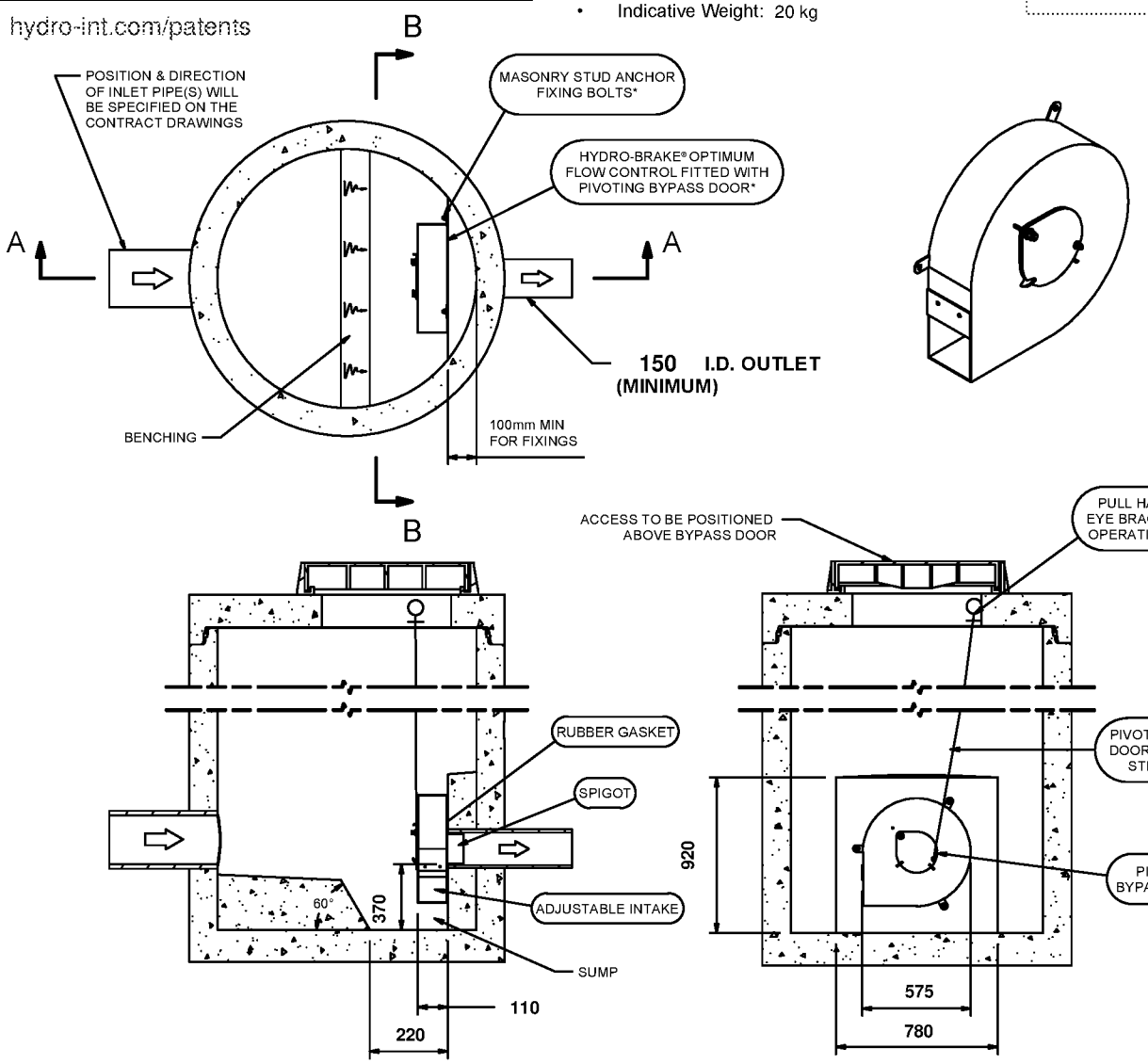
Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	1.300	5.080
Flush-Flo™	0.387	5.073
Kick-Flo®	0.803	4.064
Mean Flow		4.446

Hydro-Brake® Optimum Flow Control including:

- 3 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Variable flow rate post installation via adjustable inlet
- Indicative Weight: 20 kg

hydro-int.com/patents



SECTION A-A SECTION B-B

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SHE-0102-5080-1300-5080 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International
A CRH COMPANY

DATE	27/09/2024 15:01
SITE	24_21_5580 Land West of Pagham Road, Bognor Regis
DESIGNER	
REF	HQT-174626

SHE-0102-5080-1300-5080
Hydro-Brake® Optimum

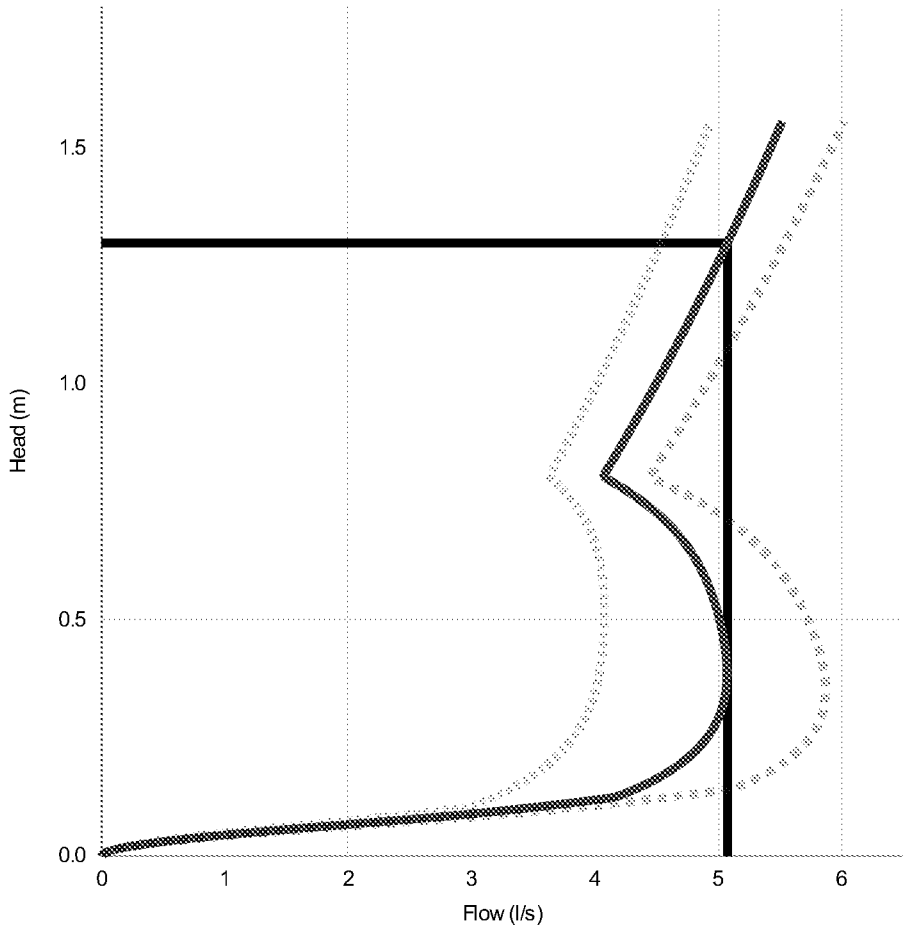
Technical Specification

	Original Setting		Minimum Setting		Maximum Setting	
Control Point	**Head (m)**	**Flow (l/s)**	**Head (m)**	**Flow (l/s)**	**Head (m)**	**Flow (l/s)**
Primary Design	1.300	5.080	1.300	4.539	1.300	5.541
Flush-Flo™	0.387	5.073	0.515	4.079	0.352	5.873
Kick-Flo®	0.803	4.064	0.803	3.627	0.803	4.440
Mean Flow		4.446		3.759		4.989

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

wrc approved
PY/609/0422

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.045	1.007
0.090	3.012
0.134	4.262
0.179	4.603
0.224	4.823
0.269	4.958
0.314	5.034
0.359	5.067
0.403	5.071
0.448	5.054
0.493	5.021
0.538	4.973
0.583	4.909
0.628	4.823
0.672	4.706
0.717	4.546
0.762	4.331
0.807	4.075
0.852	4.175
0.897	4.274
0.941	4.372
0.986	4.467
1.031	4.559
1.076	4.650
1.121	4.739
1.166	4.826
1.210	4.911
1.255	4.994
1.300	5.076

DESIGN ADVICE

The head/flow characteristics of this SHE-0102-5080-1300-5080 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International
A CRH COMPANY

DATE	27/09/2024 15:01
Site	24_21_5580 Land West of Pagham Road, Bognor Regis
DESIGNER	
Ref	HQT-174626

SHE-0102-5080-1300-5080

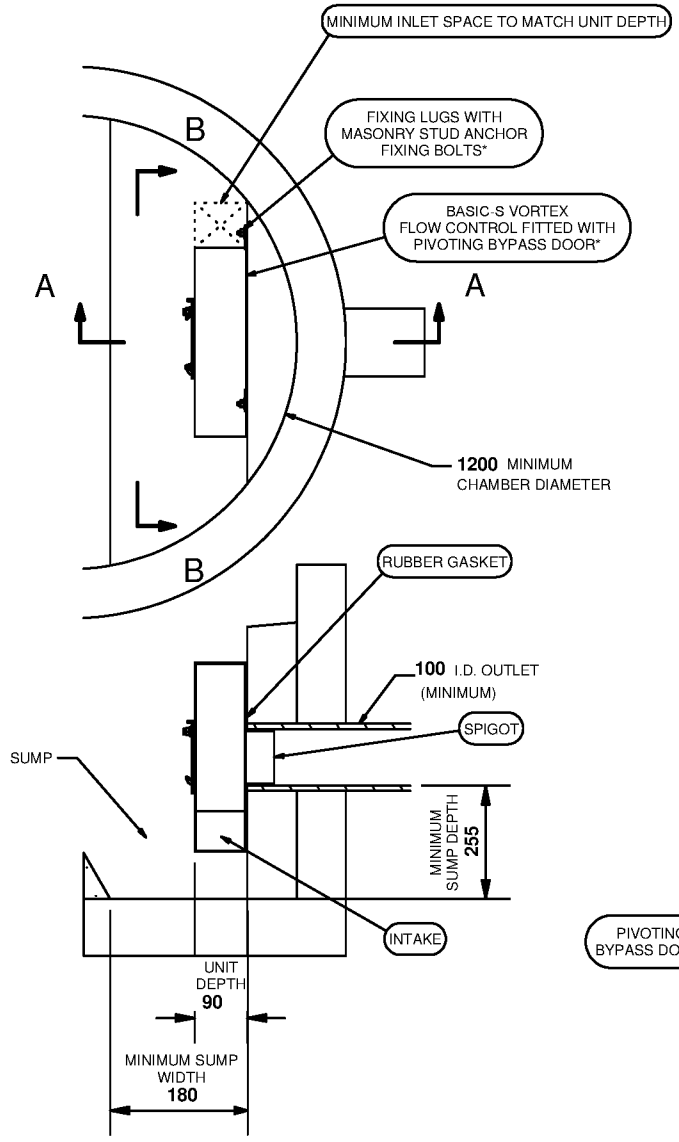
Hydro-Brake® Optimum

Technical Specification

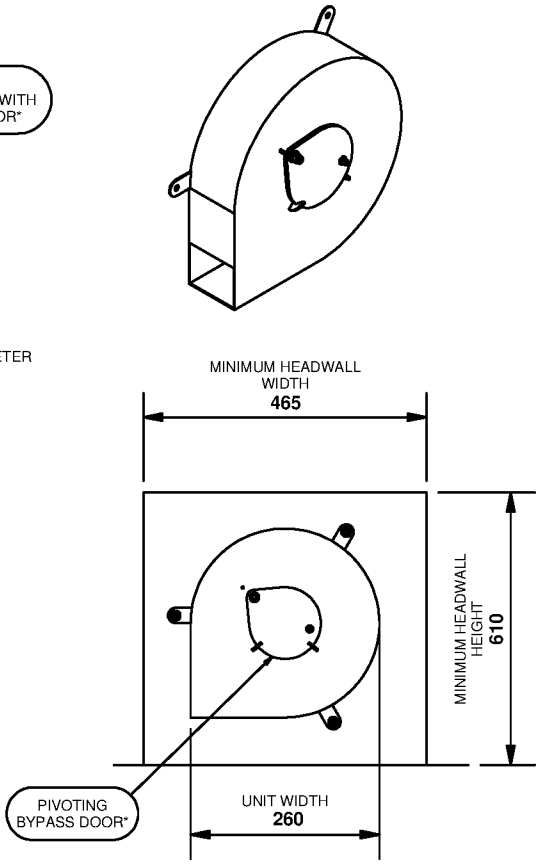
Control Point	Head (m)	Flow (l/s)
Primary Design	1.300	5.080

Basic-S Vortex Flow Control including:

- **3 mm** grade 304L stainless steel
- integral stainless steel pivoting bypass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Bead blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- identification plate on operating handle



SECTION A-A



SECTION B-B

* All measurements are in millimetres unless otherwise specified

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS * WHERE SUPPLIED

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this Basic-S Vortex Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International
A CRH COMPANY

DATE	27/09/2024 15:01
SITE	24_21_5580 Land West of Pagham Road, Bognor Regis
DESIGNER	
REF	HQT-174626

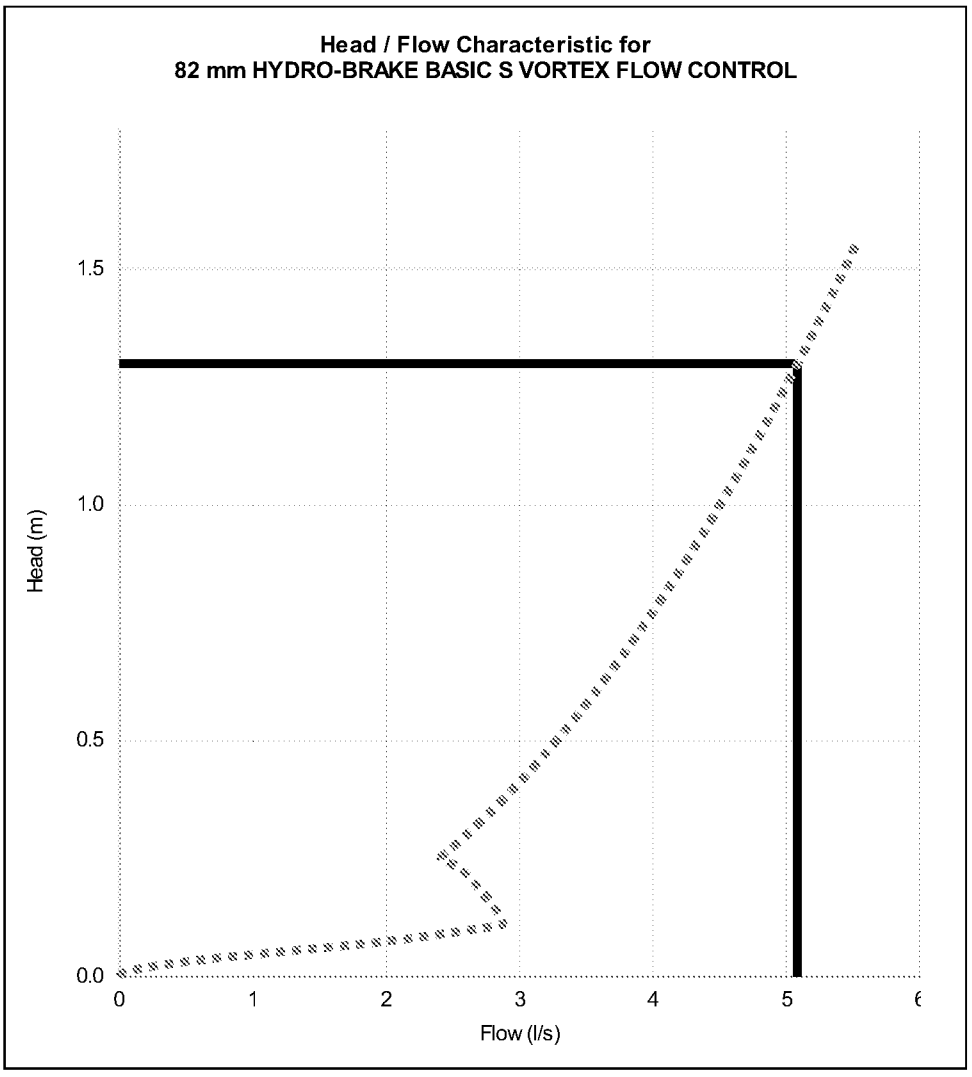
82 mm
Basic-S Vortex Flow Control

Hydro International Ltd • Unit 2, Rivermead Court • Kenn Business Park • Windmill Road • Kenn • Clevedon • BS21 6F

82 mm HYDRO-BRAKE BASIC S VORTEX FLOW CONTROL
SPECIFICATION SHEET

Project Information			
Date:	27/09/2024 15:01	**Site Ref:**	HQT-174626
Site Name:	24_21_5580 Land West of Pagham Road, Bognor Regis		

Primary Design Point			
Flow (l/s)	5.08	**Head (m)**	1.30



Head (m)	Flow (l/s)
0.000	0.000
0.045	0.942
0.090	2.415
0.134	2.838
0.179	2.717
0.224	2.569
0.269	2.475
0.314	2.652
0.359	2.817
0.403	2.971
0.448	3.116
0.493	3.254
0.538	3.386
0.583	3.512
0.628	3.633
0.672	3.749
0.717	3.862
0.762	3.971
0.807	4.077
0.852	4.179
0.897	4.279
0.941	4.377
0.986	4.472
1.031	4.564
1.076	4.655
1.121	4.744
1.166	4.831
1.210	4.916
1.255	5.000
1.300	5.082

Rivermead Court · Kenn Business Park · Windmill Road · Kenn · Clevedon · BS21 6FT

[redacted] www.hydro-int.com

APPENDIX L: SuDS Management & Maintenance Plan

mayer brown

BARGATE HOMES LTD
LAND WEST OF PAGHAM ROAD
PAGHAM

SUDS MANAGEMENT AND MAINTENANCE PLAN

OCTOBER 2024

BARGATE HOMES LTD
LAND WEST OF PAGHAM ROAD
PAGHAM

SUDS MANAGEMENT AND MAINTENANCE PLAN

OCTOBER 2024

Project Code:	**SL/BHPAGHAM.10**
Prepared by:	**FA**
Approved by:	**SL**
Issue Date:	**October 2024**
Status:	**2nd Issue**

Mayer Brown Limited, Lion House, Oriental Road, Woking, Surrey GU22 8AR
[redacted]

Bargate Homes Ltd

Land West of Pagham Road

Pagham

SuDS Management and Maintenance Plan

List of Contents

Sections

Tables

1 Introduction

1.1 The proposed surface water drainage network utilises Sustainable Drainage techniques (SuDS) including permeable paving and attenuation basins. The management and maintenance of these features is of paramount importance to ensure their effectiveness over the lifetime of the development.

1.2 The proposed surface water features will not be adopted by any public body and will be maintained by a Management Company organised by the Client which would enable tight control over the operation and maintenance of the drainage/SuDS as proposed in the report.

1.3 This Owner's Manual is for advising the required maintenance activities for the sustainable drainage network. This report has been prepared with reference to CIRIA document C753 – The SuDS Manual and Building Regulations Part H and provides current best practice guidance on Sustainable Drainage Systems (SuDS) and other drainage features to facilitate their effective implementation within developments.

2 Management and Maintenance of Drainage Features

Introduction

2.1 There are three categories of maintenance activities:

- **Regular Maintenance** *(including inspections and monitoring)* – Consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, and inspections.
- **Occasional Maintenance** – Comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (e.g. sediment removal).
- **Remedial Maintenance** – Comprises intermittent tasks that may be required to rectify faults associated with the system.

Health and Safety

2.2 All those responsible for maintenance should take appropriate health and safety precautions of all activities (including lone working, if relevant) and risk assessments should always be undertaken.

Attenuation Basins

2.3 The attenuation basins are designed to store excess surface water runoff by temporarily before it is released through the Hydrobrake to prevent flooding.

2.4 Regular inspection and maintenance is important for the effective operation of attenuation basins as designed, these are described below in Table 2.1:

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter, debris and sediment.	Monthly
	Cut grass – for landscaped areas and access routes.	Monthly (during growing season) or as required.
	Cut grass – meadow grass in and around basin.	Half yearly: spring (before nesting season) or as required.
	Manage other vegetation and remove nuisance plants.	Monthly at start, then as required.
Occasional Maintenance	Reseed areas of poor vegetation growth.	Annually or as required.
	Prune and trim trees and remove cuttings.	As required.
	Repairing any damage relating to erosion, settling, or by tree roots.	As required.
Remedial Actions	Repair erosion or other damage by reseeding or re-turfing.	As required.
	Re-align rip-rap.	As required.
	Repair or rehabilitate inlets, outlets and overflows.	As required.
	Relevel uneven surfaces and reinstate design levels.	As required.
Monitoring	Inspect inlets, outlets and overflows for blockages and clear if required.	Monthly.
	Inspect banksides, structures, pipework etc for evidence of physical damage.	Monthly.
	Inspect inlets and pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies.	Half yearly.

Table 2.1: Attenuation Basin Maintenance Requirements

Swales

2.5 Swales can convey surface water through a site; however, they also provide a level of water treatment.

2.6 Regular inspection and maintenance are important for the effective operation of the Swales as designed, these are described below in table 2.2:

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris.	Monthly or as required.
	Cut grass – to retain grass height within specified design range.	Monthly (during growing season), or as required.
	Manage other vegetation and remove nuisance plants.	Monthly at start, and then as required.
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly.
	Inspect vegetation coverage.	Monthly for 6 months, quarterly for 2 years, then half yearly.
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies.	Half yearly.
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more of the swale treatment area.
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding.	As required.
	Re-level uneven surfaces and reinstate design levels.	As required.
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required.
	Remove and dispose of oils or petrol residues using safe standard practices.	As required.

Table 2.2: Swale Maintenance Requirements

Permeable Paving

2.7 Permeable paving requires regular cleaning to remove silt and other sediments, ensuring its effective drainage capacity is maintained.

2.8 Refer to Table 2.3 below for the relevant Permeable Paving Inspection and Maintenance Activities.

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using glyphosphate applied directly into weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving.	As required.
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost joining material.	As required.
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required.
Monitoring	Initial inspection.	Monthly for three months after installation.
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48h after large storms in first six months.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspections chambers.	Annually.

Table 2.3: Permeable Paving Maintenance Requirements

Hydrobrake

2.9 The Hydrobrake acts to control the rate of discharge from the site to greenfield run-off rates.

2.10 Regular inspection and maintenance are important for the effective operation of the Hydrobrake, see table 2.4 below for details:

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Debris removal from the inlet, outlet and chamber.	Monthly for 3 months, then annually or as required.
	Remove sediment from pre-treatment structures.	Annually, or as required.
Remedial Actions	Repair/rehabilitation of the inlet, outlet or chamber.	As required.
Monitoring	Inspect/check the inlet, outlet and chamber to ensure that they are in good condition and operating as designed.	Annually and after large storms.
	Check for sediment build-up and remove if necessary.	Annually and after large storms.

Table 2.4: Hydrobrake Maintenance Requirements

Manholes/Chambers

2.11 Proper management and maintenance of chambers are essential for reliable underground infrastructure systems. Regular inspections and maintenance activities ensure effective performance and enhances the longevity and functionality of underground infrastructure networks, see table 2.5 below for details:

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspect manholes periodically to identify any signs of damage, cracks, or corrosion.	Monthly for 3 months, then annually.
	Clear debris and obstructions from inlet, outlet and chamber.	As required.
	Check chamber covers and seals to ensure they are in good condition.	
	Conduct routine inspections of the surrounding area for signs of erosion or structural instability.	
	Remove sediment from pre-treatment structures.	Annually or as required.
Occasional maintenance	Perform thorough cleaning of chambers.	Every 1 - 2 years, or as required based on sediment and debris accumulation.
Remedial Actions	Repair/rehabilitation of the inlet, outlet and chamber as necessary.	As required
	Repair leaks, cracks, or joint failures promptly, with sealing performed as needed.	
	Address any issues related to groundwater infiltration or excessive stormwater during inspections or as reported.	
Monitoring	Implement a monitoring program to collect data on water levels, flow rates, or other relevant parameters regularly.	As required
	Inspect/check the inlet, outlet, and chamber to ensure that they are in good condition and operating as designed.	Annually and after large storms.
	Check for sediment build-up and remove if necessary.	Annually and after large storms.

Table 2.5: Chamber Maintenance Requirements

Pipes

2.12 Proper management and maintenance pipes are crucial for reliable drainage and wastewater systems.

2.13 Table 2.6 below details the operation and maintenance which are important to uphold the efficiency of pipe networks:

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually
	Debris removal from the pipes.	Monthly for 3 months, then annually or as required.
	Remove sediment from pre-treatment structures.	Annually, or as required.
Remedial Actions	Repair/rehabilitation of the and pipes.	As required.
	Check for any signs of structural deterioration.	
	Check for evidence of flow bypassing the facility.	
Monitoring	Inspect/check the and pipes to ensure that they are in good condition and operating as designed.	Annually and after large storms.
	Check for sediment build-up and remove if necessary.	Annually and after large storms.

Table 2.6: Outfall and Pipes Maintenance Requirements

Headwall (Outfall)

2.14 Effective management and regular maintenance of a headwall, serving as a crucial outfall structure, is essential for ensuring optimal stormwater drainage, erosion prevention, and the long-term integrity of the surrounding infrastructure.

2.15 Table 2.7 below presents comprehensive guidelines outlining operational protocols and maintenance prerequisites tailored to headwalls.

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Perform regular clearing based on sediment accumulation and debris presence.	Every 1 to 3 months, or as required
	Inspect the integrity of headwall structure and connections.	During each clearing or maintenance activity.
	Conduct inspections to identify damage, erosion, or sediment buildup in headwall components.	Every 6 to 12 months.
	Ensure unobstructed water flow by clearing any blockages in the headwall's openings or channels.	During inspection or as required.
Occasional Maintenance	Thoroughly clean headwall components, removing sediment and debris accumulation.	Every 1 to 2 years, or as required.
	Inspect and maintain seal or gasket between headwall and surrounding infrastructure.	During inspection or as required.
	Verify the proper functionality of any bypass or overflow mechanisms.	During heavy rainfall events or as part of annual inspections.
Remedial Actions	Promptly address and repair any damages to the headwall structure, bags, or connections.	As required
	Resolve any leaks, cracks, or joint failures by applying suitable sealing materials.	
	Investigate and rectify issues related to sediment buildup or inadequate drainage efficiency.	During inspections or as reported.
Monitoring	Implement a monitoring program to assess the headwall's performance, including water flow, sediment levels, and structural integrity.	Annually or as specified.
	Inspect headwall and pipes for proper condition and operational efficiency.	Annually and after significant storm events.
	Check for sediment accumulation and remove as necessary to maintain optimal performance.	Annually and after significant storm events.

Table 2.7: Headwall Maintenance Requirements

Swale Underdrain / Filter Drains

2.16 Regular maintenance of filter drains / underdrains that capture water beneath attenuation basins / swales is essential for optimal performance and longevity. These systems help manage excess water, prevent flooding, and improve water quality by filtering sediments and pollutants.

2.17 Table 2.8 below presents the required management and maintenance of filter drains below.

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspect filter media for clogging or sediment accumulation.	Every 1 to 3 months, or as required.
	Ensure that the filter drain inlets/outlets are clear of debris and functioning properly.	During each inspection or maintenance activity.
	Check the surrounding vegetation for overgrowth that may obstruct water flow.	Every 6 to 12 months.
Occasional Maintenance	Conduct a thorough cleaning of filter media to remove accumulated silt and organic matter.	Every 1 to 2 years, or as required.
	Inspect the integrity of the filter drain system and surrounding infrastructure.	During inspection or as required.
Remedial Actions	Address and repair any damage to the filter drain structure or connections promptly.	As required.
	Replace or repair damaged filter media to restore functionality.	
	Investigate any issues related to groundwater capture efficiency and rectify as needed.	During inspections or as reported.
Monitoring	Implement a monitoring program to assess the performance of the filter drains, including water quality and flow rates.	Annually or as specified.
	Inspect for signs of erosion or instability in the surrounding area.	Annually and after significant storm events.
	Review sediment accumulation and implement removal strategies as necessary to maintain optimal performance.	Annually and after significant storm events.

Table 2.8: Swale Underdrain / Filter Drain Maintenance Requirements

3 Maintenance Activities

Regular Maintenance Activities

Inspections and Reporting

3.1 Inspections can generally be carried out at monthly site visits and should be subsumed into regular maintenance requirements. During the first year of operation, inspections should ideally be carried out after every significant storm event to ensure proper functioning, but in practice this may be difficult or impractical to arrange.

3.2 Typical routine inspection questions that will indicate when occasional or remedial maintenance activities are required, and/or when water quality requires investigation include:

- Are inlets or outlets blocked?
- Is there evidence of poor water quality? (e.g. algae, oils, milky froth, odour, unusual colourings.)
- Is there evidence of sediment build up?
- Is there evidence of structural damage that requires repair?

Litter/Debris Removal

3.3 This is an integral part of drainage maintenance and reduces the risks of inlet and outlet blockages, retains amenity value and minuses pollution risks.

Irregular Maintenance Activities

Sediment Removal

3.4 To ensure long-term effectiveness, the sediment that accumulates in drainage features should be removed periodically.

3.5 Sediment accumulation will typically be rapid for the entire construction period (including time required for the building, turfing and landscaping of all upstream development plots). Once a catchment is completely developed and all vegetation is well-established, sediment mobility and accumulation is likely to drop significantly.

Remedial Maintenance

Structure rehabilitation/repair

3.6 There will come a time with most drainage features when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between

10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load.

3.7 Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other drainage features are unlikely to need major overhaul if routine maintenance is undertaken as required.

Maintenance Access for Attenuation Basins / Hydrobrake / Headwalls / Manholes

Feature Locations

3.8 Each basin, Hydrobrake, headwalls and manholes can be found on the General Arrangement Plan, refer to Appendix H of the Discharge of Conditions report. These locations are described below:

- Manhole SW07: Located to the north of Plot 50.
- Manhole SW09: Located to the north of Plot 42.
- Headwalls: Located downstream of SW07, at the base of Attenuation Basin 1, at the base of Attenuation Basin 2, downstream of SW09, and upstream of the Hydrobrake Flow Control.
- Attenuation Basins: Located opposite plots 50-53.

Access points: Designated Pedestrian and Vehicle Routes

3.9 Two visitor parking bays are located on the proposed layout, to the west of Plot 52 which can be used to park vehicles during inspections carried out on foot. A footway is located around the perimeter of the basins which ensures access to the basins, headwalls and manholes.

3.10 When vehicles are required to access the basin, headwalls, Hydrobrake, they can use the planned risk-assessed entry points which include:

- via a gate (3m wide opening) opposite plot 51, where vehicles can travel through the 3m wide opening between the basins to access and maintain the features.
- via a gate (3m wide opening) opposite plot 41 so the features can be accessed by traveling clockwise around the track provided.

APPENDIX M: Arun District Council Surface Water Drainage Checklist

Surface Water Drainage Design Checklist

This checklist has been created to assist designers, by clearly defining our expectations and requirements for surface water drainage designs that are submitted to support planning applications. It is recommended that applicants and their designers take time, at the outset of the planning process, to familiarise themselves with the checklist and our guidance.

Surface water drainage must be adequately considered when formulating the layout of a site, therefore it is expected that surface water drainage information is submitted with all planning applications. Surface water drainage information may be requested for smaller proposals where drainage is expected to affect determination – for example, in the Lidsey Wastewater Treatment Catchment.

The items listed in the checklist cover our expectations for a fully detailed surface water drainage design. The final details of a design may be agreed via planning condition, or prior to determination of a full, or reserved matters planning application.

Applicants who submit all the information requested by the checklist, as early as possible in the planning process, benefit from quicker review times and less delays caused by requests for further information. The omission of information may lead to objection to, or refusal of planning applications or applications to discharge conditions.

Applicants for major development sites must be aware that West Sussex County Council [WSCC] acting as Lead Local Flood Authority [LLFA] are a statutory consultee for flood risk and surface water drainage design. It is important to consult WSCC guidance in addition to our guidance and this checklist.

A major planning application is defined as:

- The creation of 10 or more residential units,
- Residential development of on a site of 0.5 hectares or more (where the number of residential units is not yet known i.e. for outline applications),
- Non-Residential development or change of use on a site of at least 1 hectare,
- Creation or change of use of 1000 square metres or more of gross floor space (not including housing).

Applicants have the option to apply for confidential pre-application advice relating to their surface water drainage design from either Arun District Council or WSCC. Bespoke advice is not offered outside of a fee-paying application.

ADC pre-application advice: https://www.arun.gov.uk/pre-application-advice

WSCC pre-application advice: https://www.westsussex.gov.uk/roads-and-travel/information-for-developers/flood-risk-management-pre-application-advice/

Critical Items for Detailed Surface Water Drainage Design	
A detailed checklist of our requirements follows this advice. However, we highlight that the failure to adequately address the following critical items will result in an **objection** to any application to discharge a surface water drainage design condition and will likely result in an objection on a full or reserved matters planning application. It is expected that if any of these items are inadequately addressed by a submission then their correction may result in a redesign of the surface water drainage scheme. A redesign may have the potential for storage structures to increase in volume or plan area.	
Critical Item	**Reason**
Winter groundwater monitoring data.	Adequate winter groundwater monitoring data must be supplied to evidence that infiltration designs have sufficient freeboard from the base of structures and the peak groundwater level. The same data is necessary to ensure that the potential for buoyancy has been adequately considered in attenuation designs.
Winter infiltration testing data.	Adequate winter infiltration testing must be supplied to justify the proposed discharge method and design infiltration rates. Infiltration tests must be completed strictly in accordance with BRE DG 365, CIRIA R156 or a similar approved method. Testing depths must account for peak groundwater levels and correspond with the location and depth of proposed infiltration features. Designs must be based upon the slowest infiltration rate evidenced closest to a proposed infiltration feature. Average design rates will not be accepted. The results of incomplete tests should not be extrapolated to obtain design values for infiltration rates.
The hierarchy for sustainable drainage.	The proposed discharge method must accord with the SuDS hierarchy as given below. Evidence must be supplied to justify the proposed discharge method. 1. Rainwater reuse where possible. 2. Complete discharge into the ground (infiltration). 3. Hybrid infiltration and restricted discharge to an appropriate water body or surface water sewer. 4. Restricted discharge to an appropriate water body. 5. Restricted discharge to a surface water sewer. 6. Restricted discharge to a combined sewer. A water body may be defined as a river, watercourse, ditch, culverted watercourse, reservoir, wetland or the sea. **Engineers cannot support any proposed connection of surface water to the foul sewer.**
Calculations	Calculations for pre-development run off rates must be based upon the positively drained area only.

	Proposed discharge rates must not increase flood risk on site or elsewhere. Discharge rates must be restricted to QBAR or 2 l/s/ha, depending on whichever is higher.
	Designs must be based on the most recently available rainfall data at the time of conditions being applied. **FSR rainfall data will not be accepted.** FEH rainfall data is based upon more recent records and continues to be updated.
	Designs must use the correct climate change allowances at the time of determination of the outline or full planning application. CV values for all events must be set to 1. This includes summer, winter, design, and simulation events. The correct allowance for urban creep must be applied. Additional storage must be set to zero unless it can be evidenced where this is provided. Infiltration half-drain times must be less than 24 hours. Infiltration design rates must be applied to the sides of soakaways, or to the base of infiltration blankets. Design rates must not be applied to both the base and sides of infiltration structures. A surcharged outfall must be modelled.
Natural catchments design.	The submission must define the natural drainage characteristics within, and hydraulically linked to, the site and demonstrate that the drainage proposals will integrate with and not compromise the function of the natural and existing drainage systems. The condition, performance (including capacity where appropriate) and ownership of any existing site surface water drainage infrastructure must be accurately reported. Appropriate easements to watercourses and other services must be shown on all plans. Where there are areas of flood risk from any source on the site, it must be shown how a sustainable surface water drainage design can be accommodated on the site without conflicting with those areas of flood risk. Designs must replicate the natural drainage catchments of the site. All surface water drainage designs must therefore drain via gravity to corresponding points of discharge. **The use of pumps for surface water drainage is not sustainable and will not be supported**. .
Plans	Plan areas, depths and levels of drainage infrastructure must accurately correspond with the supporting calculations.

Water quality benefits.	An assessment of water quality is necessary to evidence that the proposed design provides adequate treatment of surface water.
Biodiversity and amenity benefits.	The surface water drainage design must provide biodiversity and amenity benefits.
Trees and planting	There should be no conflict between surface water drainage infrastructure and existing or proposed trees or planting. The design must consider the potential growth of proposed trees and adequate mitigation must be provided to protect drainage infrastructure where conflict **cannot** be avoided.

Full Detailed Surface Water Drainage Design Checklist

Site Name/Address:	Land West of Pagham Road, Pagham
Application Description:	Reserved Matters Application (Application ref: APP/C3810/W/22/3302023)

Policy and Guidance Information

Arun District Council Surface Water Drainage Guidance - https://www.arun.gov.uk/surfacewater

Land Drainage Consent – https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/flooding/flood-risk-management/ordinary-watercourse-land-drainage-consent/
and
https://www.arun.gov.uk/land-drainage-consent/

Arun District Council surface water pre-commencement conditions -
https://www.arun.gov.uk/planning-pre-commencement-conditions

The SuDs Manual [C753] by CIRIA

Sustainable drainage systems: non-statutory technical standards'
https://assets.publishing.service.gov.uk/media/5a815646ed915d74e6231b43/sustainable-drainage-technical-standards.pdf

Ground Investigation Results

Groundwater monitoring – Please refer to Appendix D
☒ Plan showing location of monitoring points provided.
☒ Depths of holes detailed.
☒ Dates of observations and depth to groundwater recorded.
☒ Evidence of the strata within borehole or monitoring pits provided.

Requested to aid speed of assessment
☒ Plan showing the peak groundwater levels at each monitoring point in mAOD.
☒ Peak groundwater levels recorded in metres below ground level and mAOD.
☐ If in an area of possible tidal influence, provide a comparison of readings against tide times/levels.

Infiltration testing – Due to high groundwater levels, infiltration to the ground is an unsuitable means of surface water discharge for this site. Furthermore, West Sussex County Council are in agreement that due to ground conditions and groundwater levels, infiltration testing is not required. Correspondence confirming this is included at the end of this checklist.
☐ Completed strictly in accordance with BRE DG 365, CIRIA R156 or a similar approved method.
☐ Plan showing location of trial pits provided.
☐ Pit dimensions provided.
☐ Depths of testing provided.
☐ Dates, times and readings of each test recorded.
☐ Calculations for the infiltration rate for each test provided.
☐ Evidence of the strata within trial pits provided.

☐ Test locations, and depths correspond with the expected location and depths of proposed infiltration features.

Requested to aid speed of assessment
☐ Depths of testing provided in m below ground level and mAOD.

Other – As per the above, infiltration to the ground has been confirmed as an unsuitable means of surface water discharge from the site.
As appropriate, dependent upon specific site conditions
☐ Geotechnical advice relating to the siting of infiltration features and risk of dissolution. (Usually where chalk strata is evidenced.)
☐ Geotechnical advice relating to the risk of slope instability due to infiltration.
☐ Geotechnical and structural advice where infiltration is proposed closer than 5m to buildings or structures.
☐ Contamination evaluation assessment where infiltration is proposed in ground that may be contaminated.
☐ Geotechnical advice where infiltration is proposed into made ground (to be generally avoided).
☐ Geotechnical advice relating to infiltration capacity, and risk of settlement or instability where careful use of ground raising is proposed.
☐ Specialist advice and confirmation of acceptability from the Environment Agency where the use of deep bore soakaways is proposed.

Surface Water Drainage Statement

Disposal method (Select as appropriate)
☐ Rainwater reuse is proposed where possible.
☐ Infiltration is proposed and maximised wherever possible.
☐ Hybrid infiltration and restricted discharge to an appropriate water body or surface water sewer is proposed where a full infiltration design is not possible.
☒ Restricted discharge to a water body is proposed where a full infiltration design is not possible.
☐ Restricted discharge to a surface water sewer is proposed where a full infiltration design is not possible and there are no nearby water bodies.
☐ Restricted discharge to a public or private highway drainage network is proposed where a full infiltration design is not possible and there are no nearby water bodies or surface water sewers.
☐ Restricted discharge to a public combined sewer is proposed where a full infiltration design is not possible and there are no water bodies, surface water sewers, highway, or private drainage systems nearby.

Disposal method justification
☒ Infiltration has been adequately investigated, in winter, at appropriate and varying depths where appropriate, above peak recorded winter groundwater levels at the given location.
☒ Onsite and boundary, open and culverted water bodies are investigated (location, mapping, network, flow direction, ownership/responsibility, depth, and condition).
☒ Offsite nearby downstream water bodies are investigated (location, mapping, network, flow direction, ownership/responsibility, depth, and condition).
☐ Surface water sewer network is investigated (location, mapping, network, flow direction, ownership/responsibility, depth, capacity, and condition).
☐ Public and private downstream highway drainage networks are investigated (location, mapping, network, flow direction, ownership/responsibility, depth, capacity, and condition).
☐ Combined downstream sewer network is investigated (location, mapping, network, flow direction, ownership/responsibility, depth, capacity, and condition).

☐ Any relevant permissions or legal agreements from asset or landowners that are needed are identified and evidence of consents provided.

Requested to aid speed of assessment

☒ Any previous relevant correspondence or pre-application advice from the Local Planning Authority [LPA] or the Lead Local Flood Authority [LLFA] regarding the surface water drainage design is included with the statement.

Existing Site

Essential

The flood risk and drainage considerations have been covered at the Outline Planning application stage and can be found in Appendix N of the Mayer Brown Discharge of Conditions report.

☒ It is clear what the natural drainage characteristics of the site and hydraulically linked areas are.

☒ Natural flow paths are identified on a plan (where applicable).

☒ Existing site drainage features are investigated – condition, performance, and ownership.

☒ Environmentally sensitive receiving water bodies are identified – for example groundwater source protection zones.

☒ Any appropriate easements to watercourses or other infrastructure are investigated.

☒ Existing and future flood risk from any source is detailed.

It is suggested that the above is achieved with the following, which may be combined where appropriate:

☒ An existing topographical plan.

☐ An existing drainage catchment plan. – A description is provided in the report.

☐ An existing site surface water drainage plan (where applicable). – A description is provided in the report.

☒ Flood maps (fluvial, tidal, pluvial, groundwater, sewer, and reservoir) are supplied (or Flood Risk Assessment referred to).

☒ Confirmation and surveys of any existing drainage infrastructure on the site.

☒ Full details of any known flooding on the site.

Proposed Design

Essential

☒ Statement confirming the proposed design criteria including fixed design calculation inputs for the SuDS system. Examples include:

- Climate change allowances,
- Urban creep allowance,
- CV values,
- Rainfall data,
- MADD factor or additional storage.

☒ Natural catchments are followed.

☐ Where phased construction is proposed, the phases correspond to natural catchments and can function independently from each other. – Phased construction is not proposed.

☒ The design is gravity based with no use of pumps.

☒ Natural systems that deliver specific hydrological function, such as watercourses or wetlands, are preserved.

☒ Where there is existing drainage infrastructure on the site it is clearly explained or illustrated what is being retained, upgraded, or removed.
☐ Relevant restrictions relating to discharging to an environmentally sensitive receiving water body – for example a groundwater source protection zone - are investigated, reported and adhered to. – According to the Magic Map provided by the Department of Environment Food & Rural Affairs, the site is not located within a Source Protection Zone.
☐ Details of necessary off-site works and consents are provided. – No offsite drainage works are required for the proposals. Ordinary Watercourse Consent will be required for the outfall into the ditch, as outlined in paragraph 4.9 of the accompanying report.
☒ It is shown how a surface water drainage design will not conflict with additional areas of flood storage or compensation.
☒ Surface water flow entering the site from elsewhere is conveyed safely around or through the site without compromising the SuDS system.
☐ Where runoff from elsewhere is drained together with the site runoff, the contributing catchment is modelled as part of the drainage system.
☒ If the surface water drainage is designed to flood in the 1% Annual Exceedance Probability [AEP] + Climate Change Allowance [CCA] event, then the flood volume is contained safely on site without flooding any part of a building or utility plant susceptible to water or affecting safe access or egress.

☐ The design provides and evidences interception drainage and is able to capture and retain on site the first 5mm of the majority of all rainfall events.
☒ Water quality and treatment is adequately assessed – with an assessment appropriate for the scale and proposed use of the site.
☒ Adequate freeboard is provided between the top water level of any open storage features and the top of the bank.
☒ There are no clashes with other infrastructure.
☒ Self-cleansing velocities are achieved where pipes are proposed.

☐ 1m freeboard is provided between peak groundwater levels and the base of any infiltration feature. – N/A

☒ The proposed discharge rate is explained and justified (for attenuation designs).
☐ Where discharge is proposed to a public surface water or combined sewer, a capacity check confirming that the sewer can receive the proposed flows is submitted.
☒ Adequate freeboard is provided between peak groundwater levels and the base of any attenuation feature (refer below if this is not possible).
☒ Where there is a risk that the base of an attenuation feature may penetrate peak groundwater levels, additional mitigation measures to prevent groundwater ingress are incorporated into the design and construction method statement.
☒ Where there is a risk that the base of an attenuation feature may penetrate peak groundwater levels the effects of buoyancy have been considered in the design.

☒ Amenity benefits are provided by the drainage system (assessed by others).
☒ Biodiversity benefits are provided by the drainage system (assessed by others).
☒ Landscaping has been designed to ensure ease of maintenance of drainage assets.
☒ The justification and criteria for tree root avoidance and mitigation measures is clear, referencing adopting body standards where applicable.
☒ Biodiversity and ecological enhancements do not impede the functionality, maintenance or capacity of the drainage system.

☒ It is confirmed what elements of the SuDS will be private.

☒ It is confirmed what the adoption arrangements for SuDS components will be.
☐ A construction method statement for the SuDS system, appropriate to the scale of the development, is submitted.
☒ A maintenance plan for the SuDS system, appropriate to the scale of the development, is submitted. [Please refer to our SuDS Maintenance Checklist where this is stipulated by condition.]
☒ Any potential health and safety issues relating to SuDS implementation and management have been considered and managed.

Preferred
☒ Ground raising is avoided where possible.
☒ The drainage system is considered by and contributes to the biodiversity net gain statement (assessed by others).

Impermeable Area/Catchment Plan

Essential
☐ Different drainage catchments are demarcated. – All one catchment.
☐ Where phased construction is proposed, each phase is shown on a plan. – Not phased.
☒ An impermeable area plan is provided showing all positively drained areas including open surface water storage plan areas.

Preferred
☒ Impermeable areas are shown in m^2 on the impermeable areas plan(s).
☐ Demarcated impermeable areas correspond with the distribution of those areas in the supporting calculations.

Surface Water Drainage Calculations

General
☒ The most recently applicable, or previously agreed FEH rainfall data is used.
☒ CV values for all events are set to 1. This includes summer, winter, design, and simulation events.
☒ The correct climate change allowances, appropriate for the full lifetime of the development, have been applied to all calculations.
☒ A 10% allowance for urban creep is applied to all residential roof areas.
☒ 100% Annual Exceedance Probability [AEP] + Climate Change Allowance [CCA] (1 in 1 year) event calculations provided.
☒ 10% AEP + CCA (1 in 10 year) event calculations provided showing that the incoming pipe to any infiltration feature is above this level.
☒ 3.33% AEP + CCA (1 in 30 year) event calculations provided showing that the full surface water volume is contained within the designed system without flooding.
☒ 1% AEP + CCA (1 in 100 year) event calculations provided showing that the full surface water volume is contained safely on site, without flooding any part of a building or utility plant susceptible to water or affecting safe access or egress.

Infiltration – As per the above, infiltration to the ground has been confirmed as an unsuitable means of surface water discharge from the site.
☐ Half drain times do not exceed 24 hours for the 10% AEP + CCA and 1% AEP + CCA events.
☐ If half drain times exceed 24 hours for the 1% AEP + CCA event, then advice and agreement from the LPA has been sought and submitted.
☐ The most precautionary design infiltration rate is used.

☐ Design infiltration rates are applied to the sides of soakaways only.
☐ Design infiltration rates are applied to the base of permeable paving, infiltration blankets or basins only.
☐ Where the design infiltration rate is applied to the base an appropriate factor of safety is applied.

Attenuation and Restricted Discharge
☒ Greenfield run off rates are based upon the positively drained area of the site only.
☒ Discharge rates are restricted to QBAR or 2 l/s/ha, depending on whichever is higher, for all storms up to the 1% AEP + CCA event.
☒ Half drain times and available capacity in the drainage system for subsequent storms are considered.
☐ Brownfield run off rates are based upon the positively drained area of the site only.
☐ Brownfield sites aspire to achieve greenfield runoff rates and volumes, where infiltration is not viable. If the proposed run off rate is higher than the greenfield run off rate, then an acceptable justification is provided, and the rate has been agreed with any relevant bodies.
☒ A surcharged outfall to a watercourse or sewer has been modelled. The surcharge level is the 1% AEP + CCA flood event for the receiving watercourse, or to the top of the bank if appropriate hydraulic modelling is not available.
☒ A surcharged outfall to a tidal waterbody has been modelled. The surcharge level is based upon present day extreme sea levels with an allowance for sea level rise applied.

Requested to aid assessment
☒ FEH22 point descriptors for the site are provided.

Drainage Plans and Specifications

Essential
Plans are provided showing:
☒ The proposed design within the proposed site layout.
☒ Existing site sections and levels.
☒ Proposed site sections and levels.
☒ Long and cross sections for the proposed drainage system including final finished floor levels.
☒ Exceedance flow management routes.
☒ Details of connections to watercourses and sewers.
☒ Maintenance access and any arisings storage and disposal arrangements. – Discussed within the SuDS Management & Maintenance Plan in Appendix L.

These plans must be of sufficient detail that a reviewer can be confident that the design can be constructed without flood risk being increased on site or elsewhere.

Specifications are required for all materials used in the design. We suggest that this is best achieved and illustrated with site specific construction detail drawings. The combination of construction details, with plans and sections, ensure that the proposed standard of construction will facilitate adoption and maintenance by an appropriate body and have structural integrity.

The following checklist is designed to demonstrate the level of detail required:

Easements
☒ 3m easements are shown from the top of the bank of all ordinary watercourses, and from the edge of all culverted watercourses on all plans.
☐ 8m easements are shown from the top of the bank of all main rivers on all plans - unless an alternative easement has been stipulated by the Environment Agency. - NA

☒ Any appropriate easements as stipulated by any public or private utility provider shown on all plans.
☐ Infiltration features (aside from permeable paving that does not take any extra impermeable catchment such as a roof) are shown at least 5m from buildings or structures.
☒ Maintenance easements are shown from the top of the bank from all open SuDS features on all plans.
☒ Existing trees and their root protection zones are shown on any drainage layout.
☒ Proposed trees and appropriate easements are shown on any drainage layout.

Detail
☒ It can be clearly determined what a pipe's diameter, pipe materials, gradients, flow directions and invert levels are from the plans.
☒ It can be clearly determined what an inspection chamber or manhole's cover level, invert level, cover loading grade and sump depth (where applicable) are from the plans.
☒ All infiltration or attenuation features (including permeable paving) are clearly labelled with their dimensions, invert/base levels and cover levels.
☒ Control structures are labelled with discharge rates, hydraulic head, invert and cover levels and ideally model number.
☐ Operational characteristics of any other mechanical features are detailed. – N/A
☒ Measures to protect drainage from tree root damage are clearly shown on any drainage layout. – Root barriers will be provided to prevent roots entering the drainage system where required.
☐ Any areas of necessary ground raising are clearly justified and demarked on a plan, with depths and levels.
☐ If the 1% AEP + CCA event floods, then the extent and depth of the flooding is shown on a site plan. This plan includes proposed external ground levels and finished floor levels of buildings.– N/A
☐ Potential flow routes off site are shown. The plan also includes proposed external ground levels, finished floor levels of buildings and designed slopes on all impermeable surfaces such as highways or car parks. – N/A
☒ Cross sections and long sections of all open features are provided.
☒ Construction detail drawings are site specific.
☒ Construction detail drawings are provided for all components including but not limited to:

- ☐ Infiltration structures
- ☒ Attenuation structures
- ☒ Manholes/inspection chambers
- ☐ Catchpits/silt traps
- ☒ Flow control devices
- ☒ Permeable paving
- ☒ Headwalls
- ☐ Channel drains
- ☐ Gullies
- ☐ Pipe bed and surround
- ☐ Pipe to pipe connections
- ☐ Filter strips or drains
- ☒ Swales
- ☐ Bio-retention systems
- ☐ Ponds and wetlands
- ☐ Tree pits and measures to protect drainage from root incursion
- ☐ Water treatment features
- ☐ Green roofs

- ☐ Measures to protect drainage from tree roots.
- ☐ Water butts or alternative methods of water reuse – also to be shown on plans.

<u>The following items are requested to aid assessment or confidence in construction:</u>

☐ Where features have a non-uniform plan area, a plan showing the coordinates of the perimeter is provided.
☐ All drainage infrastructure is labelled to correspond with the supporting calculations.

Other
☐ Open feature planting specification is provided (to be assessed by others).

This checklist is designed to aid an applicant with their submission. The list is not exhaustive, and our engineers may request additional information to enable them to review a proposal to their satisfaction.

The checklist may also request information that an applicant does not feel is relevant to their submission. In this case the applicant can provide an explanation as to why they have omitted certain information in their drainage statement. However, the appraising engineer reserves the right to request this information if they believe it is necessary for their review.

Steven Lecocq

From: Sarah Burrow <Sarah.Burrow@arun.gov.uk>
Sent: 16 August 2024 11:12
To: Steven Lecocq; Land Drainage; Paul Cann
Cc: Luke Vallins; Francesca Egan; Rachel Davies; Suzannah Duke; Caroline Gower; Farris Alkhatib; Mat Jackson
Subject: RE: Pagham - APP/C3810/W/22/3302023 - Infiltration Testing Query

Hi Steven,

I can confirm that based upon your groundwater monitoring data, infiltration will not be viable as a means of surface water disposal.

Please ensure that you account for the risk of buoyancy in your design and consider the high groundwater levels in construction method and planning.

Kind regards

Sarah Burrow
Engineering Assistant, Coastal Engineers and Flood Prevention

T: 01903 737815
E: sarah.burrow@arun.gov.uk
M: 07733 125764

Usual working pattern:
Monday – Flexible between 8am and 4pm
Tuesday and Wednesday – 9:15am to 2:45pm
Thursday – 9am to 5pm
Friday – 8am to 2:45pm

Arun District Council, Civic Centre, Maltravers Rd
Littlehampton, West Sussex, BN17 5LF
www.arun.gov.uk

From: Steven Lecocq [redacted]
Sent: Wednesday, August 14, 2024 9:44 AM
To: Land Drainage <Land.Drainage@arun.gov.uk>; Sarah Burrow <Sarah.Burrow@arun.gov.uk>; Paul Cann <Paul.Cann@arun.gov.uk>
Cc: Luke Vallins [redacted] Francesca Egan [redacted] Rachel Davies [redacted]; Suzannah Duke [redacted]; Caroline Gower [redacted]; Farris Alkhatib [redacted]; Mat Jackson [redacted]
Subject: FW: Pagham - APP/C3810/W/22/3302023 - Infiltration Testing Query

Good morning Sarah / Paul,

We are currently working on the Land West of Pagham Road scheme in Pagham (ref: APP/C3810/W/22/3302023), and we were hoping you could clarify something if possible?

Condition 13 states the below (decision notice attached):

> *13) No development shall commence, other than works of site survey and investigation, until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the local planning authority. The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, and the recommendations of the SuDS Manual produced by CIRIA. Design considerations must take full account of the 'Supplementary Requirements for Surface Water Drainage Proposals' produced by Arun District Council and are an overriding factor in terms of requirements. Winter groundwater monitoring to establish highest annual ground water levels and winter percolation testing to BRE 365, or similar approved, will be required to support the design of any infiltration drainage. No dwelling shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity.*

The Outline FRA proposes to discharge to the surrounding ditch network at greenfield rates due to the underlying ground conditions not being suitable for infiltration drainage. Furthermore, we have undertaken groundwater monitoring which demonstrates that the groundwater is consistently less than 1m below ground level (as shallow as 100mm below ground level in places). Therefore, the unsaturated zone of 1m between the base of any infiltration feature and the maximum groundwater levels cannot be achieved, demonstrating that infiltration drainage is not a viable option.

With the above in mind we have discounted infiltration drainage based on the ground conditions (in accordance with the Outline FRA), and just wanted to confirm this is acceptable and to confirm infiltration testing will therefore not be required (as ground conditions preclude its use anyway)?

Mat at WSCC has confirmed WSCC as the LLFA agree with our assessment, but has suggested I check with you to (see attached email for your information). With this in mind, I would be grateful if you could confirm the above when you get a minute.

I look forward to hearing from you, and in the meantime, any questions, please do give me a call.

Thanks in advance,

Steven

Steven Lecocq BEng (Hons) MSc CEng MICE MCIHT MCIWEM
Technical Director, Mayer Brown Limited
[redacted]
A: Chapel Studios 14, Purewell, Christchurch, BH23 1EP

Mind and Woking Foodbank are Mayer Brown's chosen charities

Farris Alkhatib

From: Mat Jackson <[redacted]
Sent: 12 August 2024 11:31
To: Steven Lecocq; Flood Risk Management
Cc: Luke Vallins; Francesca Egan; Rachel Davies; Suzannah Duke; Caroline Gower; Farris Alkhatib; Simon Davis
Subject: RE: Pagham - APP/C3810/W/22/3302023 - Infiltration Testing Query

Steven,

Thank you for the information.

From an LLFA perspective we would concur with your assumption and evidence. I would advise that this is checked with the local drainage engineers. The LLFA looks forward to receiving the re-consultation via the LPA in due course.

Kind Regards,

Mat Jackson *FCIWEM C.WEM CEnv CSci LLM MSc BSc (ComMons)*
Senior Flood Risk Management Officer
West Sussex County Council
[redacted]

Upcoming Leave: 27th Aug – 4th Sept 2024

From: Steven Lecocq [redacted]
Sent: Friday, August 9, 2024 4:39 PM
To: Mat Jackson <Mat.Jackson@westsussex.gov.uk>; Flood Risk Management <FloodRiskManagement@westsussex.gov.uk>
Cc: Luke Vallins <[redacted]rancesca Egan <[redacted]
Rachel Davies <[redacted] Suzannah Duke <[redacted] Caroline Gower <[redacted]Farris Alkhatib <[redacted]>
Subject: Pagham - APP/C3810/W/22/3302023 - Infiltration Testing Query

****EXTERNAL****

Good afternoon Mat,

I hope you are well.

We are currently working on the Land West of Pagham Road scheme in Pagham (ref: APP/C3810/W/22/3302023), and we were hoping you could clarify something if possible?

Condition 13 states the below (decision notice attached):

> *13) No development shall commence, other than works of site survey and investigation, until full details of the proposed surface water drainage scheme have been submitted to and approved in writing by the local planning authority. The design should follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations, and the*

recommendations of the SuDS Manual produced by CIRIA. Design considerations must take full account of the 'Supplementary Requirements for Surface Water Drainage Proposals' produced by Arun District Council and are an overriding factor in terms of requirements. Winter groundwater monitoring to establish highest annual ground water levels and winter percolation testing to BRE 365, or similar approved, will be required to support the design of any infiltration drainage. No dwelling shall be occupied until the complete surface water drainage system serving the property has been implemented in accordance with the agreed details and the details so agreed shall be maintained in good working order in perpetuity.

The Outline FRA proposes to discharge to the surrounding ditch network at greenfield rates due to the underlying ground conditions not being suitable for infiltration drainage. Furthermore, we have undertaken groundwater monitoring which demonstrates that the groundwater is consistently less than 1m below ground level (as shallow as 100mm below ground level in places). Therefore, the unsaturated zone of 1m between the base of any infiltration feature and the maximum groundwater levels cannot be achieved, demonstrating that infiltration drainage is not a viable option.

With the above in mind we have discounted infiltration drainage based on the ground conditions (in accordance with the Outline FRA), and just wanted to confirm this is acceptable and to confirm infiltration testing will therefore not be required (as ground conditions preclude its use anyway)?

I would be grateful if you could confirm the above when you get a minute.

I look forward to hearing from you, and in the meantime, any questions, please do give me a call.

Thanks in advance,

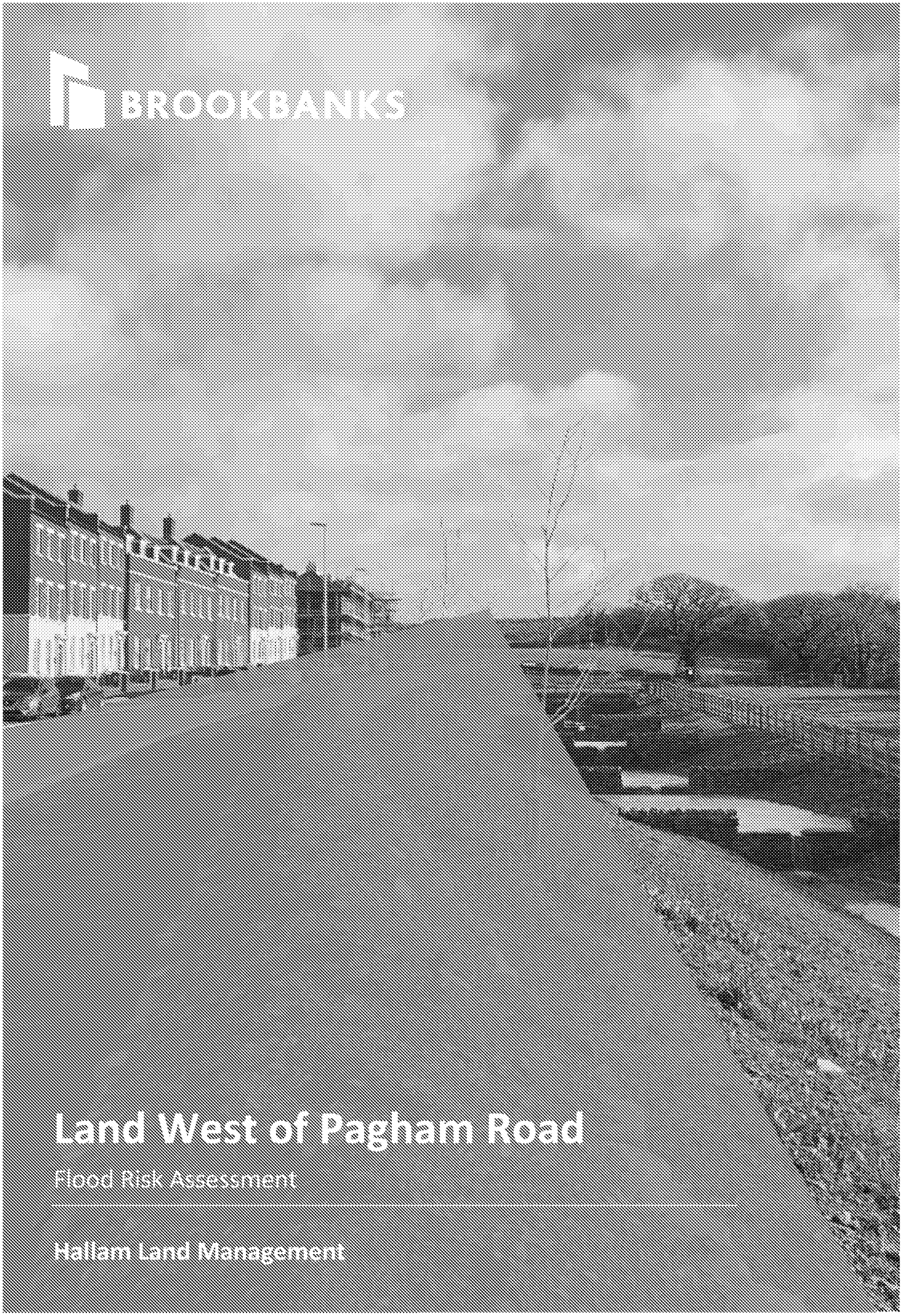
Steven

Steven Lecocq BEng (Hons) MSc CEng MICE MCIHT MCIWEM
Technical Director, Mayer Brown Limited
[redacted]

Mind and Woking Foodbank are Mayer Brown's chosen charities

APPENDIX N: Outline Approved Flood Risk Assessment

BROOKBANKS



Land West of Pagham Road

Flood Risk Assessment

Hallam Land Management

Document Control Sheet

Document Title	Flood Risk Assessment
Document Ref	10821 FRA01 Rv2
Project Name	Land West of Pagham Road
Project Number	10821
Client	Hallam Land Management Ltd

Document Status

Rev	Issue Status	Prepared By / Date	Checked By / Date	Approved By / Date
0	Final	KM 26.11.21	LW 26.11.21	LW 26.11.21
1	Final	KM 07.12.21	LW 07.12.21	LW 07.12.21
2	Final	KM 14.12.21	LW 14.12.21	LW 14.12.21

Issue Record

Name / Date & Revision	26.11.21 -	07.12.21 1	14.12.21 2			
Ruth McKeown – Hallam Land Management	-	1	2			

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Appendix B - IoH Greenfield Runoff Rates
Appendix C - WinDES Detention Calculations
Appendix D – Southern Water Sewer Records
Appendix E – Topographic Survey
Appendix F – GEG Groundwater Monitoring

1 Introduction

1.1 Brookbanks is appointed by Hallam Land Management Ltd to complete a Flood Risk Assessment for a proposed residential development at Pagham.

1.2 The objective of the study is to demonstrate the development proposals are acceptable from a flooding risk and drainage viewpoint.

1.3 This report summarises the findings of the study and specifically addresses the following issues in the context of the current legislative regime:

- Flooding risk
- Surface water drainage
- Foul water drainage

1.4 The illustrative surface water drainage strategy showing the proposed development and drainage strategy is contained within **Appendix A.**

Planning Application

1.5 This Flood Risk Assessment has been produced in order to provide information for an outline planning application.

1.6 Everything designed within this report is to illustrate that the a drainage strategy can be successfully designed and applied for the development site.

1.7 The FRA will then be the subject of a reserved matters application where detailed design layouts and criteria will be provided.

2 Background Information

Location and Details

2.1 The proposed development lies to the north-west of Pagham in West Sussex. The site is bound to the north by open fields and to the west by woodland. To the south, the site is bound by an area of existing residential properties. To the east, the site is bound by Pagham Road, situated adjacent to which is the Pagham North Strategic Site allocation.

2.2 The site is currently undeveloped agricultural land and is not thought to have been historically subject to any significant built development. The historical land uses within 1000m of the site is explored in further detail within Chapter 3 of the Geo-Environmental Phase 1 report submitted alongside this application.

2.3 The site location and boundary is shown indicatively on **Figure 2-1**.

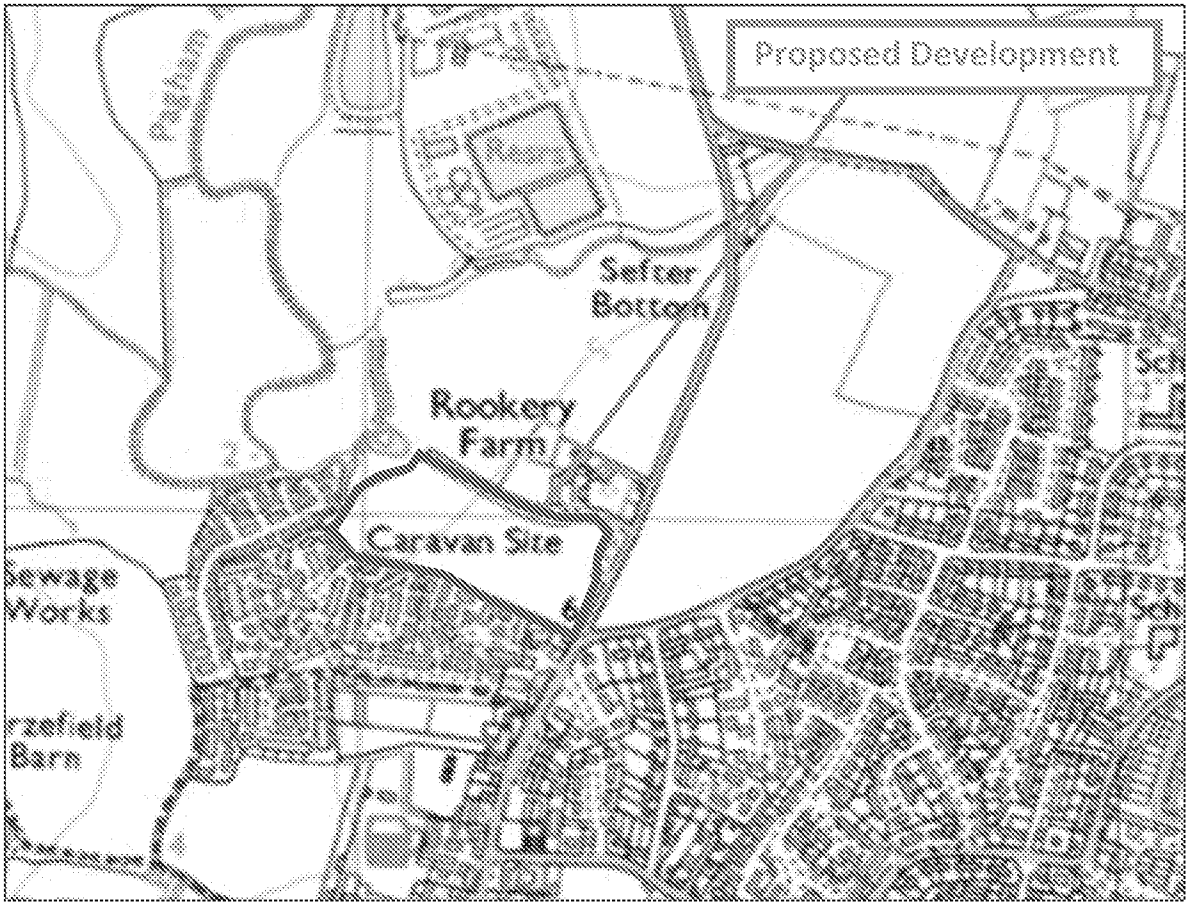

Figure 2-1: Site Location (Bing Maps, 2021)

Development Criteria

2.1 The proposed development is to comprise of:

"The construction of up to 106 new homes, formation of access onto Pagham Road, new pedestrian and cycle links, the laying out of open space, new strategic landscaping, habitat creation, drainage features and associated ground works and infrastructure."

Sources of Information

2.2 The following bodies have been consulted while completing the study:

- Southern Water - Storm & foul water drainage
- Environment Agency - Flood risk and storm drainage
- West Sussex County Council - Flood risk, drainage and associated policy

2.3 The following additional information has been available while completing the study:

- Mastermap Data - Ordnance Survey
- Published Geology - British Geological Survey

3 National Planning Policy

National Planning Policy

3.1 The National Planning Policy Framework (NPPF), updated in July 2021, sets out Governmental Policy on a range of matters, including Development and Flood Risk. The policies were largely carried over from the former PPS25: Development & Flood Risk, albeit with certain simplification. The allocation of development sites and local planning authorities' development control decisions must be considered against a risk-based search sequence, as provided by the document.

3.2 Allocation and planning of development must be considered against a risk-based search sequence, as provided by the NPPF guidance. In terms of fluvial flooding, the guidance categorises flood zones in three principal levels of risk, as follows in **Table 3-1**.

Flood Zone	Annual Probability of Flooding
Zone 1: Low probability	< 0.1 %
Zone 2: Medium probability	0.1 – 1.0 %
Zone 3a / 3b: High probability	> 1.0 %

Table 3-1: NPPF Flood Risk Parameters

3.3 The Guidance states that Planning Authorities should "apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change".

3.4 According to the NPPF guidance, residential development at the proposed site, being designated as "More Vulnerable" classifications, should lie outside the envelope of the predicted 1 in 100 year (1%) flood, with preference given to sites lying outside the 1 in 1,000 (0.1%) year events and within Flood Zone 1.

3.5 Sites with the potential to flood during a 1 in 100 (1%) year flood event (Flood Zone 3a) are not normally considered appropriate for proposed residential development unless on application of the "Sequential Test", the site is demonstrated to be the most appropriate for development and satisfactory flood mitigation can be provided. Additionally, proposed residential developments within Flood Zone 3a are required to pass the "Exception Test", the test being that:

- The development is to provide wider sustainability benefits
- The development will be safe, not increase flood risk and where possible reduce flood risk.

Regional Policy

3.6 **Regional Flood Risk Assessment**: The South East England Regional Assembly published their Regional Flood Risk Assessment (RFRA) in October 2008. The document is a high level review of flood risk and strategy. In this document, concerns over the effects of flood risk and potential of climate change are identified across the wider South East region.

3.7 As with many RFRA's, this document outlines the broad understanding of flooding risk across areas of potential higher growth however makes no specific reference to the proposed site at Pagham.

3.8 **Catchment Flood Management Plans**: A Catchment Flood Management Plan (CFMP) is a high-level strategic plan through which the Environment Agency seeks to work with other key-decision makers within a river catchment to identify and agree long-term policies for sustainable flood risk management.

3.9 The Arun and Western Streams Catchment Flood Management Plan (December 2009), outlines that the catchment has been divided into 9 sub-catchments. The Site is shown to be situated within the Chichester and Lower Chalk Streams catchment which is covered by the following policy:

"Policy 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.

This policy will tend to be applied where the risks are currently deemed to be appropriately-managed, but where the risk of flooding is expected to significantly rise in the future. In this case we would need to do more in the future to contain what would otherwise be increasing risk. Taking further action to reduce risk will require further appraisal to assess whether there are socially and environmentally sustainable, technically viable and economically justified options."

4 Local Planning Policy Compliance

4.1 Pagham lies within West Sussex County Council (WSCC) which is the Lead Local Flood Authority (LLFA). A **Preliminary Flood Risk Assessment** (PFRA) was produced in 2011 by WSCC according to the guidance and information provided by DEFRA. The PFRA identifies flood risk from local flood sources and extreme events occurrence.

4.2 Indicative Flood Risk Areas consist of an area where flood risk is most concentrated, and over 30,000 people are predicted to be at risk of flooding.

4.3 **Strategic Flood Risk Assessment**: To support local planning policy, NPPF guidance recommends that local planning authorities produce a Strategic Flood Risk Assessment (SFRA). The SFRA should be used to help define the Local Plan and associated policies; considering potential development zones in the context of the sequential test defined in the guidance.

4.4 Arun District Council published their Level 1 and Level 2 Strategic Flood Risk Assessment in September 2016. The document generally underpins national guidance and provides recommendations to developers with regards to SuDS and design which will be explored further in this report under the Storm Drainage section.

4.5 This report undertakes the NPPF "Sequential Test" on the three sites identified within the Level 1 SFRA which do not meet the required standard for flood risk vulnerability classification.

4.6 The site design has had full regard to the recommendations set out within the SFRA.

4.7 West Sussex County Council published the **Surface Water Management Strategy** in October 2016. The document offers Guiding Principals in managing flood risk and a structure of managing strategy, in addition to that provided in the SFRA.

4.8 The objectives of the document are to:

- Obtain an understanding of the current surface water catchments and their associated issues.
- Determine the required storage volume at six potential strategic development locations to mitigate surface water flood risk, up to the 1 in 100 year event plus climate change allowance, as a result of an assumed level of potential development.
- Develop options for on-site and / or off-site surface water management schemes to provide the required storage, considering potential constraints and opportunities for the creation of multifunctional assets and biodiversity enhancements.
- Report on findings and produce technical drawings and costings for a preferred surface water management strategy.

4.9 This study has identified that all surface water generated from the development can be attenuated within the space available on site, and within the topographical and geographical constraints.

4.10 The objectives detailed above will be delivered through a series of local measures and actions. Site level Specific Management Actions are introduced so they could be implemented within locally important flood risk areas in order to translate the aims of the overall strategic actions onto a local scale.

4.11 **Development Flood Risk Assessment**: At a local site by site level, the NPPF and guidance and supporting documents advocate the preparation of a Flood Risk Assessment (FRA). The NPPF requires that developments covering an area of greater than one hectare prepare a FRA in accordance with the guidance. The FRA is required to be proportionate to the risk and appropriate to the scale, nature and location of the development.

4.12 This document forms a Flood Risk Assessment (FRA), to accord with current guidance and addresses national, regional and local policy requirements in demonstrating that the proposed development lies within the acceptable flood risk parameters.

Local Plan Policies

4.13 The proposed drainage strategy will be designed in full compliance with the Arun District Councils Local Plan policies. The relevant policies are outlined below with Brookbanks response to how these requirements have been met in blue.

Policy W DM2 Flood Risk

Development in areas at risk from flooding, identified on the latest Environment Agency flood risk maps and the Council's Strategic Flood Risk Assessment (SFRA) , will only be permitted where all of the following criteria have been satisfied:

a. The sequential test in accordance with the National Planning Policy Guidance has been met.

A sequential test is not required for this development as the site is located within flood zone 1. Flood Risk vulnerability is covered in Chapter 7 of this report.

b. A site specific Flood Risk Assessment demonstrates that the development will be safe, including access and egress, without increasing flood risk elsewhere and reduce flood risk overall.

This document is the FRA for this development.

c. The sustainability benefits to the wider community are clearly identified.

The proposed SuDS will discharge to QBAR, reducing the flood risk further downstream. Once at the detailed design stage, should the need arise, the basin could be designed to retain an area of permanent water.

d. The scheme identifies adaptation and mitigation measures.

This will be provided at the appropriate stage once at reserved matters.

e. Appropriate flood warning and evacuation plans are in place; and

As the site lies outside of any flood risk, no warning or evacuation plans will need to be provided.

f. New site drainage systems are designed to take account of events which exceed the normal design standard i.e. consideration of flood flow routing and utilising temporary storage areas.

SuDS (illustrated on drainage strategy 10821-DR-01 A) have been designed to the 1 in 100 year + 40% storm events. A full exceedance plan will be produced at the appropriate time.

The reports prepared as part of the criteria above must take into account contingency allowances, taking climate change into account as set out in Flood Risk Assessments: climate change allowances section of the NPPG.

The SuDS have been designed to accommodate the 1 in 100 year + 40% climate change allowance storm event, with a 300mm freeboard.

In locations where strategic flood defence or resilient and resistant construction measures are necessary within the site itself, proposals will be required to demonstrate how measures have been incorporated as an intrinsic part of the scheme in a manner which is compatible with the latest Strategic Flood Risk Assessment.

All development proposals must take account of relevant Surface Water Management Plans, Catchment Flood Management Plans and related Flood Defence Plans and strategies such as the Lower Tidal River Arun Strategy. The council may require financial contributions from development on sites where measures to address flood risk or to improve the environmental quality of watercourses have been identified by these Plans and Strategies.

Policy W DM3 Sustainable Urban Drainage Systems

To increase the levels of water capture and storage and improve water quality, all development must identify opportunities to incorporate a range of Sustainable Urban Drainage Systems (SUDS), appropriate to the size of development, at an early stage of the design process.

Proposals for both major and minor development proposals must incorporate SUDS within the private areas of the development in order to provide source control features to the overall SUDS design. These features include:

- *Green roofs*
- *Permeable driveways and parking*
- *Soakaways*
- *Water harvesting and storage features including water butts.*

The use of additional SuDS apart from basins will be looked at in further detail once a layout has been fixed. This is detailed more in Chapter 8.

Proposals for major development must also integrate SUDS within public open spaces and roads, reflecting discussion with the appropriate bodies. SUDS must therefore be integrated into the overall design of a development and must:

a. Contribute positively to the appearance of the area, integrating access to allow maintenance of existing watercourses and the system.

A 5m earthworks and maintenance strip around the top of the basin has been included within the design.

b. Effectively manage water (including its quality)

Water management and quality is detailed in Chapter 10.

c. Accommodate and enhance biodiversity by making connections to existing Green Infrastructure assets and

d. Provide amenity for local residents (ensuring a safe environment)

For points c and d, permanent water could be incorporated into the design should the need arise to enhance biodiversity and amenity across the site. This would be explored at reserved matters.

e. Retain the existing drainage network of the site and the wider area,

The site will not remove or change the existing drainage network.

f. Be maintained in perpetuity, supported through a Maintenance and Management Plan/Regime, including its financing, agreed with the Local Planning Authority.

A maintenance schedule has been provided in Chapter 10 of this document. All other information will be provided at the appropriate stage.

In order to ensure that SUDS discharge water from the development at the same or lesser rate, as prior to construction, developers must:

g. Follow the hierarchy of preference for different types of surface water drainage disposal systems as set out in Approved Document H of the Building Regulations and the SUDS manual produced by CIRIA.

The drainage hierarchy is outlined in paragraph 8.9 and 8.10.

h. Undertake up to six months groundwater monitoring within the winter period.

3 months of groundwater monitoring have already been completed however a full SI works including 6 months monitoring will be completed at reserved matters.

i. Undertake winter percolation testing in accordance with BRE365.

Full SI works including infiltration testing will be completed at reserved matters. Due to high groundwater levels across the site the use of infiltration features in not a viable option. Therefore, current designs utilises detention features.

i. The proposed drainage system must be designed to ensure that there is no flooding on a 1 in 30 year storm event.

Calculations showing the SuDS design for the 1 in 30 year storm event is provided in Appendix C.

j. The design must also take account of the 1 in 100 year storm event plus 30% allowance for climate change, on stored volumes, to ensure that there is no flooding of properties or the public highway or inundation of the foul sewerage system. Any excess flows must be contained within the site boundary, and within designated storage areas.

Basins have been designed to a 1 in 100 year + 40% climate change allowance with an additional 300mm freeboard. Calculation shave been provided in Appendix C.

SuDS Design Guidance

4.14 The SuDS guidance for Arun District Council is outlined on its website within the supplementary requirements for surface water drainage proposals. The requirements by the council are outlined in italics below with Brookbanks response to how these requirements have been met in blue.

***Restricted discharge**: Discharge to a watercourse or surface water sewer must be restricted to the estimated mean greenfield runoff rate (Qbar) for all design storm events, using the impermeable area (and including other permeable areas that are positively drained) of the site to be developed as the basis for the calculations, rather than the entire greenfield site area.*

The proposed SuDS basin has been designed to discharge at QBAR using a 55% impermeable area for the site with 10% urban creep added on.

***Flow exceedance routes:** The drainage design should show flow routes through the proposed development, demonstrating where surface water will be conveyed for three types of flow:*

1. Low flow routes

Regular flow from source control features such as permeable pavements should travel in low flow channels through the development in a controlled way contributing to landscape quality.

Through detailed design at reserved matters stage, urban SuDS, such as roadside swales, will be considered as a design inclusion to support low flow routes. Any urban SuDS provision is subject to detailed design and agreement outside of this outline planning application.

2. Overflows

In the event of local blockages or surcharge a simple overflow arrangement should allow water to bypass the obstruction and return to the management train sequence until conditions return to normal.

An overflow arrangement will be finalised at the detailed design stage.

3. Exceedance routes

When SuDS are overwhelmed by exceptional rainfall, then exceedance routes are required to protect people and property. These provide unobstructed overland flow routes from the development and should be considered for all drainage schemes. Exceedance routes should also be protected from future changes in land use.

The proposed SuDS are located adjacent to the existing watercourses so any exceedance from the basin will flow downhill directly into the watercourse.

***Maintenance and management**: Ditches and watercourses (including culverts) should retain a three metre easement with access that allows for its future maintenance. Details of the maintenance and management of the SuDS system are to be set out in writing in a site specific maintenance manual. This manual shall include details of the financial management and arrangements for the replacement of components at the end of the manufacturers recommended design life. This document is then to be submitted as part of the planning process*

No development of SuDS feature will be constructed within 3m of the existing drainage ditch that forms the northern boundary of the development site. A maintenance regime for the SuDS is outlined in paragraph 10.17.

5 Baseline Conditions

Present Day

5.1 As identified above the site is currently undeveloped agricultural land therefore, is not subject to any existing site drainage.

5.2 **Figure 5-1** below illustrates the site at present.

Figure 5-1: Existing Site Conditions (Google Maps, 2021)

Topography & Site Survey

5.3 A detailed topographical survey of the site was completed in October 2021 by Interlocks Surveys. A review of the survey indicates that the topography across the site is characterised by moderate gradients falling generally in a north easterly direction. Levels fall from a high point of circa 6.13mAOD in the southern corner of the site, to a low point of circa 3.34mAOD along the western boundary.

5.4 The topographical survey can be seen in **Appendix X**.

Geology & Hydrogeology

5.5 With reference to the British Geological Survey map, the Site is shown to be underlain by clay, silt, and sand of the London Clay Formation.

5.6 Full details of the existing geology can be seen in the Geo-Environmental report submitted with this application.

5.7 The majority of the Site highlights Superficial sand, silt and clay Deposits of the River Terrace Deposits (Undifferentiated). Ares to the north-west are shown to be overlain by sand and gravel River Beach Deposits, with the furthest west overlain by superficial clay, silt, sand and gravel Raised Marine Deposits.

5.8 The published site geology is illustrated on **Figure 5-2** and **5-3.**

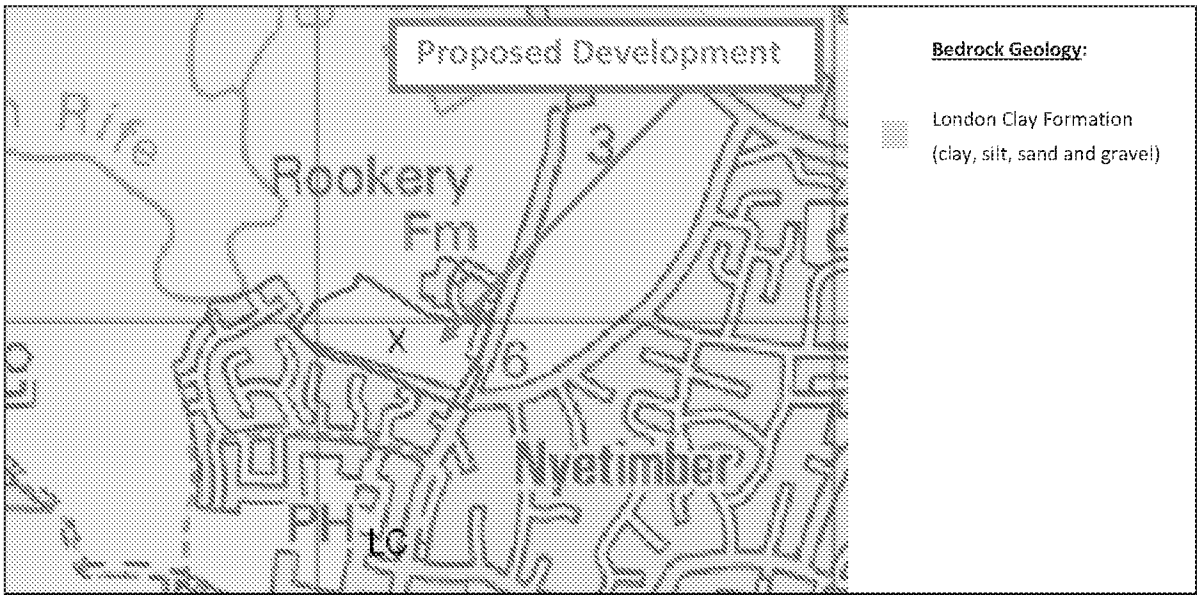

Figure 5-2: BGS Published Bedrock Geology

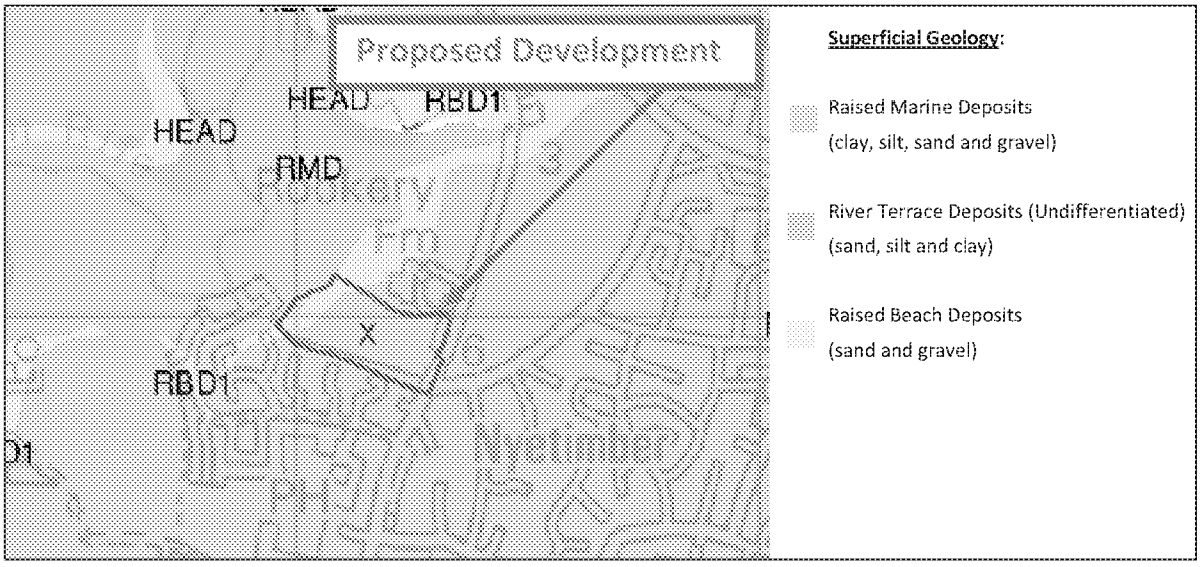

Figure 5-3: BGS Published Superficial Deposits

5.9 The underlying sand of the London Clay Formation, forming Unproductive Strata across the whole site and the superficial deposits form a secondary A Aquifer (**5-4**).

5.10 The EA provides the following definitions for Aquifers:

Secondary Aquifers *- These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:*

Secondary A *- 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. These are generally aquifers formerly classified as minor aquifers.*

Unproductive Strata *- These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.*

5.11 The EA Groundwater Vulnerability Zones (GVZ) Mapping summarises the overall risk to groundwater, taking into account groundwater vulnerability, the types of aquifer present (superficial and/or bedrock) and their designation status, as discussed previously.

5.12 The site is shown (**Figure 5-4**) to be situated within a 'high risk', in terms of groundwater vulnerability.

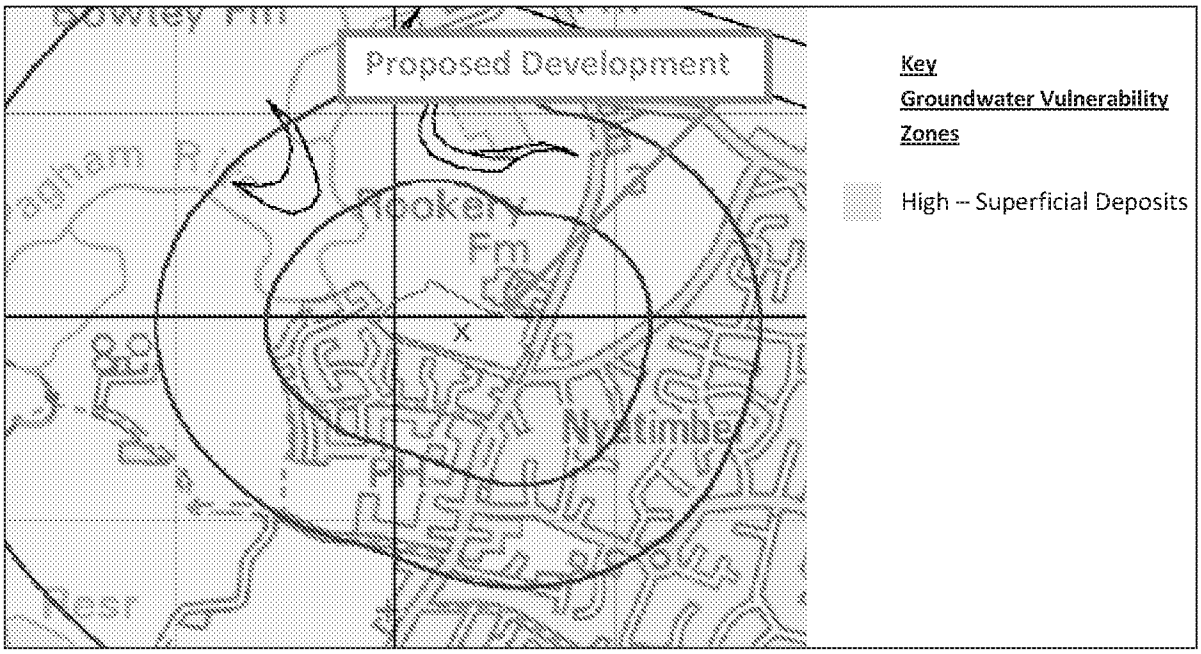

Figure 5-4: EA Groundwater Vulnerability Zones Map (Magic Maps, 2021)

5.13 The EA provides the following definition for the underlying GVZ:

High *– These are high priority groundwater resources that have very limited natural protection. This results in a high overall pollution risk to groundwater from surface activities. Operations or activities in these areas are likely to require additional measures over and above good practice pollution prevention requirements to ensure that groundwater isn't impacted.*

Drainage Network and FEH Catchment Data

5.14 Reference to the online Flood Estimation Handbook shows the Site to lie adjacent to a drainage network associated with the Pagham Rife.

5.15 The Site lies within Pagham Rife catchment, lying within a catchment area of 16.94km^2. The catchment has an average annual rainfall value of 769mm.

5.16 The FEH catchment information will be used in determining the size of the SuDS required for the proposed development.

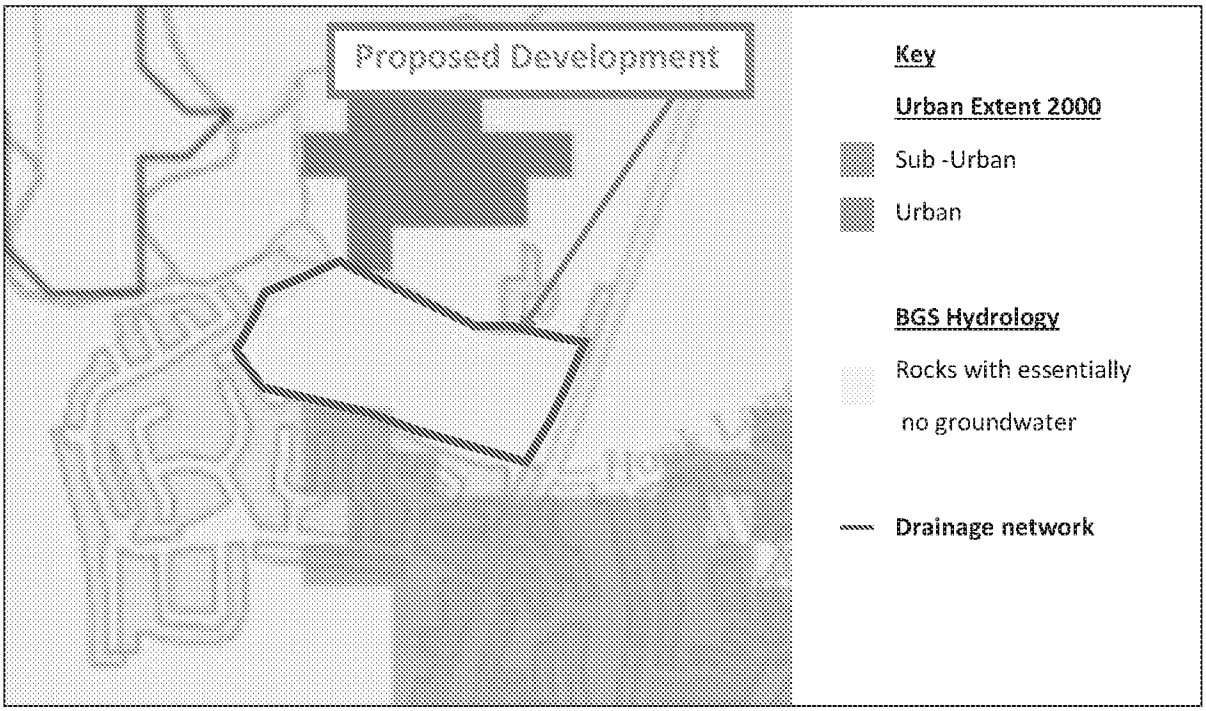

Figure 5-5: FEH web service – Urban Extent 2000 and BGS Hydrology and Drainage Network

6 Flood Risk

Flood Mechanisms

6.1 Having completed a site hydrological desk study and walk over inspection, the possible flooding mechanisms at the site are identified as follows in **Table 6-1**.

Mechanisms	Potential	Comment
Fluvial	Y	The Pagham Rife lies to the west of the site and has the potential to impact upon the proposed development.
Coastal & Tidal	N	The site is not affected by tidal flooding.
Overland Flow (Pluvial)	Y	Surface water flood mapping shows as such the risk relating to overland flow is considered low.
Groundwater	Y	The SFRA identifies a high risk of groundwater flooding.
Sewers	N	No foul or surface water sewers lies within the site.
Reservoirs, Canals etc	N	There is no risk of flooding from reservoirs.

Table 6-1: Flooding Mechanisms

6.2 Where potential risks are identified in **Table 6-1**, above, more detailed assessments have been completed and are outlined and discussed further within the following sections.

Fluvial Flooding

6.3 The Environment Agency's (EA) National Generalised Modelling (NGM) Flood Zones Plan indicates predicted flood envelopes of Main Rivers across the UK. In many circumstances, the NGM is based on basic catchment characteristic data and modelling techniques. Where appropriate, more accurate Section 105 / SFRM models are produced using more robust analysis techniques.

6.4 The mapping below on **Figure 6-1** shows that majority of the site to lie within Flood Zone 1; being an area of Low Probability of flooding and outside both the 1 in 100 (1% AEP) and 1 in 1,000 (0.1% AEP) year flood events.

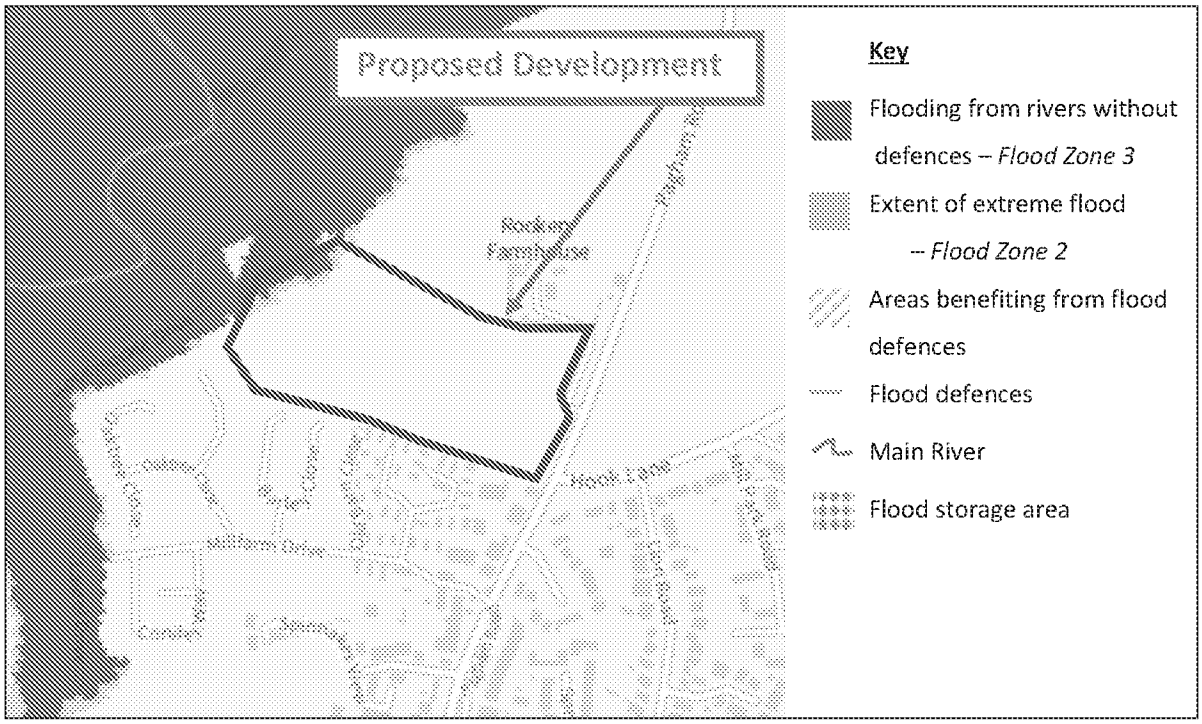

Figure 6-1: EA Flood Zone Plan showing 1 in 100 & 1 in 1,000 year floodplains

Surface Water Modelling

6.5 Surface water modelling is based on high level fluvial assessment models and terrain data. It is not based on observed or recorded flooding but is an extremely broad brush tool for seeing where water could collect given the topography.

6.6 In the design however the EA's surface water mapping has been acknowledged and the basins for the water management of the SuDS are placed in the these low areas of flooding as shown the surface water mapping. SuDS are obviously water compatible development and have the effect of keeping the built environment to the edge of the surface water flooding shown the mapping.

Coastal Flooding

6.7 The EA's flood mapping does not show any risk tidal flood risk within the site boundary.

Overland Flow (Pluvial)

6.8 Overland flow mechanisms result from the inability of unpaved ground to infiltrate rainfall or due to inadequacies of drainage systems in paved areas to accommodate flow directed to gullies, drainage downpipes or similar. In minor cases, local ponding may occur. In more extreme events, flows accumulate and may be conveyed across land following the topography.

6.9 The Environment Agency, in partnership with lead local flood authorities, produced a series of surface water flood maps for many parts of the UK.

6.10 **Figure 6-2,** illustrates areas of low to high risk from surface water flooding:

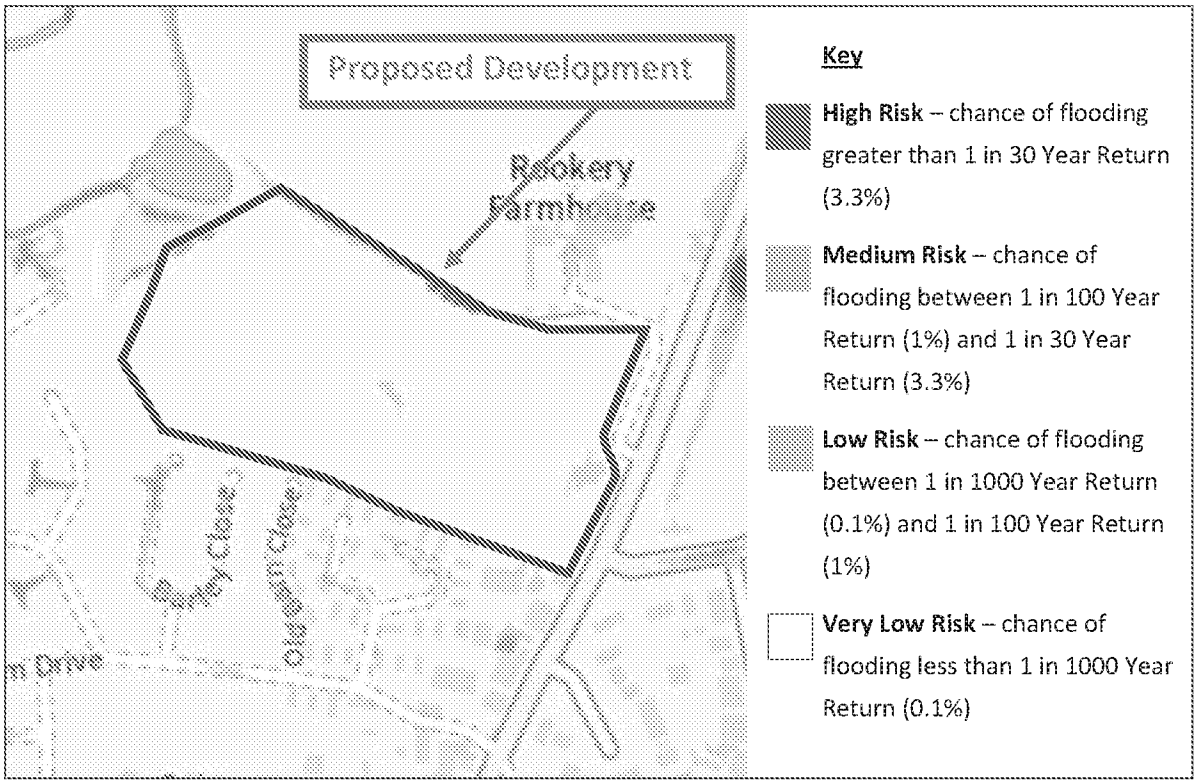

Figure 6-2: EA Long Term Flood Risk Maps – Flood risk from Surface Water (Gov.Uk website)

6.11 The mapping above identifies that most of the site has a very low risk of surface water flooding. However, a small area in the centre of the site is shown to have a low risk from surface water flooding.

6.12 Initial investigations suggest that the risk of overland flow relates primarily to the topography of the site; low areas of the site naturally store water limiting the surface runoff in concentrated areas. As part of the development, the topography will be altered, providing a rationalised surface for water runoff.

6.13 Recognising the risk of overland flow mechanisms, published guidance in the form of the Design and Construction Guidance for Foul and Surface Water Sewers and the Environment Agency document Improving the Flood Performance of New Buildings: Flood Resilient Construction et al advocate the design of developments that implement infrastructure routes through the development that will safely convey flood waters resulting from sewer flooding or overland flows away from buildings and along defined corridors. Further to protect the Proposed Development, current good practice measures defined by guidance will be incorporated. However, given the nature of the development this is unlikely to be onerous or to have any material effect on layout.

6.14 Given the baseline site characteristics and further mitigating measures to be implemented residual flood risk from an overland flow mechanism is considered of a low probability.

Groundwater

6.15 Groundwater flooding is characterised by low-lying areas often associated with shallow unconsolidated sedimentary aquifers which overly non-aquifers. These aquifers are reported to be susceptible to flooding, especially during the winter months, due to limited storage capacity.

6.16 Groundwater related flooding is fortunately quite rare, although where flooding is present, persistent issues can arise that are problematic to resolve. Such mechanisms often develop due to construction activities that may have an unforeseen effect on the local geology or hydrogeology.

6.17 The Environment Agency's national dataset, Areas Susceptible to Groundwater Flooding (AStGWF), provides the main dataset used to assess the future risk of groundwater flooding. The AStGWF map uses four susceptibility categories to show the proportion of each 1 km grid square where geological and hydrogeological conditions show that groundwater might emerge.

6.18 This mapping (**Figure 6-3**) identifies that the area lies within a >=75% susceptibility to groundwater flooding.

Figure 6-3: Groundwater Flooding Susceptible

6.19 Within the SFRA it is reported that, "Significant groundwater flood events have been recorded across the district."

6.20 Positive drainage systems incorporated into the Proposed Development will further reduce the risk as a result of permeable pipe bedding materials and filter drains incorporated within elements of the built development.

6.21 Given the baseline site characteristics and further mitigating measures to be implemented, residual flood risk from a ground water mechanism is considered to be of a low probability.

Sewerage Systems

6.22 Flooding related to sewerage systems is a result of there being insufficient capacity within an existing sewerage system (combined and surface water sewers) or from there being a blockage within the system.

6.23 The SFRA collected data from Southern Water and determined that there have been 315 recorded flood incidents in the Arun district.

6.24 Positive drainage measures incorporated on site, coupled with sustainable drainage systems (SuDS) will ensure that no increase in surface water will result from the site. Flood risk associated with sewer flooding is therefore considered to be a low probability.

Artificial Water Bodies - Reservoirs & Canals

6.25 Non-natural or artificial sources of flooding comprises of reservoirs, canals and lakes where water is retained above the natural ground level. However unlikely, reservoirs, canals and other artificial sources have a potential to cause flooding due to the release of large volumes of water, resulting from a dam or bank failure.

6.26 The Environment Agency has produced mapping to indicate a worst case scenario of flooding that would be caused, as a result of unlikely structural failure or damage of a reservoir. The site is shown to lie a considerable distance from the potential maximum extent of flooding.

Summary

6.27 In terms of fluvial flood risk, the site lies primarily within Flood Zone 1 and hence has a low probability of flooding from this mechanism. Assessment of other potential flooding mechanisms shows the land to have a low probability of flooding from overland flow, ground water and sewer flooding.

6.28 Accordingly, the Proposed Development land is in a preferable location for development when appraised in accordance with the NPPF Sequential Test and local policy.

Objectives

6.29 The key development objectives that are recommended in relation to flooding are:

- Work collaboratively with the Environment Agency to identify potential flooding.
- Compliance with the Design and Construction Guidance for Foul and Surface Water Sewers and EA guidance in relation to flood routing through the Proposed Development in the event of sewer blockages.

7 Flood Risk Vulnerability

7.1 In accordance with the NPPF technical guidance when building within a Flood Zone, the vulnerability of the development must be taken into consideration. The impacts of flooding will affect types of development differently.

7.2 The EA's vulnerability classification table is illustrated below in **Figure 7-1.** The table outlines the NPPF technical guidance for flood risk vulnerability and Flood Zone compatibility assessment to propose which type of development is appropriate for which sites.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test Required	X	Exception Test Required	✓	✓
Zone 3b	Exception Test Required	X	X	X	✓

Table 7-1: Environment Agency's Flood Risk Vulnerability Classification Table

7.3 Housing is considered as highly vulnerably infrastructure, and has been located within flood zone 1.

Sequential Testing

7.4 The aim of a sequential test is to ensure that new development is steered towards sites with the lowest probability of flooding.

7.5 The proposed built development lies entirely within flood zone 1, therefore an exception test does not need to be completed.

Exception Test

7.6 The exception test is:

"a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available."

7.7 The exception test assesses the suitability of locations within the site for development that are appropriate to the relevant levels of flood risk.

7.8 As all built development is located within flood zone 1, an exception test is not required.

8 Storm Drainage

Background

8.1 To understand the baseline provision for storm drainage in the area, a copy of Southern Water network records has been obtained. No public surface water sewers or combined sewers are shown to be present within the vicinity of the proposed development.

8.2 There is a rising main that crosses through the centre of development. Full details of the existing network can be seen in the Services and Utilities report submitted with this application.

8.3 As the site is currently greenfield, it is thought that storm water currently drains to the ground and collects within the existing ditch situated along the northern boundary.

SuDS Components

8.4 It is proposed to implement a SuDS scheme consistent with local and national policy at the proposed development.

8.5 At the head of the drainage network, across the site, source control measures will be implemented to reduce the amount of run-off being conveyed directly to piped drainage systems.

8.6 As the site is currently at outline planning the nature of source control measures to be implemented will need to remain flexible, providing each house builder with a 'toolkit' of options to reach an agreed target for peak discharge reduction and water treatment.

8.7 **Table 8-1** is an extract of Table 7.1 from the CIRIA SuDS Manual C753 which outlines a number of options available.

Component Types	Description	Collection Mechanism	Design Criteria					
			Water Quantity			Water Quality	Amenity	Biodiversity
			Peak Runoff Rate	Runoff Volumes				
				Small Events	Large Events			
Rainwater Harvesting Systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●	
Green Roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	●

Infiltration Systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	●	●	●	●	●	●
Proprietary Treatment System	Subsurface structures designed to provide treatment of runoff	P				●		
Filter Strips	Grass strips that promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	○
Filter Drains	Shallow stone filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	○
Swales	Vegetated channels (sometimes planted) used to convey and treat runoff	L	●	●	●	●	●	●
Bioretention Systems	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	P	●	●	●	●	●	●
Trees	Trees within soil-filled tree pots, tree planters or structural soils used to collect, store and treat runoff	P	●	●		●	●	●
Pervious Pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	●	●	●	●	○	○
Attenuation Storage Tanks	Large, below ground voided spaces used to temporarily store runoff before infiltration, controlled release or use	P	●					
Detention Basins	Vegetated depressions that store and treat runoff	P	●	●		●	●	●
Ponds and Wetlands	Permanent pools of water used to facilitate treatment runoff – runoff can also be stored in an attenuation zone above the pool	P	●			●	●	●

Table 8-1: Ciria Guidance Table 7.1 (SuDS Component Delivery of Design Criteria)

* **Key**

P - Point, L - Lateral, S – Surface

● Likely Valuable Contribution ○ Some Potential Contribution to Delivery of Design Criterion **T**

Drainage Hierarchy

8.8 The following paragraphs in this section outline the proposed drainage strategy to meet national and local design requirements and guidance.

8.9 Current guidance[1] requires that new developments implement means of storm water control, known as SuDS (Sustainable Drainage Systems), to maintain flow rates discharged to the surface water receptor at the pre-development 'baseline conditions' and improve the quality of water discharged from the land.

8.10 When appraising suitable storm water discharge options for a development site, Part H of the Building Regulations 2002 (and associated guidance) provides the following search sequence for identification of the most appropriate drainage methodology.

"Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority -

a) an adequate soakaway or some other adequate infiltration system; or where that is not reasonably practicable,

b) a watercourse; or where that is not reasonably practicable,

c) a sewer. "

8.11 Dealing with the search order in sequence:

a) Source control systems treat water close to the point of collection, in features such as soakaways, porous pavements, infiltration trenches and basins. The use of same can have the benefit of discharging surface water back to ground rather than just temporarily attenuating peak flows before discharging it to a receiving watercourse or sewer.

As source control measures generally rely upon the infiltration of surface water to ground, it is a prerequisite that the ground conditions are appropriate for such. Site ground investigations specific to flood risk have yet to be completed however published geology suggests the presence of potentially impermeable formations within the site.

b) Next in the search sequence, defined by Part H, is discharge to a watercourse or suitable receiving water body. Where coupled with appropriate upstream attenuation measures, this means of discharge can provide a sustainable drainage scheme that ensures that peak discharges and flood risk in the receiving water body are not increased.

The Pagham Rife lies approximately 120m west of the site, which part of its drainage network forming the northern boundary. As such represents an appropriate receptor for storm water discharge, have the potential to receive flows from the proposed development once restricted to the pre-existing 'greenfield' rates of run-off.

c) Last in the search sequence is discharge to a sewer. In the context of SuDS this is the least

[1] NPPF, CIRIA C522, C609, C753 et al.

preferable scheme as it relies on 'engineered' methods to convey large volumes of water from development areas, has a higher likelihood of flooding due to blockage and provides less intrinsic treatment to the water.

Southern Water records confirm the presence of public combined, storm sewer along Pagham Road that could be employed should the need arise.

8.12 **Table 8-2** outlines which options will be used within the outline application and which will be considered at reserved matters.

Component Types	To be Considered at Outline	To be Considered at Reserved Matters
Rainwater Harvesting Systems		
Green Roofs		
Infiltration Systems		
Proprietary Treatment System		
Filter Strips		
Filter Drains		
Swales		
Bioretention Systems		
Trees		✓
Pervious Pavements		✓
Attenuation Storage Tanks		
Detention Basins	✓	✓
Ponds and Wetlands		

Table 8-2: Types of SuDS Components to be Considered

8.13 The search sequence outlined above indicates that the existing ditch along the northern boundary is the most appropriate receptor of storm water from the proposed development, having the potential to employ source control measures and on-line SuDS to control peak discharges to no greater than the baseline conditions.

8.14 Proposals have been developed to inform the strategic drainage network across the development. It is proposed that the drainage system for the site utilises a SuDS system as the primary storm water management scheme.

8.15 Accordingly, a plan showing the conceptual drainage masterplan for the site is contained within the Appendix as drawing 10821-DR-01 A.

8.16 Coupled with the storm water control benefits, the use of SuDS can also provide betterment on water quality. National guidance in the form of CIRIA 753 outlines that by implementing SuDS, storm water from the site can be polished to an improved standard thus ensuring the development proposals have no adverse effects on the wider hydrology.

9 Preliminary Drainage Proposals

Primary Drainage Systems (source control)

9.1 The common aims of a Primary Drainage System are:

- Reduction in peak discharges to the agreed site wide run-off rate from the development areas.
- Provide water quality treatment where appropriate

9.2 Preliminary assessment of the requirements for storm drainage have been based on the following criteria as shown in **Table 9-1.**

Criteria	Measure/Rate/Factor
Application Site Area	4.91 ha
Developed Area	2.85 ha
Landscaped Area	2.06 ha
Impermeability - Residential	0.55
Sewer design return period[2]	1 in 1 year
Sewer flood protection[2]	1 in 30 years
Fluvial / Development flood protection [1]	1 in 100 years
C (1km)*	-0.026
D1 (1km)*	0.419
D2 (1km)*	0.243
D3 (1km) *	0.359
E (1km) *	0.308
F (1km)*	2.319
Minimum cover to sewers [1]	1.2 m
Minimum velocity [1]	1.0 m/sec
Pipe ks value [1]	0.6 mm
Allowance for climate change [3]	40%

Table 9-1: Drainage Criteria and Measure

* FEH Catchment Descriptors- Site constants for calculating rainfall depths

[2] Design and Construction Guidance for Foul and Surface Water Sewers
[3] NPPF requirements for residential development

Groundwater Monitoring

9.3 Groundwater monitoring was completed by GEG in January-March 2021 in 7 boreholes across the site. The trial pit location plan can be seen in **Appendix F.**

Borehole	Date	Depth of Installation (m)	Groundwater Depth (m)
WS01	22.01.21	2.50	1.00
	26.02.21		Flooded at Surface
	26.03.21		0.74
WS02	22.01.21	4.00	0.83
	26.02.21		0.88
	26.03.21		1.08
WS03	22.01.21	2.00	0.78
	26.02.21		0.77
	26.03.21		0.85
WS04	22.01.21	2.00	0.30
	26.02.21		0.44
	26.03.21		0.81
WS05	22.01.21	2.00	0.90
	26.02.21		0.86
	26.03.21		1.08
WS06	22.01.21	2.50	0.79
	26.02.21		1.15
	26.03.21		1.38
WS07	22.01.21	1.50	0.38
	26.02.21		0.76
	26.03.21		0.99

Table 9-2: Groundwater Monitoring Results

9.4 Monitoring has shown that groundwater is within 1m of ground level and therefore any designed SuDS will need to be lined in order to prevent groundwater contamination and groundwater ingress into the basin.

Detention Basins

9.5 To date infiltration testing has not been completed, but due to high groundwater levels infiltration basins will not be viable for this site.

9.6 National policy[1] requires that new developments control the peak discharge of storm water from a site to the baseline, undeveloped, site conditions. Over very large development areas, the baseline rate of run-off is normally estimated using the FEH methodologies. However, Paragraph 3.1.2 of the FEH guidance states:

9.7 "The frequency estimation procedures can be used on any catchment, gauged or ungauged, that drains an area of at least 0.5km2. The flood estimation procedures can be applied on smaller catchments only where the catchment is gauged and offers simple flood peak or flood event data".

9.8 On undeveloped and ungauged catchments of less than 0.5km2 in area, it is correct to complete baseline site discharge assessments using the nationally accepted IoH124 methodology for small rural catchments. Local policy is to employ IoH124 in a manner set out by CIRIA C697. This methodology requires that, for catchments of less than 50ha, the IoH assessment is completed for a 50ha area with the results linearly interpolated to determine the flow rate value based on the ratio of the development to 50ha.

9.9 The baseline IoH run-off rates are shown on **Table 9-3** below:

Event	IoH 124 (4.9ha)	IoH 124 Scaled to 1ha
1 in 1 year (l/s)	11.85	2.42
Qbar (l/s)	13.94	2.84
1 in 100 year (l/s)	44.45	9.07

Table 9-3: IoH124 baseline discharge rates

9.10 In order to determine the permitted rates of run-off from the development, the future impermeable catchment areas must be derived. This has been based on a BCL measured ratio from previous projects. Calculations below show these ratios and areas and how these correlate to the rates of discharge.

9.11 The calculations for this are shown in **Table 9-4** below:

Catchment	Land Use	Developable Area (ha)	Impermeable Area (ha)	Existing 100 Year Run-off (l/s)	Proposed 100 Year Run-off (l/s)
A	Residential	2.95	1.78	16.19	5.08

Table 9-4: Run-off calculation

9.12 Using these methods, development at the site will comply with the requirements set out in paragraph 9 of the Technical Guide to the National Planning Policy Framework (NPPF), with the discharge of surface water from the proposed developments not exceeding that of the existing greenfield sites, thus ensuring that there is no material increase in the flood risk to surrounding areas.

9.13 Assessments have thereafter been completed to determine the characteristics of proposed SuDS features to be situated within the development. Best practice methods have been employed by performing detention routing calculations for both the 1 in 1 and 1 in 100 years + 40% climate change.

Catchment A

9.14 Calculations demonstrate that storm water detention storage extending to maximum 1,677m^3 will be required to attenuate storm water discharges from the site during the critical 1 in 100 year event storm. This will limit the peak discharges to 5.08l/s, being equivalent to the mean annual storm (Qbar), estimated by the IoH124 calculations above, representing a circa 69% reduction on peak greenfield rates. **Table 9-5**, below summarises the overall detention requirements.

Catchment Area (ha)	Impermeable Area (ha)	1 in 100 Year Run-off (l/s)	Detention Volume for 1 in 100 Year Event (m^3)
2.95	1.78	5.01	1,677

Table 9-5: Summary run-off & detention assessment output

9.15 In accordance with legislative requirements, the detention proposals have been assessed for the potential effects of climate change. The 1 in 100 year (1% AEP) return events have been modelled for 40% climate change (including peak rainfall intensity). Calculations for the climate change scenarios are contained within the Appendix. Climate change assessments show each detention feature to perform adequately by retaining the additional flows within the system without overflow.

9.16 A hydro-brake will be provided on the detention features, at a level above the 1 in 100 year + 40% flood level to allow more extreme event flows to safely be conveyed away from properties, while at the same time not increasing flood risk to surrounding areas, in line with current good practice recommendations. The detailed design stage will provide further detail into the positioning of overflows and direction of flow.

9.17 The proposed strategic drainage masterplan is shown illustratively on drawing 10821-DR-01 A contained in **Appendix A.**

9.18 The summary calculations are contained in **Appendix C.**

Summary

9.19 A strategy for storm drainage at the site has been developed to meet both national and local policy. The above options outline the viability of the site to employ means of drainage to comply with NPPF guidance, together with the Arun District Council SFRA and other national and local policy and guidance.

9.20 The development drainage system will manage storm water by conveying surface water through a piped network before discharging into the detention basin at the low point of the site. The basin will ensure peak discharges from the developed land is not increase from the appraised baseline rates. The system will also provide to maintain the quality of water discharged from the development.

Objectives

9.21 The key objectives for the site drainage will be:

- Implementation of a sustainable drainage scheme in accordance with current national and local policy together with principles of good practice design.
- Control of peak discharges from the site to a rate commensurate with the baseline conditions.
- Development of storm water management proposals that maintain water quality and biodiversity of the site.
- Implementation of the storm water management system prior to first use of the site.

10 SuDS Management

Water Quality

10.1 Impermeable surfaces collect pollutants from a wide variety of sources including cleaning activities, wear from car tyres, vehicle oil and exhaust leaks and general atmospheric deposition (source: CIRIA C609). The implementation of SuDS in development drainage provides a significant benefit in removal of pollutant from development run-off.

10.2 The SuDS Manual C753 describes a 'Simple Index Approach' for assessing the pollution risk of surface run-off to the receiving environment using indices for likely pollution levels for different land uses and SuDS performance capabilities.

10.3 CIRIA document C753 Table 26.2, as shown in **Table 10-1** below, indicates the minimum treatment indices appropriate for contributing pollution hazards for different land use classifications. To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index.

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day	Low	0.5	0.4	0.4

Table 10-1: CIRIA 753 Table 26.2 Pollution Hazard Indices

10.4 For a residential type development, roof water requires a very low treatment of 0.2 for total suspended solids, 0.2 for heavy metals and 0.05 for hydrocarbons, and run-off from low traffic roads such as cul-de-sacs and individual property driveways requires low treatment of 0.5 for total suspended solids, 0.4 for heavy metals and 0.4 for hydrocarbons.

10.5 To provide the correct level of treatment, an assessment needs to be made of the mitigation provided by each SuDS feature. Tables 26.3 and 26.4 of The SuDS Manual CIRIA document C753 shown as **Table 10-2** for discharges to surface waters and groundwater respectively indicate the treatment mitigation indices provided by each SuDS feature.

Type of SuDS component	Total suspended solids (TSS)	Metals	Hydro-carbons
Swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the one in 1-year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 10-2: CIRIA 753 Table 26.3 SuDS Mitigation Indices for discharges to surface waters.

10.6 Where more than one mitigation feature is to be used, CIRIA guidance states that the total mitigation index shall be calculated as follows:

Total SuDS mitigation index = Mitigation Index 1 + 0.5 x Mitigation Index 2

10.7 At present, the site and surrounding area does not benefit from any additional measures of stormwater treatment.

10.8 Due to the need to provide wider sustainability benefits and view the development at a strategic level, SuDS will be implemented to passively treat run off from the development so as to have a positive impact on the surrounding natural environment.

10.9 The site will employ SuDS features, such as detention basins. These are widely accepted to be of high pollutant removal efficiency (CIRIA 609). This provides for at least one stage of treatment onsite. A petrol interceptor can be provided at the inflow of the basin in order to provide another source of treatment to surface water.

10.10 Coupled with this however, the unknown watercourse should also be seen as an additional stage of treatment as the sedimentation process is not limited to artificial drainage systems but is taken from the natural processes observed within the water cycle.

10.11 As the site is not presently served by any means of storm water treatment mechanisms, by providing the afore mentioned SuDS within the proposed development it will be possible to maintain present water quality in the area and thus the development can be seen to be having no significant environmental impact in relation to water.

Exceedance Flows

10.12 Careful regard has to be made in respect of potential exceedance flows, being events that are more extreme than current design criteria. Various national guidance has been published on the matter of exceedance flows and measures that should be incorporated into a development to ensure the safety of occupiers and those using the infrastructure.

10.13 The principal aim is to direct any exceedance flows away from properties and along defined corridors. At a local level, this may mean water being conveyed along a length of highway, as long as the predicted flow

depths and velocities are acceptable. More strategically, the implementation of conveyance corridors is important in avoiding deep and high velocity flows that present a high risk. The drainage system being promoted for Pagham provides a good opportunity to incorporate exceedance flow routes into the design.

10.14 Clearly, many of the measures for dealing with exceedance flows must be dealt with at the detailed design stage. However, the strategic layout for proposed development at Pagham provides the framework of a network that can effectively deal with any future exceedance problems.

Implementation Proposals

10.15 The conceptual drainage proposals have been developed in a manner that will allow the site wide system to be designed to encourage passive treatment of discharged flows and to improve the water quality by removing the low-level silts, oils which could be attributed to track/parking area run off of this nature. Final design will provide for appropriate geometry and planting to maximise this benefit.

10.16 The storm water management features will be constructed and operational prior to the first use of the site.

10.17 It has previously been the case that the functionality of the storm water management system would be ensured by ongoing maintenance, completed by the Local Authority, Drainage Authority, or a private maintenance company as appropriate. It is proposed that, for this development, a private maintenance company will be appointed to carry out the maintenance regime below in **Table 10-3**.

10.18 It is usual for the following maintenance regime to be implemented:

Frequency	Operation
Post major storm events	Inspection and removal of debris.
Every two months	Grass mowing (growing season) & litter removal.
Annual	Weeding & vegetation maintenance. Minor swale clearance. Sweeping of
2 years	Tree pruning.
5-10 years	Desilting of channels. Remove silt around inlet and outlet structures.
15-20 years	Major vegetation maintenance and watercourse channel works.

Table 10-3: Framework maintenance of detention / retention system

10.19 The conceptual drainage masterplan proposals outlined in this report will be used for final drainage design and detailing. The storm water management system will be constructed and operational in full prior to first use of the relevant phase of development.

11 Foul Drainage

Background

11.1 A copy of the Southern Water sewerage network records has been obtained which confirms the presence of a rising main crossing through the development site. Foul and surface water sewers are located within Pagham Road which bounds the west of the site.

11.2 The proposed development area lies approximately 500m east from the treatment works believed to be serving the site.

Design Criteria / Network Requirements

11.3 Peak design discharges have been calculated based on the current development criteria as described in Section 2 of this report and for the following:

Domestic peak (peak) = *4,000 litres / dwelling / day*

11.4 Assessed in accordance with the Design and Construction Guidance for Foul and Surface Water Sewers requirements, the development will have a design peak discharge of approximately 5.5l/s.

11.5 A review of the Chichester Local Plan Website, includes for a note prepared by CDC in August 2021 noted that the Pagham Wastewater Treatment Works has an estimated remaining capacity for approximately 734 dwellings. This has been combined by CDC from Environment Agency and Southern Water data. Therefore, there is indicatively enough headroom in the Wastewater Treatment Works for the proposed development of Land at Pagham Road.

11.6 Furthermore, the *Statement of Common Ground between Chichester District Council, Environment Agency and Southern Water – Waste Water Treatment in Chichester Plan Area* document produced on the 24th November 2021, confirmed:

The improvement schemes at Pagham WWTW, which include a growth design horizon up to 2035 are due for completion by 2025 – more information about the options and capacity is expected to be available by the end of 2021

Combined growth and quality improvement schemes for Pagham WWTW due for completion by 2025 will provide additional capacity there.

11.7 Therefore, the document provides confirmation that capacity will be available for the proposed development Site.

Network Requirements / Options

11.8 SW has been contacted to provide a pre-development enquiry for the Site. SW has confirmed a connection from the proposed development to the 150mm sewer along Pagham Road, to the south-east of the Site currently has inadequate capacity to supply the proposed development. Therefore, additional off-site

sewers/improvements to the existing sewer will be required to provide sufficient capacity. With the Ofwat instigated changes in April 2018, SW has confirmed that they have a duty to provide network capacity from the practicable Point of Connection, funded through the New Infrastructure Charges.

11.9 SW have provided confirmation the nearest Point of Connection with sufficient capacity for 120 dwellings would be the Pagham Wastewater Treatment Works (WTW), situated approximately 600m west of the Site. Rights are not issued to a direct connection to the WTW and therefore the connection would need to be agreed with Southern Water, prior to the works being carried out.

Treatment Requirements

11.10 Water companies have a statutory obligation through the Water Industry Act 1991, 2003 et al., to provide capital investment in strategic treatment infrastructure to meet development growth. This investment planning is managed and regulated by OFWAT through the Asset Management Plan (AMP) process. The five yearly cyclical process requires that water companies allocate finances to a range of strategic projects to meet their statutory obligations.

11.11 Where development programming requirements necessitate the reinforcement of facilities ahead of allocation in an AMP period, mechanisms are available to ensure the infrastructure can be delivered in a timely fashion, to meet the development programme.

Implementation Proposals

11.12 The proposed drainage network across the site will be designed to current Design and Construction Guidance for Foul and Surface Water Sewers standards, employing a point of connection agreed with Southern Water. The system will be offered for the adoption of Southern Water under S104 of the Water Industry Act 1991.

Summary

11.13 A site drainage strategy has been developed that meets with current regulatory requirements by discharging drainage to a sewerage network with capacity to accommodate the flows.

11.14 Once development is complete, the network conveying flows from the site will be adopted by Southern Water and be maintained as part of their statutory duties.

Objectives

11.15 The key development objectives required for the site drainage scheme are:

- Implementation of a drainage scheme to convey water to the local Southern Water network which is designed and maintained to an appropriate standard.

12 Summary

12.1 This FRA has identified no prohibitive engineering constraints in developing the proposed site for the proposed developments.

12.2 The site is fully able to comply with NPPF guidance together with associated local and national policy and guidance.

12.3 In regards to policy W DM2 Flood Risk, the proposed SuDS will discharge to QBAR, reducing the flood risk further downstream. The detention basins has been designed to accommodate the 1 in 100 year + 40% storm event, with a 300mm freeboard.

12.4 And to policy W DM3 Sustainable Urban Drainage Systems, a full SI investigation will be completed at reserved matters. Until the SI has been completed the proposed strategy has not assumed any infiltration SuDS. The SuDS will provide at least 1 level of treatment before discharging surface water into the existing drainage network.

12.5 Assessment of fluvial flood risk shows the land to lie within Flood Zone 1 and hence be a preferable location for residential development when considered in the context of the NPPF Sequential Test. Assessment of other potential flooding mechanisms shows the land to have a low probability of flooding from overland flow, ground water and sewer flooding.

12.6 Storm water discharged from development will be disposed of by way of SuDS measures to the existing ditch within the site. A detention basin located at the lowest point of the site has been proposed to detention and discharge surface water to a rate of QBAR.

12.7 Means to discharge foul water drainage have been established that comply with current guidance and requirements of Southern Water.

13 Limitations

13.1 The conclusions and recommendations contained herein are limited to those given the general availability of background information and the planned usage of the site.

13.2 Third party information has been used in the preparation of this report, which Brookbanks, by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Brookbanks accepts no liability for same.

13.3 The benefits of this report are provided solely to Hallam Land Management Ltd for the proposed development Land West of Pagham Road only.

13.4 Brookbanks excludes third party rights for the information contained in the report.

Appendix A - Drainage Plan