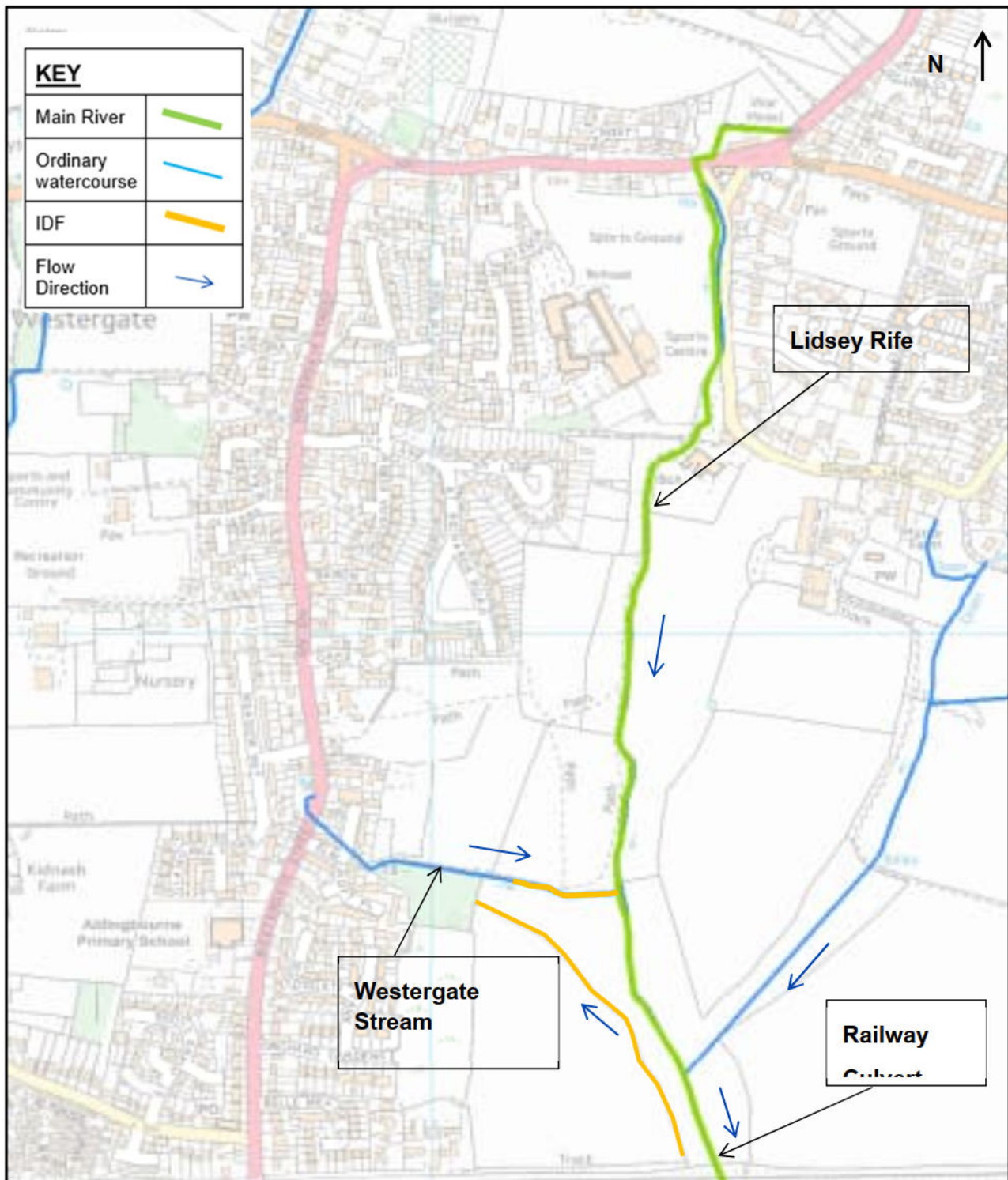


Figure 3 – Local Watercourses

2.6 AQUIFER CHARACTERISTICS

- 2.6.1. The superficial deposits are designated as Secondary Aquifers (i.e., permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers). Groundwater within these deposits will be perched upon the Unproductive London Clay Formation (i.e., low permeability layers with negligible significance for water supply or river base flow) which is known to be in excess of 100m thick beneath the existing site.
- 2.6.2. Considering the topography and underlying impermeable geology it is likely that groundwater within the superficial deposits is in hydraulic continuity with the Lidsey Rife and the Westergate Stream, which are located respectively along the eastern boundary and through the centre of the existing site.
- 2.6.3. Groundwater movement in the Superficial Deposits will generally be down the slope and towards the Lidsey Rife, hence resulting in a slow decline in groundwater levels between rainfall periods.

2.7 GROUNDWATER VULNERABILITY

- 2.7.1. The vulnerability of groundwater at a location is based on the hydrological, geological, hydrogeological and soil properties within a one km square grid and is expressed as high, medium or low vulnerability, as defined by the Environment Agency. Typically, this information is used to assess the exposure of groundwater to pollution hazards, however it can also be a useful tool for judging the likely permeability, flow and storage characteristics of the underlying strata.
- 2.7.2. The Secondary A aquifers beneath the existing site are designated as high vulnerability and therefore, likely to have good permeability, flow and storage properties.

2.8 SOURCE PROTECTION ZONES

- 2.8.1. Groundwater provides a third of the drinking water in England and Wales. The Environment Agency has defined Source Protection Zones around protected groundwater sources such as wells, boreholes and springs used for public drinking water supply. The zones are defined by the groundwater travel time from a point below the water table to the source. Zone 1 is defined by a travel time of 50 days, Zone 2 by a travel time of 400 days and Zone 3 by the total catchment area within which all groundwater recharge is presumed to be discharged at the source.
- 2.8.2. The existing site is not within a Source Protection Zone therefore the groundwater beneath it is not used for public drinking water supply.

3 ASSESSMENT OF EXISTING FLOOD RISK

3.1 OVERVIEW

- 3.1.1. This FRA has investigated all sources of potential flood risk within and in the vicinity of the existing site (pre-development condition) based on the various sources of information collected (refer to **Sections 1.2.2 and 1.2.3**).
- 3.1.2. A list of all potential sources of flood risk and their relevance for this study is summarised in **Table 3** below. Further details for those sources of flood risk that are relevant are provided in **Chapters 4, 5 and 6**.

Table 3 - Overview of sources of flood risk and relevance

SOURCE OF FLOOD RISK	RELEVANCE AND LEVEL OF RISK	COMMENT ¹
Fluvial flood risk	Yes, high ²	The existing site is within Flood Zones 2 and 3. For further details refer to Chapter 4 .
Coastal flood risk	No	Although the lowest level of the existing site is 1.7m AOD there is no coastal flood risk. There are defences in place at Bognor Regis and the Beachy Head to Selsey Bill Shoreline Management Plan (SMP) indicates that these defences will be maintained in the future (Ref 8).
Tidal flood risk	No	
Surface water flood risk from overland flows	Yes, low	Refer to latest surface water flood map in Figure 11 .
Groundwater flood risk	No	The assessment of groundwater flood risk (Ref 23) confirms that the existing site is not at risk from groundwater flooding, however it is acknowledged that in winter periods, this is near the ground surface.
Foul flood risk	No	The WSCC SWMP does not indicate flood risk originated solely from foul sewers (without groundwater intrusion), within or in the vicinity of the existing site (Ref 10).
Residual fluvial flood risk	Yes, high	The residual flood risk from this source is from partial or full blockages of culverts along the Lidsey Rife and the Westergate Stream. The main risk is from the culvert under the railway embankment located at the downstream (south-east corner) of the existing site. Other culverts along the Westergate Stream are not placed beneath embankments and therefore can be easily overtopped, without creating backwater effects upstream. For further details refer to Section 4.4 .

¹ See Sections 1.2.2 and 1.2.3 for source of information (references).

² A fluvial flood risk is considered high if the probability is higher than 1% of occurrence in a given year (1 in 100 year return period)

SOURCE OF FLOOD RISK	RELEVANCE AND LEVEL OF RISK	COMMENT ¹
Residual coastal and tidal flood risk	No	It is anticipated that a breach in the defences (or overtopping for an extreme event) would not result in flooding of the existing site, as this is located many km upstream from the coast.
Residual surface water flood risk	No	There is no residual flood risk from this source as the existing site does not benefit from defences from surface water flood risk.
Residual groundwater flood risk	No	There is no residual flood risk from this source as there are no pumping systems which keep groundwater levels artificially low.
Residual foul flood risk	Yes, high however within the fluvial floodplain	There is indication that groundwater intrusion into the foul drains results in manholes overflowing within the existing site. For further details refer to Chapter 6 .

4 FLUVIAL FLOOD RISK

4.1 FLOOD ZONES

- 4.1.1. The flood zones published from the Environment Agency website (March 2026) confirm that the existing site is at risk from fluvial flooding from the Lidsey Rife and the Westergate Stream (refer to **Figure 4**).

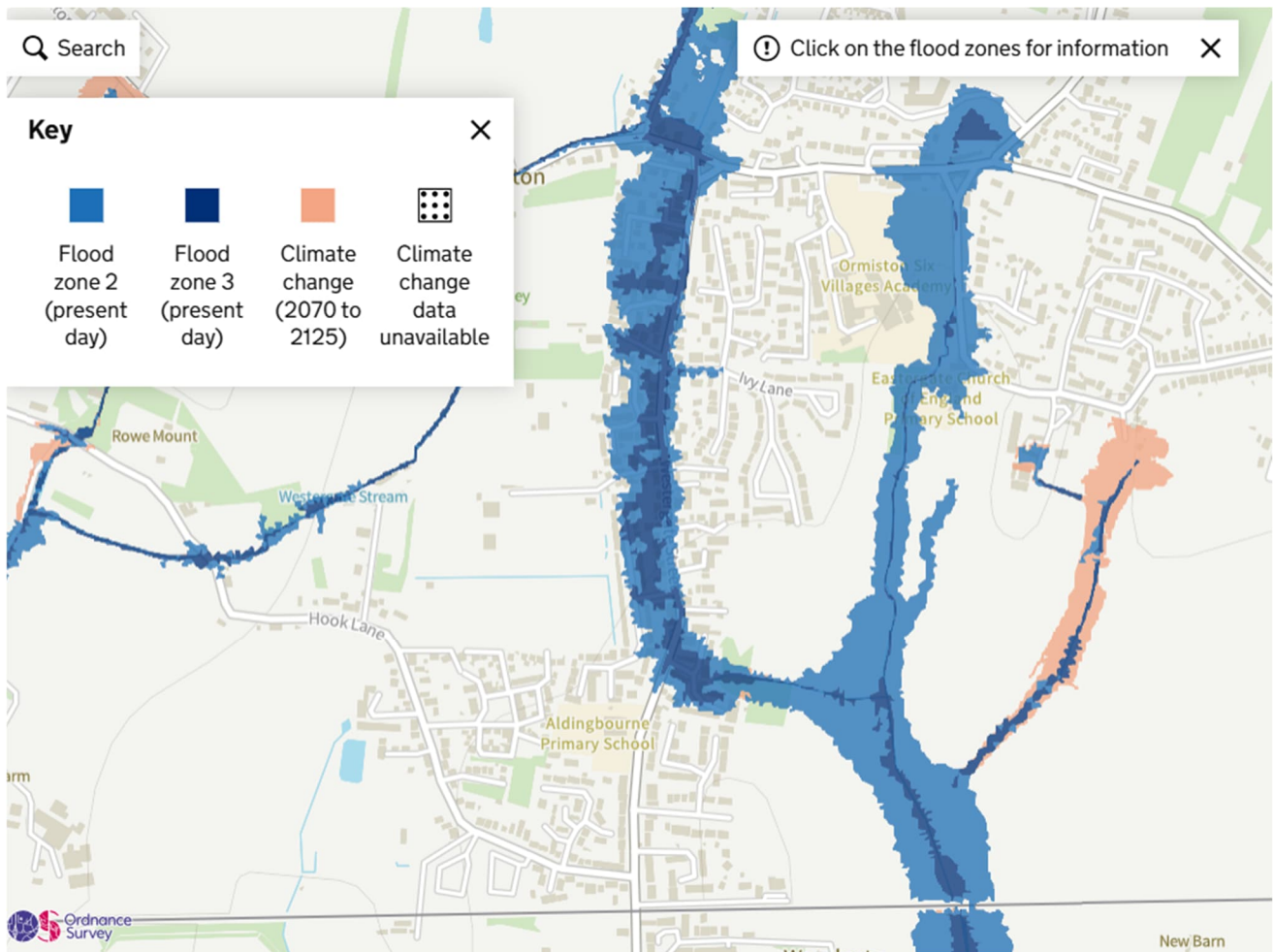


Figure 4 – Flood Zones 2 and 3

- 4.1.2. The Flood Zones are based on the latest Environment Agency 2015 Infoworks Aldingbourne Model (defined as the Environment Agency model – see **Ref 15** in **Table 2**). In addition, a cut version of the Environment Agency model has been specifically developed by WSP for this area (defined as the Westergate model), for the purpose of undertaking additional runs for the purpose of this FRA (refer to **Sections 4.3, 4.4 and 4.5**).

4.2 CHANGES TO THE ENVIRONMENT AGENCY MODEL

- 4.2.1. The main improvements in the Westergate model are (for full details see Hydraulic Modelling Report, which has been submitted as part of this planning application):

- a larger resolution (larger mesh triangle sizes representing broader variations in ground levels of the digital terrain) outside of the Westergate area to reduce model run times;
- a finer resolution at the Westergate area to represent flood risk in more detail;
- removal of irrelevant downstream information (removal of the 2D domain a long distance downstream of the proposed Site, as well as conduits and an in-line connection to remove model instabilities);
- use of the updated **FEH2022 rainfall** as it is best practice to use the latest available data (the Environment Agency model used the FEH2013 rainfall estimates).

4.3 MODELLING WITH AND WITHOUT CLIMATE CHANGE ALLOWANCE

- 4.3.1. The Westergate model has been used for the assessment of the effect of climate change (CC) on flood risk at the site. The latest climate change peak river flow allowances for the site (which falls within the Arun and Western Streams Management Catchment) are shown in **Table 4**:

Table 4 – Climate change allowances for Westergate

SCENARIO	CENTRAL	HIGHER	UPPER
2080s (applicable for residential development which is assumed to last 100 years)	25%	36%	64%

- 4.3.2. For a residential scheme the central allowance of 25% would be sufficient in accordance with national guidance. However, due to the presence of critical infrastructure and to maximise the sustainability of the development, the following allowances have been adopted for different elements of the design:
1. Higher 36% allowance to ensure that the following land uses are placed outside the 1 in 100 year plus 36% CC flood extents:
 - a. the residential land uses;
 - b. the development runoff attenuation basins;
 - c. compensation storage areas; and
 - d. the proposed bridge and abutments.
 2. Upper 64% allowance to estimate the peak water level at the proposed bridge over the Lidsey Rife, and thus to check that there is sufficient freeboard and for the estimate of compensation storage requirements.
- 4.3.3. The flood extents for the 1 in 100 year, 1 in 100 year plus 36% CC and the 1 in 100 year plus 64% CC events are shown in **Figures 5, 6 and 7**. These maps were used as the basis for the allocation of land uses specified in the previous paragraph.

Figure 5 - Flood Depth Map - 1 in 100 year baseline scenario

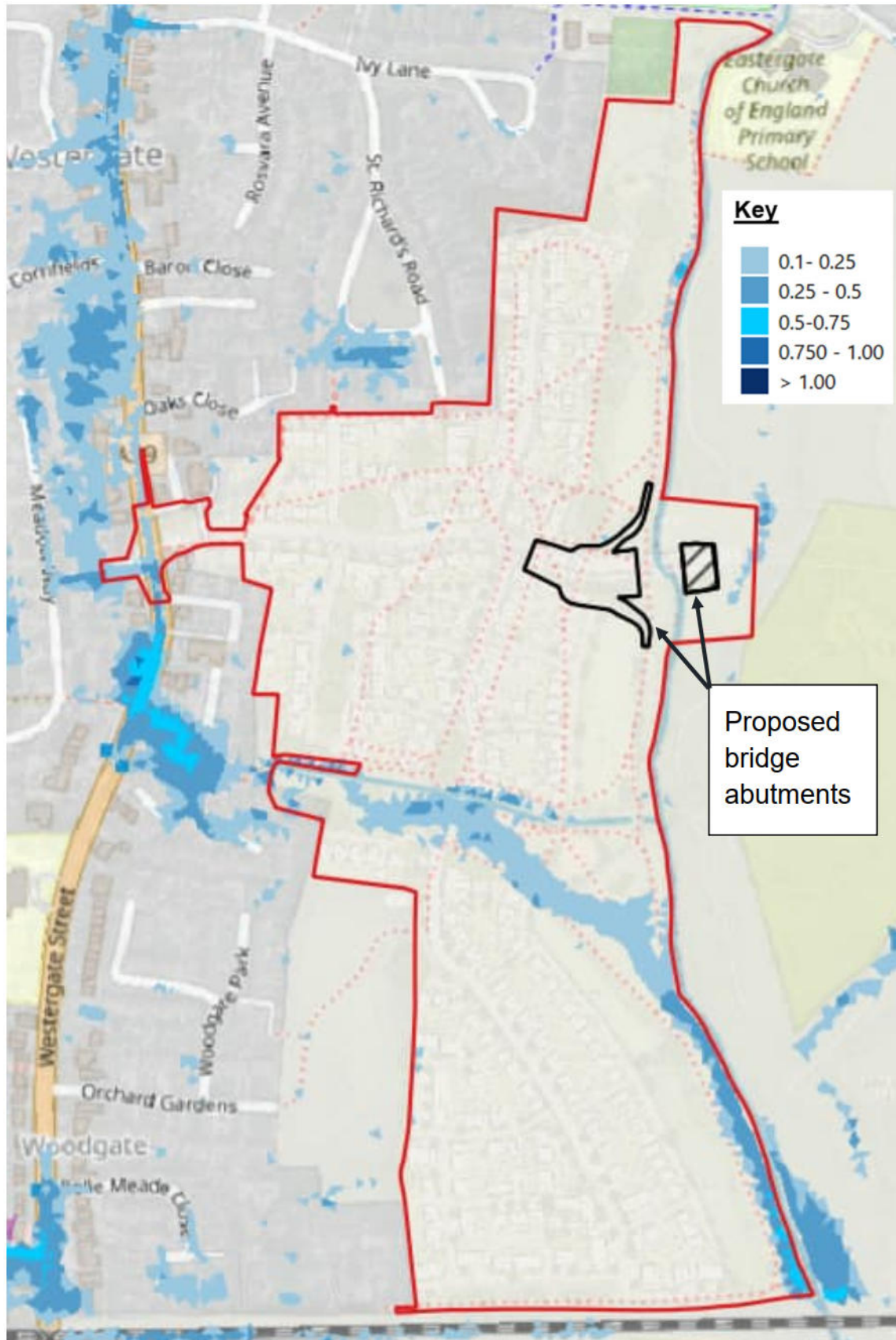


Figure 6 - Flood Depth Map - 1 in 100 year + 36% CC baseline scenario

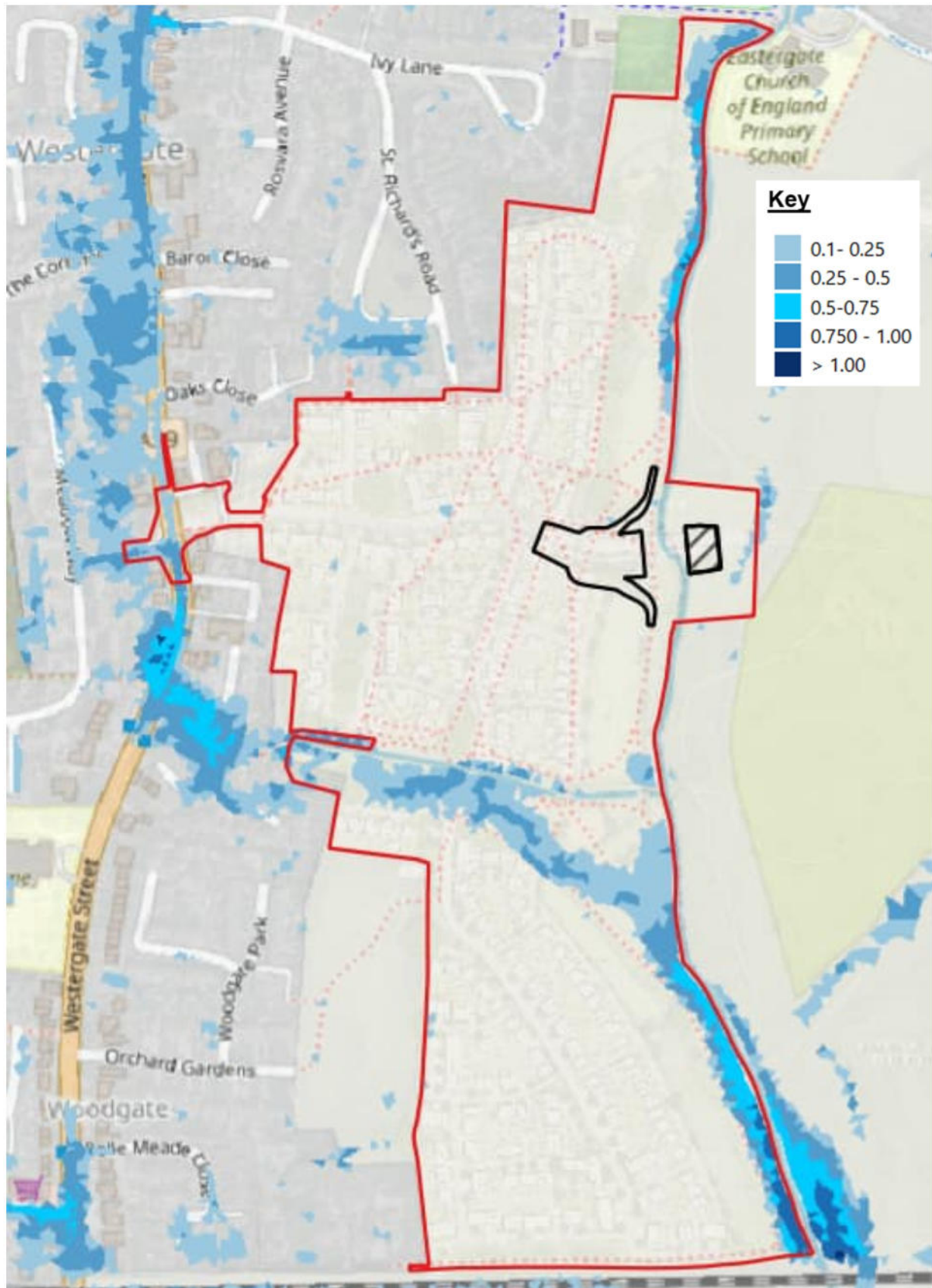
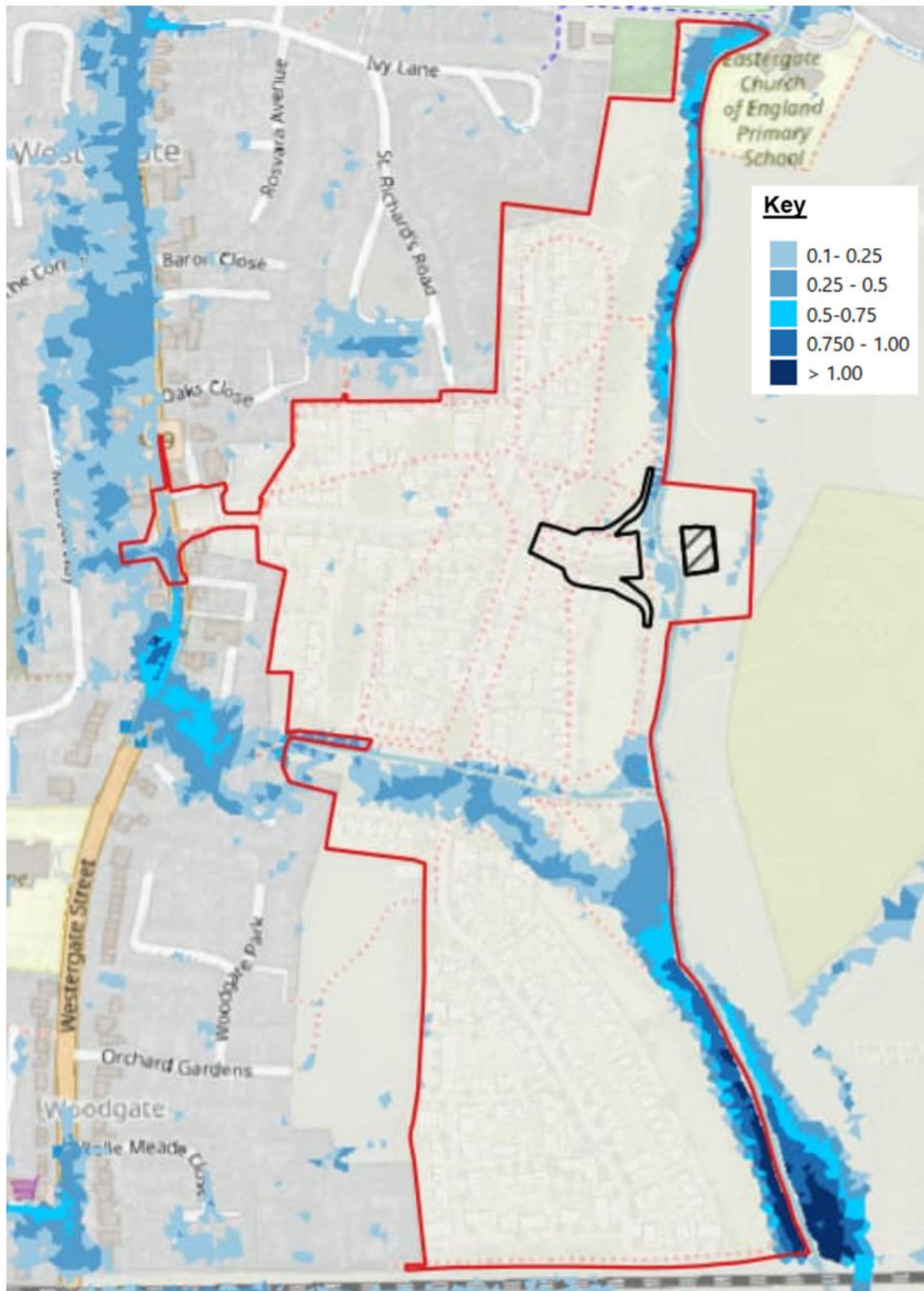


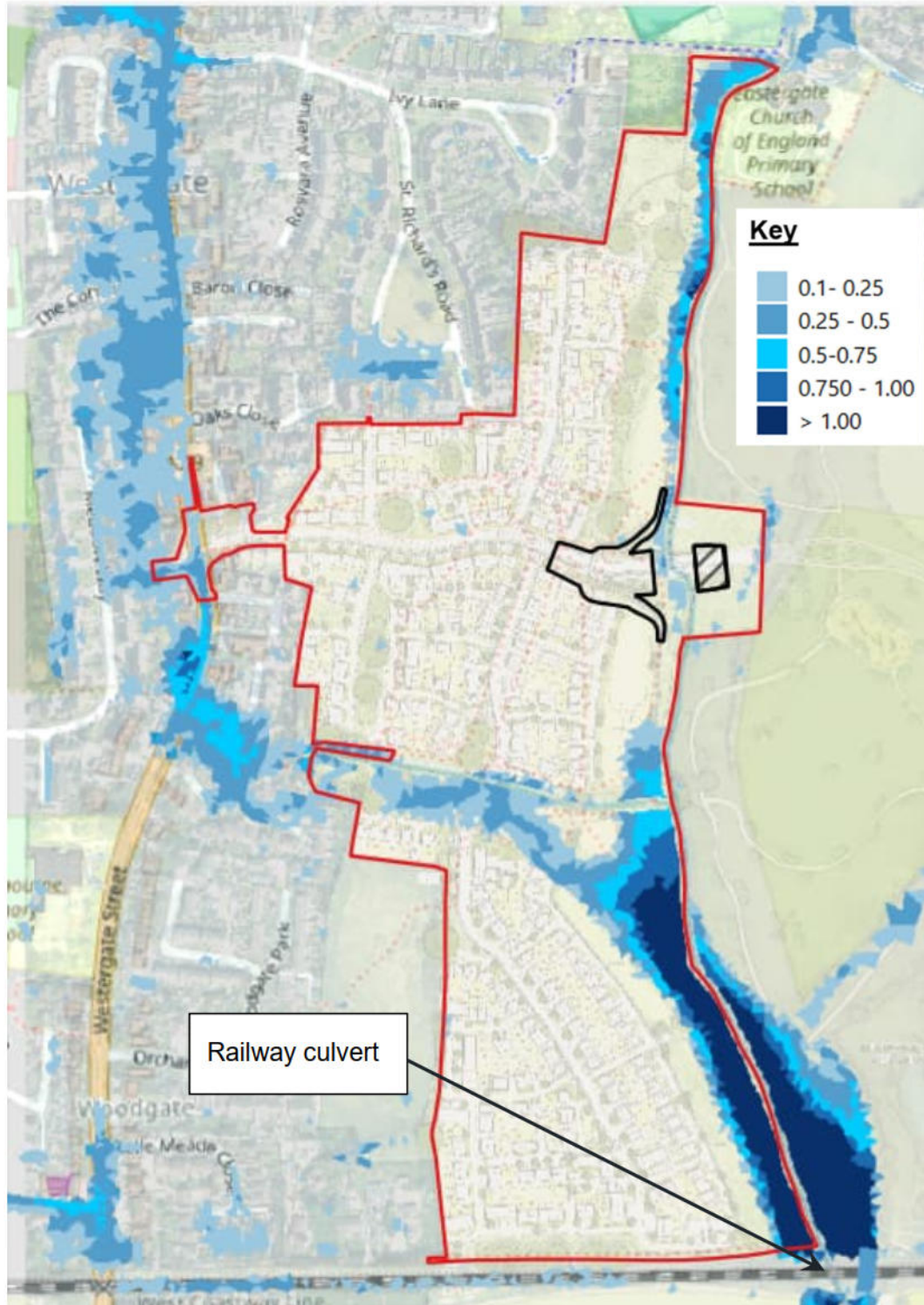
Figure 7 – Flood Depth Map – 1 in 100 year + 64% CC baseline scenario



4.4 RESIDUAL FLUVIAL FLOOD RISKS

- 4.4.1. The main residual fluvial flood risk for the existing site is from a partial blockage of the railway embankment crossing. **Figure 8** shows the effect of 50% blockage of the railway culvert for the 1 in 100 year plus 64% CC event which can be compared against **Figure 7**, for the same event.

Figure 8 – Effect of partial blockage of the railway culvert – 1 in 100 year + 64% CC event



- 4.4.2. The comparison indicates that the effect of a 50% blockage, results in wider flood extents and deeper peak flood depths upstream of the railway bridge however the proposed development residential plots are not affected by this.
- 4.4.3. Another residual fluvial flood risk is the intermittent discharge of up to 0.127m³/s into the Lidsey Rife at Church Lane, Eastergate (upstream of the site). This relates to Portsmouth Water disposal of abstracted groundwater to the river when drinking quality standards are not met.
- 4.4.4. Page 17 of the Arun Strategic Surface Water Management Study, Stage 1 report (**Ref. 13**) suggests that if the Portsmouth Water intermittent discharge occurs during a storm event, it could potentially cause localised surface water flooding. However, a 0.127m³/s discharge would have little effect on the fluvial flood extents through the site, as peak flows for the 1 in 100 year plus climate change event (36%) on the Lidsey Rife range approximately between 7-10m³/s.

4.5 FLUVIAL FLOOD RISK SENSITIVITY TESTS

- 4.5.1. The Westergate model has been run to assess the sensitivity of key model parameters.
- 4.5.2. **Figures 5, 6 and 7** indicate that the effect of climate change predictions and increases in flows are the most significant parameters in terms of changes in peak flood depths and flood extents.
- 4.5.3. **Figures 9 and 10** show the effect of increasing the Manning's n parameter by 20% for the 1 in 100 year event. The flood maps confirm that the results are not sensitive to changes in this parameter.
- 4.5.4. **Table 5** provides a summary of the outcome of the sensitivity tests undertaken.

Table 5 - Summary of Sensitivity Tests

SENSITIVITY TEST	EFFECT
Effect of culvert blockage	High
Effect of climate change	Very high
Effect of Manning's n roughness	Low

Figure 9 - With 20% increase in Manning's roughness coefficient

Peak flood depths (m) for the 1 in 100 year event:

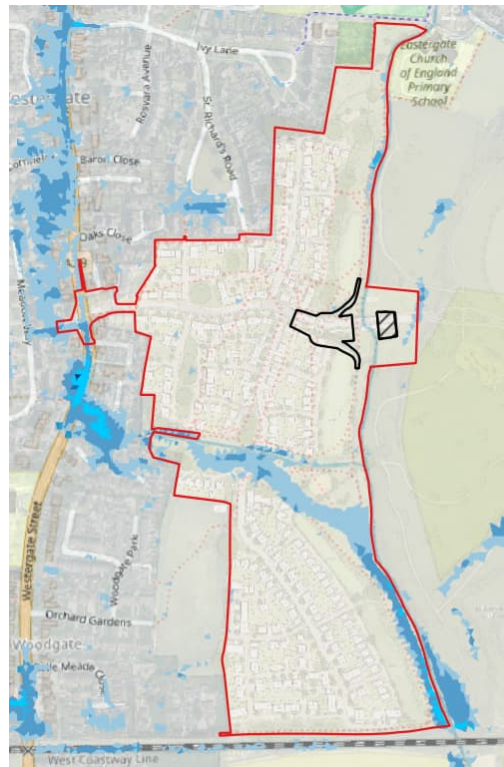
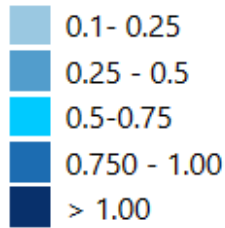
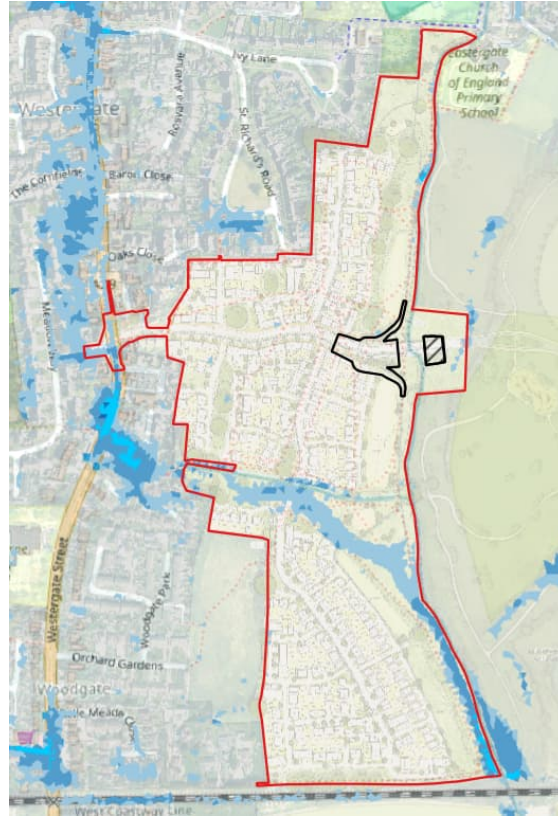
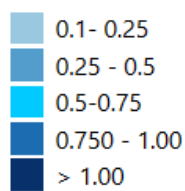


Figure 10 - Without increase in Manning's n values

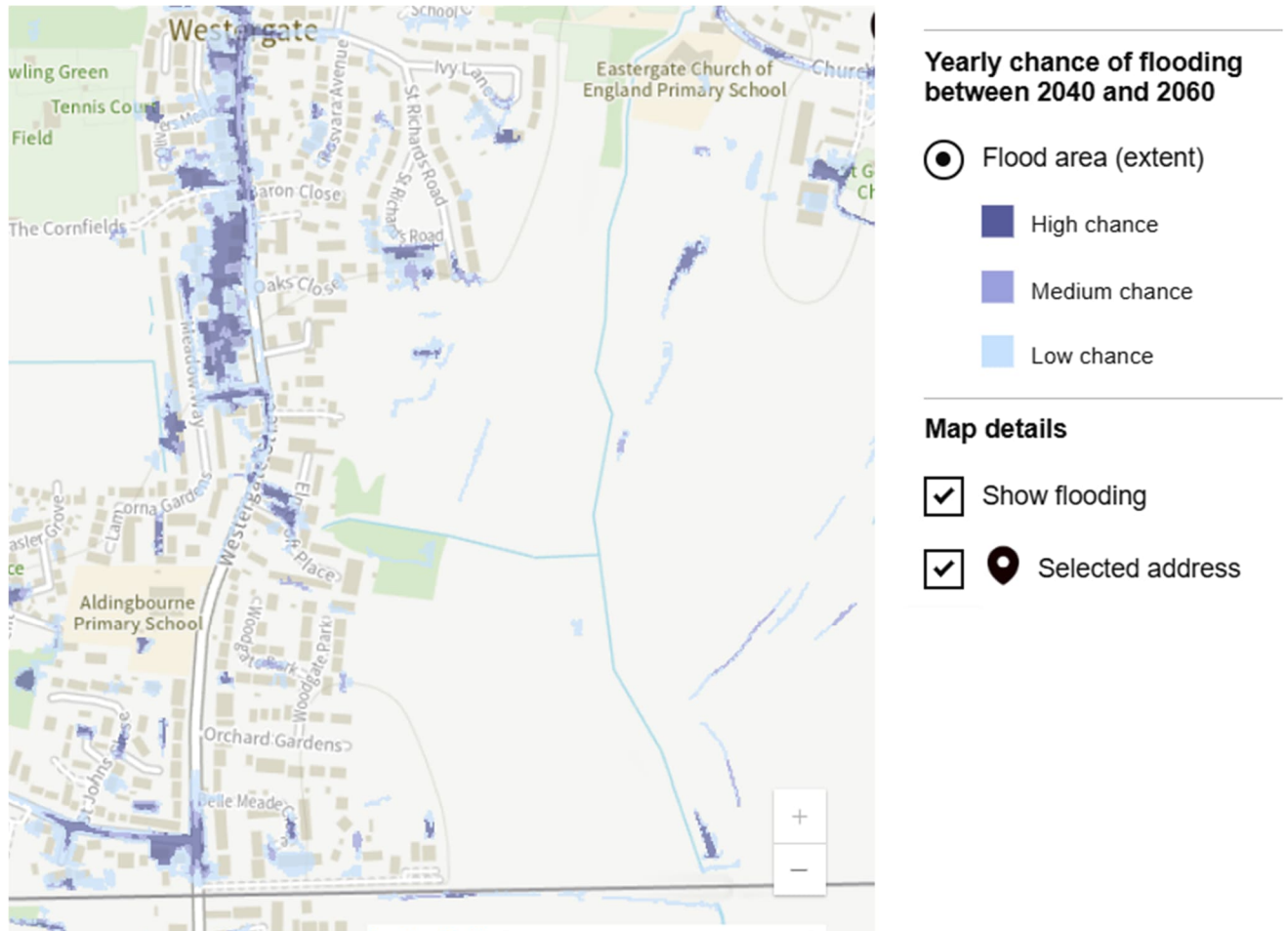
Peak flood depths (m) for the 1 in 100 year event:



5 SURFACE WATER FLOOD RISK

- 5.1.1. The recent surface water flood maps from the Environment Agency indicate that the proposed site is mostly at low risk of surface water flood risk between years 2040 and 2060, as shown in Figure 11.

Figure 11 – Surface water flood risk map



6 RESIDUAL FOUL FLOOD RISK

- 6.1.1. Arun District Council has indicated that foul manholes within the site overflow within the floodplains of the Lidsey Rife and the Westergate Stream. The likely source is groundwater intrusion within or upstream of the existing site. There is no available information of the exact location or locations of where groundwater intrusion occurs.
- 6.1.2. Based on the ground contours and the locations of the foul manholes, which are located in the vicinity of the watercourses, it is concluded that flooding from this source will be limited to the floodplains of the Lidsey Rife and the Westergate Stream. Therefore, if new residential dwellings are positioned away from fluvial flood risk, they will also be placed away from this residual foul flood risk.
- 6.1.3. It is not clear if climate change would increase groundwater intrusion however the extents will still be limited to the floodplain of the Lidsey Rife and the Westergate Stream.

7 OVERVIEW OF THE PROPOSED DEVELOPMENT

7.1.1. The appraisal of constraints and opportunities and the various inputs within the design team has led to the development of a coherent development framework for the site layout (refer to Indicative Development Layout in **Figure 12**).

Key elements related to flood risk and drainage are as follows:

- Application of the principle of avoidance of all relevant sources of flood risk to ensure that the development is safe and does not increase flood risk elsewhere (refer to **Chapters 4, 5 and 6**).
- Application of the Sequential Approach within the site (refer to **Chapter 8**).
- Safe access and egress (refer to **Chapter 9**).
- A summary of the drainage strategy (refer to **Chapter 10**).
- Integration of shallow and long basins within the natural landscape and avoidance of buried storage structures below ground (refer to **Chapter 10**).
- Retention of ditches where possible and setting up of a regular maintenance regime (refer to **Chapter 11**).



Figure 12 – Indicative Development Layout

8 THE SEQUENTIAL APPROACH

8.1 INTRODUCTION

- 8.1.1. The site comprises of vulnerable uses (residential dwellings), water compatible uses (open spaces, sports grounds, etc) and essential infrastructure (the East-West link road has been assumed to be critical infrastructure). Less vulnerable uses (commercial or industrial units) are not proposed.
- 8.1.2. The sequential approach within the site has been achieved by allocating vulnerable uses as far away as possible from all sources of flood risk, however by also taking account of development constraints and objectives. Once this was achieved then water compatible uses have been allocated in the remaining spaces available. Essential infrastructure has been allocated based on access requirements. The sections below describe the sequential approach in further detail.
- 8.1.3. No residential dwellings are placed within Flood Zone 3 and therefore the application of the Exception Test is not required.

8.2 PROPOSED BRIDGE OVER THE LIDSEY RIFE

INTRODUCTION

- 8.2.1. A link road is proposed to connect in an east-west direction, between Westergate Street, through the proposed development and to the future BEW development – the East West Link Road. The crossing of this road over the Lidsey Rife is part of this proposal.

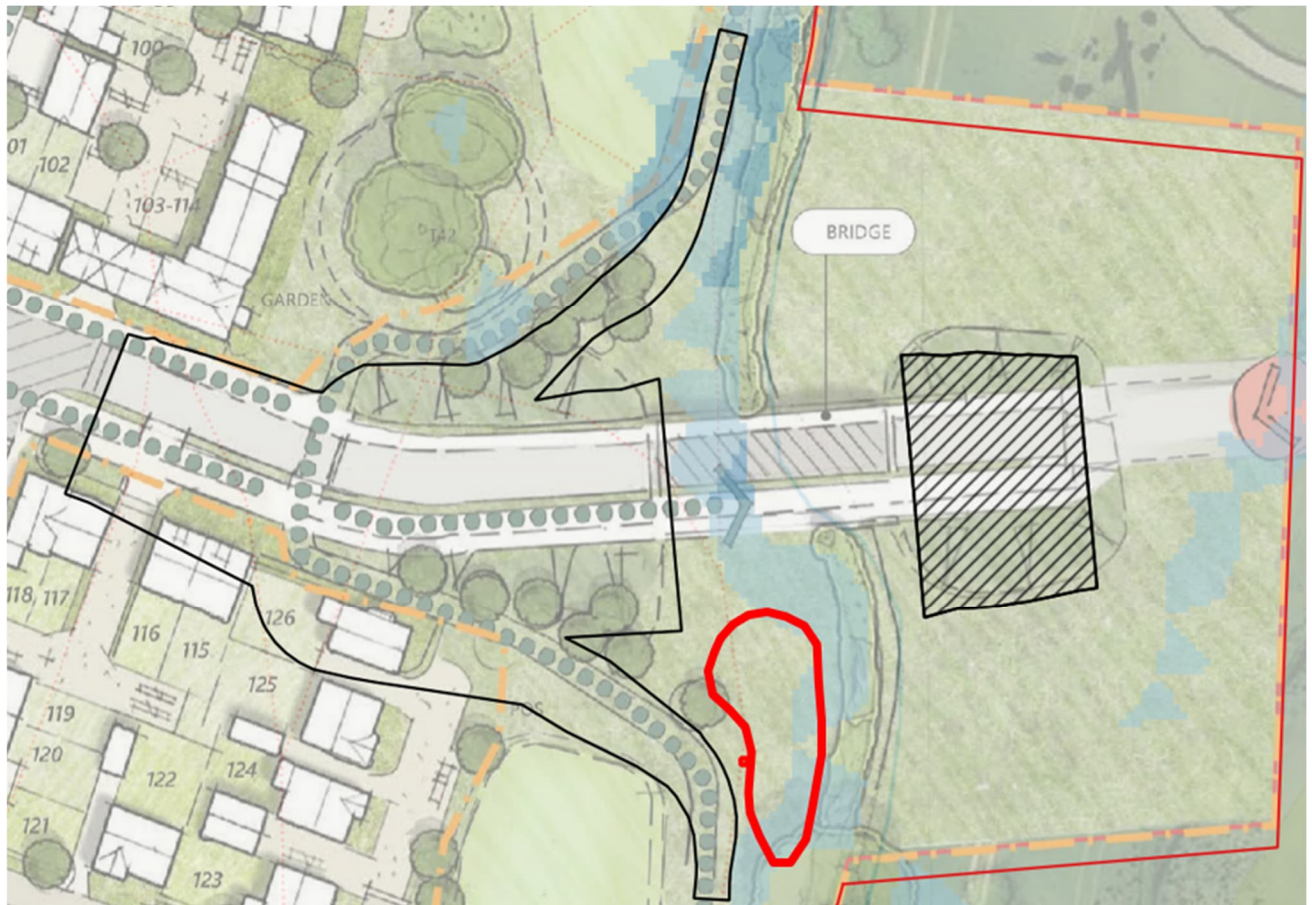
BRIDGE DESIGN

- 8.2.2. The design of the crossing is a free span bridge which avoids encroaching the 1 in 100 plus 36% climate change flood extents. This bridge has been set to be 1.5m above the top of bank levels and therefore it provides at least 1.2m freeboard above the 1 in 100 year plus 64% climate change extents (refer to Section 4.4 of the March 2026 Hydraulic modelling report).

COMPENSATION STORAGE

- 8.2.3. As the proposed bridge over the Lidsey Rife is considered critical infrastructure, it is proposed that compensation storage is estimated for the, more extreme upper, 1 in 100 year plus 64% CC extents. This results in a total volume of 27m³ requirement for compensation storage (for further details refer to Section 4.2 of the March 2026 Modelling report).
- 8.2.4. **Figure 13** shows the 1 in 100 year plus 64% peak flood depths encroaching the two raised access to the bridge structure.
- 8.2.5. Compensation storage is proposed downstream of the bridge crossing by flattening the right bank floodplain by an average of 0.2m (refer to area within the red polygon in **Figure 13**). This area does not affect the main channel or the tree roots zone along the channel corridor. This approach will provide an additional 60m³ since the approximate area of the polygon is 300m². Levels will be dropped from between 4.7m and 5.1m, to approximately between 4.5m to 4.9m AOD.
- 8.2.6. No level to level compensation storage could be found in the vicinity of the loss of floodplain volume and thus the reason for proposing above a double amount (60m³ instead of 27m³) of compensation storage.

Figure 13 – Proposed compensation storage (red polygon)



8.3 PROPOSED BRIDGE OVER THE WESTERGATE STREAM

- 8.3.1. The current design assumes that this will be a free span bridge crossing with sufficient freeboard above the 1 in 100 year plus climate change peak level.

8.4 RESIDENTIAL DWELLINGS

- 8.4.1. The sequential approach within the site has been applied by allocating as many residential properties as possible within Flood Zone 1 and then the reminder in Flood Zone 2 (taking account of development constraints and within the plots available at the site - refer to **Figure 4**).

8.5 ATTENUATION BASINS

- 8.5.1. Basins are proposed for the attenuation of development surface runoff to reduce flows to greenfield runoff rates. These are located outside the 1 in 100 year plus 36% climate change fluvial extents. This allocation approach minimises the risk of fluvial water overflowing into the basins.

8.6 WATER COMPATIBLE USES

- 8.6.1. The following water compatible uses have been placed in the reminder of the site.

- Natural and semi natural green spaces;
- Biodiversity areas;

- Amenity green spaces;
- Areas of play;
- Cycle routes; and
- Allotments and community orchards.

8.7 SAFETY OF THE RESIDENTIAL DWELLINGS

- 8.7.1. The allocation of residential dwellings as far away as possible from all sources of flood risk, within the available plots at the site has followed the principle of avoidance - the sequential approach within the site. The main benefit of this principle is that the residential dwellings will be safe from all the relevant sources of high flood risk identified for the existing undeveloped site (refer to **Table 3** in **Section 3.1**).
- 8.7.2. The application of the principle of avoidance also translates into not increasing flood risk elsewhere, which could have resulted from diverting flood flows as a result of mitigation proposals (such as the installation of raised defences).

9 SAFE EMERGENCY ACCESS/EGRESS TO/FROM THE SITE

- 9.1.1. In addition to the East-West Link Road which will provide safe access/egress to and from the site, there is also the potential access to the North via St Richard's Road and to Nyton Road where the flood hazard is sufficiently low to allow access from emergency services. These are the alternative access routes, should Westergate Street become impassable during extreme rainfall events.
- 9.1.2. An Evacuation Plan for the development will ensure that future residents and visitors are aware of the procedures should an extreme flood event takes place. The plan will be fully developed for the detailed planning application based on the following principles:
- registering the development to flood warnings;
 - providing information of the flood risks from all sources of flooding and identifying areas to avoid during flood events;
 - providing full details of access/and egress routes;
 - develop a full procedure for evacuation if needed; and
 - ensuring that fire wardens are also briefed on flooding procedures.

10 SURFACE WATER STRATEGY

10.1 OVERALL APPROACH

ASSUMPTIONS

- 10.1.1. The proposed system is based on the design parameters used in the Masterplan of the previous planning application for the site. These assumptions are considered sufficient as the boundary of the site and the areas allocated for attenuation basins have not changed significantly.
- 10.1.2. It is anticipated that the final Masterplan will be available as a result of the outcome of the consultation process during this planning application.
- 10.1.3. It is not anticipated that the overall approach of the Drainage Strategy will change, however attenuation volumes may increase by around 5-10%. Additional areas for volume have been identified to allow for the eventuality that more volume attenuation will be required as a result of the final Masterplan.

A SEALED SYSTEM

- 10.1.4. The overall approach to the surface water strategy is to ensure that the drainage systems within the site are sealed and as shallow as possible. Sealed systems are needed to ensure that during extreme high groundwater levels, there is no groundwater intrusion into the system. It is anticipated that groundwater levels will be high during winter periods however these will not reach ground levels (**Ref 23**).
- 10.1.5. Shallow attenuation systems will be cheaper to maintain due to the presence of high groundwater. Shallow outfalls will have the advantage of working in free flow, even when the Lidsey Rife and the Westergate Stream are partially full. The outfalls into the river will be flapped to ensure there is no backing up of floodwater during extreme fluvial flood events, including the 1 in 100 year CC event (taking account of 36% flow increases due to climate change).

THE PREFERRED OPTION

- 10.1.6. The design includes a number of relatively shallow sealed basins located at the end of the drainage systems and prior to discharging into the Lidsey Rife, via flapped outfalls. They attenuate development runoff to QBAR, taking into account of long-term storage and the new FEH2022 rainfall. The FEH2022 rainfall increases the runoff volumes by approximately 3.3%, when compared to the FEH2013 estimates.
- 10.1.7. Some of the basins will have raised embankments. Their purpose is to:
- allow storage above ground level however without creating a significant backwater effect on the pipe system upstream;
 - allow a greater driving head to discharge into the Lidsey Rife, even if this is full,
 - stop any residual overland runoff entering them; and
 - stop fluvial flows entering for a more extreme event above the design fluvial 1 in 100 year plus 36%CC event (not through the flapped outfalls but from overtopping of the Lidsey Rife).

OTHER DISCOUNTED OPTIONS

- 10.1.8. The soakaway solution was considered for the northern part of the site where groundwater levels were found lower than to the south. The drop in water levels measured during the successive infiltration tests were not significant enough to determine infiltration rates. Although infiltration rate values could not be obtained, the tests confirmed that seepage to the ground is not a suitable mean to dispose surface water from the site. The soakaway option has therefore been discounted.
- 10.1.9. Permeable paving was considered as a potential option. However due to high groundwater levels there is limited scope to implement extensively such structures at the site, other than at specific locations and in shallow and tanked configuration.
- 10.1.10. The current strategy is considering an alternative option which is focusing on the use of a limited number of sealed basins (4 number) to ensure the long-term functionality of the system. Permeable paving in large areas of high groundwater can easily allow groundwater intrusion over the years and finding the location of groundwater intrusion would be very difficult. A replacement of large areas of permeable paving every 20 years would be prohibitive for the development; therefore, having a limited number of sealed basins allows easy monitoring and repair of potential groundwater intrusion.

11 MANAGEMENT OF WATERCOURSES WITHIN THE SITE

11.1 MINOR WORKS DURING CONSTRUCTION

11.1.1. The following works are proposed once the earthworks are completed:

1. All ditches within the site boundary will be cleaned out (including any on the boundary for which there is shared responsibility), to be desilted where necessary and the bankside vegetation managed to enable access to the ditches for future maintenance.
2. Minor embankment works may be required to re-instate ditches **E-D** and **X-D-F** in addition to the works identified in point 1 above.
3. If possible, and subject to landowner agreement, clearance/desilting will be extended to point **A** in **Figure 14**, where the public surface water sewer connects. Alternatively culverting may be required (to be investigated during the detailed planning application stage). This will help to ensure that this heavily silted section does not have a negative effect on any ditches within the site boundary that are cleaned out i.e., silt transportation. It will also benefit existing development to the west.
4. The shortening of any ditches which are no longer used for the proposed development, will be replaced with similar lengths elsewhere (this will be investigated as part of the detailed planning application).

11.1.2. Once the planning application is approved and prior to initiating these minor works, consents may be required from Arun District Council for any culverting / crossing points proposed on the local ditch network (refer to <https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/dealing-with-flooding/flood-risk-management/ordinary-watercourse-land-drainage-consent/>). This includes any footpath crossing over the local ditch network.

11.1.3. Once the planning application is approved, Environment Agency consents (called Environmental Permits) will be required for any works within 8m to the Lidsey Rife.

11.2 MAINTENANCE REGIME

11.2.1. Independently from the type of watercourse, it is proposed that a maintenance regime is targeted to avoid blockages of watercourses, in particular at culvert locations. This applies to all ditches within the site boundary or where there is shared responsibility, as follows:

- Removal of potential sources of blockages in vicinity to the watercourses (in particular loose trees that could result in a partial blockage of the railway culvert);
- Removal of obstructions within the watercourses and plant growth (particular care needs to be taken to avoid affecting trees and tree roots);
- Walkovers to ensure that the watercourses will work as intended during a flood event (for example protecting the bank slopes to avoid erosion);

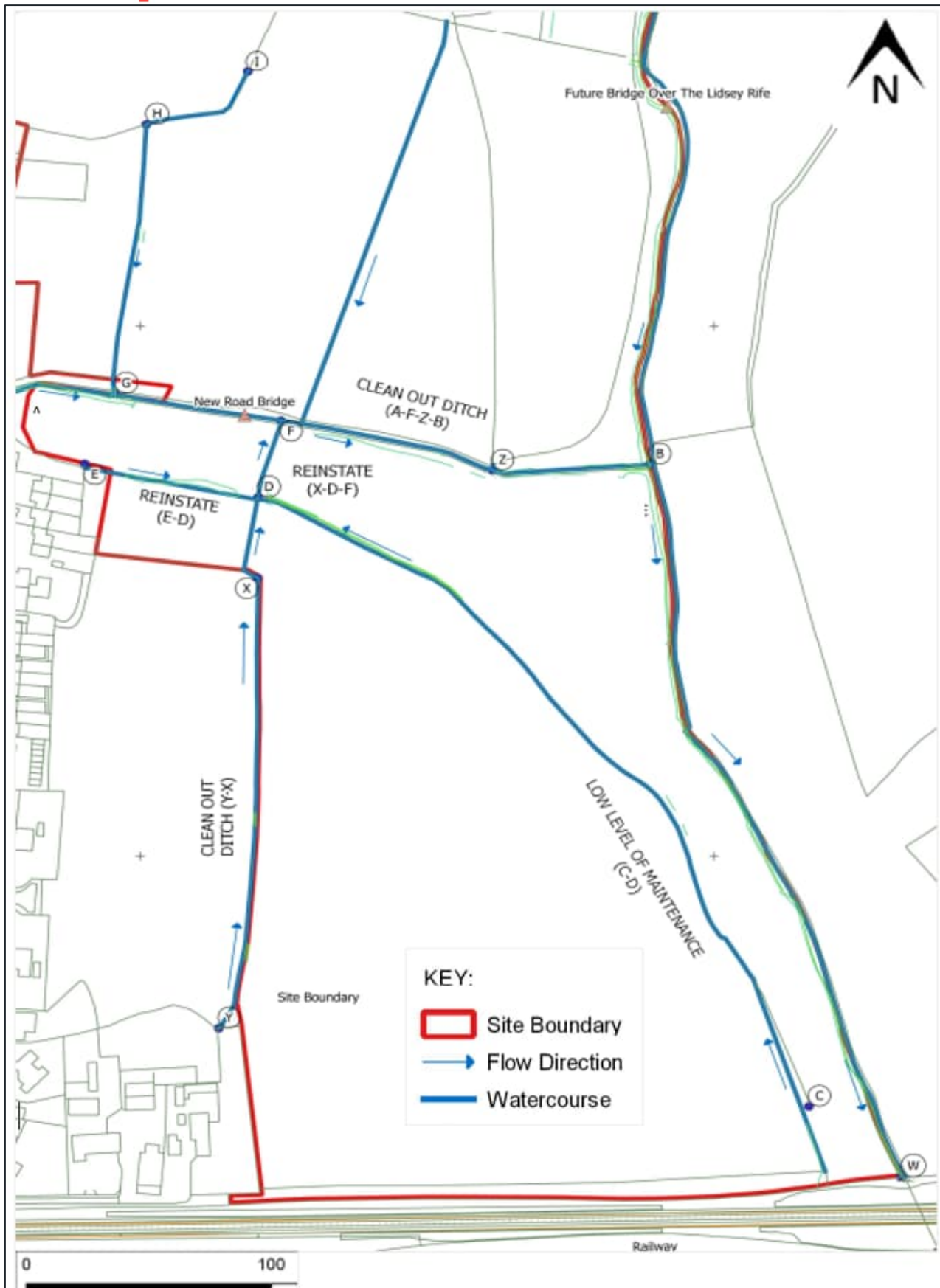


Figure 14 - Ditches Requiring a Maintenance Regime

- Allow for a free access corridor to ensure easy access in the vicinity of the banks (the Environment Agency requires 8m access however for the other watercourses a 6m access corridor should be sufficient);
- Removal of silt at critical locations;
- Ensure that the two proposed crossings over the Westergate Stream (refer to **Figure 14**) are structurally safe and maintained to the required standard,

11.2.2. The level of maintenance required will depend on location and seasonality and therefore a flexible arrangement needs to be in place, so that the Maintenance Manual is updated regularly during the life of the development; this is to ensure that the objective of avoiding blockages is achieved.

12 CONCLUSIONS

12.1 EXISTING FLOOD RISK

- 12.1.1. This FRA has investigated all sources of potential flood risk within and in the vicinity of the existing site (pre-development condition), based on the sources of information collected.
- 12.1.2. A summary of all the relevant sources of flood risk is provided in **Table 6** below.

Table 6 - Overview of existing sources of flood risk

SOURCE OF FLOOD RISK	LEVEL OF RISK	COMMENT
Fluvial flood risk	Yes, high	The existing site is within Flood Zones 2 and 3.
Surface water flood risk from overland flows	Yes, high however only within the fluvial floodplain	Shallow flooding is anticipated from this source based on the modelling undertaken for the area.
Residual fluvial flood risk	Yes, high however only upstream the railway culvert	The residual flood risk from this source is from partial or full blockages of culverts along the Lidsey Rife and the Westergate Stream, mainly the railway culvert located at the downstream (south-east corner) of the existing site.
Residual foul flood risk	Yes, high however only within the fluvial floodplain	There is indication that groundwater intrusion into the foul drains results in manholes overflowing within the existing site.

12.2 SEQUENTIAL ALLOCATION OF LAND USES

- 12.2.1. Taking account of the existing sources of flood risk, this FRA avoids flood risk by sequentially allocating residential units away from all flood risk areas, including Flood Zone 3 and the conservative fluvial 1 in 100 year plus climate change (Higher estimate) extent.
- 12.2.2. The application of the principle of avoidance also translates into the avoidance of increasing flood risk elsewhere, which could have resulted from diverting flood flows because of mitigation proposals (such as the installation of raised defences).
- 12.2.3. For a residential scheme the central allowance of 25% would be sufficient in accordance with national guidance. However, due to the presence of critical infrastructure and to maximise the sustainability of the development, the following allowances have been adopted for different elements of the design:
1. Higher 36% allowance to ensure that the following land uses are placed outside the 1 in 100 year plus 36% CC flood extents:
 - a. the residential land uses;
 - b. the development runoff attenuation basins;
 - c. compensation storage areas; and
 - d. the proposed bridge and abutments.

2. Upper 64% allowance to estimate the peak water level at the proposed bridge over the Lidsey Rife, and thus to check that there is sufficient freeboard and for the estimate of compensation storage requirements.

12.2.4. It is proposed that all finished floor levels are placed 0.2m above existing ground levels, to ensure that any residual flood risk, such as burst pipes or blocked drainage systems, do not affect any property. An Evacuation Plan will be fully developed for the detailed planning application however the key principles have been set in this application. A robust framework for the development of a Maintenance Manual of all watercourses within the site is proposed; this will be completed as part of the detailed planning application.

12.3 SAFE ACCESS/EGRESS

12.3.1. In addition to the East-West Link Road which will provide safe access/egress to and from the site, there is also the potential access to the North via St Richard's Road and to Nyton Road, where the flood hazard is sufficiently low to allow emergency vehicles to the site. These are the alternative access routes, should Westergate Street become impassable during extreme rainfall events.

12.4 SURFACE WATER STRATEGY

- 12.4.1. The overall approach to the surface water strategy is to ensure that the drainage systems within the site are sealed and as shallow as possible. Sealed systems are needed to ensure that during extreme high groundwater levels, there is no groundwater intrusion into the system.
- 12.4.2. Shallow attenuation systems will be cheaper to maintain due to the presence of high groundwater. Shallow outfalls will have the advantage of working in free flow, even when the Lidsey Rife and the Westergate Stream are nearly full. The outfalls into the river will be flapped to ensure there is no backing up of floodwater during extreme fluvial flood events, including the 1 in 100 year CC event (taking account of 36% flow increases due to climate change – the Higher allowance).
- 12.4.3. The design includes several relatively shallow sealed basins located at the end of the drainage systems and prior to discharging into the Lidsey Rife, via flapped outfalls. They attenuate development runoff to greenfield rates, considering long-term storage and the new FEH2022 rainfall. The FEH2022 rainfall increases the runoff volumes by approximately 3.3%, when compared to the FEH2013 estimates. The basins will be located outside the conservative 1 in 100 year plus climate change (Higher estimate) flood extent.

12.5 OVERALL CONCLUSION

The application of the principle of avoidance of all sources of flood risk including the conservative 1 in 100 year climate change (Higher estimate) flood extent, ensures the resilience of the development. This principle together with the following approach has resulted in acceptable levels of residual flood risk: a) setting finished floor levels 0.2m above existing ground levels, b) setting the foundations for developing a full Evacuation Plan and a Maintenance Manual for watercourses within the site, and c) developing a robust Surface Water Drainage Strategy.

APPENDIX A - TOPOGRAPHIC SURVEY





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wsp.com

PUBLIC