Homes England

The Housing and Regeneration Agency

West of Ifield, Crawley
Surface Water Drainage Statement

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WEST OF IFIELD
DRAINAGE STRATEGY REPORT

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WEST OF IFIELD - DRAINAGE STRATEGY REPORT

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1. INTRODUCTION

1.1 Objective

Homes England supports a hybrid planning application to redevelop approximately 171 ha of land located west of Ifield within the administrative area of Horsham District Council (HDC) in West Sussex for a residential-led mixed use sustainable community. The proposed Development (herein described as 'West of Ifield') is presented in Figure 1.

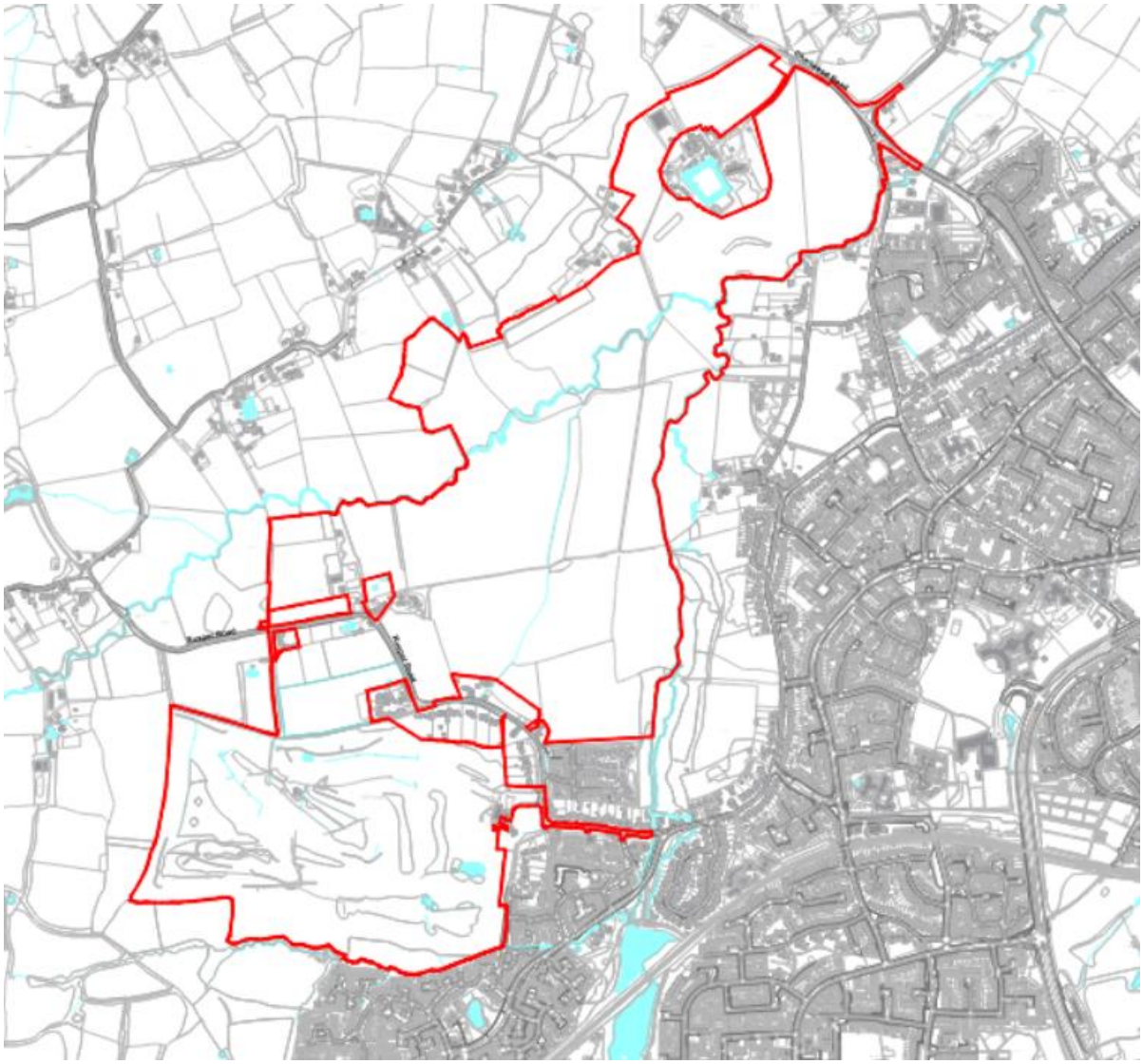


Figure 1 – Existing site arrangement

2. LIMITATIONS

This report has been prepared for the hybrid planning application and shall not be relied upon by any third party unless that party has been granted a contractual right to rely on this report for the purpose for which it was prepared.

The findings and opinions in the report are based upon information derived from a variety of information sources. Ramboll believes these information sources to be reliable and where possible has tried to verify the information.

This report has been prepared on the basis of the proposed end use defined by the Client at the time of writing. If this proposed end use or duration is altered, then it will be necessary to review the findings of this report.

It should be noted that some of the aspects considered in this study are subject to change with time. Therefore, if the development is delayed or postponed for a significant period then it should be reviewed to confirm that no changes have taken place, either at the Application Site or within relevant legislation.

3. LEGISLATION, PLANNING POLICY AND GUIDANCE

The following reference documents have been reviewed and considered in preparation of the proposed drainage strategy.

3.1 Local and National Planning guidance for sustainable drainage

In December 2014, the government announced that from 6th April 2015 they will strengthen existing planning policy by also making SuDS a material consideration for major development.

Local planning policies and decisions on planning applications relating to major developments are to ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate. The sustainable drainage system should be designed to ensure that the maintenance and operation requirements are economically proportionate.

The Flood and Water Management Act 2010

The Flood and Water Management Act 2010 (F&WMA) was introduced to address the concerns and recommendations raised in the Pitt Review (2007). The Act imposes many duties on all upper tier councils, such as West Sussex County Council (WSCC) as the LLFA, including coordinating local flood risk management within its area, including smaller 'ordinary' watercourses, surface, and ground water.

Some of the F&WMA has not been implemented, including Schedule 3. This would have required LLFAs to determine applications for drainage systems against national standards and then adopt those SuDS serving more than one property

National Planning Policy Framework (NFFP)

The National Planning Policy Framework (NPPF Feb 2025) sets out the expectation that new development is sustainable and requires that LPAs should avoid flood risk to people and property and should manage any residual risk. The NPPF states that "when determining planning applications, development [must be] appropriately flood resilient and resistant".

Paragraph 103 states that all new developments in areas at risk of flooding should give priority to the use of sustainable drainage systems. The NPPF also sets out other key priorities for planning to address including climate change, water quality and biodiversity – all challenges that SuDS help to address.

Planning Practice Guidance (PPG)

PPG supports the use of SuDS. It emphasises that generally the aim should be to discharge surface run off as high up the hierarchy of drainage options as reasonably practicable, with infiltration to the ground the most preferred and connection to a combined sewer the least.

As per the (NPPF) guidance and the Sewers Sector Guidance, surface water design storm criteria for the development should be as follows.

- No surcharging for the 1 in 1 year return period.
- No flooding for the 1 in 30-year return period, unless where noted to allow overflow in above ground SuDS features.
- No flooding permitted to residential or commercial properties for the 1 in 100-year return period storm event with an additional allowance for climate change as outlined below.

Climate Change Requirements
The climate change allowance has been determined based on the Environment Agency's guidance on "Flood Risk Assessments and Climate Change Allowances" and the current Government Guidance, as per the table below. 40% CC factor is applicable for the proposed site (as below).

1% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	20%	40%
2070s	25%	40%

*Use '2050s' for development with a lifetime up 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

Table 1– Summary of Climate Change allowances

West Sussex Drainage and Flood Risk Management

As the LLFA, West Sussex County Council is required under Article 18 of the Town and Country Planning (Development Management Procedure) (England) Order 2015 (the Development Management Procedure Order) to provide consultation response on the surface water drainage provisions associated with major development.

SuDS are designed to control surface water as close to its source as possible. They should also aim to closely mimic the natural, predevelopment drainage across a site, wherever possible. Well-designed SuDS also provide opportunities to:

- *reduce the causes and impacts of flooding;*
- *remove pollutants from urban run-off at source; and*
- *combine water management with green space yielding benefits for amenity, recreation and wildlife.*

3.2 Record Review

The key reports and drawings made available to Ramboll, and subsequently reviewed as part of this study are listed in "Table 1" below.

Table 2 - Records Review

Title	Author	Date
Flood Risk Assessment	Ramboll	April 2023
West Sussex LLFA Policy for the Management of Surface Water	West Sussex County Council	Updated November 2018
Climate Change Allowances	Department for Environment Food & Rural Affairs - Online	May 2022

4. SITE INFORMATION

4.1 Site Description and Setting

The site is located to the west of Ifield, approximately 2.75 km northwest of Crawley Town Centre, it is bound by Charlwood Road in the northeast, beyond which lies Gatwick Airport. The site lies to the north of the Horsham-Crawley railway line. The existing residential areas of Ifield and Langley Green, associated with the town of Crawley are located to the east. Ifield West and ancient woodland are located to the south, with the River Mole and further ancient woodland present to the west. The site is predominantly occupied by a mixture of arable and pastoral fields and includes the Ifield Golf Course and Country Club in its southernmost portion.

The site location is presented in Figure 2 below, refer to **Appendix 1** for the Site Location Plan. The application is made by the Applicant to West Sussex County Council LLFA who acts on behalf of the local authorities interested in the development, Horsham District Council (HDC).

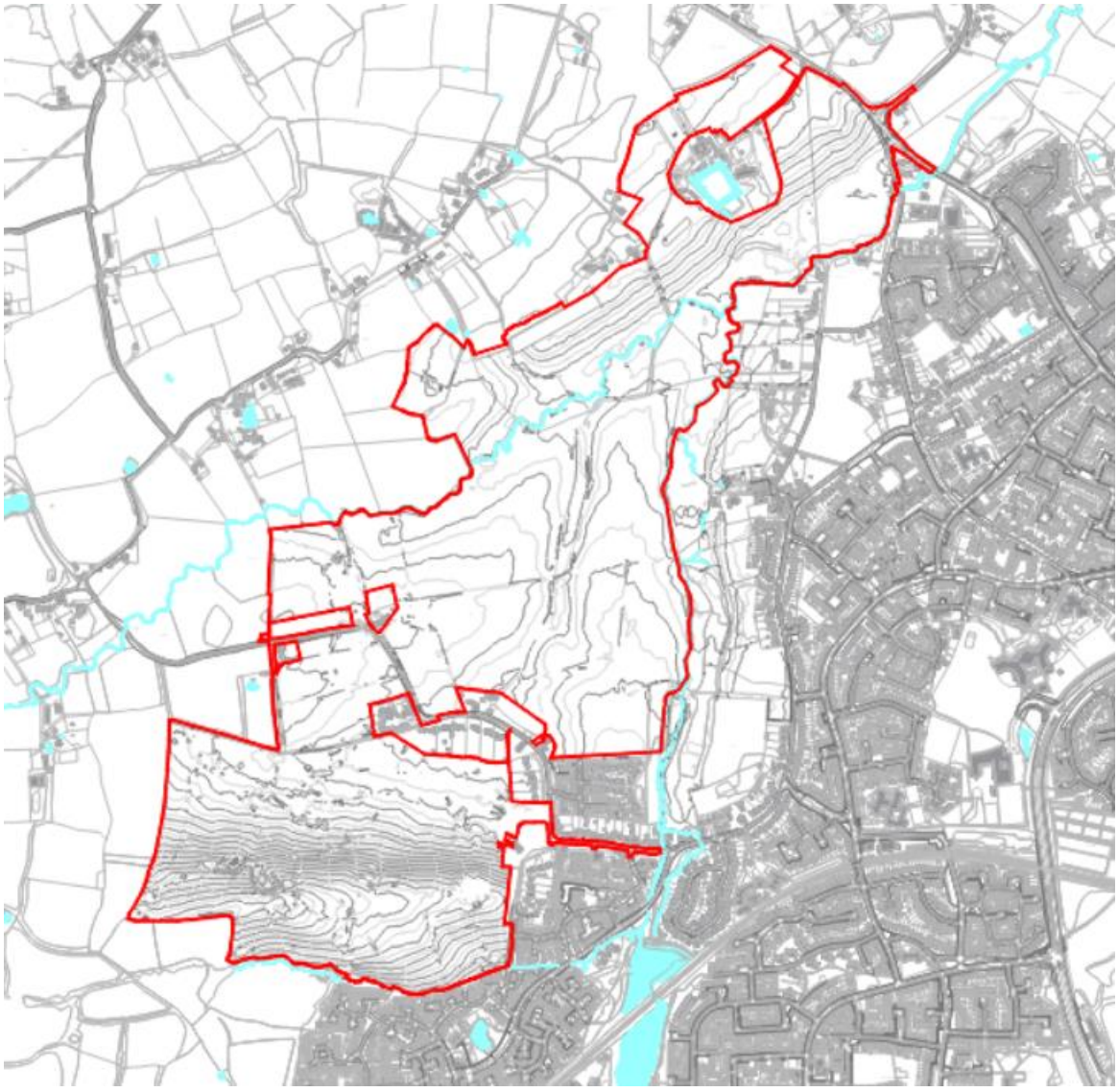


Figure 2 – Existing Site Location, National Grid Reference: E -523958, N – 137166.

5. PROPOSED DEVELOPMENT

The area within the red line planning boundary of the proposed Development extends to 171ha and will form a highly sustainable urban extension to Crawley and includes land within Horsham District Council administrative area. Figure 3 below shows a proposed development plan that involves changing the land use to create a vibrant and sustainable community. The plan covers a large part of the current greenfield site. Out of the total 171 hectares within the red boundary line for the hybrid, of which 146 hectares forms part of the outline element and 29ha included in the full element of the proposed development. Ample green spaces, parks, and walking trails will intertwine with the residential areas, encouraging an active and healthy lifestyle while providing residents with opportunities to immerse themselves in nature. The careful integration of community facilities, such as schools, healthcare centers, recreational amenities, and retail establishments, will foster a sense of convenience and promote a vibrant neighbourhood atmosphere. The proposed development plan is presented in Figure 3 below, refer to **Appendix 2** for the Proposed Development General Arrangement Plans.

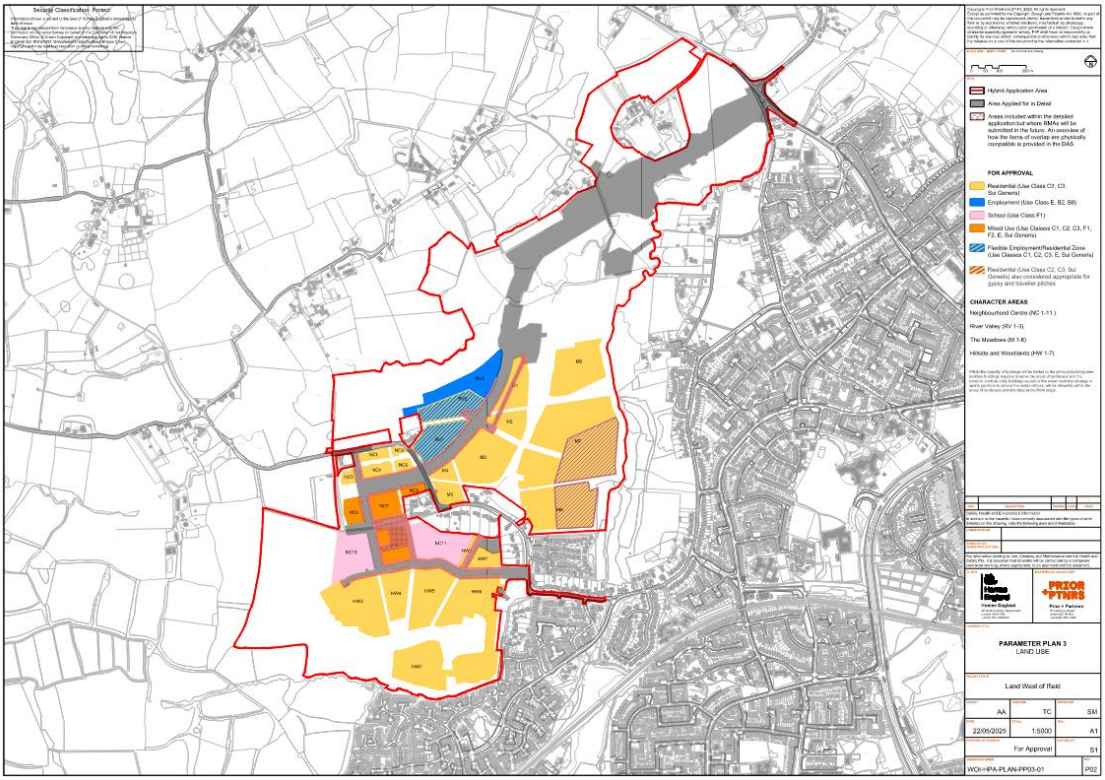


Figure 3 – Proposed Development

The proposed Hybrid planning application (part outline and part full planning application) for a phased, mixed-use development comprising:

- Phased mixed use development of up to 3,000 homes, including a range of flats and houses, of which 35% will be affordable.

- Neighbourhood centre and associated community facilities, including a primary and secondary school, and minimum commitments to health centre, community centre, early year nursery and Local Leisure facility, alongside small-scale centre uses including retail and potential hotel.

- Employment uses including flexible office and innovation space, alongside general industrial and logistics space across the neighbourhood centre and in the River Valley character area.

- Allowances for the potential delivery of specialist accommodation to suit older persons, as well as up to 15 gypsy and traveller pitches and commitments to Custom and Self build housing.

- Public open space and multifunctional green space with allotments, sports pitches, including a new sports hub, recreation, amenity green space play and ancillary facilities, retained landscape features, a minimum of 10% net gain in biodiversity, and strategic green space commitments.

- Allowances for key infrastructure and utilities, notably to achieve water neutrality including water treatment works and abstraction boreholes.

- The prioritisation of more sustainable travel modes and facilitated active mode connections, including an off-site pedestrian and cycle link across Ifield Meadows, off-site improvements to connect to Ifield station via public transport and cycle links, and through safeguarded expansion to multi-modal corridor provided under the detailed element.

- A full element covering enabling infrastructure including the Crawley Western Multi-Modal Corridor (Phase 1, including access from Charlwood Road and crossing points) and access infrastructure to enable servicing and delivery of secondary school site and future development, including access to Rusper Road, supported by associated infrastructure, utilities and works, alongside

- An outline element (with all matters reserved) including up to 3,000 residential homes (Class C2 and C3), commercial, business and service (Class E), general industrial (Class B2), storage or distribution (Class B8), hotel (Class C1), community and education facilities (Use Classes F1 and F2), gypsy and traveller pitches (sui generis), public open space with sports pitches, recreation, play and ancillary facilities, landscaping, water abstraction boreholes and associated infrastructure, utilities and works, including pedestrian and cycle routes and enabling demolition.

- This hybrid planning application is accompanied by an Environmental Statement.

- This hybrid planning application is for a phased development intended to be capable of coming forward in distinct and separable phases and/or plots in a severable way.

For the purposes of this drainage strategy document, of the 171ha, the total drained catchment area of 107ha has been considered to be modified as part of the proposed development. Of this, around 49 hectares are part of the Phase 1 detailed design, while the remaining 58 hectares are covered in the broader site-wide design described within this report. Reference will be made solely to the calculations associated with the broader site-wide development and excludes the consideration of Phase 1 development area and its associated plots which is subject to detailed design and makes up to 49ha of the total site development boundary. The Phase 1 design was undertaken by Arcadis; please refer Figure 4 on the 'Orange Hatched Areas' delineating the Phase 1 considerations below which are included in document 10051123-ARC-050-ZZ-TR-CE-00002 for further details.

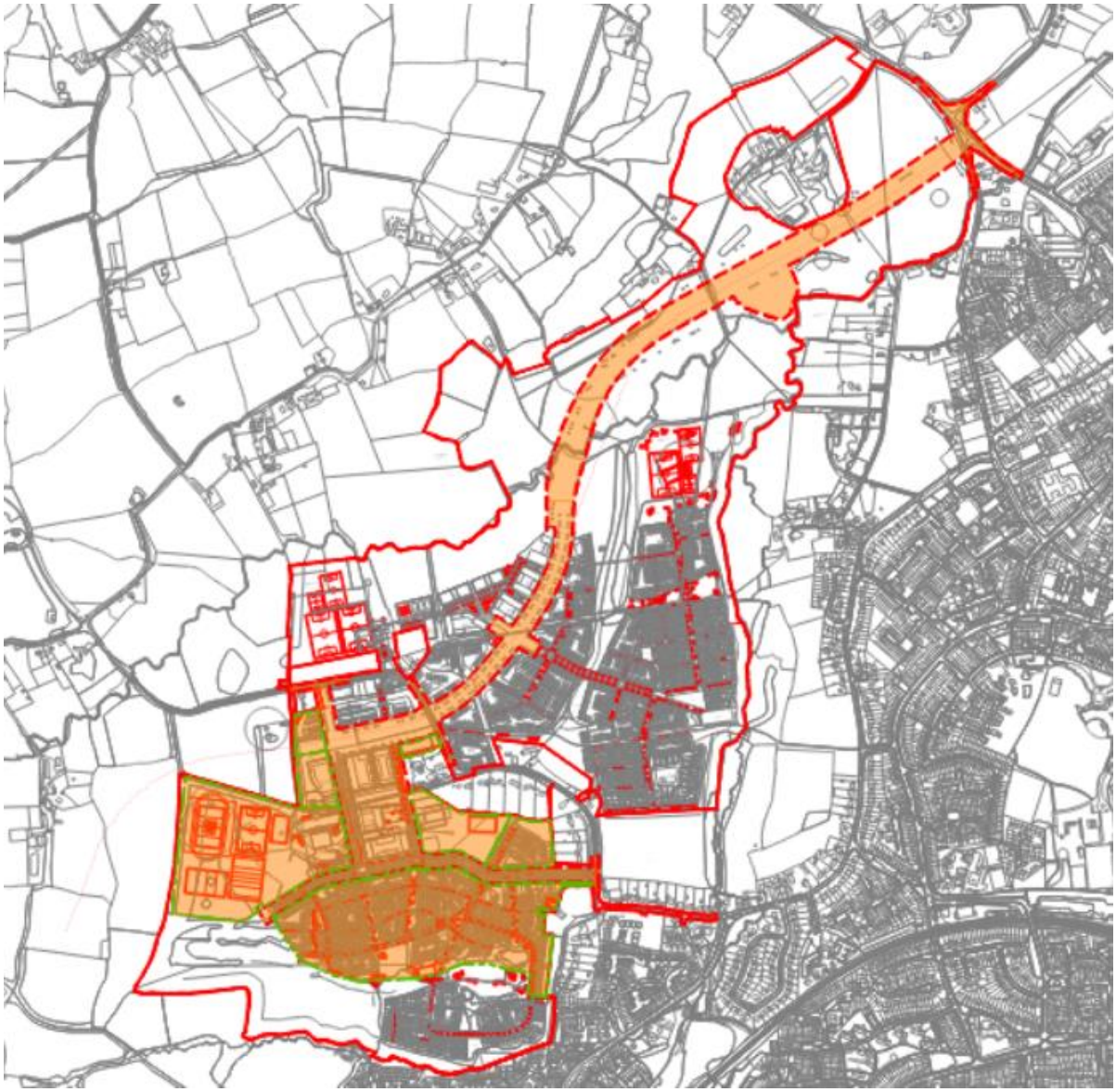


Figure 4 – Phase 1 Detailed Design Areas as shown in 'Orange Hatch'

All areas outside the Phase 1 detailed design but within the overall site development boundary, located south of the River Mole, will be considered within this report as part of the outline planning application – as illustrated above. The site-wide development catchment areas equate to 57.84ha with the remaining Phase 1 works accounting for the remaining 49.16ha. The catchment areas discussed in this document will be self-sustaining and independently serviced, separate from the Phase 1 development, which is currently progressing as part of a detailed application of the hybrid planning application. However, the Phase 1 design will adhere to the principles as set out in the site-wide drainage strategy which also makes reference to the total 107ha development boundary, particularly when assessing the existing site conditions.

6. EXISTING SITE CHARACTERISTICS

6.1 Topography

LiDAR (Light Detection and Ranging) composite data obtained from DEFRA's online data services platform and provided as a 1m resolution DTM (Digital Terrain Model) as presented in Figure 4. The topography of the site is shown to slope in a northern direction, with elevations at the southern site boundary recorded as approximately 85 mAOD, sloping downwards to elevations of approximately 61 mAOD at the northern site boundary. The below information demonstrates the level changes across site with LiDAR information in Figure 5 below. More detailed Topographical survey information has also been obtained for the site and is contained within **Appendix 3**.

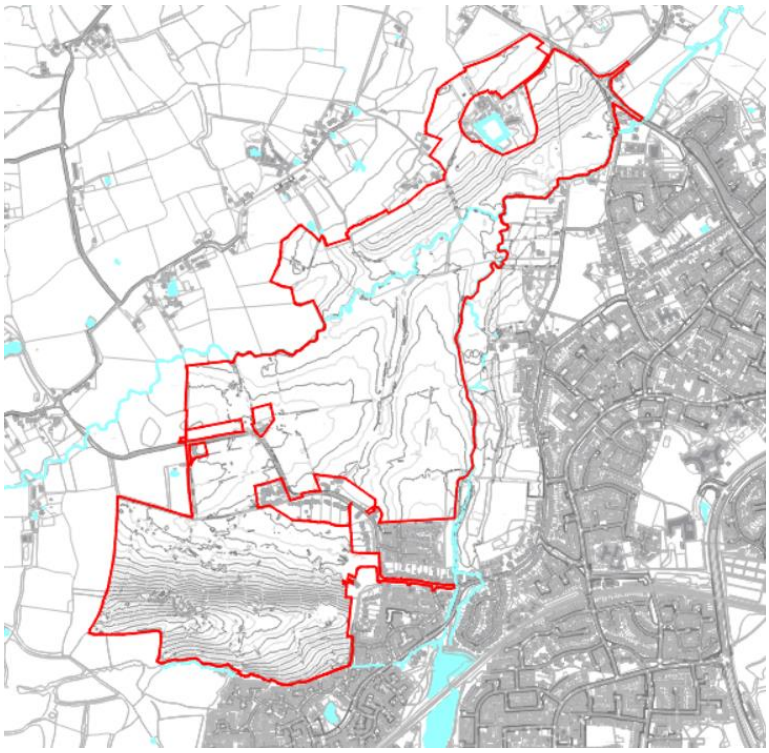


Figure 5 – Site Topography (LiDAR)

6.2 Flood Risk Considerations

The majority of the site is situated in Flood Zone 1, with land adjacent to the River Mole and Ifield Brook in Flood Zones 2 and 3. The Crawley Western Multi-Modal Corridor (CWMMC) will cross the River Mole and its floodplain. This part of the development was subject to site-specific flood modelling carried out within the Flood Risk Assessment (Ramboll).

The modelling showed negligible increases in flood extents were simulated upstream and downstream of the Proposed Scheme. As the agricultural land is already located within the floodplain of the River Mole and Ifield Brook, the comparative increase in flood risk is considered negligible. There is no change to flood risk downstream of the site. Based on the findings of this Flood Risk Assessment and in consideration of the recommendations made, it was concluded that the change in fluvial flood risk will be appropriately managed by the scheme design. It has also been identified within the FRA that the risk of surface water flooding is concentrated to low-lying depressions within

the site and is considered low risk. "Irrespective of the flood risks identified, the proposed development has been concluded to meet the requirements of the Sequential and Exception Tests, in accordance with the NPPF and NPPG, on the basis of adopting a recommended site-based 'sequential approach' to development land-use."

6.3 Existing Surface Water Drainage

The River Mole dissects the northern section of the Site flowing in a north-east direction. The Ifield Brook flows in a northerly direction parallel with the eastern site boundary. The Hyde Hill Brook is located along the southern boundary flowing in an easterly direction. These are all classified as Main Rivers. There is also an ordinary watercourse which flows through the spine of the northern section, this appears to be an existing ditch. The existing ditch manages overland flow from parts of the site and main outlet for surface water drainage for existing residential houses in the centre of the site outside of the proposed works boundary. Refer below to Figure 6 which indicates the location of these watercourses that drain the overland flow from site.

Examining the site topography and flood mapping, the overland flow routes tend to direct the majority of the site to the north and eastern boundaries of the site where the River Mole and Ifield Brook receive runoff from the site. There is a small portion of the site where the land forms a crest and a small portion of the site falls south where surface water runoff is directed towards the Hyde Hill Brook. Figure 5 below illustrates the overland flow routes and crest points (dark blue lines) in between catchment areas which indicate which direction areas drain to the adjacent watercourses.

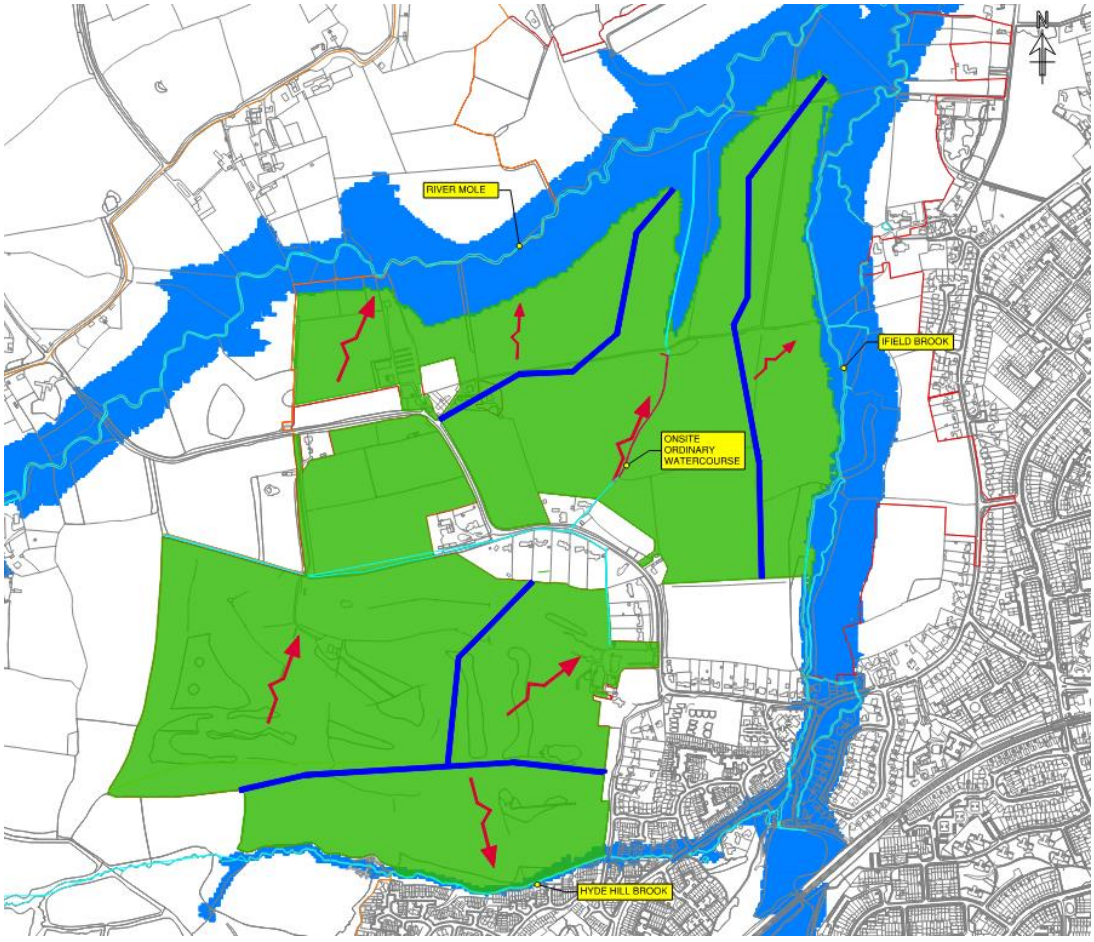


Figure 6 – Existing site drainage arrangement

The proposed development provides a drainage strategy for the developed areas to drain towards these watercourses on a like-for-like basis. The catchment areas described in Figure 5 are related to the modified catchment areas as part of the proposed development. It is only anticipated that 107ha of the overall 171ha site will be modified with the proposed works which will change the characteristics of the existing site. It is anticipated that the characteristics of the remaining area (north of River Mole) will not be altered and will drain as per existing greenfield site conditions.

A breakdown of the existing greenfield discharge rates has been calculated as below, these discharge rates have been calculated to determine the appropriate discharge rates that need to be considered as part of the proposed discharge rates in line with local, national guidance with particular consideration for CIRIA SuDS Manual C753. This equates to 5.25 l/s/ha and is to be considered for both the site wide and phase 1 designs.

Storm Event	$Q_{1\ year}$	$Q_{30\ year}$	$Q_{100\ year}$	Q_{Bar}
Existing Discharge Rates (l/s) - Main Site	477.66	1292.49	1792.63	**561.95**

Table 3 – Existing Greenfield Runoff Rates

Existing greenfield discharge rates are shown within **Appendix 4**.

7. PROPOSED DRAINAGE STRATEGY

7.1 Proposed Site Surface Water Strategy

The site through its redevelopment will see an increase in impermeable area in place of the predominantly greenfield existing site, this will lead to an increase in runoff from the site, as all surface water from these areas will need to be properly captured and managed via sustainable drainage systems. Although there is still a considerable amount of soft landscape to be included as part of the developed areas, the drainage strategy considers that all the surface water will be captured within the site wide drainage system as the natural flow paths and site characteristics will change how the current landscape drains.

The means of discharging the drainage through infiltration has been determined, from Ground Investigations, to be unsuitable for the use of soakaways on site. The proposed drainage for the site will utilise as close as possible the existing drainage regime where the overland flow conveys towards the watercourses that bound the site. The site will achieve a proposed drainage arrangement on a like-for-like basis with a consideration of 40% climate change factor for all storm events up to and including the 1 in 100-year storm event.

7.1.1 Site Wide Catchments

As part of the site wide catchments, the existing site drainage characteristics were considered to ensure that the catchment areas modified as part of the proposed development maintain a similar route into the watercourses that bound the site, the River Mole, Ifield Brook and Hyde Hill Brook.

Below is a split of how the proposed drained catchment areas will be conveyed and discharge into the offsite watercourses with the proposed development general arrangement in mind. The catchments extents considered take into account the opportunities for the use of site wide attenuation space provision across the development. The aim is to utilise as much off plot communal attenuation to minimise the on-plot attenuation requirements.

Catchment	Site Area (ha)	Greenfield Runoff Rate (Qbar) l/s
Catchment 1	11.94	62.1
Catchment 2	11.1	57.72
Catchment 3	19.3	100.36
Catchment 4	6.8	35.36
Catchment 5	8.7	45.24

Table 4 - Proposed Catchment Peak Surface Water Discharge Rates

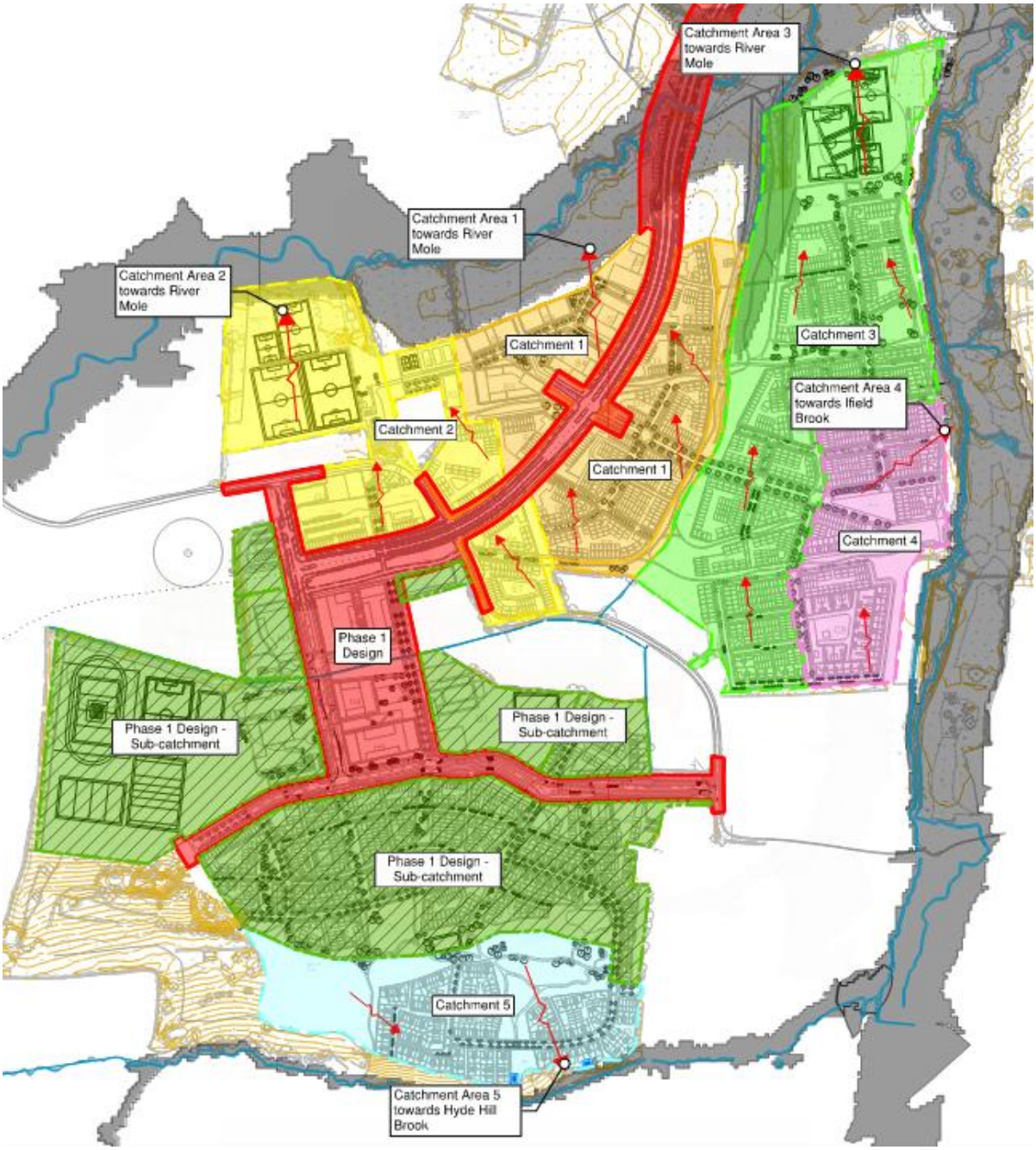


Figure 7 – Proposed site drainage arrangement

7.1.2 Conveyance and Attenuation provision

A series of swales, detention basins, manholes and pipes will direct surface water to a discharge location for the catchment areas to the north and south of the site, in line with the existing characteristics of the site which drain to the adjacent watercourses. Due to the proximity of the proposed site to the nearby Gatwick Airport, careful consideration should be when selecting green features which have the potential of attracting birds and/or encouraging nesting. Hydraulic modelling will be undertaken to ensure that drain down time is considered for these features to

avoid the possibility of nesting on site alongside a robust maintenance regime to uphold the hydraulic performance.

Below is an assessment of the site-wide drainage requirements for the total **57.84ha** of proposed site wide development, considering that the Phase 1 drainage detailed design will be addressed separately. This approach evaluates the overall discharge rate from the site and the necessary drainage strategy to accommodate changes in site characteristics. The attenuation provision outlined below is based on restricting the overall site discharge to Qbar, with an allowance for a 40% climate change factor. Surface Water Calculations are shown within **Appendix 6**.

Storm Event	$Q_{1\ year}$	$Q_{30\ year}$	$Q_{100\ year}$	Q_{Bar}
Existing Greenfield Runoff Discharge Rates (l/s) - Main Site	248.96	672.1	932.17	**300.38**
Proposed Discharge Rate limited to Qbar (l/s)=	**300.38**			
Quick Storage Estimate (m^3) =			**52,723**	

Table 5 - Proposed Peak Surface Water Discharge Rates

By distributing attenuation between the site-wide masterplan and individual plot catchments, a balanced approach is achieved. The masterplan establishes a robust infrastructure capable of managing a significant portion of runoff, while individual plots contribute through tailored solutions suited to their specific characteristics and requirements. This approach optimises the drainage system's efficiency, enhances resilience against flooding, and promotes sustainable water management practices across the site.

Drawing RAM-XX-XX-DR-C-0100 & 101 in **Appendix 5** shows the proposal of the surface water drainage.

7.1.2.1 Phase 1 Drainage Strategy

The plots incorporated within the Phase 1 design include the following: O Plots, Q1 Primary School, J Plots, I Plots, P1 Secondary School, H Plots, G3 plot and the associated link road running through the central spine of the site. Details regarding drainage, along with considerations for both on-plot and off-plot hard and soft landscaping, are provided in the Arcadis Drainage Design Report (10051123-ARC-050-ZZ-TR-CE-00002). Also incorporated within the report are the associated connections into site wide ditches and headwall connection points.

7.1.2.2 Main Site Wide Drainage

The illustrative masterplan serves as the overarching framework for the entire site, encompassing various plots and their respective catchments. It outlines the overall drainage strategy, including the provision of infrastructure, such as detention basins, below ground storage and other attenuation features, within the site-wide network. This network is designed to convey and store surface water runoff, ensuring efficient drainage across the entire area. Flow control devices will be used to manage surface water flow across site ensuring that the attenuation tanks/ basins are fully utilised.

The plots incorporated within the site wide design include the following: A, B, C, D, E, F, S, M Plots and G Plot excluding G3.

The site wide drainage strategy is based on five catchment areas individually treating, storing and conveying surface water to each of the individual outlets which will evenly discharge at a controlled rate into the adjacent water courses. The site wide drainage strategy aims to convey runoff anticipated from the proposed development whilst trying to achieve a like-for-like basis with the existing characteristics of the site.

The total attenuation provision from the main site drainage through below ground storage and detention basins is circa **36,985m^3**.

7.1.2.3 On Plot Drainage

The main on plot drainage will utilise a drainage system which will capture roof drainage from all buildings and may choose traditional gutter systems to achieve this, whilst the majority of external hardstanding drainage will be collected via gullies and drainage channels. However, individual plots within the masterplan (residential, commercial and schools) are allocated a specific role in managing their catchment attenuation.

The remaining attenuation provision from the on-plot residential and commercial areas to manage site drainage is circa **15,128m^3**.

Each plot will provide attenuation to assist with the site wide drainage network will provide the remaining attenuation requirements for surface water management techniques that effectively reduce and delay the release of water into the broader drainage system and improving the water quality. Attenuation features should be provided by the following sustainable drainage systems:

- Detention basins
- Below ground tanks
- Muga attenuation
- Swales
- Filter trenches
- Blue/ green roofs
- Rain gardens
- Oversized pipe

7.1.2.4 Road Drainage

Transportation infrastructure will play a vital role in ensuring seamless connectivity within and beyond the development. Thoughtful planning will incorporate well-designed road networks, pedestrian-friendly pathways, and efficient public transportation systems, reducing reliance on private vehicles and promoting sustainable commuting options.

Sustainable Drainage Systems can be incorporated as part of road drainage to enhance water management and mitigate the impacts of urban development on the environment. Swales are an effective solution which can be incorporated to capture and convey surface water runoff at shallow level. Where there are no spatial constraints, these can be included along road edges to capture, filter runoff before it enters the below ground network. Similarly, where space above ground to include a swale may not be achievable, Filter Strips can be a narrower alternative along road edges which provides good treatment and conveyance of surface water runoff at a shallow depth.

Where there may not be sufficient road width to incorporate swales or filter strips, runoff can be directed to other sustainable drainage systems such as Rain Gardens, Tree Pits and Permeable On-Street Parking bays. Roads can be designed so that runoff is directed with the engineered falls towards these areas of sustainable drainage systems at low depressions along the road where there are no spatial constraints.

The drainage strategy for the proposed site wide road network aims to utilise sustainable drainage techniques as the design develops to aid with the attenuation requirements to achieve the target greenfield runoff rate.

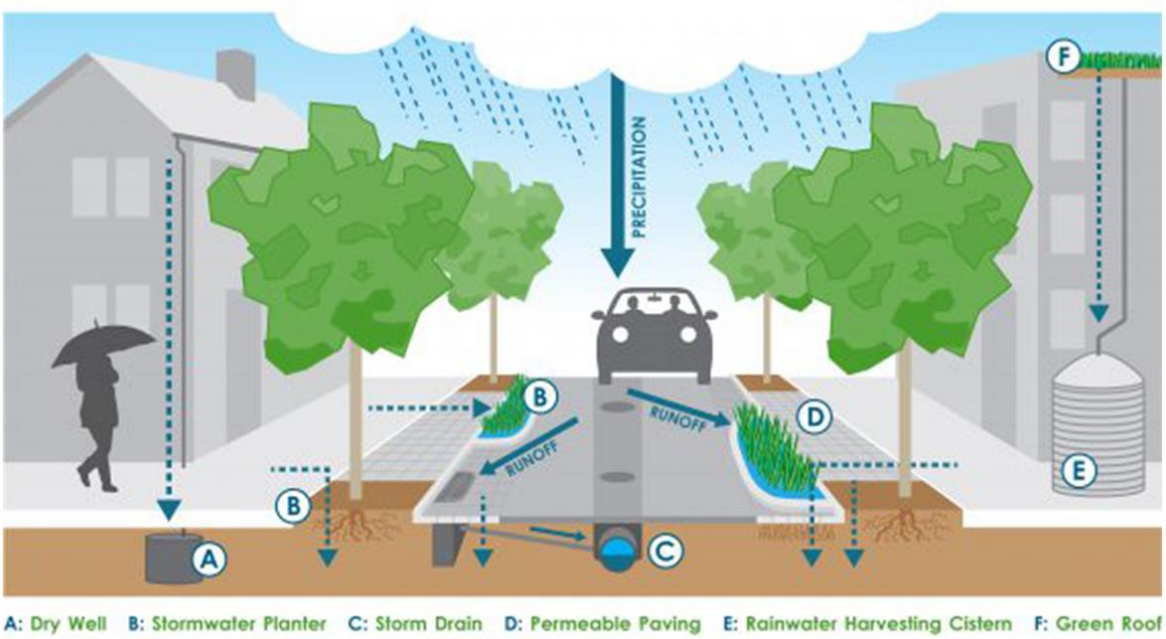


Figure 8 – Sustainable road drainage techniques

7.2 Proposed Site Foul Water Drainage Strategy

7.2.1 Design Parameters

The below ground foul drainage system will be designed to 'The Code', BS EN 752 Parts 3 and 4, and the Building Regulations Document H.

7.2.2 Proposed Foul Water Drainage Strategy

The proposed foul water drainage strategy is based on the Area Schedule for proposed onsite residential and commercial properties contributing to the site wide demands for drainage for the development. It is envisaged that a gravity drainage network will be utilized to convey foul water towards the adjacent Thames Water public sewer to the east of the site. Due to the nature of the development changing from an undeveloped greenfield site to a residential and commercial use development, the foul water discharge rate will increase as a result.

The proposed foul water discharge rate from the site has been calculated to be in the region of 85.96 l/s peak flow and average flow of **14.33 l/s**. Proposed Foul Water discharge rates are shown within **Appendix 7**. NB - the peak figure is not anticipated to be reached as this would require full usage of appliances at the same time constantly in use. The proposed discharge rate will need to be agreed with Thames Water via a pre-development enquiry application. Initial discussions with Thames Water suggest that there would be no issues with the proposed rates and connections to their sewer. Further liaison with Thames Water is required to agree the final arrangement.

7.2.3 Conveyance

Thames Water records show that there is a public Foul/ Combined sewer located along the eastern boundary of the site. Initial assessment of the site with relation to the proposed foul water design suggests that the majority of the site can achieve connections via gravity to the sewer with a western portion of the develop struggling to achieve the desired levels. As such a pump station will need to be provided to lift and convey the drainage to an appropriate height/ location for connection to the sewer via gravity.

The pump station will be provided with a duty/ assist/ standby pump arrangement to ensure that the pump can manage the foul water demand. In order to ensure the performance of the pump station is operating and in good working condition, the pumps will alternated with a duty, assist and standby pumps arrangement. This will ensure that the pumps remain in good working condition as part of the Operating and Maintenance regime and combined with a backup power supply, this will further mitigate any issues of failure during an extreme storm event. An allowance of 24hr emergency storage shall be provided within the pump chamber in the event of failure. This can be mitigated with a backup pump arrangement and backup power supply where possible.

7.3 Adoptable Drainage

The proposed site wide drainage system is to be designed and implemented in accordance with Thames Water Adoptable Standards. As an essential component of the development's infrastructure, the drainage system plays a crucial role in managing foul and surface water runoff, preventing flooding, and protecting the environment.

By adhering to Thames Water Adoptable Standards, the design will ensure that the drainage system meets the highest industry standards, Sewerage Sector Guidance (June 2022), and is compatible with the existing regional infrastructure. This approach guarantees the long-term effectiveness,

reliability, and maintainability of the drainage system, minimising potential risks and ensuring its seamless integration into the wider network.

Thames Water Adoptable Standards encompass various technical specifications and guidelines, encompassing aspects such as pipe material, sizing, gradients, access points, connections, and overall system design. Adhering to these standards not only ensures compliance with regulatory requirements but also facilitates future maintenance and operations, enabling efficient management of the drainage infrastructure.

All of the above will need to be demonstrated clearly to Thames Water and submitted as part of a Section 104 Adoption Application for Sewer Network and a Section 102 Adoption Application for a Pumping Station both under the Water Industry Act 1991.

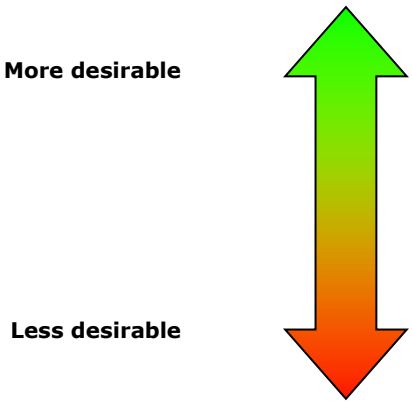
8. SUDS AND WATER QUALITY ASSESSMENT

8.1 SuDS Strategy & Hierarchy

Sustainable Drainage Systems (SuDS) generally mimic the natural drainage patterns of the undeveloped site, allowing where possible, infiltration into the ground/attenuation, improving water quality and controlling outflow rates from the development.

The proposed surface water drainage system has been designed to incorporate the current SuDS principles and approaches. The following hierarchy for managing surface water has been considered:

- Water Reuse and Living Roofs
- Basins and Ponds
- Infiltration Devices
- Permeable Surfaces
- Tank Systems



West Sussex County council as the Lead Local Flood Authority (LLFA) and Local Planning Authority (LPA) have produced guidance to support the efficient planning, design, and delivery of Sustainable Drainage Systems (SuDS) on all developments within the Crawley and Horsham areas.

The Sustainable Drainage Systems (SuDS) Handbook: published in June 2017 together with National Planning Policy Framework encourages the use of sustainable drainage systems where appropriate to manage surface water from new developments.

The form and function of SuDS to be used within a development, is heavily dependent on catchment characteristics. The topography and geology of the area is the key determining factor for which form of SuDS would be most beneficial for the site; whether to assist the movement of water through infiltration, or to store excess flows.

West Sussex County Council Guidance, together with other associated guidance, details the SuDS options that could be developed within the sites.

8.2 SuDS Strategy

Surface water run-off should preferably be discharged via infiltration. The initial ground investigation testing needs to determined the suitability of soakaways being a suitable solution for this site.

For the development site, it is anticipated that surface water flows will be discharged via headwall connections to the existing watercourses which bound the site to the north, east and south. This report is to be submitted along with the Pre-Development Enquiry application to the Lead Local

Flood Authority and will be updated with any comments/ requirements set out by the LLFA, to avoid any information related to risks which has not been considered to date or within this report.

Attenuation is required, sustainable drainage systems will include a range of features (e.g: green roofs, permeable paving, swales, rain gardens, bio retention, MUGA pitched and detention areas), will be integrated within the proposed development parcels, access corridors and strategic open spaces.

CIRIA C753 requires that surface water run-off is treated to improve the quality of the discharge water so that it does not negatively impact on the quality of the receiving watercourse or groundwater. Flows from roofs generally require a single stage of treatment, whereas flows from roads, car parks and yard areas generally require two stages of treatment.

The table below discusses types of SuDS (taken from C753), and whether they might be utilised at this site, to provide a contribution to either attenuation and/or treatment of the surface water flows. The final choice of SuDS treatment train elements will be confirmed at the detailed design stage.

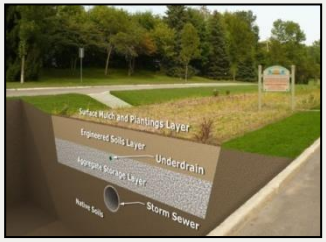
8.3 SuDS Strategy Site Assessment

The use of Sustainable Drainage Systems (SuDS) is mandatory for most new surface water drainage systems within the UK. SuDS can be used as source, conveyance, storage/attenuation, and discharge dependent on various site conditions using vortex flow control devices. The table below describes many of the SUDS approaches that are available and explains their advantages, disadvantages, and appropriateness for use on the proposed development site.

Table 6 – Sustainable Drainage (SuDS) Options

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Retention	Balancing pond		Provides both storm water attenuation and treatment. Runoff from each rain event is detained and treated in the pool. The retention time promotes pollutant removal through sedimentation.	Good removal of pollutants can be used where groundwater is vulnerable, good community acceptability, high ecological, and amenity benefits.	No reduction in runoff volume, land take may limit use in high density sites.	No – this feature cannot be included within the scheme due to close proximity to Gatwick Airport which requests that no features that will attract nesting on site which will increase the risk to the nearby airport.
	Subsurface storage		Oversized pipes, tank systems and modular geocellular systems that can be used to create a below ground storage structure.	Modular and flexible, dual usage (infiltration/storage, high void ratios, can be installed beneath trafficked and soft landscaped areas.	No water quality treatment.	Yes – implemented across main site

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Wetland	Shallow wetland Extended detention wetland Pond wetland Pocket wetland Submerged gravel wetland Wetland channel		Wetlands provide stormwater attenuation and treatment. They comprise shallow ponds and marshy areas, covered in aquatic vegetation. Wetlands detain flows for an extended period to allow sediments to settle and to remove contaminants They can provide significant ecological benefits.	Good pollutant removal and if lined can be used where groundwater is vulnerable. Good community acceptability, ecological and amenity benefits.	Land take is high, requires baseflow, little reduction in runoff volume, not suitable for steep sites.	No – this feature cannot be included within the scheme due to close proximity to Gatwick Airport which requests that no features that will attract nesting on site which will increase the risk to the nearby airport.
Infiltration	Infiltration trench Infiltration basin Soakaway		Surface water runoff can be discharged directly to ground for infiltration by soakaway, basins, or trenches. A prerequisite is that both groundwater and ground conditions are appropriate to receive the quality and quantity of water generated.	Reduces the volume of runoff, effective at pollutant removal, contributes to groundwater recharge, simple and cost-effective, easy performance observation.	Requires appropriate pre-treatment, basins require a large flat area, offset from foundations.	No – infiltration not deemed sufficient for site. Further soil testing required to determine if suitable in some parts of the site.

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Infiltration	Surface sand filter Sub-surface sand filter Perimeter sand filter		Structures designed to treat surface water runoff through filtration using a sand bed filter medium. The filters can be designed with or without infiltration. Temporary storage of runoff is achieved through ponding above the filter layer. They are used where particularly high pollutant removal is required.	Flexibility of design, efficient in removing pollutants, suitable for retrofits and in tightly constrained urban locations.	Not for high sediment content, detention times can support algae growth, minimum hydraulic head of 1.2m required, possible odor problems, high capital and maintenance cost.	No – infiltration not deemed sufficient for site. Further soil testing required to determine if suitable in some parts of the site.
	Bioretention/filter swale		Vegetated strips of land designed to accept runoff as overland sheet flow between a hard-surfaced area and a receiving system.	Landscaping features, effective in removing pollutants, flexible layout to fit into landscape, suited for highly impervious areas, good retrofit capability, effective pre-treatment option	Requires landscaping and management, large land requirement, not suitable for steep sites, no significant attenuation or reduction of flows.	No – infiltration not deemed sufficient for site. Further soil testing required to determine if suitable in some parts of the site.
	Filter trench/drain		Shallow excavations filled with rubble or stone that create temporary subsurface storage for filtration of storm water runoff.	Hydraulic benefits achieved with filter trenches, trenches can be incorporated into site landscaping and fit well beside roads and car parks.	High clogging potential without effective pre-treatment, limited to small catchments, high cost of replacing filter material.	No – infiltration not deemed sufficient for site. Further soil testing required to determine if suitable in some parts of the site.

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Detention	Detention basin		Surface storage basins that provide flow control through attenuation. Normally dry and in certain situations the land may also function as a recreational facility.	Cater for a wide range of rainfall events, can be used where groundwater is vulnerable, potential for dual land use, easy to maintain.	Land take, little reduction in runoff volume, detention depths constrained by levels.	Yes – Can be included where sufficient space is provided.
	Enhanced dry swale		Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate.	Incorporate into landscaping, good removal of pollutants, reduces runoff rates and volumes, low cost.	Not suitable for steep areas, significant land take, not suitable in areas with roadside parking.	Yes – Wet swales utilised along main roads throughout site.
	Enhanced wet swale					
Conveyance	Conveyance swales		Formal linear drainage features in which surface water can be stored or conveyed. They can be incorporated with water features such as ponds or waterfalls where appropriate.	Negate the need for underground pipework. Can provide some attenuation. Possible reduction in runoff volume via plant uptake and infiltration.	Potential trip/wheel hazard, disabled access issues.	Yes – Swales are utilised across the site for collection and conveyance.
	Rills					

SUDS Group	Technique	Image	Description	Advantages	Disadvantages	Suitable for use at site?
Source control	Green/Brown roof		Multi-layered system that covers the roof of a building with vegetation cover/landscaping over a drainage layer. Designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.	Mimics greenfield state of building footprint for high density developments, good removal of pollutants, ecological benefits, insulates buildings, sound absorption.	Additional weight, not appropriate for steep roofs, maintenance of roof vegetation.	TBC – Appropriate for flat roofs as building designs develop
	Rainwater harvesting		Uses rainwater coming from roofs to supply toilets, washing machines and irrigation systems. Harvested rainwater is stored underground and is substituted for potable water mains supply, reducing both site discharge and water consumption.	Can provide source control of storm water runoff, reduces demand on mains water.	Use is dependent on demand requirements, contributing surface area, and seasonal rainfall characteristics	TBC – Appropriate if buildings make allowance as designs develop

8.4 Water Quality

Water quality treatment is provided to the surface water run-off through the following methods as detailed in the CIRIA 753 SuDS manual (CIRIA, 2015):

- Filtration and settlement - removal of silt or suspended solids (with associated pollutants).
- Biodegradation – chemical dissolution of organic contaminants such as oil, petrol and diesel by bacteria, fungi, or other biological means within the pavement layers.
- Adsorption – adhesion of contaminant particles to sand and gravel material surfaces within the pavement build-up. Dependent on factors such as aggregate type, structure, texture, and moisture content.

The Simple Index Approach has been used to determine whether the proposed water quality measures are sufficient for the site for discharge to a watercourse. This approach uses indices to indicate the level of pollution from particular land uses, ranging from 0 (no pollution hazard for contaminant type) to 1 (high pollution hazard for contaminant type).

TABLE 26.1 Approaches to water quality risk management

Design method	Hazard characterisation	Risk reduction	
		For surface water	For groundwater
Simple index approach	Simple pollution hazard indices based on land use (eg Table 26.2 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.3 or equivalent)	Simple SuDS hazard mitigation indices (eg Table 26.4 or equivalent)
Risk screening[1]	Factors characterising traffic density and extent of infiltration likely to occur (eg Table 26.5 or equivalent)	N/A	Factors characterising unsaturated soil depth and type, and predominant flow type through the soils (eg Table 26.5 or equivalent)
Detailed risk assessment	Site specific information used to define likely pollutants and their significance	More detailed, component specific performance information used to demonstrate that the proposed SuDS components reduce the hazard to acceptable levels	
Process-based treatment modelling	Time series rainfall used with generic pollution characteristics to determine statistical distributions of likely concentrations and loadings in the runoff	Models that represent the treatment processes in the proposed SuDS components give estimates of reductions in event mean discharge concentrations and total annual load reductions delivered by the system	

Figure 9 – Table 26.1 from the CIRIA SuDS Manual

Pollution hazards can be mitigated with standard mitigation elements which are set out in the Pollution Mitigation Index within the SuDS Manual. The drainage features provided on site will have a total pollution mitigation index that equals or exceeds the pollution hazard index.

The pollution hazard indices for different land uses across the developable site area have been identified below.

Water pollution has been considered and methods of treatment chosen against criteria outlined in the Ciria SuDS Manual. Treatment measures are to be confirmed sufficient in accordance with Ciria SuDS Manual (Chapter 26) at detailed design stage. An outline using extracts from the document to allocate suitable pollution indices for the proposed land use is provided below:

Selection of Design Method – Select design method approach in accordance with Figure 10 below from the CIRIA SuDS Manual.

The simple index design method has been selected to mitigate pollution based on the land use of the development.

Figure 10 – Table 26.2 from the CIRIA SuDS Manual

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Step 2 – *"Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index."* - The selected mitigation indices are selected with a green box within Figure 11 below.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Figure 11 - Table 26.3 from the CIRIA SuDS Manual

Step 3 – *"Where the discharge is to protected surface waters or groundwater, consider the need for a more precautionary approach."* – Not applicable.

Table 7 – Summary of SuDS mitigation measures for each land use

		TSS	Metals	Hydrocarbons
Parking Areas – Managed through use of permeable paving, detention basin	Pollution Hazard Indices	0.5	0.5	0.4
	SuDS Mitigation Indices	Petrol interceptor designed to provide suitable water quality improvements		
Commercial roofs - Managed through swales / permeable paving / rain gardens / **filter drains/ granular tank**	Pollution Hazard Indices	0.3	0.2	0.05
	SuDS Mitigation Indices	0.4	0.4	0.4
Access Yard / Delivery Yard – Managed through the use of a petrol interceptor	Pollution Hazard Indices	0.7	0.6	0.7
	SuDS Mitigation Indices	Petrol interceptor designed to provide suitable water quality improvements		

8.5 Flood Exceedance Routes

Flood exceedance routes throughout the proposed site has been considered should rainfall event exceeds the inlet capacity of the drainage network, when the receiving water or pipe system becomes overloaded, blocked or when the outfall becomes restricted due to flood levels in the receiving water.

The proposed hardstanding areas should seek to direct flows away from occupied residential blocks and primarily to the larger areas of low depressions, roads, ditches and other means of surface water storage/ conveyance. Design of the finished floor levels for the buildings will ensure that levels fall away from the building thresholds. The routes ultimately seek to mimic the current flow routes associated with the existing site – via the existing ditch networks.

The current proposed levels relate to the existing topography of the site and it is generally viewed that with overland flow being directed away from buildings, the surface water runoff will generally fall towards roads, external hardstanding and soft landscaped areas. The path of least resistance for the site generally falls towards the watercourses which bound the site, it is envisaged that using the external areas and road the overland flow will convey towards the watercourses in a flood exceedance event.

The Flood Exceedance Routes for the site are shown within **Appendix 8**.

9. DESIGN AND CONSTRUCTION APPROACH

9.1 Design Standards and Criteria

The proposed surface water and foul water drainage networks will be designed and installed to achieve self-cleaning velocity. Flows will generally be kept above 0.75 m/s to avoid erosion of the internal pipe surface, respectively, within the pipelines to ensure that self-cleaning velocities are achieved. This is subject to the condition, location, and level of the existing off-site drainage.

To give a long design life, with minimum embodied energy, the buried pipework will generally be:

- Externally: Vitrified clay and concrete, where possible; and
- Cast iron when laid below or cast within or through foundations or building structures.

Chambers will generally be either (subject to availability of space):

- Pre-cast manholes (if deeper than 1.2m to invert and in areas subject to vehicle over-run).
- In-situ concrete manholes.

Pipe diameters will generally be as follows:

- Foul water drainage – DN100 to DN300 to minimise the risk of blockage.
- Surface water drainage – DN100 to DN450 to minimise the risk of blockage.

The development will be drained by dedicated and fully segregated surface and foul water systems designed in accordance with the following documents (where appropriate);

- Building Regulations - Approved Document Part H.
- BS EN 12056: Parts 1-5: Gravity Drainage Systems Inside Buildings.
- BS EN 752: Drain and Sewer Systems outside buildings.
- Sustainable Drainage Systems - Design manual for England and Wales (CIRIA C753).
- Sewers Sector Guidance 2019.
- Sustainable Design and Construction Supplementary Planning Guidance, April 2014.
- Non-statutory Technical Standards for Sustainable Drainage Systems.
- Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England (The Code).
- National Planning Policy Framework (NPPF) and subsequent addendums
- Ciria C753 (SuDS Manual)

9.2 Construction Materials Consideration

The table below details the site-specific approach to construction of the below ground drainage system. In order to provide the most cost-efficient solution, the preferred design option or material specification for each element of the system will be determined in accordance with Clients and/or contractors requirements.

Table 8 – Construction Approach

Element	Standard Options	Selected Option
Pipework Below Ground	Clay Plastic Cast iron HDPE Concrete	Clay (external) Cast Iron (below building footprint) Concrete (for 300mm dia and above)
Pipework External	Clay Plastic Ductile iron HDP Concrete	Clay Concrete (for 300mm dia and above)
Access chambers	Concrete rings Brick chambers PPIC Reduced access	Concrete rings Reduced access
Building Drainage Point Connection	Below slab 'y' connections External 'y' connections Connect to internal manholes Connect to external manholes	Connect to external manholes
Repair to existing drainage systems	No re-use of existing drains Localised pipe replacement Pipe lining/patching	Drains (exception of final outfall systems of-site to authority requirements)
Pipework through foundations/floor slabs	Cast within rafts/ground beams/pile caps Cast below rafts/ground beams/pile caps	Cast within rafts/ground beams/pile caps Cast below rafts/ground beams/pile caps
Below ground attenuation	Oversized pipework Geocellular modular storage units GRP tanks Gravel filled pits	Oversized pipework Geo-cellular modular storage units
Infiltration devices	Granular pits/trenches Concrete ring chambers Geocellular modular storage units Borehole soakaways	N/A
Pervious Paving Finishes	Interlocking blocks Pervious asphalt Reinforced gravel/grass	N/A

Pipe Bedding	Standard single sized aggregate Recycled aggregate	Standard single size Aggregate Recycled aggregate
Significant invert level changes	Backdrops (at what level change) Steep graded pipework	Backdrops (at what level change)
Point Drainage Preference	Gullies Channel drains Channel drains at door thresholds	Gullies Channel drains Channel drains at door thresholds
Pump Stations	Preferred supplier Single/dual pumps Storage time period/volume	Single/dual pumps

10. MAINTENANCE REQUIREMENTS OF DRAINAGE COMPONENTS

The tables below, taken from the Ciria SuDS Manual, provides guidance on the type of operational and maintenance requirements that may be appropriate for the drainage features proposed in this Drainage Strategy report.

TABLE 11.6 Operation and maintenance requirements for RWH systems

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters	Annually (and following poor performance)
	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris	Annually (and following poor performance)
Occasional maintenance	Cleaning and/or replacement of any filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or damage to tank	As required
	Pump repairs	As required

Figure 12 - Maintenance Requirements of Rainwater Harvesting System taken from CIRIA SuDS Manual

TABLE 16.1 Operation and maintenance requirements for filter drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Figure 13 - Maintenance Requirements of Filter Drains taken from CIRIA SuDS Manual

TABLE 17.1 Operation and maintenance requirements for swales

Maintenance schedule	Required action	Typical 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, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	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
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	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

Figure 14 - Maintenance Requirements of Swales taken from CIRIA SuDS Manual

TABLE 18.3 Operation and maintenance requirements for bioretention systems

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

Figure 15 - Maintenance Requirements of Bioretention Systems taken from CIRIA SuDS Manual

TABLE 19.3 Operation and maintenance requirements for trees (after CRWA, 2009)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Figure 16 - Maintenance Requirements of Trees taken from CIRIA SuDS Manual

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical 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 glyphospate applied directly into the 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 50 mm 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 jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
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, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Figure 17 - Maintenance Requirements of Pervious Pavements taken from CIRIA SuDS Manual

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/ or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

Figure 18 - Maintenance Requirements of Attenuation Storage Tanks taken from CIRIA SuDS Manual

In addition to the items listed above, the table below provides further guidance on type of operational and maintenance requirements that may be appropriate for the drainage features not included in the tables provided above.

Table 9 – Drainage Maintenance Strategy

Drainage Feature	Regular Maintenance	Occasional/Remedial Maintenance	Monitoring
Drainage channels/Gullies	Inspections will include gratings; covers including their locking bolts; sumps and sump buckets; exposed concrete surround and adjacent surfacing. Check for accumulation of debris and silt and cleaned as necessary Gratings, frames and all associated locking parts to be checked for damage. Exposed concrete and adjacent surfacing to be checked for cracking and general damage. Check condition of inlet and outlet pipes, flow controls, baffles and isolation structures	Channel cleaning will be by flushing with water or high pressure jetting (no boiling water or cleaning agent will be used). All silt buckets and sumps will be cleaned out replaced back into the units ensuring they are correctly fitted. All channel surfaces and joints will be checked and repaired as necessary. Repair/rehabilitation of inlets, outlet, overflows and vents, as required.	Inspect every 4 months or after large storm.
Catchpit Manholes/Inspection Chambers	Check for accumulation of debris and silt and cleaned as necessary. Covers and frames to be checked for damage.	Clean as necessary. All manhole and inspection chamber covers and frames to be replaced as necessary.	Inspect every 6 months or after large storm.

	Exposed concrete and adjacent surfacing to be checked for cracking and general damage. Check condition of inlet and outlet pipes, flow controls, baffles and isolation structures	Repair exposed concrete and surfacing as necessary Repair/rehabilitation of inlets, outlet, overflows and vents, as required.	
Proprietary treatment system	Remove litter and debris and inspect for sediment, oil and grease accumulation; six monthly Change the filter media; as recommended by manufacturer Remove sediment, oil, grease and floatables; as necessary – indicated by system inspections or immediately following significant spill	Replace malfunctioning parts or structures; as required	Inspect for evidence of poor operation; six monthly Inspect filter media and establish appropriate replacement frequencies; six monthly Inspect sediment accumulation rates and establish appropriate removal frequencies; monthly during the first half year of operation, then every six months
Flow Control	Flow control devices should be regularly checked after a major storm to ensure they are free from blockage and reviewed annually.	Maintenance should be carried out in accordance of manufacturer guidance & specification.	Maintenance should be carried out in accordance of manufacturer guidance & specification.

11. CONCLUSION

This drainage strategy has considered the existing site conditions and demonstrates how the proposed site will perform with the existing setting.

The following points are considered pertinent to the proposed development's suitability for this site:

- The proposed development is predominantly located within a Flood Zone 1 area with land adjacent to the River Mole and Ifield Brook in Flood Zones 2 and 3. Flood Risk modelling showed negligible increases in flood extents were simulated upstream and downstream of the proposed scheme and it was concluded that the change in fluvial flood risk will be appropriately managed by the scheme design.

- In accordance with the requirements of Chapter 14 of the NPPF consideration has been given both to risk to the site, and to risk elsewhere caused by the anticipated development. Based on our understanding of the site setting and the proposed development, it is considered that the proposed development can be constructed and operated safely and will not increase flood risk elsewhere.

- Ground investigations for the development site are required in advance of any construction to highlight any risks not picked up within this report. Infiltration techniques to be investigated and implemented, if possible, subject to the result of the site investigation and the soil permeability;

- SuDS techniques such as detention ponds, swales, filter trenches and below ground tanks have been considered viable for this development and have been integrated within the proposals.

- The proposed drainage system is capable of managing runoff from all rainfall events up to and including the critical duration of a 1 in 100-year storm event plus 40% allowable for climate change. Surface water discharged from the site will be treated to an acceptable standard as informed by CIRIA Guidance Document C753.

- It has been established that both Foul and Surface water drainage strategies discharge via gravity for the majority of the site. Allowances have been made for areas which cannot achieve connection to outfalls via gravity with a provision of a pump station. This is based on the current levels strategy.

- The main on plot drainage will utilise sustainable drainage systems whilst individual plots within the masterplan (residential, commercial and schools) are allocated a specific role in managing their catchment attenuation.

- Surface water collected from vehicular and delivery areas will be treated with a petrol interceptor as appropriate and in accordance with best practice to provide treatment for contaminants to a quality suitable for discharging to a surface water course.

- It is intended for foul water to discharge to the existing Thames Water public sewer which bounds the site to the east. Some of the site foul water is anticipated to be too far away from the public sewer and a pumping station is proposed to aid with areas which cannot make suitable connection via gravity.

- The proposed site-wide drainage strategies have been developed in accordance with local and national design guidelines; however, they will be subject to Adoptable Standards and will require applications to the relevant water authorities, in compliance with the Water Industry Act 1991.