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Concept Drainage Strategy for Lancing Meadows, Barns at New Salts Farm and Land East of Adur Close

Version 3

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Adur and Worthing
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This report describes work commissioned by Moira Hayes on behalf of Adur and Worthing Councils by an instruction dated May 2025. The Client's representative for the contract was Moira Hayes of Adur and Worthing Councils. George Williams and Faye Tomalin of JBA Consulting carried out this work.

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Abbreviations

AEP	Annual Exceedance Probability
BFIHOST	Base Flow Index estimated from soil type
BGS	British Geological Survey
CC	Carbon Calculator
CDM	Construction (Design and Management) Regulations 2007
CIRIA	Company Providing research and training in the construction industry
DTM	Digital Terrain Model
EA	Environment Agency
FEH	Flood Estimation Handbook
FMfP	Flood Map for Planning
ID	Identifier
LiDAR	Light Detection And Ranging
NGR	National Grid Reference
OS	Ordnance Survey
OS NGR	Ordnance Survey National Grid Reference
QBAR	Mean Annual Maximum Flood
ReFH	Revitalised Flood Hydrograph method
SAAR	Standard Average Annual Rainfall (mm)
SFRA	Strategic Flood Risk Assessment
SPRHOST	Standard percentage runoff estimated from soil type

1 Introduction

1.1 Terms of Reference

JBA Consulting were commissioned by Adur and Worthing Councils to prepare a Concept Drainage Strategy (CDS), which shall outline the opportunities and constraints for site surface water drainage for identified proposed candidate sites as part of the Level 2 Strategic Flood Risk Assessment (SFCA). This report shall highlight site-specific opportunities and constraints, along with advice for potential developers on the data requirements and site investigations that should be undertaken and submitted with any future planning submission.

1.2 Site Descriptions

This CDS focuses on three proposed site areas, all located within Adur District Council authority boundary, to the west of the Tidal River Adur as shown in Figure 1-1. The three site areas are;

- The Lancing Meadows
- Land East of Adur Close
- Barns at New Salts Farm

The Lancing Meadows site comprises of five separate sites;

- Land East of Minstrels Gallery
- Land South of Minstrels Gallery
- Land North of Minstrels Gallery
- Land North West of West Avenue
- Land North of Willowbrook Park

Each site is further described below with an overview given to the Lancing Meadow Sites as a whole.

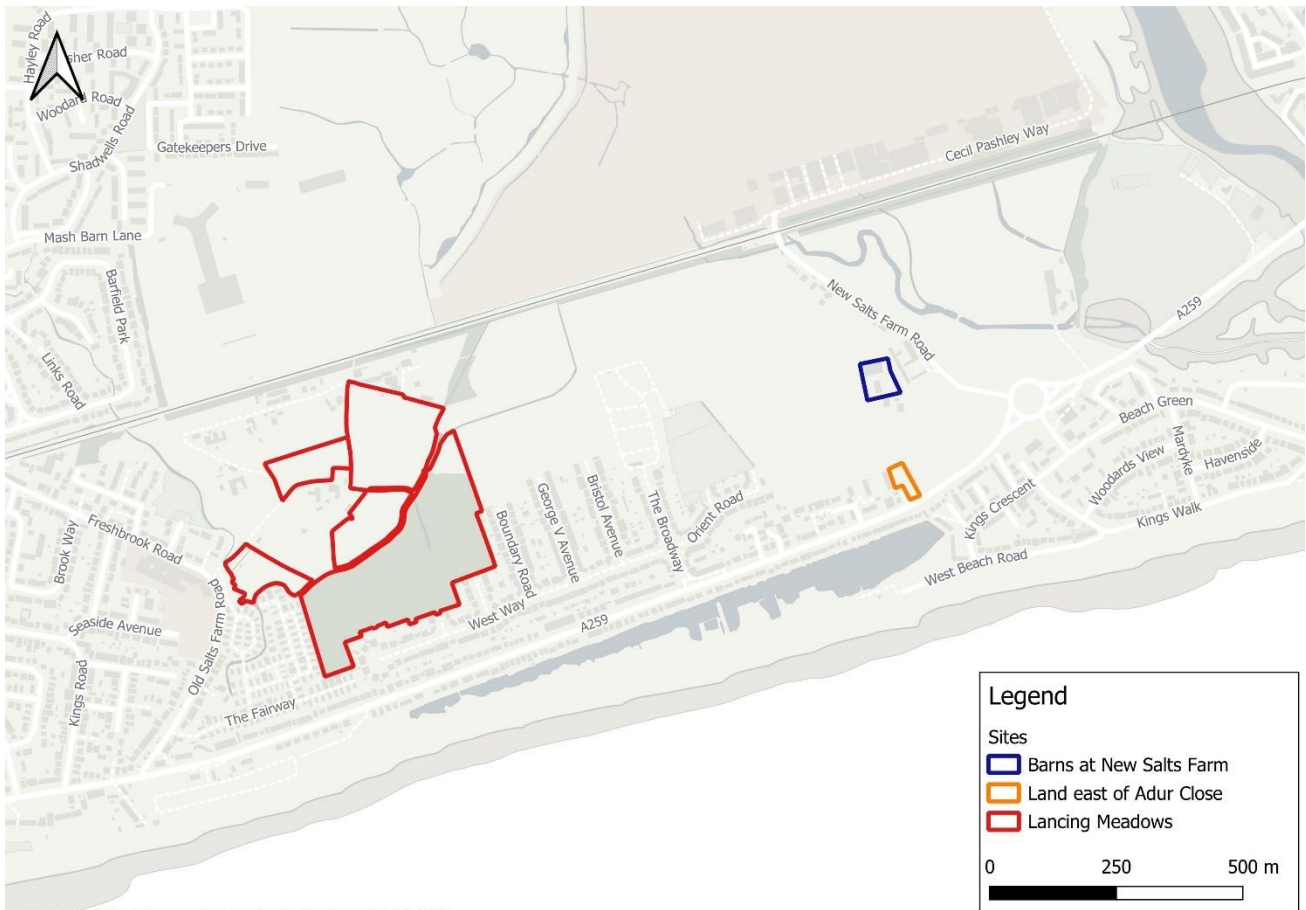


Figure 1-1 Site Overviews

Lancing Meadows

Lancing Meadows is located approximately 1.75km to the west of the River Adur and 300m-500m north of Glancer beach. The total area of the Lancing Meadows site is approximately 13.7ha and comprises of five individual sites, as seen in Figure 1-2. All five sites are currently greenfield in nature.

Lancing Meadows is situated to the north and east of an existing residential area. The coastline is located towards the south, with the A259, a main through road, located to the south of the site. The Network Rail Main Line is located to the north of the site, with the airport beyond. Access to the site will vary depending on the parcel of land in question but Old Salts Farm Road provides access to the majority of the sites. Table 1-1 provides a summary of each site which combines to form Lancing Meadows.

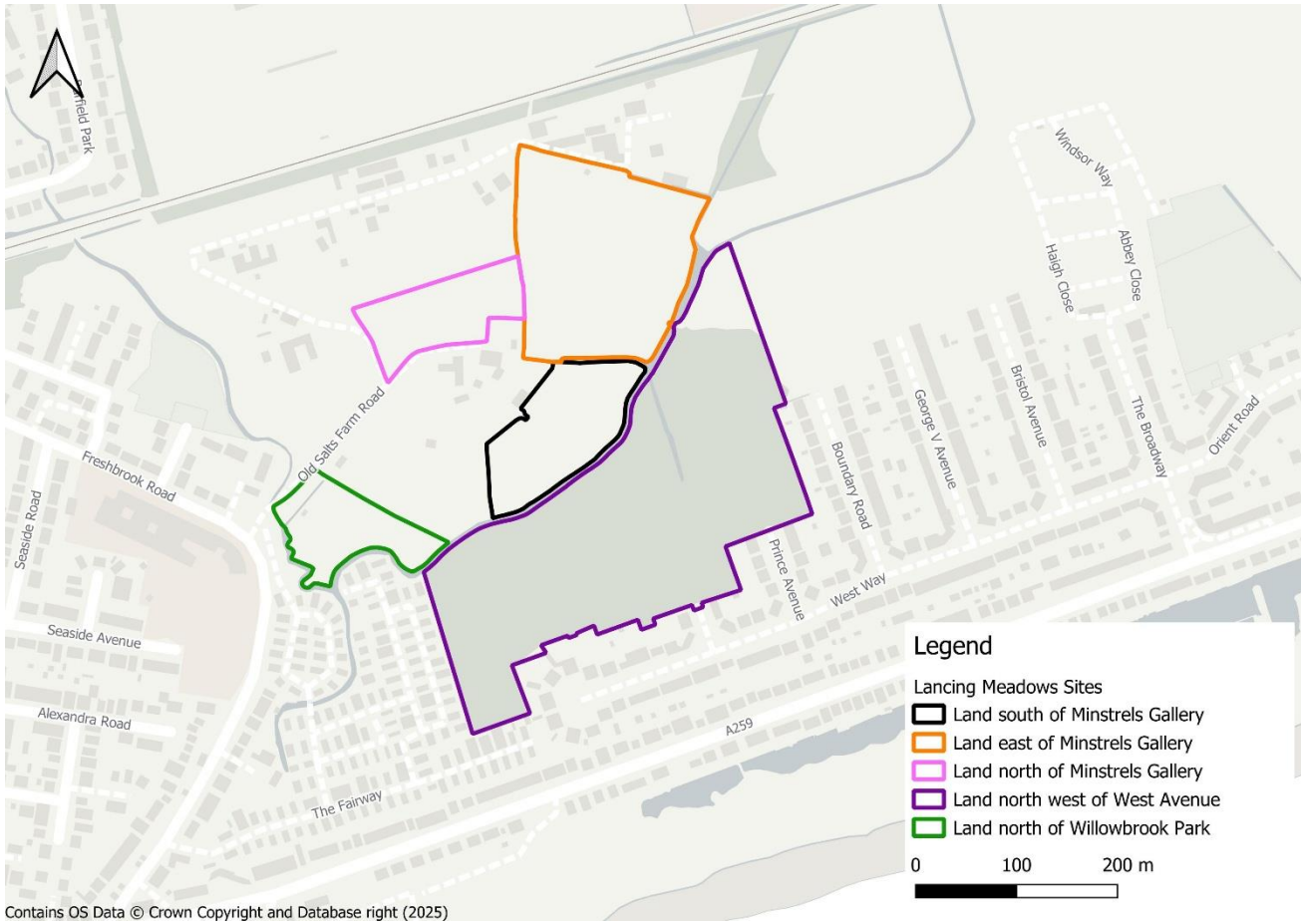


Figure 1-2 Lancing Meadows Site Overview

Table 1-1 Site Overviews

Site Location	Site Area (ha)	OS NGR	Postcode	Existing Land Use	Lead Local Flood Authority	Sewage Undertaker
Land North West of West Avenue	7.27	TQ 19397 04308	BN15 8NB	Greenfield - agricultural purposes/ scrubland	West Sussex County Council	Southern Water Services Limited
Land North of Willow Brook Park	0.95	TQ 19127 04298	BN15 8GB	Greenfield - agricultural purposes	West Sussex County Council	Southern Water Services Limited
Land South of Minstrels Gallery	1.36	TQ 19338 04395	BN15 8ND	Greenfield - agricultural purposes	West Sussex County Council	Southern Water Services Limited

Site Location	Site Area (ha)	OS NGR	Postcode	Existing Land Use	Lead Local Flood Authority	Sewage Undertaker
Land East of Minstrels Gallery	3.1	TQ 19363 04546	BN15 8JQ	Greenfield - agricultural purposes	West Sussex County Council	Southern Water Services Limited
Land North of Minstrels Gallery	1.02	TQ 19237 04523	BN15 8JG	Greenfield - agricultural purposes	West Sussex County Council	Southern Water Services Limited

Land East of Adur Close

The site currently comprises greenfield land, which appears to consist of overgrown vegetation, located to the east of Adur Close. The site is bounded by agricultural land to the north and east, Brighton Road to the south and residential properties to the west. Access to the site is provided by Adur Close. Table 1-2 below provides a summary of the site.

Table 1-2 Land East of Adur Close

Site descriptors	Site details
Site Location	Land East of Adur Close
Site Area (ha)	0.20
Existing Land Use	Greenfield
OS NGR	TQ 20399 04486
Lead Local Flood Authority	West Sussex County Council
Sewerage Undertaker	Southern Water Services Limited

Barns at New Salts Farm

The site currently comprises of three existing barns that are agricultural in use, located to the west of New Salts Farm Road. The site is bounded to the north and west by agricultural land and to the south and east by residential properties. Access is via a track located off New Salts Farm Road. Table 1-3 below provides a summary of the site.

Table 1-3 Barns at New Salts Farm

Site descriptors	Site details
Site Location	Barns at New Salts Farm
Site Area (ha)	0.44
Existing Land Use	Existing Agricultural Barns
OS NGR	TQ 20339 04704
Lead Local Flood Authority	West Sussex County Council

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Site descriptors	Site details
Sewerage Undertaker	Southern Water Services Limited

1.3 Watercourses

The River Adur, a tidally influenced EA-designated main river, is located approximately 1.75km to the east of the Lancing Meadows sites, 0.86km to the east of Land East of Adur Close and 0.75km to the east of Barns at New Salts Farm, as seen in Figure 1-5.

The River Adur flows in a southerly direction towards the English Channel, where it discharges.

A series of small, unnamed, ordinary watercourses transgress or pass close to the Lancing Meadows sites. These watercourses run initially in a north-easterly direction and then in an easterly direction towards the River Adur.

No watercourses pass through the Land East of Adur Close site or the Barns at New Salts Farm site.

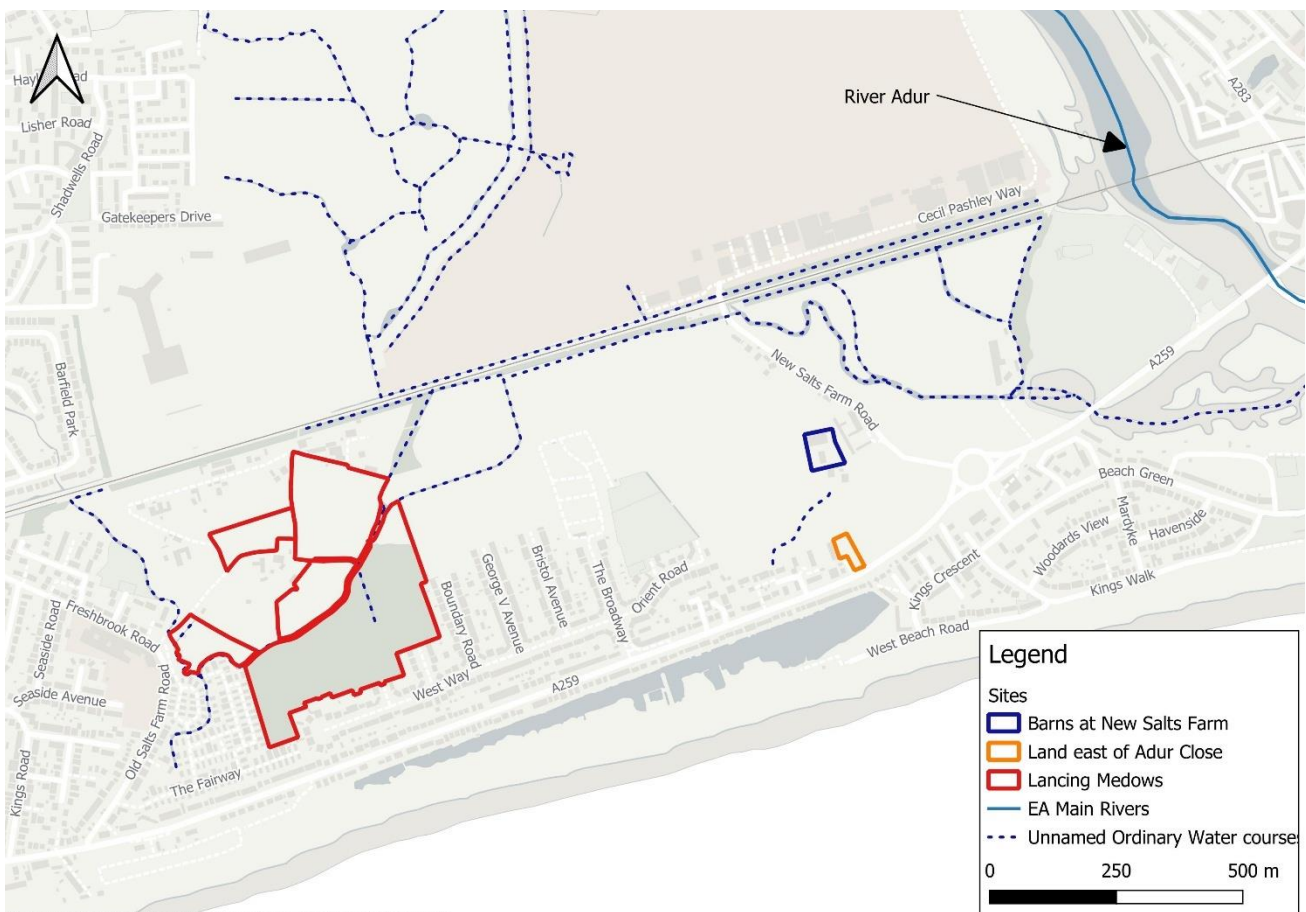


Figure 1-3 Watercourses

1.4 Topography

Currently, no topographic surveys are available for proposed sites. In place of a site-specific topographic survey, publicly available EA Light Detection and Ranging (LiDAR) data has been used to infer site levels. An overview of the topography for each site is given below.

Lancing Meadows

Across Lancing Meadows there is a general fall from the north-west to the south-east towards an existing watercourse located to towards the southern extent of the area. A brief overview of each individual site's topography is given below in Table 1-4.

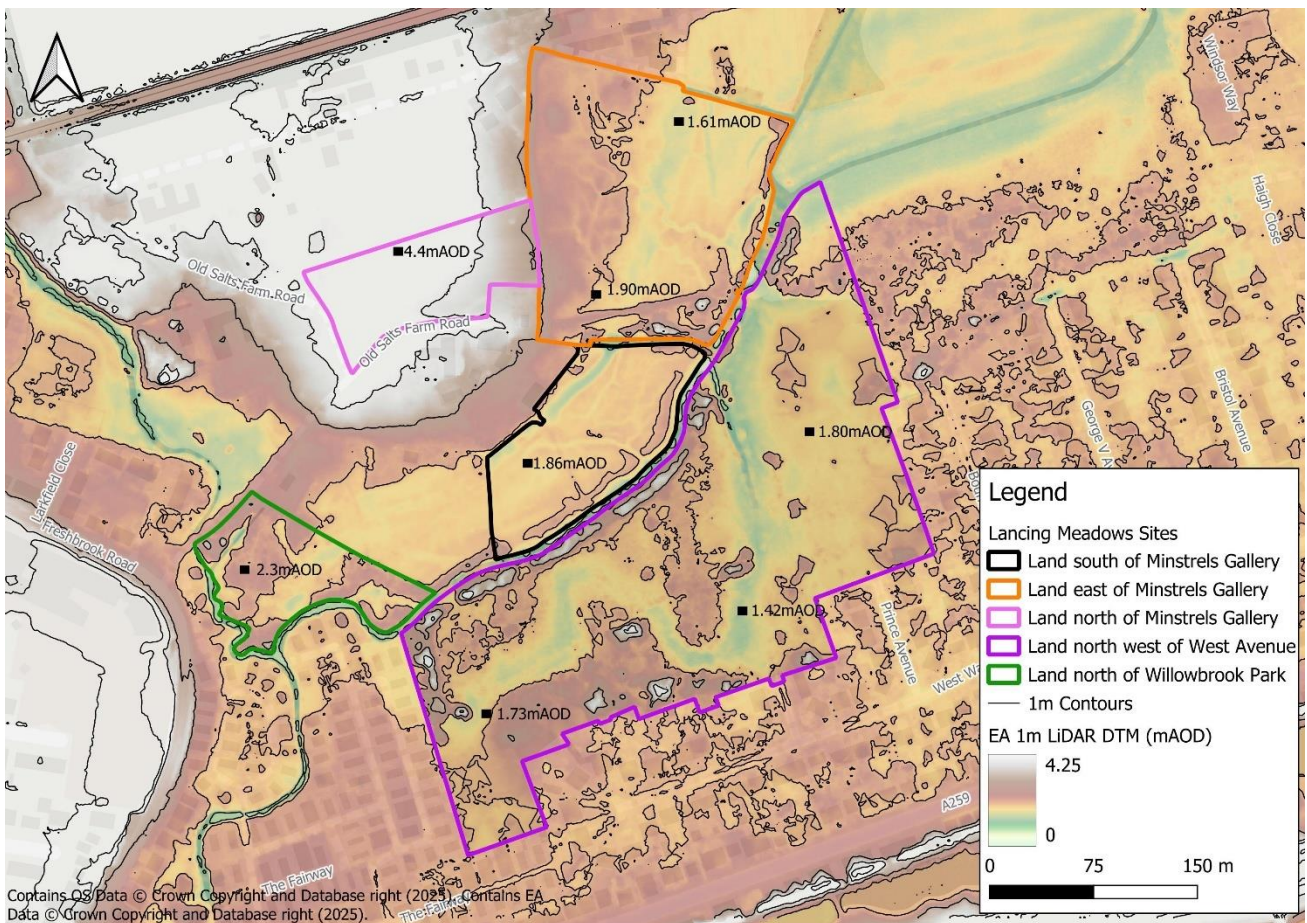


Figure 1-4 Lancing Meadows Topography

Table 1-4 Topography Overview of Lancing Meadow Sites

Site	Description of Topography
Land North West of West Avenue	
Land North of Willowbrook Park	The highest elevations are found in the north-west corner of the site at around 2.4mAOD. Typically, site levels are around 2.0-2.3mAOD. Some topographic depressions are present where elevations are as low as 1.5mAOD.
Land South of Minstrels Gallery	
Land East of Minstrels Gallery	Site levels fall in a general west-to-east direction, with the highest elevation found in the west and northwest of the site, and the lowest in the east. Highs are around 2.75mAOD, and lows are typically around 1.42mAOD.
Land North of Minstrels Gallery	

Land East of Adur Close

The site is predominantly flat, with a slight fall from a south-easterly to north-easterly direction, as shown in Figure 1-5. The highest levels on the site are found in the south-east corner of the site at 3.33mAOD. The lowest elevation is in the northeast at approximately 1.86mAOD. Typically, ground levels are around 2.0mAOD across the site.

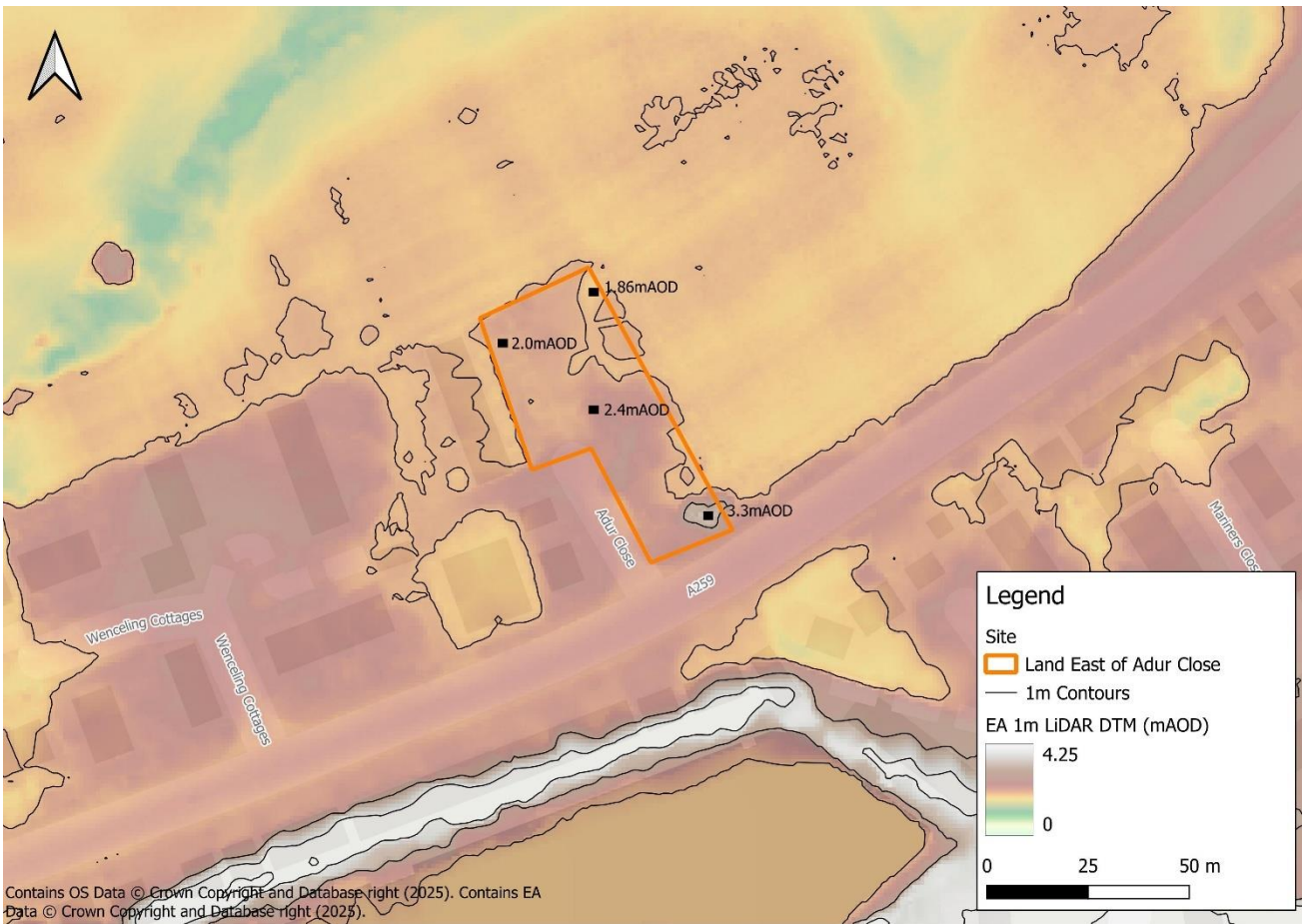


Figure 1-5 1m EA LiDAR DTM- Land East of Adur Close

Barns at New Salts Farm

LiDAR data indicates that the site falls in a south-easterly to north-westerly direction, as shown in Figure 1-6. The highest point on the site is within the southeast corner of the site at approximately 3.99m AOD, with the lowest elevation of 1.98m AOD in the northwest corner. Typically, elevations are around 2.2m AOD to 2.4m AOD.

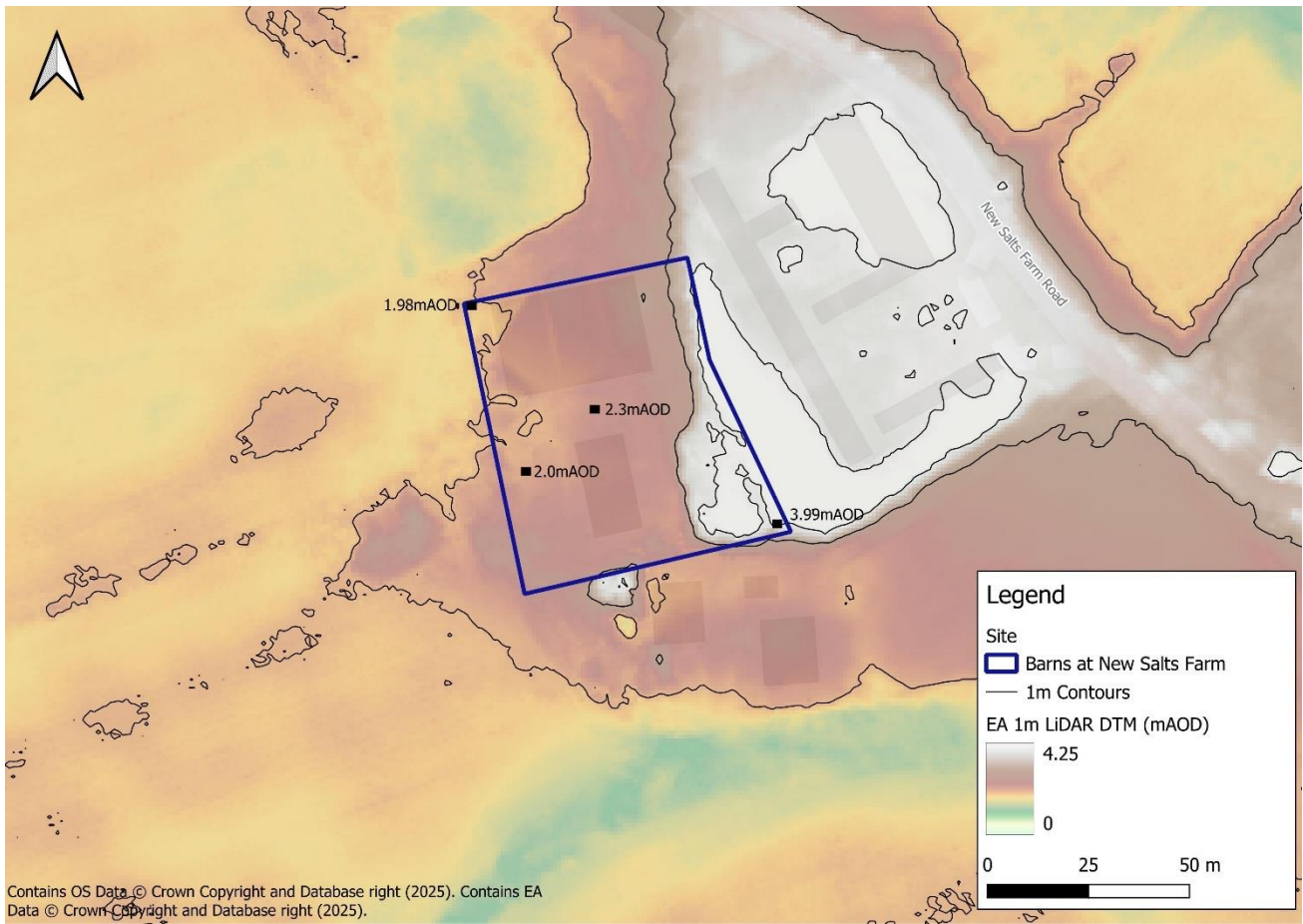


Figure 1-6 1m EA LiDAR DTM- Barns at New Salts Farm

1.5 Surface Water Flood Risk

Surface water flooding arises following periods of intense rainfall, or rain falling on saturated soil that is unable to soak into the ground or where drainage systems are insufficient or unable to manage surface water runoff. This surface water runoff forms overland flow when following the topography of the land, often pooling in topographic low spots. Surface water flooding and subsequent overland flow can also originate from surcharging or blocked sewers and drains.

Overland flow can pose a risk to both the development site and the land surrounding the development site. Overland flow can originate within the development site itself or from adjoining land at a higher elevation, from which flow migrates onto the development area. The layout of the proposed development needs to reflect, and where necessary, mitigate against these risks. Development should be located outside of existing overland flow paths and watercourse corridors. It is encouraged for overland flow routes to be enhanced or retained within a wider drainage strategy. This proposed strategy has, where possible, retained and enhanced existing surface water flow paths and treated them as an asset in the development of the concept drainage strategy.

The risk of flooding from surface water has been outlined below.

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Lancing Meadows

Within the Lancing Meadows sites, the flood risk from surface water varies between the sites, with all sites having some areas at High and Medium risk. Medium risk areas have between a 1% AEP and 3.3% AEP chance of flooding as shown in Figure 1-8. High-risk areas are at a greater than 3.3% AEP chance of flooding from these sources. Typically, the areas at risk are associated with existing channels or watercourses or with topographical depressions as shown in Figure 1-7. A further detailed breakdown per site is provided below. This observed risk is likely to be adequately managed through the use of SuDS techniques and a comprehensive surface water drainage strategy.

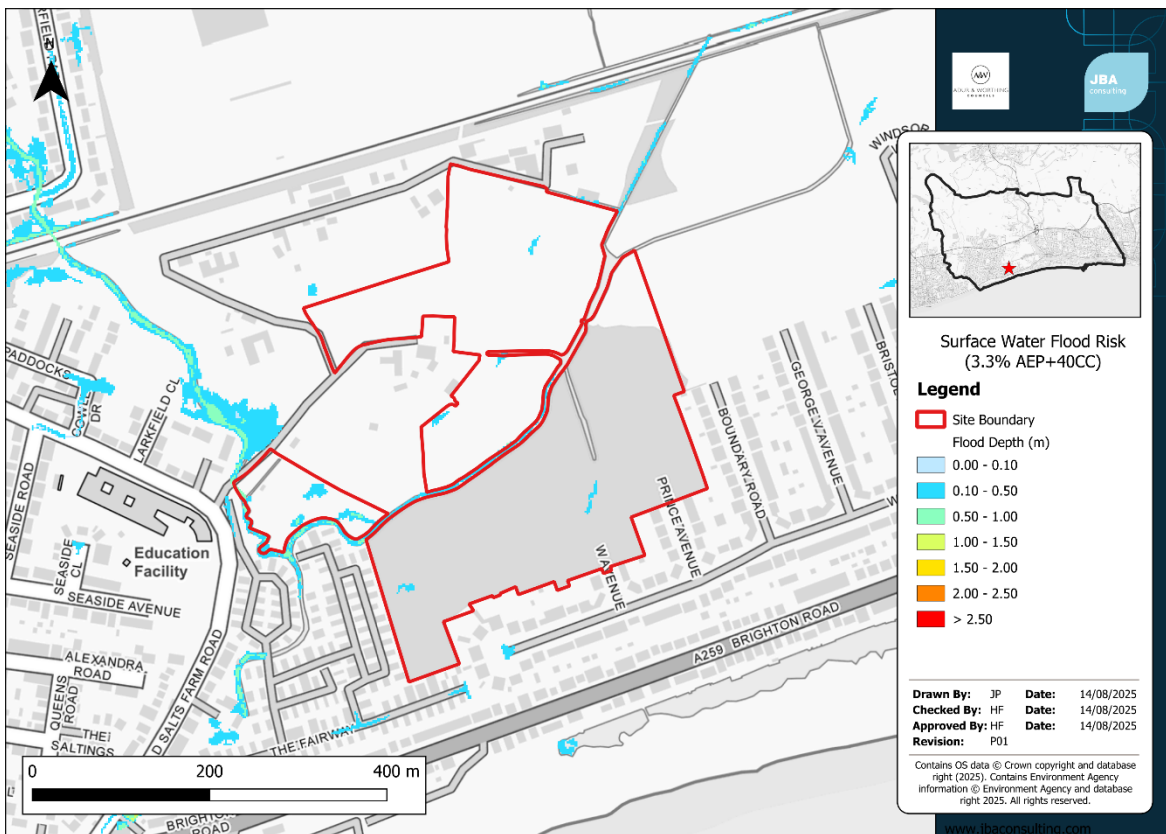


Figure 1-7 Lancing Medows - Surface Water Flood Risk Depth (m) High Risk Scenario

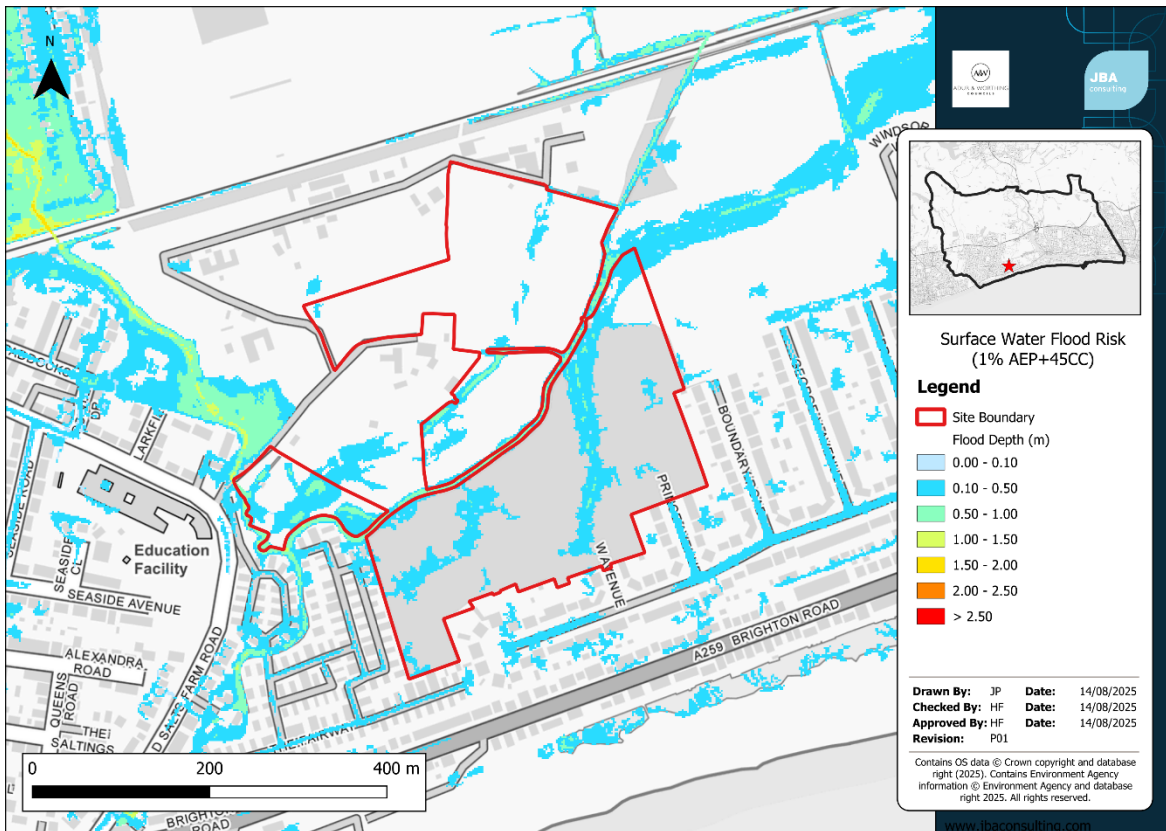


Figure 1-8 Lancing Meadows - Surface Water Flood Risk Depth (m) Medium Risk Scenario

Table 1-5 Surface Water Overview for Each Site

Site	Description of Surface Water Flood Risk
Land North West of West Avenue	
Land North of Willowbrook Park	The site is shown to have more extensive areas at medium and high risk associated with an existing surface water channel that transgresses the site in a south to east direction and topographic depressions. Depths out of the channels in all events are shallow.
Land South of Minstrels Gallery	Depths in all events are shallow.

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Site	Description of Surface Water Flood Risk
Land East of Minstrels Gallery	<p>Mostly at low and very low risk from surface water flooding; however, there are areas at medium and high risk. These areas are associated with an existing surface water channel that runs towards the eastern boundary of the site.</p> <p>Depths in all events are low, reducing the hazard and meaning the site could be managed by an adequate future drainage strategy</p>
Land North of Minstrels Gallery	

Land East of Adur Close

The site is predominantly at very low risk of Surface Water flooding, meaning there is a less than 0.1% (1 in 1000 year) AEP chance of surface water flooding at the site. Furthermore, the site is shown to be outside the extent for surface water flooding during both the 'medium' and 'high risk' scenarios. No Figure has been provided as very low risk is represented by a transparent layer.

Therefore, it's been assessed that the risk from surface water flooding is very low.

Barns at New Salts Farm

As with the Land East of Adur Close site much of the site is at very low risk of Surface Water flooding, meaning there is a less than 0.1% (1 in 1000 year) AEP chance of surface water flooding at the site. Furthermore, the site is shown to be outside of the extent for surface water flooding during both the 'medium' and 'high risk' scenarios. No Figure has been provided as very low risk is represented by a transparent layer.

Therefore, it's been assessed that the risk from surface water flooding is very low.

1.6 Flood Map for Planning - Flood Risk from Rivers and the Sea.

All sites are shown to be within Flood Zone 3 of the EA FMfP- Flood Risk from Rivers and the Sea, as shown in Figure 1-9 to 1-15 . A small area of the Lancing Meadows site, within the Land North of the Minstrels Gallery area, is located within Flood Zone 2.

Areas in Flood Zone 3 have a between 3.3% (1 in 30 year) AEP and 1% (1 in 100 year) AEP chance of flooding from fluvial mechanisms or 3.3% AEP and 0.5% (1 in 200 year) AEP chance of coastal flooding in any given year.

Whereas those areas in Flood Zone 2 have a between 1.0% (1 in 100 year) AEP and 0.1% (1 in 1000 year) AEP chance of flooding from fluvial mechanisms or 0.5% (1 in 200 year) AEP and 0.1% AEP chance of coastal flooding in any given year.

The main source of flood risk to all the sites is tidal risk. This has been detailed further below.

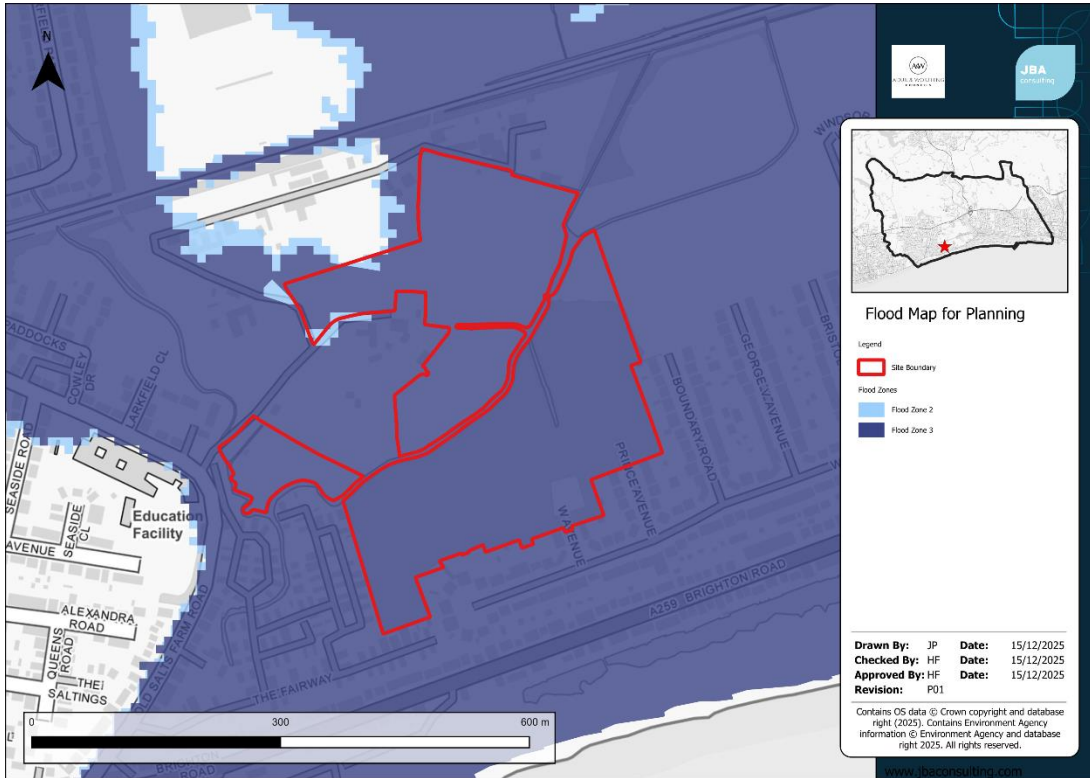


Figure 1-9 Lancing Meadows - EA FMfP - Flood Risk from Rivers and the Sea

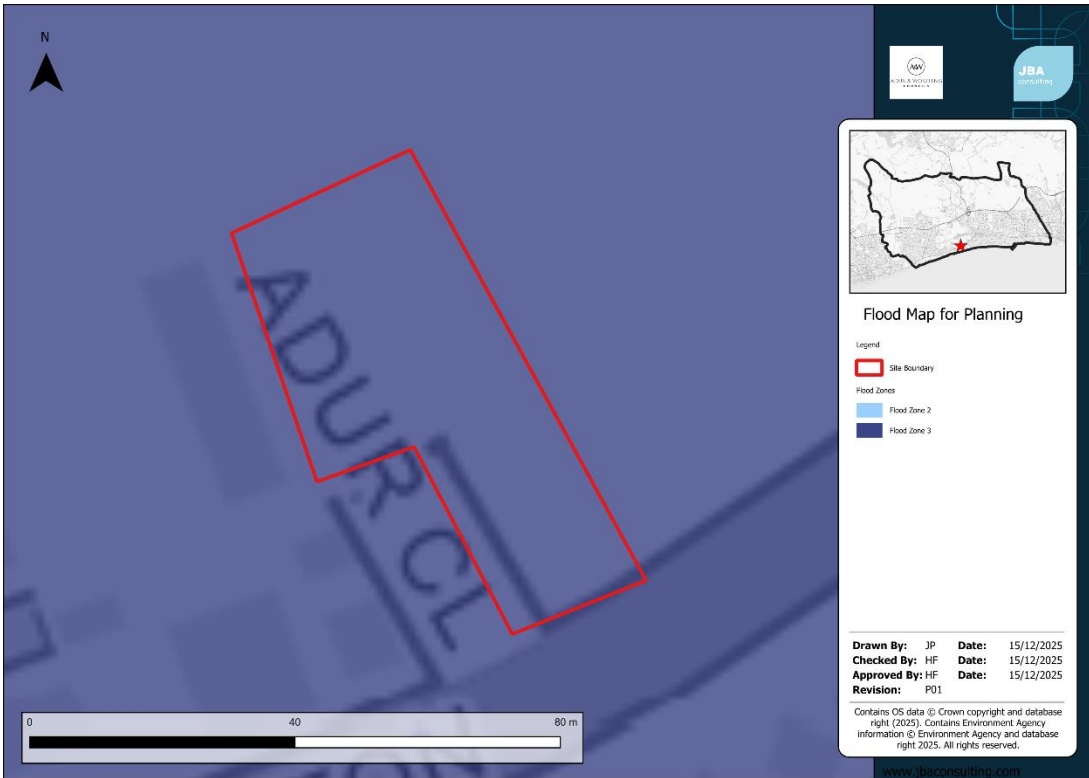


Figure 1-10 Land east of Adur Close - EA FMfP - Flood Risk from Rivers and the Sea

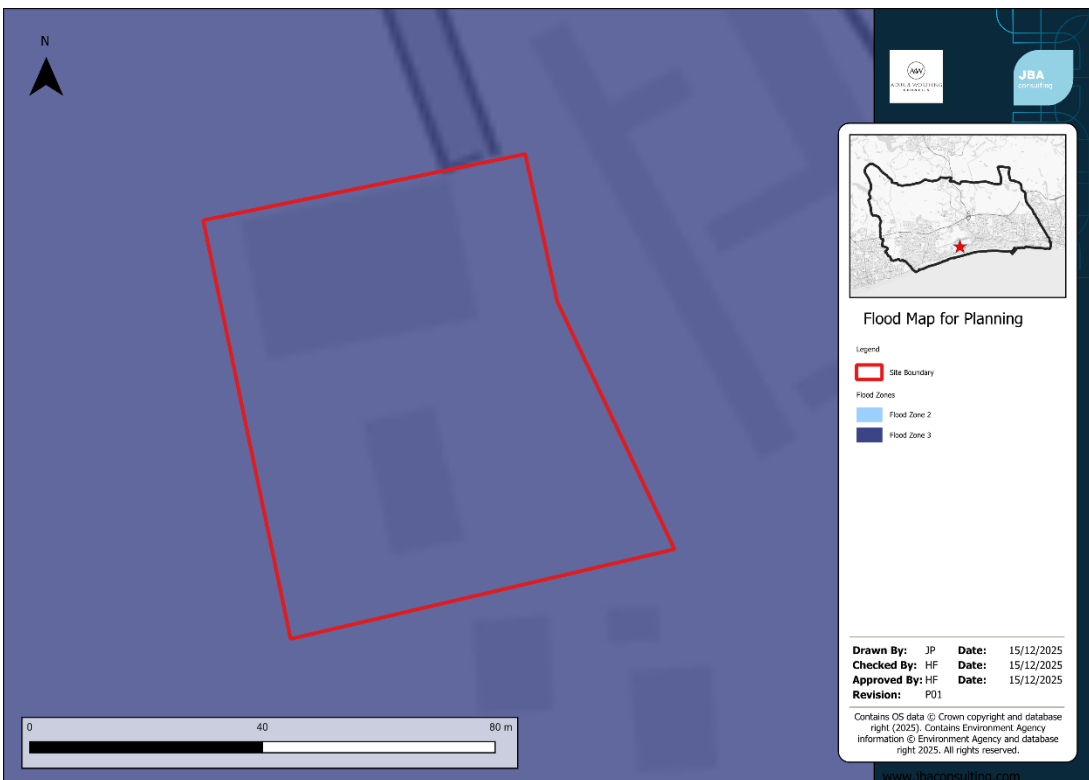


Figure 1-11 Barns at New Salts Farm - EA FMfP - Flood Risk from Rivers and the Sea

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1.6.1 Tidal Flooding

Tidal flood risk is a constraint to the development of the candidate sites, which has been detailed further in site specific flood risk appraisals outside of this report. The Ciria SuDS Manual (C753) advises that SuDS should not be placed in areas of Flood Zone 3 (areas at risk of flooding in a greater than 0.5% AEP event, plus an allowance for climate change) due to risk of inundation and capacity issues during instances in which the tidal flood event coincides with the peak rainfall event. Below, an overview of the predicted tidal flood risk has been undertaken for each of the sites.

Lancing Meadows Sites

Detailed modelling of the area provides an overview of the predicted flood risk to the proposed development sites. Despite the presence of flood defences along the River Adur, the site is predicted to flood in the 0.5% AEP plus climate change event. Figure 1-13 presents the model results, demonstrating significant flood depths across the site.

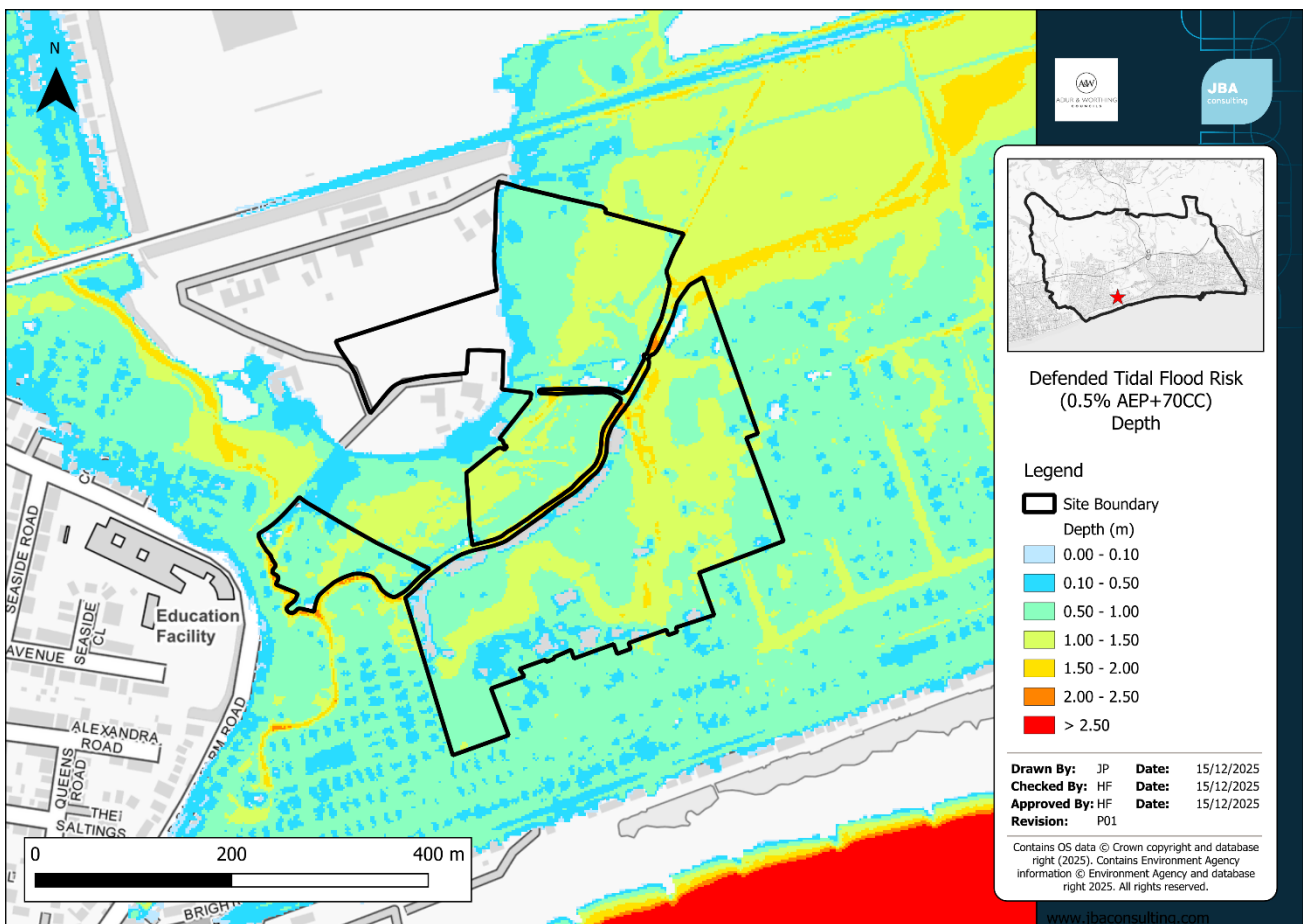


Figure 1-12 2125 70th Percentile 0.5% AEP Max Depth - Lancing Meadows Site

Land East of Adur Close

As with the Lancing Meadows site, the Land East of Adur Close is not located in an area at tidal risk during the present day. However, when considering the impacts of climate change, OYL-JBA-XX-XX-RP-D-0001-S0-P02-Lancing_Meadows_Concept_Drainage_Strategy

the site is shown to be at risk from tidal flooding. The predicted flood depths for the 0.5% AEP plus climate change event are shown in Figure 1-14., and range predominantly between 0.5 and 1.0m.

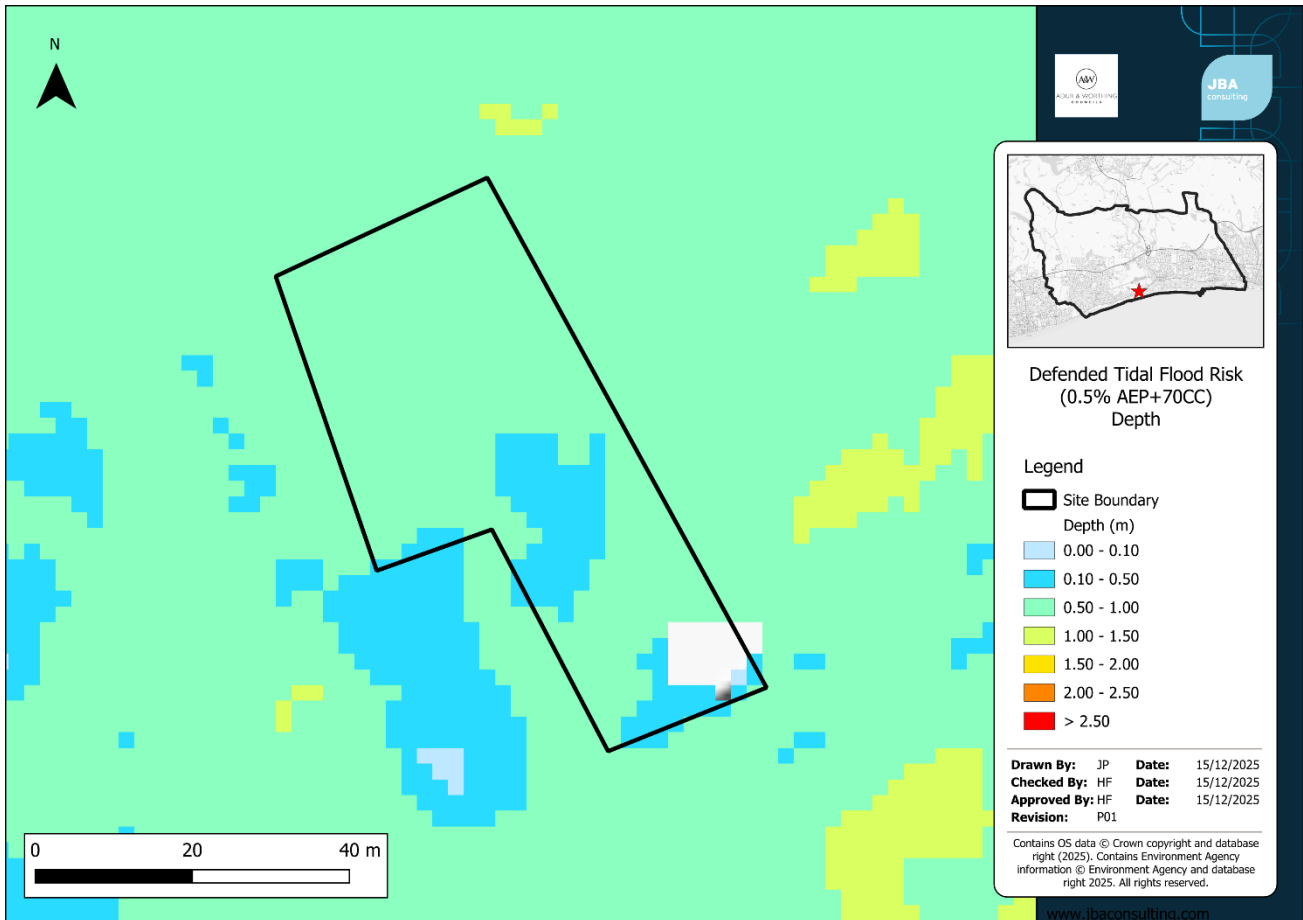


Figure 1-13 2125 70th Percentile 0.5% AEP Max Depth - Land East of Adur Close

Barns at New Salts Farm

During the 0.5% AEP plus climate change event, the site is predicted to flood, predominantly within the western extent of the site. Areas along the eastern boundary are shown to be flood free, as shown in Figure 1-15. Flood depths range between 0.1 and 1.0m.

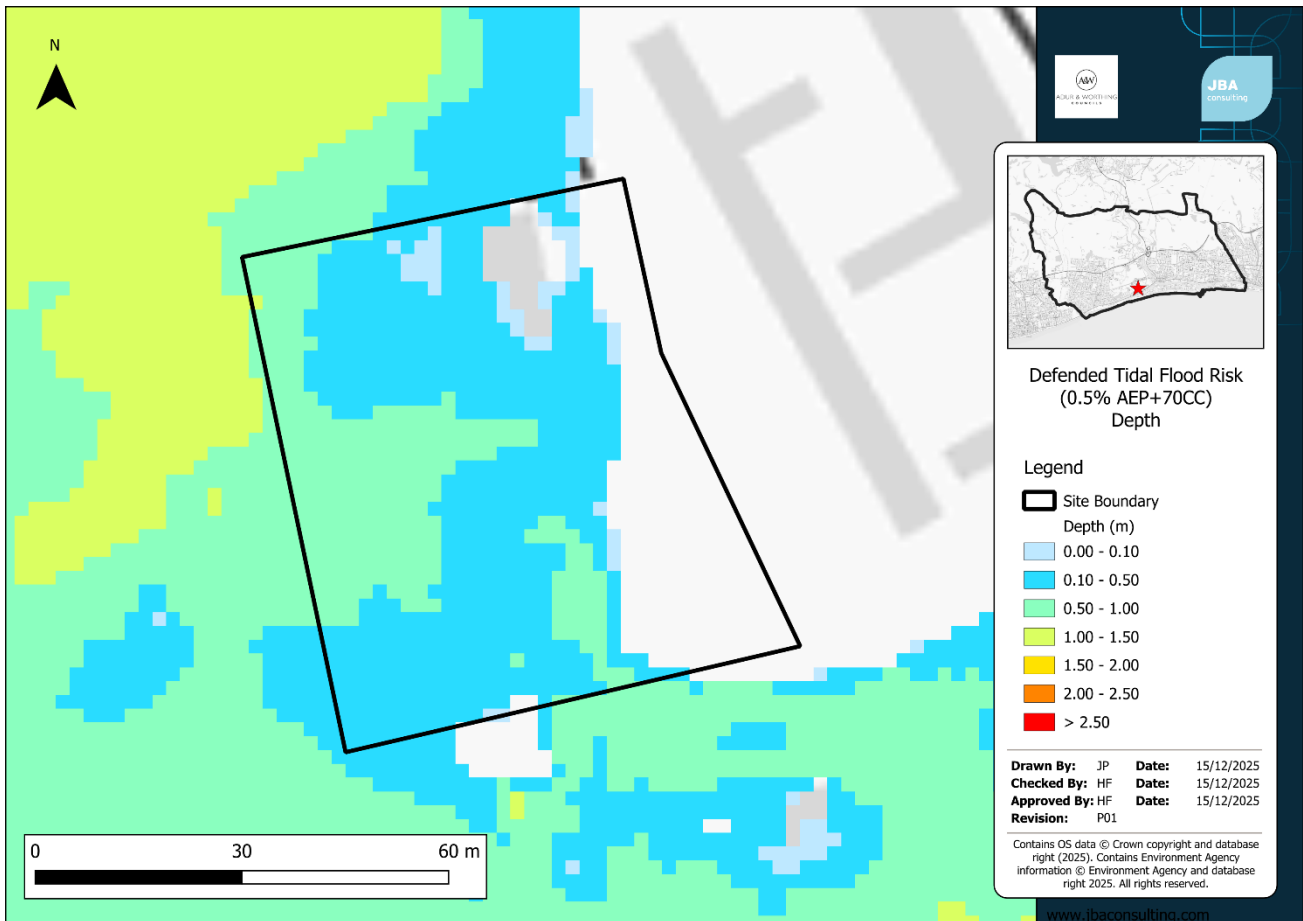


Figure 1-14 2125 70th Percentile 0.5 % AEP Max Depth - Barns at New Salts Farm

1.7 Flood Mitigation: Ground Raising

Tidal flood risk is a major constraint to the development of the candidate sites. In order to develop the sites, substantial flood mitigation measures will be required to ensure the predicted flood risk is adequately managed to permit sustainable development. The site assessments accompanying the SFRA detail the likely options for managing flood risk to these sites. To inform this report, and its subsequent Conceptual Drainage Strategy, it is assumed that ground raising will occur across all the sites. Such ground raising shall result in the sites being flood free in the 0.5% AEP plus climate change event, resulting in SuDS assets being flood free during this design event, in line with the requirements of the Ciria SuDS Manual. Furthermore, sufficient ground raising will provide the necessary gradient for a gravity-based system.

Any future application for the sites will require a site-specific Flood Risk Assessment (FRA) to detail the tidal risk to the site, alongside site specific detail of any mitigation provided.

2 Existing Surface Water Regime

2.1 Existing Site Geology and Hydrogeology

The geology of the site has been assessed using the BGS Geindex Onshore Viewer¹. The underlying geology is consistent across the sites, with the exception being the north-western extent of the Lancing Meadows site, predominantly within 'Land north of Minstrels Gallery'.

Bedrock across the area comprises Newhaven Chalk Formation with superficial deposits of alluvium, clay, silt and peat. Across the Land North of Minstrels Gallery site the superficial deposits comprise Raised Beach Deposits (RBD) of sand and gravel.

The soils on site have been assessed on the Cranfield University Soilscales Viewer². All sites except Land North of the Minstrels Gallery site are shown to have the same underlying soils, which as described as '*Loamy and clayey soils of coastal flats with naturally high groundwater and freely draining slightly acid loamy soils*'. Soils at the Land North of the Minstrels Gallery site have '*Freely draining slightly acid loamy soils*'.

Based on the desktop review of the sites, it is considered likely that surface water drains predominantly via surface overland flows towards nearby watercourses and evapotranspiration losses, with limited potential for infiltration across the majority of the sites. High groundwater is likely to be encountered across the sites as indicated by the JBA groundwater risk mapping, contained in the site specific flood risk appraisals and the SFRA. With the change in superficial deposits to Raised Beach Deposits across the 'Land North of Minstrels Gallery' site, there may be some potential for infiltration losses across that site.

2.2 Greenfield Runoff Rates

Table 24.1 of the CIRIA SuDS Manual indicates that the FEH methods (FEH Statistical and ReFH) should be the preferred methods for calculating peak runoff rates. This is supported by Environment Agency research by Faulkner et al which concluded that FEH methods are applicable across a range of catchment sizes and that they should be used in place of outdated methods such as IH124 and ADAS 345 where possible.

The UK SuDS Tool has been used to calculate Greenfield runoff rates for the sites. Catchment descriptors (SAAR and BFIHOST) for the local catchment were extracted from the FEH Web Service. The calculated greenfield runoff rates are shown in Table 2-1 below, and the UK SuDS calculation record is included in Appendix A.

1 Geology of Britain Viewer. <https://www.bgs.ac.uk/map-viewers/geoindex-onshore/>

2 Cranfield Soilscales Viewer. <https://landis.org.uk/soilscales/>

Table 2-1 Greenfield Runoff Rates

Site	Area (ha)	Greenfield Runoff Rate (QBAR) l/s	Greenfield Runoff Rate l/s/ha
Land North West of West Avenue	7.27	13.69	1.88
Land North of Willowbrook Park	0.95	1.79	1.88
Land South of Minstrels Gallery	1.36	2.59	1.90
Land East of Minstrels Gallery	3.1	5.84	1.88
Land North of Minstrels Gallery	1.02	1.92	1.88
Land East of Adur Close	0.204	0.37	1.81
Barns at New Salts Farm	0.44	0.8	1.81

2.3 Greenfield Runoff Volumes

Greenfield runoff volumes were calculated for the six-hour storm event using the FSSR16 method as shown in Equation 1 below. This is in line with Table 24.1 of the CIRIA SuDS Manual.

Equation 1:

$$\text{Runoff Volume} = \text{Site Area} \times \text{Rainfall Depth} \times \text{Percentage Runoff}$$

The percentage runoff was calculated using the FSSR16 methodology, which accounts for soil type, catchment wetness, and storm intensity. The rainfall depths for a six-hour 100-year storm event were extracted from the FEH Web Service and are summarised in Table 2-2 with the calculated Greenfield runoff volumes.

Table 2-2 Greenfield Runoff Volume

Site	6 hour rainfall runoff depth (mm)		Greenfield Runoff Volume (m ³)	
	30-year return period	100-year return period	30-year return period	100-year return period
Land North West of West Avenue	56.9	71.0	1304	1716
Land North of Willowbrook Park			170	224
Land South of Minstrels Gallery			244	321
Land East of Minstrels Gallery			556	732
Land North of Minstrels Gallery			183	241
Land East of Adur Close	52.5	71.0	31	46
Barns at New Salts Farm	52.5	71.0	68	99

3 Surface Water Management Approach

3.1 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of Greenfield surface water drainage by allowing water to flow along natural flow routes, ensuring that runoff rates and volumes during storm events are not increased above the Greenfield values whilst providing water treatment benefits. SuDS also aim to provide biodiversity and amenity benefits within blue and green corridors.

The National Planning Policy Framework states that new developments should:

"Incorporate sustainable drainage systems, unless there is clear evidence that this would be inappropriate"

3.2 Design Criteria

A conceptual drainage strategy outlining the means of surface water management for the proposed candidate sites has been produced in line with the latest guidance and design standards including:

- C753 'The SuDS Manual' (CIRIA 2015)
- National standards for sustainable drainage system (SuDS) (June 2025)³
- Water. People. Places: A guide for master planning sustainable drainage into developments⁴

The National Standards for Sustainable Drainage Systems (SuDS) were published by Defra in June 2025. These standards have been reviewed, and the concept surface water strategy contained within this report has been considered in line with these standards. The standards are intended for application in the design of surface water drainage systems for new infrastructure and development, whether on greenfield or brownfield sites.

The national standards promote a natural approach to managing water through early and integrated design, promoting the use of above ground SuDS which link to the four pillars of SuDS design (quantity, water quality, amenity and biodiversity), whilst also considering the need for future maintenance and a system's structural integrity.

3.3 Standard 1: runoff destinations

Standard 1 of the National SuDS standards sets out a hierarchy of discharge for runoff from a development. The hierarchy is comprised of 5 priorities, with priority 1 being the highest priority and priority 5 being the lowest:

3 <https://www.gov.uk/government/publications/national-standards-for-sustainable-drainage-systems/national-standards-for-sustainable-drainage-systems-suds>

4 https://www.westsussex.gov.uk/media/2270/suds_design_guidance.pdf

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- Priority 1: Collected for non-potable use
- Priority 2: Infiltrate to ground
- Priority 3: Discharge to an above ground surface water body
- Priority 4: Discharge to a surface water sewer, or another piped surface water drainage system
- Priority 5: Discharge to a combined sewer

Collected for non-potable use

Water reuse should be considered as part of any development proposals at the proposed development sites where there is:

- a demand for non-potable water,
- the need for landscape irrigation or,
- a site is within an area which is identified as seriously water stressed.

As development proposals for the site are for residential purposes, it is considered unlikely that there is sufficient yield: use ratio to viably provide rainwater harvesting systems to manage rainfall. This concept strategy is therefore based a system which does not include rainwater harvesting.

However, this does not negate the need for full consideration of the provision of such methods for water disposal at the planning submission stage, noting the water-stressed locality in which the sites are positioned is recommended that, as a minimum, all properties are supplied with a rainwater butt to promote water re-use at a plot-scale. Such provision should not be included within surface water storage calculations due to the potential for such assets to be full during rainfall events.

Infiltrate to ground

No formal infiltration testing has been undertaken to inform this concept strategy, and infiltration considerations have therefore been based on a desktop review of underlying ground conditions (Section 2.1). This desktop review indicates that the site is underlain by superficial deposits of Tidal Flat Deposits, with noted impeded drainage from the soils and high groundwater levels. Ground raising is also likely to result in large areas of 'Made Ground' which shall also need to be considered in terms of stability, content and the risk of dissolution. It is therefore considered that infiltration is unlikely to be viable means of discharge across the sites.

Whilst it is noted that 'Land North of Minstrels Gallery' may be conducive to infiltration as a result of superficial deposits comprising Raised Beach Deposits across this area, it has been considered that infiltration is not a viable means of discharge for the purposes of this report.

The potential for infiltration should be confirmed via site specific infiltration testing in accordance with BRE365, and ground water monitoring to determine winter maximum ground water levels.

Discharged to an above ground surface water body

The tidal River Adur is located in close proximity to the site. Furthermore, a series of existing unnamed small watercourses flow through the Lancing Meadows site which connect to the River Adur. It is therefore proposed that discharge to the existing watercourses, and ultimately to the River Adur, should form the basis of this concept strategy.

The River Adur is tidal and tidal locking is expected to occur for at least 6 hours during the extreme events. Consequently, further investigation shall be required prior to detailed design to confirm that sizing of surface water storage assets is appropriate across the sites.

The 'Land East of Adur Close' and 'Barns at New Salts Farm' shall not be able to drain via this mechanism due to the lack of surface water waterbodies across the sites. Despite ground raising being proposed, the concept strategy has retained and enhanced the current surface water flow paths on site. A more detailed calculation of the flows intercepted or the requirement for additional storage, will be required when undertaking an FRA.

Discharge to a surface water sewer, or another piped surface water drainage system

Discharge to a surface water sewer or highway drain shall need to be considered for Land East of Adur Close and Barns at New Salts Farm sites due to the absence of suitable above ground surface water bodies. It is understood that there is unlikely to be a public surface water sewer in the area, with the surrounding properties served by a public combined sewer. Consequently, it is considered that connection to a public surface water sewer is unlikely to be viable for these sites.

Options for connection to local highway network could be considered, subject to approval by the Highways Authority. To determine if this is a viable option, capacity checks on the receiving network shall need to be undertaken to demonstrate that such a connection shall not result in detriment to the receiving network. It should also be demonstrated that the highway network does not discharge to the public combined network as a consequence of known capacity issues.

Discharged to a combined sewer

No Southern Water asset maps have been obtained as part of this assessment. However, it is assumed that much of the area is served by a network of combined sewers, given the high number of sewer-related flooding incidents in the area. This was further confirmed when the cause of much of this flooding is following heavy rainfall events as noted within

SIRF data provided by Southern Water. Flooding following heavy rainfall is typical of combined systems.

No new developments will be permitted to connect to this combined sewer system due to known capacity issues, the flood history and the focus on reducing spills from local Combined Sewer Outflows (CSOs). Consequently, discharge to a combined sewer is not considered a viable means of discharge.

Discharged via a third party easement

It is unlikely that a viable discharge location is to be found for Land East of Adur Close and Barns at New Salts Farm by conventional means due to the local constraints and associated flood risks. A local watercourse is present on intervening land between the two sites. It is anticipated that ground levels across the site shall need to be raised to allow for the necessary gradients to allow a gravity based system. In ground raising, care should be taken to ensure that levels fall towards this existing surface waterbody - this may require a small change in fall for the southern extent of the 'Land East of Adur Close' site. The concept strategy proposes to retain and enhance the current surface water flow paths and watercourses on site. As a viable means of surface water discharge has been found, Priority Levels 4 and 5 have not been considered.

3.4 Standard 2: management of every day rainfall (interception)

Standard 2 of the National Standards for SuDS requires development proposals to manage everyday rainfall (interception). The requirements expect a *'SuDS approach to surface water management so that at least the first 5mm of rainfall for the majority of rainfall events does not result from the site to surface waters or piped drainage systems'*.

The interception of surface water has not been fully assessed as part of this study. However, any accompanying drainage strategy submitted with a planning application should provide evidence to demonstrate that the runoff from each positively drained surface, for at least 5mm of rainfall, is either collected for use, infiltrated into the ground, or else captured, conveyed and stored within SuDS features. These features shall naturally absorb or retain runoff and from these the runoff will be 'lost' to soils or the atmosphere and will not discharge off the site.

Demonstration of compliance should be provided with the use of industry recognised guidance, currently set out within the Ciria SuDS Manual (C753). When undertaking the assessments where hydraulic modelling software is not being utilised, a simplified approach to delivering interception can be used based on the assumed compliance of various drainage components.

In circumstances where individual SuDS features do not provide adequate capacity for interception on their own, additional capacity can be provided by downstream features. Detailed calculations shall be provided to demonstrate compliance in these circumstances.

The interception methods within the National Standards shall be considered to be compliant for zero runoff for the first 5mm rainfall for 80% of events during the summer and 50% in winter.

It has been assumed that a SuDS management train will be incorporated to any future development. A key part of this 'management train' will be interception of water as close to the source as possible and meeting the requirement of intercepting the first 5mm of rainfall that falls on a site. This could be in the form of permeable pavement driveways and/or road, the use of rainwater harvesting systems or rain gardens.

The Lancing Meadows sites are proposed to drain to a tidal waterbody. Whilst interception is not usually required when flows are to a tidal waterbody, further consideration should be given to the meeting such requirements as a consequence of the site constraints and the tide locked nature of the receiving watercourse, evidencing capacity issues.

3.5 Standard 3: management of extreme rainfall and flooding

Standard 3 of the National Standards for SuDS in England aims to ensure that surface water drainage systems are designed to manage runoff during extreme rainfall events, reducing flood risk and protecting people, property and infrastructure.

The key requirements of this standard are to ensure that SuDS are used in the management of runoff during extreme rainfall events. This can be achieved by ensuring that any proposed SuDS are designed to attenuate and convey any exceedance flows and making use of natural drainage features. Where possible, above-ground SuDS are preferred and should be tied in with wider landscape design where possible.

3.5.1 Allowances for Climate Change

The UK Government has produced climate change allowance guidance, which contains updated peak rainfall intensity allowances for England. As the development sites are proposed for residential developments, the assumed lifetime of development is 100 years, and as such, the 2070-2115 estimate should be used. The recommended climate change factor (increase in peak rainfall intensity) for the Adur and Ouse management catchment using the Upper end estimate for the 2070s epoch is 45% and has been used within this project.

3.5.2 Concept Drainage Strategy

In order to determine the indicative attenuation volumes across the proposed development sites, a concept strategy has been prepared, in line with the National Standards for SuDS. The concept strategy for the sites can be subdivided into the Lancing Meadows sites, Land East of Adur Close and Barns at New Salts Farm. Each site should provide sufficient attenuation to manage the discharge to QBAR rate or 3l/s/ha whichever is larger.

'Quick storage estimates' calculated within InfoDrainage software were used to generate a storage volume estimate for the proposed development sites for the 1 in 100 year plus 45% OYL-JBA-XX-XX-RP-D-0001-S0-P02-Lancing_Meadows_Concept_Drainage_Strategy

climate change event, and have been included within Appendix B. Catchment descriptors were obtained from the Flood Estimation Handbook Service, and a Cv value of 1 has been applied for winter and summer storms, in line with LLFA requirements.

Each of the Lancing Meadows sites provides sufficient attenuation to manage the discharge to 3l/s/ha as this was found to be larger than QBAR in all cases, as demonstrated in Table 2-1. Land East of Adur Close and Barns at New Salts Farm are proposed to discharge at a rate of 2l/s as this is considered the minimum rate permissible to prevent blockage of flow control structures.

No proposed site layouts have been provided to inform this strategy. Consequently, the total impermeable area of the sites was assumed to be 60% of the total area, in line with industry best standard of practice. Table 3-1 outlines the calculated impermeable areas for each site, along with an overview of catchment descriptors used to inform the calculations. Table 3-2 provides the estimated storage volumes for each site. Calculation sheets are provided within Appendix B.

As discharge from the site towards the River Adur will be tide locked for approximately 6 hours during high-tide events, any plans for the Lancing Meadows sites will need to further assess the volume required during a tide lock scenario. As a conservative measure, the higher volume within the calculated storage volume range produced from the InfoDrainage Quick Storage Estimates tool has been used to inform the concept strategy. In addition, a 60% impermeable area has been assumed in the absence of a proposed site layout plan, which is likely to be revised and reduced due to subsequent storage volumes and SuDS provision on site.

Table 3-1 Summary of Impermeable area and Catchment Descriptors

Site Name	Site Area (ha)	BFIHOST	SPRHOST	Volume control approach 3L/s/ha
Land north west of West Avenue	7.27	0.68	28.27%	21.8
Land north of Willowbrook Park	0.95			2.85
Land south of Minstrels Gallery	1.36			4.08
Land east of Minstrels Gallery	3.11			9.3

Site Name	Site Area (ha)	BFIHOST	SPRHOST	Volume control approach 3L/s/ha
Land north of Minstrels Gallery	1.02			3.06
Land East of Adur Close	0.20	0.712	26.59%	1*
Barns at New Salts	0	0.712	26.59%	1*

*When QBAR or site area x 3l/s/ha is less than 1l/s/ha a minimum discharge value of 1l/s is proposed to mitigate the risk of blockage.

Table 3-2 provides a summary of the calculated storage volume for each site.

Site Name	Storage Volume Required (m ³)
Land north west of West Avenue	4070-5145
Land north of Willowbrook Park	533-673
Land south of Minstrels Gallery	768-968
Land east of Minstrels Gallery	1738-2195
Land north of Minstrels Gallery	570-720
Land East of Adur Close	702-763
Barns at New Salts	206-316
Total:	8652 - 10780

A copy of the concept strategy plan is provided in Appendix C with a breakdown of the proposed strategy for each site below.

Lancing Meadows

A holistic approach to surface water management has been proposed across the Lancing Meadows site, assuming all sites shall be brought forward for development. To manage surface water across the Lancing Meadow sites, several strategic swales are proposed, providing a total attenuation storage volume of **3767.8m³**. The proposed swales will vary in size, with a proposed breakdown shown in Table 3-3. The swales will provide storage and conveyance of surface water across the sites, discharging surface water towards the existing watercourse located to the northeast. Swales are proposed to be vegetated, with a gravel filled subbase to provide additional attenuation. Swales have been designed as 600mm depth, which includes 150mm freeboard, and a 1:3 side slope. The gravel-filled base is proposed at 2m wide and filled to 1m in depth.

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The proposed swales alone are not sufficient to provide attenuation across Lancing Meadows. Consequently, in addition to the swales, five offline ponds are proposed that connect directly to the swales. These ponds aim to provide additional storage volume to attenuate the 1 in 100-year + 45% CC rainfall event and have been placed to provide a holistic approach to drainage across Lancing Meadows. Ponds have been designed with a total depth of 1m, incorporating a 300mm freeboard and a 1:3 side slope. The proposed size of the ponds has been provided in Table 3-4, with a total storage volume of **9178.1m³**. Most proposed ponds provide attenuation for the site in which they are located on only. Ponds 3 and 4 extend across more than one site and provide attenuation for all sites they cross taking a holistic approach to the lancing meadows development. Pond 3 includes attenuation from 3 sites: Land North West of Western Avenue, Land South of Minstrels Gallery and Land East of Minstrels Gallery. Pond 4 attenuates flows from Land North West of Western Avenue and Land East of Minstrels Gallery.

Combined, the swales and ponds will provide an attenuation volume of **12945.9m³**.

It should be noted that due to the holistic approach to surface water drainage design across the Lancing Meadow area, it may be that 'Land North of Minstrels Gallery' can only be brought forward following development of downstream sites to facilitate a connection to the proposed swale and watercourse network. Should individual sites be brought forward, additional attenuation may be required where a downstream basin attenuation is not provided. Any connection to this surface water body to allow for a viable discharge location shall require easements and third party permissions for both the connection, and future maintenance of the surface water network. Should the need for easements arise, the developer is encouraged to commence engagement and negotiations with the relevant landowner early in the master planning process. If required, the LLFA shall require evidence of easement agreement early in the planning stages to respond favourably to any proposed drainage strategy.

Table 3-3 Volume Provided by Proposed Swales

Site	Swale ID	Volume Provided (m ³)	Dimensions top width, bottom width, length (m)
Land North West of West Avenue	1	1753.6	12.5 x 2 x 406
	2	497	12.5 x 2 x 115
Land North of Willowbrook Park	3	198	9.5 x 2 x 55
	4	234	9.5 x 2 x 65
Land South of Minstrels Gallery	5	523.2	11 x 2 x 132
Land East of Minstrels Gallery	6	526	14 x 2 x 120
Land North of Minstrels Gallery	N/A	N/A	N/A

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Table 3-4 Volume Provided by Proposed Ponds

Pond ID	Volume Provided (m ³)	Top surface area (m ²)
1	2620.8	2436
2	178.7	243
3	807.3	880
4	5137.2	4633
5	434.0	243

In addition to the strategic swales and ponds, it is assumed that future developers of the sites will implement SuDS on a more local and plot scale level. This will provide a large and robust SuDS management train that will slow the runoff of surface water. This is likely to reduce the volume of runoff entering the swales during the peak of the rainfall event, allowing for additional storage within a tide lock scenario. Whilst a conservative approach to attenuation storage has been used to manage the risk of a tide-locked scenario, further investigation will be required during detailed design which may impact on the attenuation volumes, and space requirements on site.

Land East of Adur Close and Barns at New Salts Farm.

Unlike the Lancing Meadow sites, there are no watercourses that run through or pass close to the Land East of Adur Close and Barns at New Salts Farms sites; therefore, an alternative means of discharge is required and still to be determined.

The use of SuDS features should still form the backbone of any future drainage strategy, with discharge being limited to 2l/s as to mitigate the risk of blockage of the flow control structures. The use of permeable paving for road and driveway services, SuDS planters, tree pits, rain gardens and if required, small shallow ponds could all be combined to provide the required attenuation at the sites.

3.5.3 Exceedance Events

Extreme events exceeding the design event could occur and result in overland flows across the site. The duration of flooding, maximum depths, velocity, and route of flood flows should be established and managed. The impact of exceedance flows onto adjacent land should also be considered.

The impact of exceedance flows onto adjacent land should also be considered - Section 3.40 of the National Standards for SuDS states that *the surface water drainage system shall be assessed for exceedance events in excess of the 1% AEP event with expected*

exceedance routes identified across the development to confirm there is no adverse flood risk to the development or elsewhere.

At the detailed design stage, consideration should be given to exceedance flow routes to ensure that no proposed building floods as a result of the system being at capacity. Primarily, surface water shall flow overland towards the existing drainage features and eastwards towards the River Adur.

In addition, care should be taken to ensure surface water overland flow paths on to the site are adequately managed. Whilst every effort has been made within this conceptual strategy to retain and enhance existing flow paths and watercourses on the site, it is acknowledged that ground raising may intercept and divert flows entering the site. Development should not result in an impact to third parties in terms of flood risk. Consequently, any future drainage strategy and FRA should provide detail on how these flows have been managed and incorporated into the strategy.

3.6 Standard 4: Water Quality

Standard 4 requires SuDS to manage the quality of the surface water runoff from the site. SuDS are required to have a suitable management train that uses sources, site and regional controls to maintain, manage and improve the water quality of runoff. The standards state that '*SuDS features located in publicly accessible or visible locations shall be designed and maintained to provide a suitable quality of water for aesthetic and amenity reasons and to support biodiversity whilst being safe to the public and not environmentally polluting*'. Waters within these features should be clear and avoid any unpleasant odours or debris or sheens.

Table 4.3 of the SuDS Manual advocates the use of the 'simple index approach' to determine an appropriate level of pollution mitigation for the development site. This splits pollution into three contaminant types (Total Suspended Solids, Metals, Hydrocarbons) and assigns a 'pollution hazard index' to each type. Different SuDS features are then assigned a 'SuDS Mitigation Index' and sufficient treatment is deemed to be provided if the 'SuDS Mitigation Index' is equal to or greater than the 'pollution hazard index' for each pollutant type. When more than one SuDS component is required, a multiplication factor of 0.5 is applied to mitigation indices for secondary and tertiary components to account for reduced performance.

Pollution hazard indices are shown below in Table 3-5, for a residential area. Overall, it is deemed that the site has a 'low' pollution hazard.

Table 26.4 of the SuDS Manual provides indicative SuDS mitigation indices for discharges to surface water body. The current strategy proposes the use of vegetated swales and the use of ponds water quality benefits will be provided, as demonstrated by Table 3-6. Future drainage strategies should implement plot and local scale SuDS that shall further enhance the management train and water quality benefits of the system.

Table 3-5 Pollution Hazard Indices for the site

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Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie <300 traffic movements □ day	Low	0.5	0.4	0.4

Table 3-6 Indicative SuDS Mitigation Indices for Discharge to Surface Water

Type of SuDS component	Mitigation Indices		
	TSS		Hydrocarbons
Swale	0.5	0.6	0.6
Pond	0.7	0.7	0.5
Bioretention System	0.8	0.8	0.8
Permeable Pavement	0.7	0.6	0.7

3.7 Standard 5: Amenity and Standard 6: Biodiversity Value

Standard 5 requires SuDS to maximise the amenity benefit through the creation of 'multifunctional' places and landscapes. Standard 6 requires SuDS to maximise the biodiversity benefits, creating diverse, self-sustaining systems that support local natural habitats for species. The two standards are often met together by creating a multifunctional and highly aesthetic design. This can be designed in conjunction with proposed areas for Biodiversity Net Gain (BNG) to further gain benefits from the proposed SuDS.

Across all of the proposed sites source control features should be implemented to manage flows at source, with assets such as permeable paving, rain gardens and tree pits provided. All above ground SuDS assets provide some degree of amenity benefit, with vegetated SuDS likely to meet biodiversity benefits where native planting and habitat linkages are provided.

Across the Lancing Meadows site, vegetated Swales and ponds will provide both amenity and biodiversity benefits to the site. However, it is suggested that future developers appoint suitable landscape architects and ecologists to ensure that the full amenity and biodiversity benefits are achieved.

3.8 Standard 7: Design for Construction, Operation, Maintenance, Decommissioning and Structural Integrity

3.8.1 Health and Safety

The surface water drainage system should be designed so that it minimises health and safety risk to the site occupants. SuDS are sometimes perceived as unsafe features with fears of drowning and trip hazards, but with correct design, these risks can be mitigated. A CDM Designers Risk Assessment should be undertaken demonstrating that any proposed surface water drainage system is fit for purpose, with risks designed out of the proposal, or mitigated wherever necessary.

The main risks associated with the construction, operation, and maintenance of the proposed system and the associated mitigation options at this stage are as follows:

- No information has been available on the locations of buried and overhead services for this design. Further information should be sought on the locations of these as part of detailed design.
- Ground investigations were not available at this stage. These should be carried out in order to identify contamination risks, instability and groundwater levels on site or other ground related issues.
- Open drainage features have been proposed as part of this drainage system. Water depths in these should be kept to a minimum and side slopes should be shallow in order to allow for maintenance access and to provide safe egress should a person fall in.
- Further consideration should be given to the provision of safe maintenance access routes to all features at detailed design stage.
- Consideration towards proposed ground levels should be given alongside the proposed depth of SuDS features, to ensure that there is sufficient fall across the site for the drainage scheme to be viable. At present, ground levels at the location of the proposed basins are relatively flat and therefore further work is required to ensure that an appropriate scheme can be designed and constructed. Additionally, the maximum depth of SuDS features may also need to be evaluated, which may result in an increase their current proposed footprint.

3.8.2 Operation and Maintenance

The surface water drainage system should be designed to reduce the need for maintenance, where possible. To facilitate any maintenance which is required, consideration should be given to the provision of appropriate access routes for

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maintenance staff, plant and equipment. Consideration should also be given to the adoption of the drainage system by a relevant authority. Figure 3-1 below depicts Table 32.1 from the Ciria SuDS Manual C753, which provides an overview of the likely SuDS components' operation and maintenance activities.

TABLE 32.1 Typical key SuDS components operation and maintenance activities (for full specifications, see Chapters 11–23)

Operation and maintenance activity	SuDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter drain	Modular storage	Pervious pavement	Swale/bioretention/trees	Filter strip	Green roofs	Proprietary treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter and debris removal	■	■	■	■	□	■	■	□	■	■	■		□
Grass cutting	■	■	■	■	□	■	■	□	□	■	■		
Weed and invasive plant control	□	□	□	□		□	□		□		□	■	
Shrub management (including pruning)	□	□	□	□					□	□	□		
Shoreline vegetation management	■	■	□										
Aquatic vegetation management	■	■	□										
Occasional maintenance													
Sediment management ¹	■	■	■	■	■	■	■	■	■	■	■		■
Vegetation replacement	□	□	□	□						□	□	■	
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation /repair	□	□	□	□	□	□	□	□	□	□	□	□	
Infiltration surface reconditioning				□	□	□	□		□	□	□		

Key

- will be required
- may be required

Notes

1 Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

Figure 3-1 Table 32.1 of the Ciria SuDS Manual.

4 Conclusion

- JBA Consulting were commissioned by Adur and Worthing Councils to prepare a Concept Drainage Strategy (CDS) overview report, which shall outline the opportunities and constraints for site surface water drainage for the proposed candidate sites forming part of the Level 2 Strategic Flood Risk Assessment (SFCA).
- The concept drainage strategy focused on three sites, Lancing Meadows, Land East of Adur Close and Barns at New Salts Farm. The Lancing Meadows sites can be further split into five sites.
- The concept strategy was designed to provide a framework from which future developers can refer when designing surface water drainage systems for the proposed residential developments.
- Following Standard 1 of the National SuDS Standards, discharge from the Lancing Meadows site will be to existing surface water channels that discharge into the tidal River Adur.
- Land East of Adur Close and Barns at New Salts Farm do not currently have a viable discharge location. Further investigation is required to determine whether discharge to a local highway network is permissible, or third party easements to drain to a local watercourse shall be permitted.
- Greenfield runoff rates were calculated using the HR Wallingford Greenfield Runoff Calculator tool, making use of FEH data.
- No site layouts have been provided to inform the concept strategy. Consequently a 60% impermeable area was assumed across the site, in line with industry best practice standards.
- A maximum storage volume of 6259-7998m³ is required for a storm event of 1 in 100 plus 45% climate change.
- The proposed drainage strategy focuses on the use of eight strategically placed swales and five ponds across the Lancing Meadow site. The swales and ponds are placed in areas with naturally low topography or where surface water will naturally accumulate and flow.
- It is proposed that across the Land East of Adur Close and Barns at New Salts Farm sites, source control SuDS features will form part of a wider management train. Space is constrained on the sites, making them unsuitable for large features such as the swales and basins.

- The proposed drainage strategy provides a total of **12945m³**, exceeding the maximum storage volume required. A conservative approach has been taken to the storage volume required to account for a tide-locked scenario.
- The concept strategy will also allow for the future development of the sites to meet the National Standards for SuDS in England, by enhancing Biodiversity and amenity whilst managing surface water runoff quality.
- The proposed drainage system has been designed to minimise the risk posed to the future occupants of the site in line with Standard 7 of the National SuDS Standards.

A Greenfield Runoff Rates

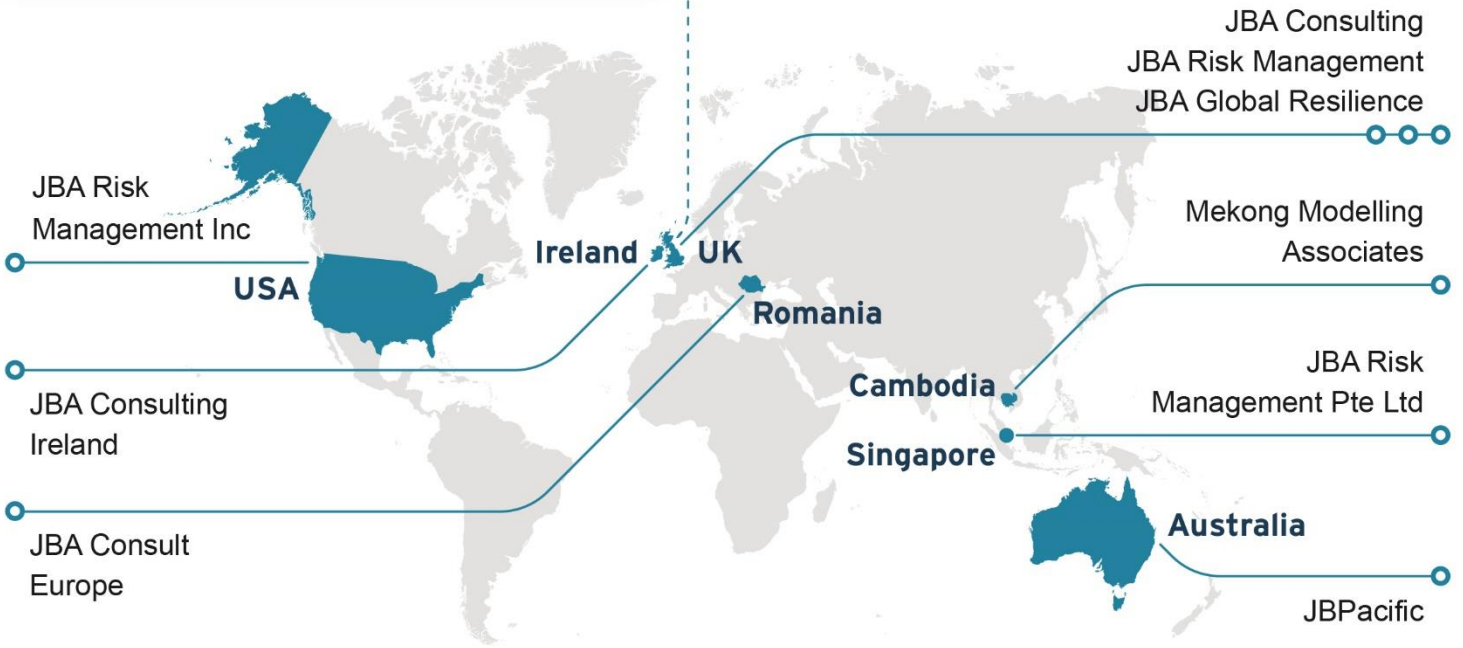
B InfoDrainage Quick Storage Estimates

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