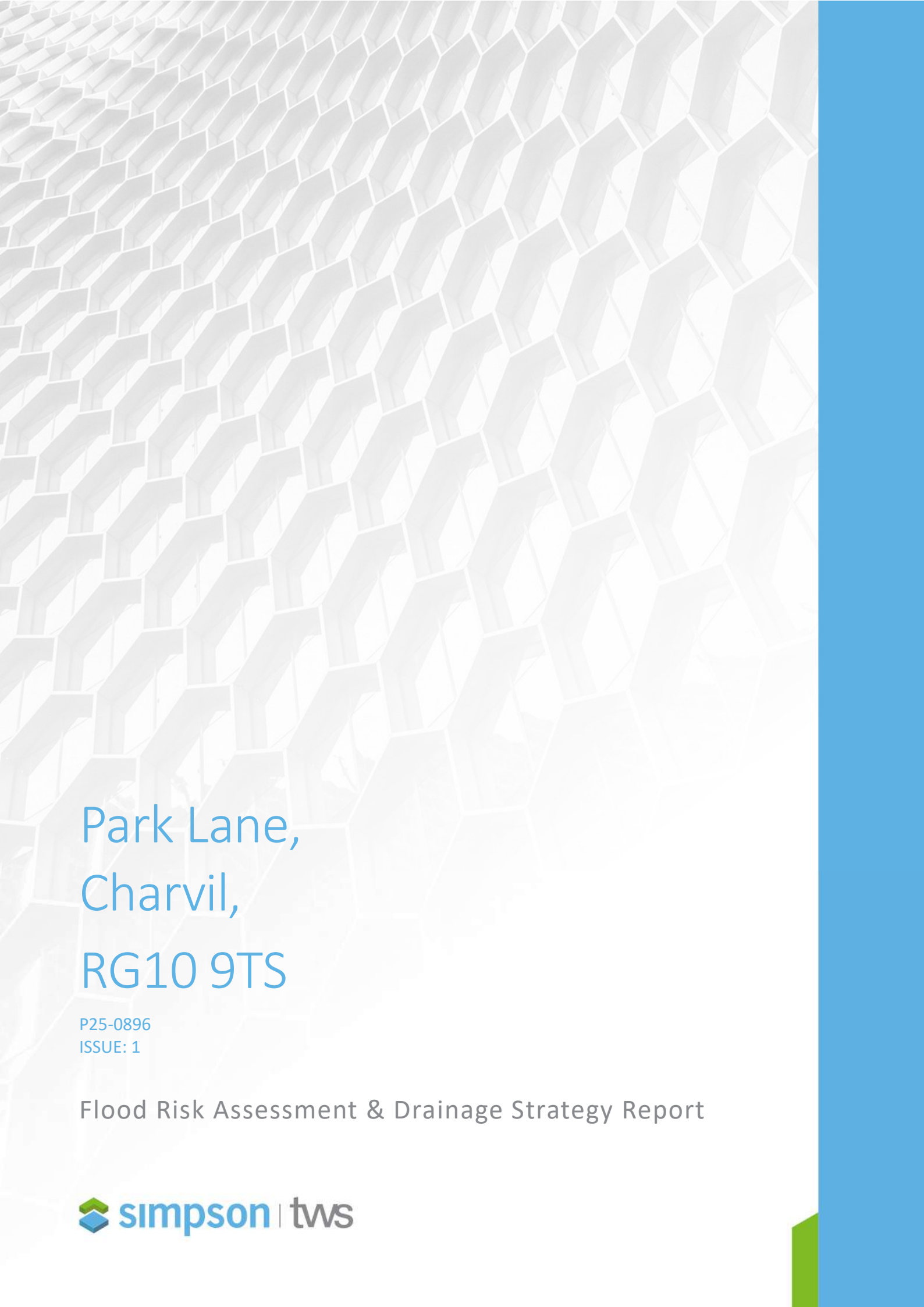




Park Lane, Charvil, RG10 9TS

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Flood Risk Assessment & Drainage Strategy Report

Park Lane, Charvil

Flood Risk Assessment & Drainage Strategy Report

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1 Introduction

1.1 Background

This report has been prepared on behalf of Bellway Homes to accompany a reserved matters planning application for a proposed 75-unit residential development at Park Lane, Charvil, RG10 9TS.

1.2 Objectives

The report assesses flood risk associated with the development proposals and outlines a strategy for the disposal of surface water and foul water runoff from the development, following guidance set out in the following local & national planning policy documents:

- The National Planning Policy Framework (NPPF) & associated Planning Practice Guidance 2024
- Wokingham Borough Council Local Plan/Core Strategy 2010-2026
- Wokingham Borough Council Managing Development Delivery (MDD) 2014
- Wokingham Borough Council Level 1 Strategic Flood Risk Assessment May 2023 – Final Report
- Wokingham Borough Council Sustainable Drainage Systems (SuDS) Strategy January 2017

1.3 Planning History

The proposed site previously received outline planning under ref: 232704 for Outline application for the proposed erection of up to 75 dwellings with only access to be considered via Park Lane. Appearance, Landscaping, Layout and Scale to be matters reserved.

Within the outline planning consent, condition 28 & 29 relates to the surface water drainage & SuDS strategy and sets out the following,

28. Drainage

No development shall take place until full details of the drainage system for the site have been submitted to and approved in writing by the LPA. The details shall include:

- 1. BRE 365 test results demonstrating whether infiltration is achievable or not.*
- 2. Use of SuDS following the SuDS hierarchy, preferably infiltration*
- 3. Full calculations demonstrating the performance of soakaways or capacity of attenuation features to cater for 1 in 100-year flood event with a 40% allowance for climate change and runoff controlled at the QBar rate of 3.83l/s/ha, or preferably better.*
- 4. Separate drainage systems for any proposed adopted highways and residential dwellings.*
- 5. A description of how the proposed development will deal with surface water overland flows.*
- 6. Groundwater monitoring confirming seasonal high groundwater levels in the area.*
- 7. A drainage strategy plan indicating the location and sizing of SuDS features, with the base of any SuDS features located at least 1m above the seasonal high water table level.*
- 8. Details demonstrating how any SuDS for this development would be managed throughout the lifespan of the development and who will be responsible for maintenance.*

29. Sustainable drainage

No building hereby permitted shall be occupied until surface water drainage works have been implemented in accordance with details that have been submitted to and approved in writing by the local planning authority. Before these details are submitted an assessment shall be carried out of the potential for disposing of surface water by means of a sustainable drainage system in accordance with the principles set out in Annex F of PPS25 (or any subsequent government guidance), and the results of the assessment provided to the local planning authority. Where a sustainable drainage scheme is to be provided, the submitted details shall:

i) provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of the receiving groundwater and/or surface waters;

ii) include a timetable for its implementation; and,

iii) provide a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.

2 Site Locations & Characteristics

2.1 Site Location

2.1.1. The site is located on land west of Park Lane, Charvil, Berkshire, RG10 9TS as shown on *Figure 2.1*, below.

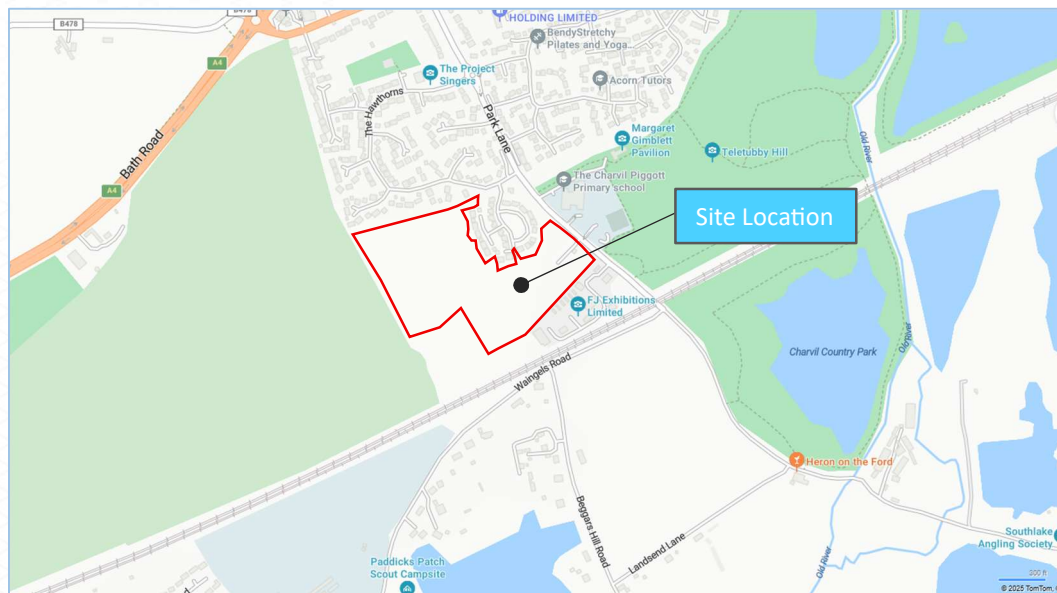


Figure 2.1 Site Location

2.1.2. The site is centred on Ordnance Survey grid reference SU 77633 75200 and co-ordinates X: 477633, Y: 175200. The nearby post code is RG10 9TS.

2.2 Site Description

2.2.1. The subject site currently comprises of greenfield land. To the north is a small residential development and to the south is a small industrial site and woodland as well as the Great Western Main Line railway.

2.2.2. The site's measured area is approximately 7 hectares.

2.3 Topography

2.3.1. A topographical survey of the site is included in *Appendix A*. The survey shows the site to have a gentle fall from north-west to south-east from respective levels of approximately 49.00m AOD to 38.00m AOD. The survey identifies two spoil heaps at heights of 3.0-3.5m located on the eastern and western sides of the site.

2.4 Existing Ground Conditions

2.4.1. British Geological Survey (BGS) online mapping indicates the site to have underlain bedrock as Seaford Chalk Formation and Newhaven Chalk Formation – Chalk to the southeast of the site and Lambeth Group to the northwest of the site. Sedimentary bedrock formed between 89.8 and 72.1 million years ago during the Cretaceous period and notes the superficial deposits as River Terrace Deposits, Sand and gravel. Sedimentary superficial deposit formed between 2.588 million years ago and the present during the Quaternary period.

2.4.2. A Site Investigation was undertaken by Geo-Integrity ref: 25-07-12 which provides further details of the underlying ground conditions. The results of the investigation works are included in *Appendix B* which identifies the test locations with soils encountered, areas of contamination and soakage tests locations / rates.

2.4.3. Topsoil underlies the majority of the site with localised made ground that exists underlying the builder's yard and a small pocket at the centre of the site – maximum thickness 0.70mbgl. River Terrace Deposits underlie the near-surface soils down to depths of 8.00mbgl in the west and 0.95m in the east (thinning in a south-east direction). These deposits vary but are predominantly granular sand and gravel (non-shrinkable). Whilst significant layers of cohesive soil were encountered, laboratory testing proved this material to be of medium shrinkability in accordance with NHBC guidelines.

2.4.4. The Lambeth Group was encountered across the site down to proven depths of 8.90m and 13.70m bgl (thinning to the east). This comprised predominantly soft to firm and firm to stiff, dark grey, green, silty clay with shell debris and calcareous horizons, and dense, dark grey, green, very sandy clayey silt with shell debris. Laboratory testing has proven this material contains layers of highly shrinkable soil in accordance with NHBC guidelines. The Lambeth Group is underlain by The White Chalk Subgroup at depths below 8.90m bgl, proven down to depths in excess of 25.00m bgl (the maximum depth achieved by the ground investigation).

2.4.5. Groundwater was encountered at significant depths ranging between 7.90m and 13.00m bgl, recorded to be at similar depths to the interface between the Lambeth Group and the underlying chalk strata. In addition, minor perched water levels were recorded within the River Terrace Deposits at depths of 1.50m and 2.80m bgl, respectively. Subsequent groundwater monitoring also recorded perched water levels within CT5 at depths of 3.36m bgl.

2.4.6. 4 no. soakage tests to BRE 365 were undertaken within the variable near-surface soils of the River Terrace Deposits. The tests were completed 3 times at each location yielding varying rates across the locations and tests. The lowest recorded rate of 1.97×10^{-6} m/s was recorded at SA3 whilst the highest recorded rate was 3.03×10^{-4} m/s at SA4.

2.4.7. Given the information gathered from this intrusive investigation, the chalk strata were proven to be overlain by a significant overburden comprising River Terrace Deposits and Lambeth Group soils. Therefore, the risk of dissolution features is less than if it was present nearer surface. No evidence of dissolution features was recorded during this investigation however, only two boreholes (BH1 and BH2) identified chalk at depth. Therefore, as a precaution, it is recommended that soakaways should be sited at least 10m away from foundations for structures, roads and railways.

2.4.8. The site investigation identified the risk of contamination to construction workers, end users and surrounding residents from the proposed development at this site is very low, and as such, no further works or remedial measures are considered necessary prior to development.

2.5 Existing Drainage Arrangements

2.5.1. An Existing Drainage Characteristics Plan is included in *Appendix C*. The plan shows fall arrows and contours generated by a digital terrain model created from the topographical survey of the site. The fall arrows are representative of the topography discussed in section 2.3.

2.5.2. Thames Water is the incumbent sewerage utility provider for the area. A review of the Thames Water's Records confirms that there is a surface water sewer running west to east along The Hawthorns to the north of the site and north to south down Park Lane to the east of the site. There is a foul water sewer that runs parallel to the surface water sewer along The Hawthorns. Not shown on the Thames Water plan is a surface water and foul water sewer that has been installed running south to north along Canberra Lake Way that has recently been built as part of an adjacent development. *Figure 2.2* below shows an extract of Thames Water's sewer records for the site.

2.5.3. There is a tributary for the old river and the river Loddon, which runs perpendicular to the southeast of the site. The Old River lies approximately 700 to 750 meters to the south east of the site; this is the closest main river to the site and receives all the surface water bodies on-site and near the site. Approximately 50 to 100 meters to the south of the site there is an ordinary watercourse feeding into the Old River. Further to the south east of the site there is another river which is roughly 1 mile away, this is the river Loddon. To the east and the south of the site, there are small lakes, the one to the east is approximately 450 meters away while the lake to the south is 550 meters away from the site.

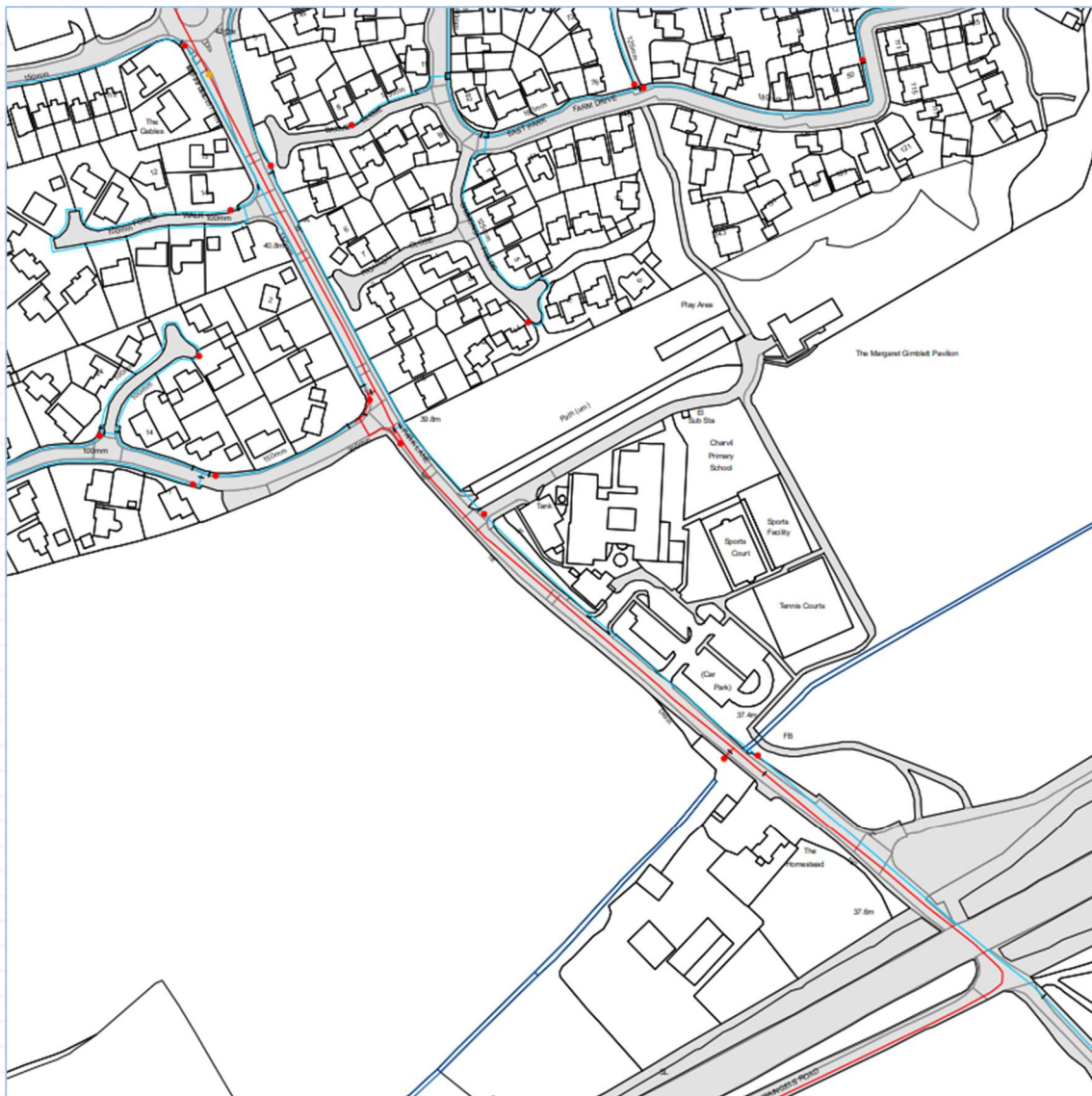


Figure 2.2: Thames Water Sewer Records

3 Proposed Scheme

3.1 Development Details

3.1.1. The proposed development includes the construction of seventy-five residential dwellings, including a range of two-bed, three-bed, four-bed, and five-bed dwellings. The red line area shown on the development proposal plan totals 7ha. The proposed dwellings include private gardens and driveways. There will also be access roads constructed, public open space and soft landscaping. It is proposed to construct attenuation basins for drainage, and there is a flood zone limit along the southern boundary. The main access will remain the same via Park Lane to the east.

3.2 Development Layout

3.2.1. A plan showing the development layout is included in *Appendix D*.

4 Flood Risk Planning Policy & Guidance

4.1 National Planning Policy Framework (NPPF) 2024

4.1.1. At a national level, the NPPF and the Planning Practice Guidance (PPG) to the NPPF seek to ensure flood risk is considered at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development towards areas at lowest flood risk. The NPPF retains a risk-based approach to the planning process and uses the Flood Zones as the basis for applying the sequential test, as well as flood risk vulnerability classifications, which define the type of development that is considered appropriate within each zone. It advises local planning authorities to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

4.1.2. The NPPF establishes the Flood Zones as the starting point for assessment with the overarching aim to steer new development to areas with the lowest probability of flooding. Flood Zone maps are available on the GOV.UK website and the definitions of the Flood Zones extracted from the National Planning Policy Framework (NPPF) are described below:

- Flood Zone 1 – Low probability. This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
- Flood Zone 2 – Medium probability. This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year.
- Flood Zone 3a – High probability. This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- Flood Zone 3b – The functional floodplain. This zone comprises land where water must flow or be stored in times of flood. Typically, land which would flood with an annual probability of 1 in 20 (0.5%) or greater in any year or is designed to flood in an extreme (0.1%) flood.

4.1.3. In areas at risk of river flooding, the NPPF advises that preference be given to new development in Flood Zone 1. If there are no reasonably available sites in Flood Zone 1 the flood vulnerability of the development can be considered in locating development in Flood Zone 2 and then Flood Zone 3. Within each flood zone new development should be directed to sites at the lowest probability of flooding from all sources.

4.1.4. The NPPF advises that when determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment with development only to be allowed in areas at risk of flooding where, in the light of the assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- within the site, the most vulnerable development is in areas of lowest flood risk, unless there are overriding reasons to prefer a different location.
- the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment.
- it incorporates Sustainable Drainage Systems (SuDS), unless there is clear evidence that this would be inappropriate.
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

4.2 Wokingham Borough Council Level 1 Strategic Flood Risk Assessment 2023

4.2.1. The Strategic Flood Risk Assessment provides details of flood risk within the local area which was completed in 2023 by JBA. The SFRA reports identified several sources of flood risk in the study area, which include:

- Fluvial flooding
- Surface water flooding
- Groundwater flooding
- Sewer flooding
- Artificial sources of flooding

4.3 Wokingham Borough Council Core Strategy 2010 - 2026

4.3.1. The Wokingham Borough Council Local Plan/Core Strategy covers the timeframe between 2010 and 2026. The plan includes a number of policies relating to flood risk and surface water, which guide design, planning and development decisions. The following Wokingham Borough Council Local Plan/Core Strategy policies should be considered when assessing flood risk and surface water management of the site:

- Policy CP1 - Sustainable Development
 1. Maintain or enhance the high quality of the environment;
 2. Minimise the emission of pollutants into the wider environment;
 3. Limit any adverse effects on water quality (including ground water);
 4. Ensure the provision of adequate drainage;
 5. Minimise the consumption and use of resources and provide for recycling;
 6. Incorporate facilities for recycling of water and waste to help reduce per capita water consumption;
 7. Avoid areas of best and most versatile agricultural land;
 8. Avoid areas where pollution (including noise) may impact upon the amenity of future occupiers;
 9. Avoid increasing (and where possible reduce) risks of or from all forms of flooding (including from groundwater);
 10. Provide attractive, functional, accessible, safe, secure and adaptable schemes;
 11. Demonstrate how they support opportunities for reducing the need to travel, particularly by private car in line with CP6; and
 12. Contribute towards the goal of reaching zero-carbon developments⁴¹ as soon as possible by:
 - a) Including appropriate on-site renewable energy features; and
 - b) Minimising energy and water consumption by measures including the use of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form

4.4 Wokingham Borough Council Managing Development Delivery (MDD) 2014

4.4.1. The Wokingham Borough Council Managing Development Delivery local plan builds on the strategy set out in the Core Strategy and sets out more detailed policies for managing development, with the following policies in respect to flood risk and drainage.

- Policy CC09 - Development and Flood Risk
 1. 1. All sources of flood risk, including historic flooding, must be taken into account at all stages and to the appropriate degree at all levels in the planning application process to avoid inappropriate development in areas at risk of flooding. Proposals must be consistent with the guidance in paragraphs 99-104 of the National Planning Policy Framework (NPPF); the Technical Guidance to the NPPF and demonstrate how they have used the Strategic Flood Risk Assessment (SFRA) to determine the suitability of the proposal.
 2. Development proposals in Flood Zones 2 or 3 must take into account the vulnerability of proposed development.
 3. Development must be guided to areas of lowest flood risk by applying the sequential approach taking into account flooding from all sources and shall ensure flood risk is not worsened for the application site and elsewhere, and ideally that betterment of existing conditions is achieved. The sequential test will not be required if at least one of the following applies:
 - a) Replacement of an existing single residential property. However, the replacement property should, where possible, be located on the part of the site at lowest risk
 - b) Conversions and change of use unless it involves a change to a more vulnerable class
 - c) Minor development, as defined in footnote 10 of the Technical Guidance Note to the NPPF.
 4. In exceptional circumstances, new development in areas of flood risk will be supported where it can be demonstrated that:
 - a) The development provides wider sustainability benefits to the community that outweigh flood risk
 - b) The development will:
 - i. Be safe for its lifetime, taking account of the vulnerability of its users
 - ii. Not increase flood risk in any form elsewhere and, where possible, will reduce flood risk overall

- iii. Incorporate flood resilient and resistant measures into the design
 - c) Appropriate evacuation and flood response procedures are in place to manage the residual risk associated with an extreme flood event.
- 5. Where required, suitable and appropriately detailed flood risk information will need to accompany a planning application. A Flood Risk Assessment (FRA) is required for:
 - a) All proposals in areas of known historic flooding from all sources
 - b) Where there is evidence of a risk from all sources of flooding identified in the Strategic Flood Risk Assessment
 - c) Those proposals set out in footnote 20 to paragraph 103 of the NPP
- Policy CC10 – Sustainable Drainage
 - 1. All development proposals must ensure surface water arising from the proposed development including taking into account climate change is managed in a sustainable manner. This must be demonstrated through
 - a) A Flood Risk Assessment, or
 - b) Through a Surface Water Drainage Strategy.
 - 2. All development proposals must,
 - a) Reproduce greenfield runoff characteristics and return run-off rates and volumes back to the original greenfield levels, for greenfield sites and for brownfield sites both run-off rates and volumes be reduced to as near greenfield as practicably possible.
 - b) Incorporate Sustainable Drainage Systems (SuDS), where practicable, which must be of an appropriate design to meet the long term needs of the development and which achieve wider social and environmental benefits
 - c) Provide clear details of proposed SuDS including the adoption arrangements and how they will be maintained to the satisfaction of the Council [as the Lead Local Flood Authority (LLFA)]
 - d) Not cause adverse impacts to the public sewerage network serving the development where discharging surface water to a public sewer.

5 Sources of Flooding

5.1 Summary

5.1.1. The following section summarises only the fluvial and surface water flooding for the site due to recent updates to the flood zone mapping by the EA in March 2025. For all other flooding sources such as Groundwater, Sewer and Artificial sources, the approved outline planning FRA prepared by Campbell Reith for outline planning ref: 13923-CRH-ZZ-XX-RP-C-0001-F1_FRA Park Lane should be referred to.

5.2 Fluvial Flooding

5.2.1. The Level 1 SFRA defines fluvial flooding as *'Flooding resulting from water levels exceeding the bank level of a river (main river or ordinary watercourse).'*

5.2.2. The EA's Flood Map for Planning is the initial dataset used for identifying the location and extent of fluvial and tidal flooding. *Figure 5.1* below shows the flood map, which identifies that whilst the site is predominately located within Flood Zone 1 with areas to the south shown as Flood Zones 2 & 3. Flood Zone 1 would be representative of land at low probability of fluvial flooding, with less than 1 in 1,000 annual probability of river flooding (<0.1%).

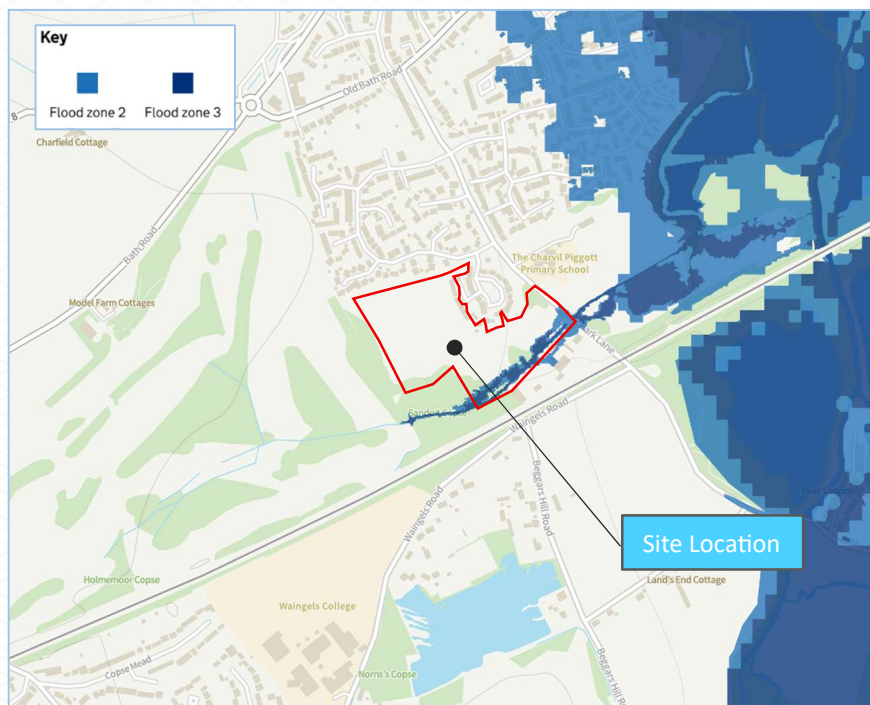


Figure 5.1: EA Flood Zone Map

5.2.3. Based on the review of mapping relating to fluvial flooding from information sources outlined above, the site overall is assessed to be at very low risk from fluvial flooding with the sections to the south shown to be at medium to high.

5.3 Surface Water Flooding

5.3.1. The Level 1 SFRA defines surface water flooding as *'Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.'*

5.3.2. The EA's risk of flooding from surface water mapping provides an understanding of the areas which may be at greater risk of surface water flooding, with the maps showing critical flow paths and areas situated in topographic depressions that could flood following an extreme rainfall event. The mapping is produced using hydrological (rainfall) modelling in combination with a digital terrain model. The mapping only indicates where surface water flooding could occur due to local rainfall. It does not fully represent flooding that occurs from; ordinary watercourses, drainage systems or public sewers caused by catchment-wide rainfall events, rivers, or groundwater.

5.3.3. The surface water flood risk map from the EA's website is shown in *Figure 5.2* below. Within the surface water flood mapping, you can view flood extents for the 1 in 30, 1 in 100, and 1 in 1000-year return periods; the below mapping displays the worst-case flood extents of 1 in 1000 year. The mapping shows there to be no areas of the site that are at risk of surface water flooding.

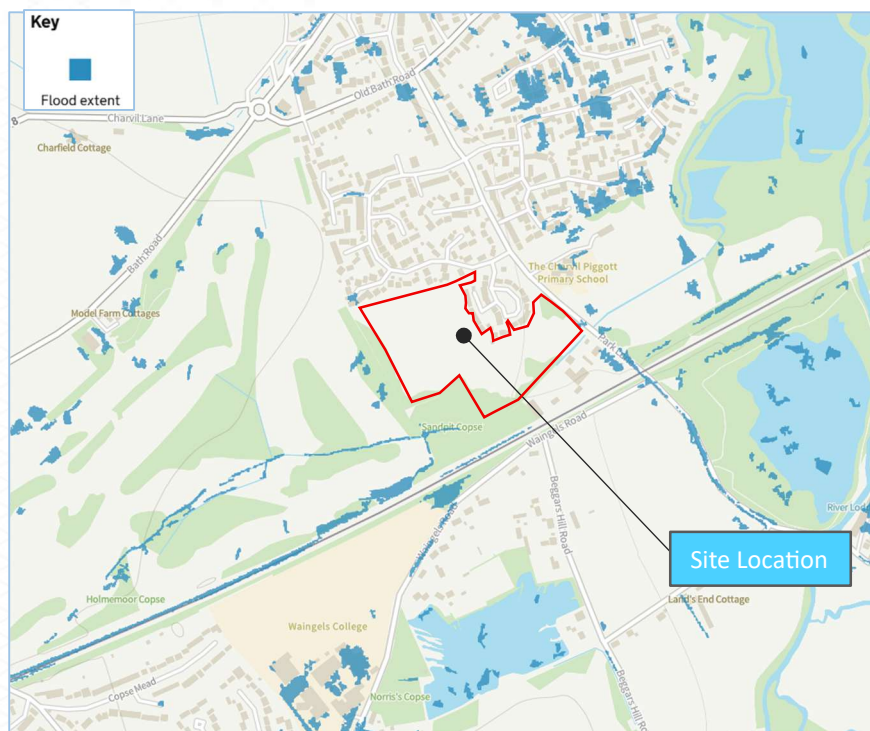


Figure 5.2: EA Risk of Surface Water Flooding Map

5.3.4. Based on the review of mapping relating to surface water flooding from information sources outlined above, the site is not assessed to be at risk from surface water flooding.

6 Managing the Risk of Flooding

6.1 The National Planning Policy Framework (NPPF)

6.1.1. The National Planning Policy Framework (NPPF) Planning Practice Guidance for Flood risk and coastal change National Planning Policy Framework (NPPF) advises that the objectives of a site-specific flood risk assessment are to establish whether:

- a proposed development is likely to be affected by current or future flooding from any source.
- it will increase flood risk elsewhere.
- the measures proposed to deal with these effects and risks are appropriate.
- the evidence for the local planning authority to apply (if necessary) the Sequential Test.
- the development will be safe and pass the Exception Test, if applicable.

6.1.2. *Figure 6.1* below provides a summary of the probability of flooding from each assessed source in Section 5, along with proposed measures to deal with the effects and risks posed by the development.

Source	Probability	Management Measures
Fluvial Flooding	Low	• All development will take place outside the areas defined as Flood Zone 2 & 3, with no works proposed to interact with these areas. It is therefore considered this risk is managed and no further measures would be required.
Surface Water Flooding	Low	• Not applicable however SuDS would be used to minimise the rate of discharge, volume, and environmental impact of surface water runoff from the development. Further details of the SuDS approach are provided in Section 7 of this report. • Floor levels of dwellings would be set above road and surrounding landscaping levels for further protection from overland surface water flooding, whilst roads would be designed with falls to direct overland flows away from dwellings as shown on the finished levels plan in <i>Appendix F</i>.

Figure 6.1: Summary of Sources of Flooding and recommended Management Measures

6.1.3. In Section 5 it was established that the developed site predominantly lies in Flood Zone 1. The NPPF and Local Policy of Wokingham Borough Council advise that all land uses are appropriate in Flood Zone 1. Therefore, the proposed development is considered appropriate in terms of the sequential test, with it not necessary to apply the exception test.

6.1.4. The provision of a surface water drainage system as part of the proposed development would reduce the risk of surface water flooding in comparison to the existing situation, whilst the inclusion of Sustainable Drainage System's (SuDS) as part of a surface water drainage strategy would further reduce surface water flood risk to the site and surrounding area as they could be designed to minimise the rate of discharge, volume, and environmental impact of surface water runoff in comparison to the existing situation. The following section of this report outlines an approach for the disposal and management of surface water runoff from the development using SuDS.

7 Surface Water Management & Drainage Strategy

7.1 Introduction

7.1.1. This section of the report outlines an approach for the disposal and management of surface water runoff from the development, with it expected that any further details of the strategy would be provided in accordance with Condition detailed design information and construction drawings are available for the development.

7.2 Surface Water Drainage Policy & Guidance

7.2.1. At a national level, the Flood and Water Management Act 2010 (FWMA) was introduced with the specific aim of reducing the risk of flooding in England and Wales and improving water management. The Act states that Lead Local Flood Authorities (LLFA's), must act within the Environment Agency's (EA) national strategy and co-operate with neighbouring authorities to address flood risk in their area and contribute towards the achievement of sustainable development.

7.2.2. The FWMA states that Sustainable Drainage System's (SuDS) should manage rainwater with the following aims:

- reducing damage from flooding
- improving water quality
- protecting and improving the environment
- protecting health and safety
- ensuring the stability and durability of drainage systems

7.2.3. This has been incorporated into the NPPF and associated PPG, which recommends SuDS are designed to control surface water run off close to where it falls and mimic natural drainage as closely as possible to provide opportunities to:

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

7.2.4. SuDS encompass a wide range of drainage techniques intended to minimise the rate of discharge, volume, and environmental impact of runoff and include; blue / green roofs; rainwater harvesting; soakaways / infiltration systems / infiltration trenches / permeable paving; swales / basins / ponds / wetlands / below ground attenuation tanks.

7.2.5. The PPG goes on to advise that generally, the aim should be to discharge surface run off as high up the as high up the following hierarchy of drainage options as reasonably practicable:

- into the ground (infiltration)
- to a surface water body
- to a surface water sewer, highway drain, or another drainage system
- to a combined sewer

7.2.6. The March 2015 DEFRA report "Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems" sets out the generic requirements for design of SuDS. It provides requirements for: flood risk outside the development; peak flow control; volume control; flood risk within the development; structural integrity; designing for maintenance considerations; and construction.

7.2.7. The July 2025 National Standards for sustainable drainage systems (SuDS) are intended for application in the design of surface water drainage systems for new infrastructure and development, whether on greenfield or brownfield sites and currently act as an addendum to the Non-statutory technical standards.

7.3 Wokingham Borough Council Sustainable Drainage Systems (SuDS) Strategy (Jan 2017)

4.4.1. The Wokingham Borough Council Sustainable Drainage Systems (SuDS) Strategy was developed in January 2017 to guide the implementation of SuDS in the Borough. The strategy aims to ensure that SuDS are integrated into the planning and design of new developments and retrofitting of existing sites to manage surface water runoff and improve water quality, biodiversity, and amenity.

The SuDS Strategy identifies the following key principles for the effective implementation of SuDS:

- SuDS should be used as the primary means of managing surface water runoff;
- SuDS should be designed to mimic natural drainage systems and manage water at source;
- SuDS should be designed to provide multiple benefits, such as flood risk management, water quality improvement, and biodiversity enhancement;
- SuDS should be designed to be sustainable, low maintenance, and have a long lifespan;
- SuDS should be integrated into the design and planning of new developments and retrofitting of existing sites;
- SuDS should be designed in a way that maximizes the use of available space and minimizes their impact on the built environment; and
- SuDS should be designed and maintained in a way that encourages community involvement and engagement.

7.4 Method of Discharge

7.4.1. In accordance with the hierarchy of drainage disposal options, *Figure 7.1* below provides an assessment of each methods suitability.

System	Assessment	Suitability
Store rainwater for later use.	Rainwater harvesting is the collection of rainwater runoff for use. Runoff can be collected from roofs and then used in place of mains water for certain applications. With the nature of development comprising residential dwellings it is likely that rainwater butts could be used to collect roof water for the purposes of irrigating domestic gardens.	✓
Discharge to ground by infiltration.	In Section 2, it was noted that soakage tests to BRE 365 were undertaken across the site. The recorded rates ranged between x10-4 in the west and x10-6 in the east. The site investigation identified the risk of solum features known to be prevalent in the area limiting the potential use of infiltration to be solely relied on and recommending a minimum of 10m from any foundations for structures, roads and railways.	✓
Discharge rainwater direct to a watercourse	In Section 2 it was identified that approximately 50 to 100 meters to the south of the site there is an ordinary watercourse feeding into the Old River. Whilst this watercourse lies predominantly in third party land, a small section attached to it is within highways land. It is feasible to discharge to the watercourse at no more than Greenfield runoff rate.	✓
Discharge rainwater to a surface water sewer / drain	In Section 2, a Thames Water surface water sewer was identified to exist along Park Lane to the east of the site which would be suitable to discharge surface water runoff to however it has been established that it would be possible to discharge runoff through a combination of infiltration and directly to a water course.	✗

Discharge rainwater to the combined sewer.

It has been established that it would be possible discharge of runoff through a combination of infiltration and directly to a water course, therefore it is not necessary to consider discharge to a combined sewer system.



Figure 7.1: Surface Water Runoff Discharge Method

7.4.2. Based on the assessment in Figure 7.1 above, a combination of storing rainwater for later use, infiltration and discharge of surface water to the existing drainage ditch adjacent the site and along Park Lane would be the most suitable methods for disposal of surface water runoff from the development.

7.5 Runoff Management

7.5.1. The development would be provided with a new surface water drainage system that would discharge to the surface water sewer and via infiltration. The system should meet requirements set out in the March 2015 DEFRA report “Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems” and the July 2025 National standards for sustainable drainage systems (SuDS).

7.5.2. The site is predominately greenfield with it considered the following policies from the DEFRA report are considered relevant in connection with runoff management.

- S2: For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event should never exceed the peak greenfield runoff rate for the same event.”
- S4: Where reasonably practicable, for greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.
- S6: Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

7.5.3. Greenfield runoff rates and volumes for a variety of storm events up to the 1 in 100-year return period have been estimated using the ReFH2 method. The calculations are included in Appendix E and are based on the 1ha. The estimated greenfield runoff rates and volumes are summarised in Figure 7.2 below for relevant return periods.

Return Period	Greenfield Runoff 1 Ha	
	Rate (l/s)	Volume (m3)
2 (QBAR)	3.83	81
30	8.8	206
100	12.21	275

Figure 7.2: Greenfield Runoff Rates & Volumes

7.5.4. The CIRIA SuDS Manual 2015 recommends FEH methods as the preferred approach for developing runoff estimates for use in surface water. Pre and post development runoff rates and volumes have been estimated for a variety of storm events up to the 1 in 100-year return period based on the existing measured drained area taken from the drained areas plan included in Appendix E. The drained areas plan shows the areas of existing hardstanding and the proposed catchments, which include a 10% allowance for creep for future increases in the roof area of houses. Runoff rates and volumes have been estimated using the Modified Rational Method Formula based on 360-minute rainfall profiles generated using FEH rainfall data. The calculations are included in Appendix E, with the results shown in Figure 7.3 below.

7.5.5. Catchment A is proposed to discharge via infiltration and is therefore not considered within the following runoff management assessment.

Return Period	Catchment B Brownfield Runoff (Post-development) 1.6 Ha	
	Rate (l/s)	Volume (m3)
2	73.9	410.3
30	162.2	900.7
30 + 35%	218.9	1215.9
100	210.1	1166.7
100 + 40%	294.1	1633.4

Figure 7.3: Post Development Brownfield Runoff Rates & Volumes

7.5.6. The global climate is changing as a result of human activity. For the UK, projections of future climate change indicate that more frequent short duration high intensity rainfall and more frequent periods of long-duration rainfall could be expected. The NPPF identifies that increased rainfall affects surface water flood risk and how drainage systems should be designed. It advises that development lifetime guidance should be used to determine appropriate climate change allowances for development with residential development to have a minimum lifetime of a 100 years. For flood risk assessments it advises that upper end allowances should be assessed with this done for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125). The site is identified to fall within the Loddon and tributaries Management Catchment. Figure 7.4 below shows the climate change allowances for the catchment taken from the peak rainfall allowances map. The climate change allowances for the 1% and 3.3% annual exceedance probability events are shown to be 40% and 35%, which have been applied to these events in Figure 7.3 above.

Loddon and tributaries Management Catchment peak rainfall allowances

3.3% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	20%	35%
2070s	25%	35%

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 to 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

Figure 7.4: Climate Change Allowances from Peak Rainfall Allowances Map
(<https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall>)

7.5.7. Figure 7.5 below compares runoff rates and volumes estimated for the greenfield situation and post development situation from Figure 7.2 and Figure 7.3. For true comparison purposes adjusted greenfield runoff rates and volumes are shown, which are based on the measured drained area in the post development situation.

Return Period	Greenfield		Post-Development		Difference	
	1.6 Ha		1.6 Ha			
	Rate (l/s)	Volume (m ³)	Rate (l/s)	Volume (m ³)	Rate (l/s)	Volume (m ³)
2 (QBAR)	6.1	129.6	73.9	410.3	+67.8	+280.7
30	14.08	309	162.2	900.7	+148.12	+591.7
30+35	14.08	309	218.9	1215.9	+204.82	+906.9
100	19.53	413	210.1	1166.7	+190.57	+753.7
100+40	19.53	413	294.1	1633.4	+174.57	+1220.4

Figure 7.5: Runoff Assessment Summary Catchment B

7.5.8. Figure 7.5 shows that surface water discharge rates and volumes would be potentially significantly greater in the post development situation than runoff rates and volumes for the greenfield situation. This is linked to the proposed impermeable areas associated with the development and allowance for potential increases in rainfall intensities due to climate change over the development lifetime.

7.5.9. The SuDS Manual C753 (2015) advises that the difference in runoff volume between the development state and the equivalent greenfield (or possibly pre-development state where this is considered to be acceptable) is termed the Long-Term Storage Volume. It is this volume that should be prevented from leaving the site (via rainwater harvesting and / or infiltration) or, where this is not possible, controlled so that it discharges at very low rates that will have negligible impact on downstream flood risk. Only the greenfield (or pre-developed) runoff volume should be allowed to discharge at greenfield (or pre-developed) rates.

7.5.10. It would not be feasible to prevent the Long-Term Storage Volume from leaving site due to the expected underlying ground conditions within the east of the site which do not possess sufficient infiltration properties to dispose of flows solely and due to the development's potential limited demand for recycled rainwater.

7.5.11. Policy S2 & S4 of the March 2015 DEFRA Report advises that where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer, or surface water body in accordance with Policy S6, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

7.5.12. The SuDS Manual C753 advises that where there is extra volume generated by the development that has to be discharged (because there are no opportunities for it to be infiltrated and/or used on site), this volume should be released at a very low rate (e.g. < 2 l/s/ha or as agreed with the local drainage approving body and/or environmental regulator) and the 1:100 year greenfield allowable runoff rate reduced to take account of this extra discharge. The SuDS Manual C753 also advises an alternative approach to managing the extra runoff volumes from extreme events separately from the main drainage system is to release all runoff (above the 1-year event) from the site at a maximum rate of 2 l/s/ha or QBAR, whichever is the higher value (or as agreed with the drainage approving body and/or environmental regulator). This avoids the need to undertake more detailed calculations and modelling. Figure 7.6 below shows maximum allowable discharge rates for the developments drained catchment areas based on 2 l/s/ha and QBAR.

2 l/s/ha / QBAR	Maximum allowable discharge rate (l/s)
	Catchment B 1.6 Ha
2 l/s/ha	3.2
QBAR	6.1

Figure 7.6: Comparison of maximum allowable discharge rate at 2 l/s/ha & QBAR

7.5.13. Figure 7.6 identifies QBAR derives a higher value. Therefore, it is deemed appropriate in this instance to select QBAR values as the maximum allowable discharge rate for surface water runoff from the development.

7.5.14. SuDS that are able to control and attenuate the estimated surface water storage volumes identified in Figure 7.7 would need to be considered as part of the developments surface water drainage strategy

7.6 Sustainable Drainage Systems (SuDS)

7.6.1. SuDS should be used across the development to control surface water flows to required levels and to address other aims of surface water management, which are water quantity (flooding), water quality (pollution), biodiversity (wildlife and plants) and amenity. Figure 7.7 below provides an assessment of a range of SuDS techniques that can be used to minimise the rate of discharge, volume and environmental impact of runoff.

System	Assessment	Suitability
Rainwater Harvesting	Rainwater harvesting is the collection of rainwater runoff for use. Runoff can be collected from roofs and then used in place of mains water for certain applications. With the nature of development comprising residential dwellings, it is likely that rainwater butts could be used to collect roof water for the purposes of irrigating domestic gardens.	✓
Infiltration Systems	In Section 2, it was noted that ground conditions at the site are in part considered suitable for disposal of surface water to ground by infiltration systems. On this basis, infiltration systems are considered feasible where the existing ground conditions permit and a minimum 10m clearance to foundations of structures, roads and railways can be achieved.	✓
Blue / Green Roofs	Green roofs are areas of living vegetation, installed on the top of buildings, for a range of reasons including visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They can be adapted to incorporate blue roof systems beneath, which comprise of a cellular system used to provide further attenuation and storage of surface water. No units with flat roofs such as apartment blocks are proposed. The sites dwellings are all residential buildings, comprising of pitched roof profiles.	✗
Filter Strips	Filter strips are uniformly graded and gently sloping strips of grass or other dense vegetation that are designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration, and infiltration. They are often used as a pre-treatment facility before swales, bioretention systems and trenches and are generally located in landscaping and open space alongside roads and parking areas. They tend to demand significant land-take, which normally restricts their use, with it	✗

also not desirable for these systems to be in areas where trees or structures will cause shade conditions that limit grass growth. The use of filter strips is unlikely to be necessary for the development with these systems normally used on commercial / industrial developments where there is a higher risk of pollution and need for pre-treatment of surface water.

Filter Drains

Filter drains are shallow trenches filled with stone / gravel that create temporary subsurface storage for the attenuation, conveyance, and filtration of surface water runoff. Generally, these systems are located alongside roads and parking areas and used in conjunction with other systems. It is likely that filter drains could be used for the collection and conveyance of surface water, as well as in combination with other SuDS systems such as swales and permeable paving systems.



Bioretention Systems

Bioretention systems (including rain gardens / tree pits) are shallow landscaped depressions that can reduce runoff rates / volumes and treat pollution using engineered soils and vegetation. They are generally used for managing and treating runoff from frequent rainfall events with the main aim of providing interception. They also provide amenity and biodiversity benefits by providing a habitat for local plants and wildlife. Systems could be provided in the form of roadside rain gardens, bioretention swales and tree pits located alongside roads and other paved areas for the collection, treatment and conveyance of surface water runoff.



Permeable Pavements

Permeable pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. The water is temporarily stored beneath the overlying surface before it soaks into the ground or is collected by a filter drain where ground conditions do not permit infiltration. It is likely that permeable paving could be used to intercept and treat surface water runoff from private drives and parking bays. Utility corridor requirements and complexities associated with adoption of roads and sewer systems would limit potential for permeable paving systems to be used in the developments road network.



Swales

Swales are shallow, flat bottomed, vegetated open channels designed to convey, treat, and store runoff. They are generally suited for managing runoff from roads because they are a linear feature and easily incorporated into the roadside space. They are also suitable for managing runoff from car parks and other impermeable and permeable areas. Swales are normally incorporated into landscape and public open spaces and feature shallow slopes. Swales could be provided in areas of open space alongside the development's road network for the collection, treatment and conveyance of surface water runoff from roads. The systems would also provide amenity and biodiversity benefits by providing a habitat for local plants and wildlife.



Basins / Ponds

Basins are large, landscaped depressions that are normally dry except during and immediately following storm events, while ponds are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. The systems are generally strategically located in areas of open space and are designed to temporarily store runoff associated with extreme rainfall events while it is released at controlled rates.



Attenuation Tanks	Attenuation tanks comprise below ground storage systems that temporarily store runoff associated with extreme rainfall events while it is released at controlled rates. It would normally only be appropriate to consider their use where site constraints preclude the use of other methods or where they offer specific benefits in facilitating the delivery of SuDS design criteria for a site however are not considered required for the scheme.	✗
Proprietary Treatment Systems	Proprietary treatment systems are manufactured products that remove specified pollutants from surface water runoff. It would normally only be appropriate to consider their use where site constraints preclude the use of other methods or where they offer specific benefits in facilitating the delivery of SuDS design criteria for a site. Instances where this would be the case are likely to be limited.	✗

Figure 7.7: SuDS Assessment

7.7 Surface Water Drainage Strategy

7.7.1. The surface water drainage strategy proposes to split the development into 2 separate catchments which is illustrated on the drained areas plan included in *Appendix E*.

7.7.2. Catchment A is proposed to dispose of flows via infiltration, whilst Catchment B will discharge of runoff through a combination of infiltration and discharging to the adjacent drainage ditch.

7.7.3. Flows from catchment A would be designed to dispose of flows via infiltration at a rate of 1.48×10^{-4} m/s. Flows from catchment B would be restricted to the maximum allowable discharge rates identified in paragraph 7.4.14, with the systems designed to attenuate excess runoff on site for all rainfall events up to and including a 1 in 100-year event with 40% allowance for climate change.

7.7.4. The new surface water drainage system would form a surface water management train, using the SuDS selected from *Figure 7.7*, to collectively capture, convey, and store surface water runoff from development, whilst also delivering interception and pollution risk management. The SuDS facilities would also promote other environmental objectives of the development by providing a habitat for local plants and wildlife and wider amenity value.

7.7.5. The surface water drainage strategy approach for the development, based on the above principles, is outlined below and shown on the drainage strategy drawing included in *Appendix F*:

7.7.6. Surface water runoff from the development would be initially intercepted and treated as close to source as possible by the following SuDS.

- Permeable paving as shown in *Figure 7.8* below would be used for the interception and treatment of surface water runoff from parking areas. Permeable paving would allow surface water runoff to filter through a block paved surface into a filter zone of sub-base beneath the bedding layer. As a result of soakage testing and differences in permeability of soils across the site, flows would be collected via a perforated pipe connecting to the proposed below ground network however the system would not be lined with any impermeable membrane to promote infiltration.

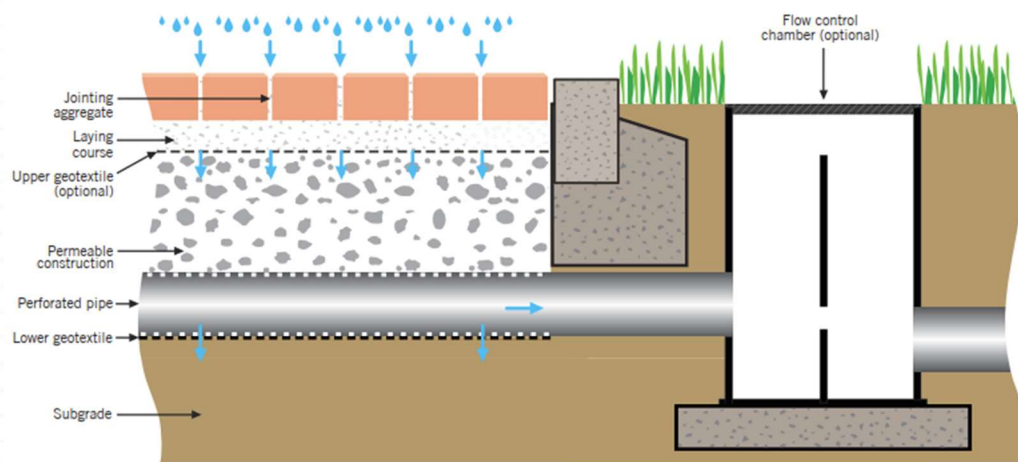


Figure 7.8: Typical partial infiltration permeable paving detail (Interpave)

- A combination of swales and rain gardens would be used alongside the road network and paved areas for interception, treatment and conveyance of road runoff. Figure 7.9 below shows typical examples of swales and bioretention swales and dry swales. The swales would be designed as shallow features 250mm deep and receive runoff directly from the adjacent roads. The swales would incorporate a road gully situated 25mm above the surface to provide resilience against silt entering the system and promote infiltration. The gully in turn would be connected to the below ground surface water network.
- Rain gardens would operate on a similar basis receiving flows directly from the adjacent roads through which the water would permeate through the engineered porous medium and collected via a perforated pipe connecting to the below ground system.

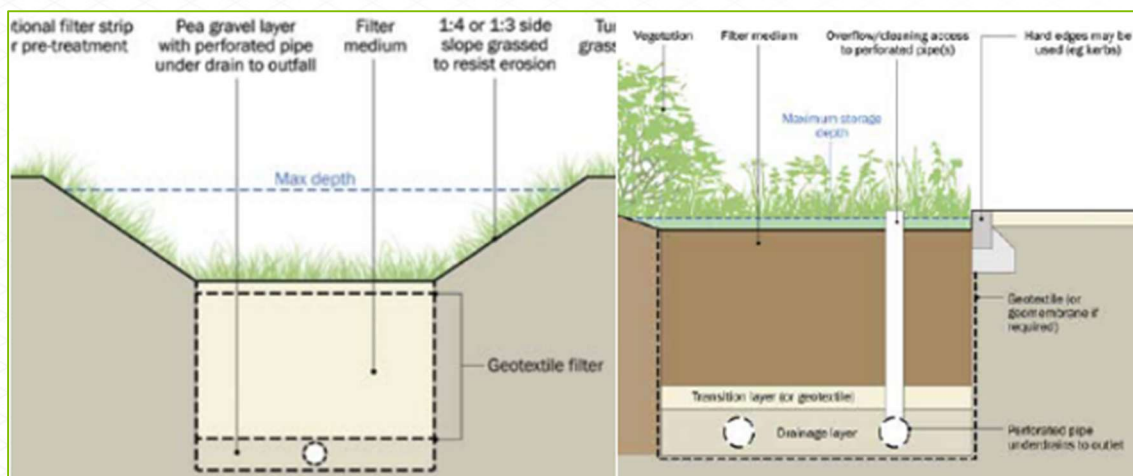


Figure 7.9: Typical swale and bioretention swale details (SuDS Manual)

- The source control systems would discharge to a traditional surface water sewer system located in the developments estate roads. The surface water sewer systems for Catchment A would discharge to a proposed infiltration basin to allow flows to be attenuated whilst discharging at the natural soils rates.
- Catchment B would discharge to an attention basin located in southeast corner to allow flows to be stored with flows discharging offsite at the maximum design rate. The basin would remain unlined and promote infiltration in accordance with the established rate. The attenuation basin has been designed with low flow channels to direct flows to a deepened section along with a shallow section to with access through shallow 1 in 6 side slopes. Figure 7.10 below shows typical example of a detention basin.

- The infiltration systems have been designed to ensure hydraulic connectivity with the permeable river deposits whilst also ensuring a minimum of 1m to the highest recorded groundwater level for which winter groundwater monitoring will be carried out to inform the design.

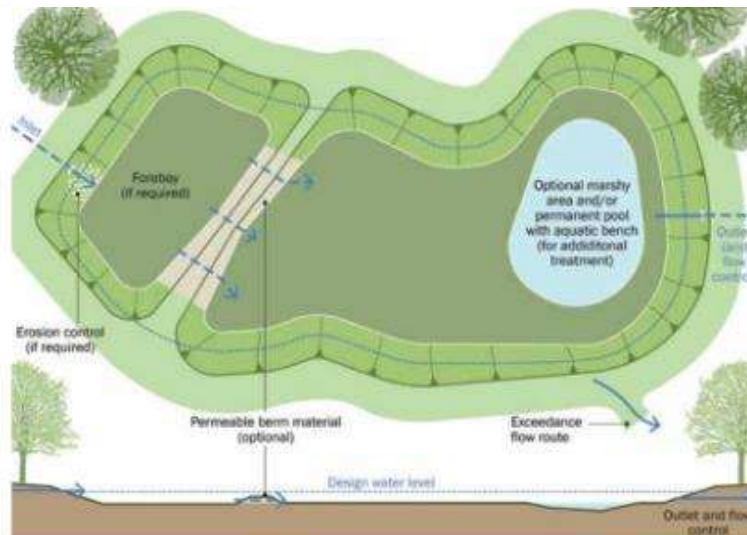


Figure 7.10: Typical examples of detention basin principles (SuDS Manual)

7.7.7. In combination the SuDS would form a surface water management train that collectively captures, conveys, and stores surface water runoff from the development whilst also delivering interception and pollution risk management. The strategy would also promote other environmental objectives of the development by using vegetated facilities that provide new habitats for local plants and wildlife. SuDS construction details have been produced for the proposed features and are included in *Appendix I*.

7.8 Hydraulic Analysis

7.8.1. Causeway Flow software package has been used to analyse the capacity and hydraulic characteristics of the surface water drainage strategy in its entirety for a variety of storm events up to and including the 1 in 100-year storm return period with 40% allowance for climate change utilising FEH 2022 rainfall data.

7.8.2. The results of the analysis are included in *Appendix H* and should be read in conjunction with the pipe numbering shown on the drainage strategy *Appendix F*.

7.8.3. The results show that the system could control surface water runoff from the development to the proposed restricted rate of discharge for all analysed storm return periods up to and including 1 in 100-year event with 40% allowance for climate change.

7.8.4. *Figure 7.11* below compares the post development discharge rates and volumes extracted from the results to the greenfield and brownfield runoff rates and volumes.

Return Period (Year)	Greenfield 1.6 Ha		Post-Development 1.6 Ha	
	Peak Runoff Rate (l/s)	6 hr Runoff Volume (m³)	Peak Runoff Rate (l/s)	6 hr Runoff Volume (m³)
2	6.1	129.6	6.1	222.5
30	14.08	309	6.1	465.7
30+35%	14.08	309	6.1	545.0
100	19.53	413	6.1	544.8
100 year + 40%	19.53	413	6.1	571.5

Figure 7.11: Comparison of Runoff Rates & Volumes – Catchment A

7.8.5. Figure 7.11 confirms that the surface water drainage scheme would be limited to the QBAR thus providing significant betterment to the existing situation.

7.8.6. Figure 7.11 show that the surface water drainage scheme would discharge at a greater volume than the greenfield runoff volume for the 1 in 100-year 6 hour rainfall event. However, surface water runoff from the development has been limited to maximum allowable discharge rates which have been deemed to be a rate that does not adversely affect flood risk and provides a significant betterment to the pre-development volumes.

7.9 Exceedance

7.9.1. Overland surface water flows resulting from exceedance of the drainage system's capacity or resulting from a blockage should be managed in a manner that minimises the risks to people and the property. Finished levels for the scheme have been designed with this in mind and are shown on the finished level layout drawings included in Appendix F. The drawing shows proposed levels to be generally set at or above existing ground levels, with floor levels of dwellings raised above road and surrounding landscaping levels. Road design contours on the drawing and exceedance flow arrows show that overland exceedance surface water flood flows would be direct flows away from the proposed dwellings and existing properties.

7.9.2. The finished level design would ensure that people and property would remain protected from flooding in the event of exceedance of the surface water drainage systems capacity. Furthermore, 10% allowance has been made for additional roof area in calculations with the cover level of the storage features at least 300mm below the propose finished floor levels.

7.10 Water Quality

7.10.1. On residential developments, runoff from roads has the most potential to cause pollution of receiving surface water or groundwater sources. The CIRIA C753 SuDS Manual 2015 sets out requirements for delivering appropriate levels of treatment to surface water runoff using SuDS. Figures 7.12 & 7.13 below identify that the SuDS systems proposed in series would have a total pollution mitigation index exceeding the recommended pollution hazard index for sources of surface water runoff on the development, thus confirming the SuDS components would provide suitable treatment of surface water runoff.

Runoff Source	Pollution Hazard Index			SUDS Component	Mitigation Index		
	TSS	Metals	TPH		TSS	Metals	TPH
Residential Roofs (very low)	0.2	0.2	0.05	Swale	0.5	0.6	0.6
				Permeable Paving	0.7	0.6	0.7
Driveways & Low Traffic Roads (low)	0.5	0.4	0.4	Infiltration Basin	0.5	0.5	0.6
Total	0.7	0.6	0.45	Total	1.7	1.7	1.9

Figure 7.12: Pollution Mitigation Assessment – Catchment A

Runoff Source	Pollution Hazard Index			SUDS Component	Mitigation Index		
	TSS	Metals	TPH		TSS	Metals	TPH
Residential Roofs (very low)	0.2	0.2	0.05	Rain Garden	0.8	0.8	0.8
				Swales	0.5	0.6	0.6
Driveways & Low Traffic Roads (low)	0.5	0.4	0.4	Permeable Paving	0.7	0.6	0.7
				Detention Basin	0.5	0.5	0.6
Total	0.7	0.6	0.45	Total	2.5	2.5	2.7

Figure 7.13 Pollution Mitigation Assessment – Catchment B

7.11 Amenity / Biodiversity

7.11.1. The development would maximise the opportunity for biodiversity and amenity benefits through areas of proposed open space, soft landscaping, buffer strips and gardens. In addition, vegetated SuDS are proposed for managing surface water runoff from the development in the form of swales, rain gardens and basins.

7.12 Management and Maintenance

7.12.1. Property owners would be responsible for the maintenance of the drainage system serving individual properties. Highway and shared systems would be offered for adoption or would be maintained as part of wider communal infrastructure by a management company funded by a communal service charge.

7.12.2. Management and maintenance plans for the sites drainage system would be finalised as part of the detailed stage design and be provided as part of discharging condition 28 of the Outline Planning Permission ref: 232704.

8 Foul Water Drainage Strategy

8.1.1. This section of the report outlines an approach for the disposal and management of foul water runoff from the development, with it expected that any further details of the strategy could be provided via a condition of the planning permission once detailed design information and construction drawings are available for the development.

8.1.2. Thames Water have been consulted regarding the existing foul sewer systems ability to accommodate foul water flows from the development. The consultation response is included in *Appendix G* and advises that the existing sewer network has insufficient capacity for foul water flows from the development. Consultation with Thames Water is underway for the proposed modelling and upgrade works to the network to accommodate the development. In accordance with Condition 44 of the outline planning permission, these works are required to be completed prior to occupation of the development and therefore would ensure sufficient capacity is made available.

8.1.3. The development would be provided with a new foul water drainage system comprising of a traditional gravity network of below ground pipework which as a result of the site being situated at a lower level than the public sewer would discharge to a proposed Type 3 adoptable pumping station. The foul water drainage strategy approach for the development, based on the above principles, is shown on the drainage strategy drawing included in *Appendix F*.

9 Conclusions

9.1.1. The site is predominantly located in Flood Zone 1, which is land assessed to not be at risk of tidal / fluvial flooding and has been determined to be at low risk of flooding from all other sources of flooding, with it also established that the development would not cause an increase in flood risk to the site or surrounding area as the measures below could be incorporated into the design of the development to deal with the effects and risks posed by the development.

- Use of SuDS to minimise the rate of discharge, volume, and environmental impact of surface water runoff from the development.
- Setting the finished level of development at or above existing ground level.
- Setting floor levels of dwellings above road and surrounding landscaping levels, with the developments roads also designed with falls to direct overland flows away from dwellings.

9.1.2. Discharge of surface water from the development via a combination of infiltration and discharging directly to the watercourse would be the most appropriate method for disposal of surface water runoff from the development.

9.1.3. The development would be provided with a new surface water drainage system covering 2 catchments. Catchment A is proposed to dispose of flows via infiltration with a design rate of 1.48×10^{-4} m/s. Infiltration systems will be designed to ensure a minimum of 1m from the base of the recorded groundwater levels. Catchment B is proposed to discharge flows to the existing drainage ditch at a restricted rate of 2l/s/ha. Winter ground water monitoring will be undertaken to inform the detail design with it considered these elements could be conditioned through this application.

9.1.4. The surface water drainage systems have been designed to attenuate excess runoff on site for all rainfall events up to and including a 1 in 100-year event with 40% allowance for climate change.

9.1.5. A variety of SuDS would be used to manage surface water runoff from the development. The systems could also be arranged in series to form an effective surface water management train that collectively captures, conveys, and stores surface water runoff from the development whilst also delivering interception and pollution risk management. The systems in conjunction with retained open space would also promote other environmental objectives of the development by providing a habitat for local plants and wildlife. The main components would include:

- Permeable paving for interception and treatment of surface water runoff from driveways and parking areas.
- Swales & bioretention rain gardens for interception, treatment and conveyance of road water runoff.
- Detention & Infiltration Basins.
-

9.1.6. The SuDS systems would suitably protect the development from surface water flooding and reduce surface water flood risk to the surrounding area through a reduction in greenfield runoff rates in comparison to the existing situation. Hydraulic analysis has confirmed that the SuDS systems would store and attenuate surface water runoff from the development for all rainfall events up to and including the 1 in 100-year storm return period with 40% allowance for climate change. Furthermore, 10% allowance has been made for additional roof area in calculations and finished levels are set a minimum of 300mm above any surface SuDS features.

9.1.7. The development would be provided with a new foul water drainage system comprising of a pumped system discharging to the Thames Water sewer located with the Hawthorns road to the north. Thames Water have confirmed that the existing sewer network has insufficient capacity for foul water flows from the development however reinforcement works are being progressed and would be secured through discharge of Condition 44 of the outline planning.

9.1.8. In terms of flood risk and drainage strategy, it is concluded that the development can be occupied and operated safely and that there will be no increase in the level of flood risk to the site or neighbouring sites because of the proposed development. On this basis, the development would fulfil the aims of national and local planning policy in terms of flood risk and drainage strategy. However, any further details of the foul and surface water drainage strategy could be provided via a condition of the planning permission once detailed design information and construction drawings are available for the development if required.

Appendices

Appendix A	Topographical Survey
Appendix B	Ground Investigation
Appendix C	Existing Drainage Characteristics Plan
Appendix D	Site Layout
Appendix E	Drained Area Plan & Runoff Calculations
Appendix F	Drainage Strategy Layout & Finished Level Layout
Appendix G	Thames Water Correspondence
Appendix H	Hydraulic Analysis Results
Appendix I	SuDS Construction Details

Appendix A

Topographical Survey

TREE	GRTH	HEIGHT	SPREAD	SPECIES
1	0.6	10.0	2.0	OKM
2	0.6	10.0	2.0	OKM
3	3.0	18.0	7.0	ASH
4	0.6	10.0	2.0	OKM
5	0.6	10.0	2.0	OKM
6	0.6	10.0	2.0	OKM
7	0.6	12.0	2.0	ASH
8	2.6	16.0	5.0	OKM
9	0.6	12.0	3.0	OKM
10	0.6	12.0	3.0	OKM
11	0.6	12.0	2.0	ASH
12	0.6	12.0	3.0	OKM
13	0.6	12.0	3.0	OKM
14	0.6	12.0	2.0	ASH
15	0.6	12.0	2.0	OKM
16	0.6	12.0	2.0	OKM
17	0.6	12.0	3.0	OKM
18	0.6	12.0	3.0	OKM
19	0.6	12.0	3.0	OKM
20	0.6	12.0	3.0	OKM
21	2.6	14.0	6.0	WILLOW
22	2.6	14.0	6.0	WILLOW
23	0.6	12.0	2.0	OKM
24	200.6	12.0	2.0	OKM
25	200.6	12.0	2.0	OKM
26	0.6	12.0	2.0	OKM
27	200.6	12.0	2.0	OKM
28	200.6	12.0	2.0	OKM
29	0.6	12.0	2.0	OKM
30	0.6	12.0	2.0	OKM
31	0.6	12.0	2.0	OKM
32	0.6	12.0	2.0	OKM
33	0.6	12.0	2.0	OKM
34	1.0	10.0	5.0	OKM
35	0.6	12.0	2.0	OKM
36	0.6	12.0	2.0	OKM
37	0.6	12.0	2.0	OKM
38	0.6	14.0	2.0	SILVER BIRCH
39	MB	14.0	3.0	WILLOW
40	2.6	14.0	3.0	WILLOW
41	1.0	14.0	2.0	WILLOW
42	MB	14.0	2.0	WILLOW
43	MB	14.0	2.0	WILLOW
44	2.6	14.0	5.0	WILLOW
45	0.6	12.0	2.0	OKM
46	0.6	12.0	2.0	ASH
47	0.6	12.0	2.0	OKM
48	0.6	14.0	2.0	OKM
49	0.6	12.0	2.0	OKM
50	0.6	12.0	2.0	OKM

TREE	GRTH	HEIGHT	SPREAD	SPECIES
51	0.6	12.0	2.0	OKM
52	0.6	12.0	2.0	OKM
53	200.6	12.0	2.0	OKM
54	0.6	12.0	2.0	OKM
55	0.6	12.0	2.0	OKM
56	0.6	12.0	2.0	OKM
57	0.6	12.0	2.0	OKM
58	0.6	12.0	2.0	OKM
59	1.4	12.0	2.0	OKM
60	0.6	12.0	2.0	OKM
61	0.6	12.0	2.0	OKM
62	0.6	12.0	2.0	OKM
63	0.6	14.0	3.0	OKM
64	0.6	12.0	2.0	OKM
65	0.6	12.0	3.0	OKM
66	0.6	12.0	2.0	OKM
67	0.6	12.0	2.0	OKM
68	4.0	16.0	7.0	OKM
69	0.6	14.0	2.0	ASH
70	0.6	12.0	3.0	OKM
71	0.6	12.0	2.0	POPLAR
72	MB	10.0	3.0	POPLAR
73	0.6/1.4	16.0	5.0	POPLAR
74	1.4	16.0	5.0	POPLAR
75	0.6	12.0	3.0	OKM
76	0.6	12.0	2.0	OKM
77	1.0	14.0	5.0	OKM
78	0.6	12.0	2.0	OKM
79	1.0	14.0	4.0	OKM
80	0.6	12.0	2.0	OKM
81	0.6	12.0	3.0	OKM
82	0.6	14.0	3.0	OKM
83	0.6	12.0	2.0	OKM
84	0.6	16.0	2.0	POPLAR
85	0.6	14.0	2.0	OKM
86	0.6	16.0	3.0	POPLAR
87	0.6	14.0	2.0	POPLAR
88	0.6	14.0	2.0	OKM
89	MB	14.0	4.0	POPLAR
90	400.6	14.0	5.0	POPLAR
91	MB	14.0	5.0	POPLAR
92	MB	14.0	3.0	POPLAR
93	0.6	14.0	3.0	OKM
94	0.6	14.0	2.0	POPLAR
95	200.6	14.0	2.0	POPLAR
96	0.6	10.0	2.0	POPLAR
97	0.6	10.0	2.0	POPLAR
98	200.6	14.0	2.0	POPLAR
99	200.6	14.0	2.0	POPLAR
100	200.6	14.0	2.0	POPLAR

TREE	GRTH	HEIGHT	SPREAD	SPECIES
101	1.0	16.0	3.0	POPLAR
102	3.2	16.0	4.0	POPLAR
103	1.8	18.0	7.0	OKM
104	1.8	18.0	7.0	OKM
105	1.8	18.0	7.0	OKM
106	1.8	20.0	8.0	ASH
107	0.6	8.0	5.0	POPLAR
108	1.4	16.0	7.0	POPLAR
109	0.6	16.0	5.0	POPLAR
110	0.6	16.0	4.0	ASH
111	0.6	16.0	4.0	ASH
112	0.6	16.0	4.0	ASH
113	0.6	8.0	4.0	POPLAR
114	200.6	16.0	4.0	POPLAR
115	0.6/1.0	16.0	4.0	POPLAR
116	0.6/1.0	16.0	5.0	POPLAR
117	0.6	16.0	5.0	POPLAR
118	200.6	16.0	4.0	POPLAR
119	200.6	12.0	3.0	POPLAR
120	0.6	13.0	3.0	POPLAR
121	0.5	13.0	3.0	POPLAR
122	400.6	16.0	4.0	POPLAR
123	1.0	18.0	5.0	SILVER BIRCH
124	601.2	16.0	7.0	WILLOW
125	0.6	16.0	4.0	POPLAR
126	200.6	16.0	4.0	POPLAR
127	201.1	16.0	5.0	POPLAR
128	0.6	8.0	4.0	TURKEY OKM
129	0.6	8.0	4.0	TURKEY OKM
130	1.1	14.0	5.0	TURKEY OKM
131	0.6	14.0	3.0	POPLAR
132	0.6	8.0	4.0	TURKEY OKM
133	1.1	16.0	7.0	POPLAR
134	1.6	20.0	7.0	OKM
135	1.4	16.0	12.0	POPLAR
136	0.6	16.0	3.0	POPLAR
137	1.6	16.0	3.0	POPLAR
138	200.6	16.0	3.0	POPLAR
139	1.6	16.0	6.0	WILLOW
140	0.6	8.0	3.0	OKM
141	1.0	8.0	4.0	WILLOW
142	0.6	4.0	4.0	WILLOW
143	0.6	8.0	4.0	BEECH
144	0.6	13.0	3.0	POPLAR
145	1.0	14.0	3.0	POPLAR
146	400.6	16.0	4.0	POPLAR
147	200.6	14.0	3.0	POPLAR
148	1.0	14.0	3.0	HAWTHORN
149	200.6	10.0	4.0	POPLAR
150	0.6	12.0	3.0	POPLAR

TREE	GRTH	HEIGHT	SPREAD	SPECIES
151	300.6	8.0	4.0	POPLAR
152	0.6	13.0	3.0	POPLAR
153	0.6	16.0	4.0	HORN BEAM
154	1.6	16.0	6.0	HORN BEAM
155	1.6	20.0	8.0	ASH
156	1.6	20.0	8.0	ASH
157	3.2	12.0	8.0	ASH
158	MB	6.0	4.0	HAZEL
159	MB	6.0	4.0	HAZEL
160	0.5	6.0	2.0	OKM
161	0.5	6.0	2.0	OKM
162	MB	5.0	3.0	HAZEL
163	4.0	8.0	6.0	HAZEL
164	3.8	18.0	8.0	OKM
165	3.8	22.0	8.0	ASH
166	0.6	8.0	3.0	ASH
167	0.6	8.0	3.0	ASH
168	0.6	8.0	3.0	OKM
169	1.4	16.0	5.0	OKM
170	1.4	16.0	5.0	OKM
171	0.6	14.0	3.0	POPLAR
172	0.6	14.0	3.0	POPLAR
173	0.6	14.0	3.0	POPLAR
174	0.6	14.0	3.0	POPLAR
175	0.6	14.0	3.0	POPLAR
176	0.6	14.0	3.0	POPLAR
177	0.6	14.0	3.0	POPLAR
178	0.6	14.0	3.0	POPLAR
179	200.5	14.0	3.0	POPLAR
180	1.4	14.0	3.0	POPLAR
181	1.0	14.0	3.0	POPLAR
182	1.4	14.0	3.0	POPLAR
183	1.2	14.0	3.0	POPLAR
184	1.0	14.0	3.0	POPLAR
185	1.2	14.0	3.0	POPLAR
186	1.0	14.0	3.0	POPLAR
187	0.6	14.0	3.0	POPLAR
188	0.6	8.0	3.0	ASH
189	0.6	8.0	3.0	OKM
190	0.6	8.0	3.0	OKM
191	0.6	8.0	3.0	OKM
192	0.6	14.0	3.0	OKM
193	0.5	6.0	5.0	HAZEL
194	1.5	6.0	5.0	POPLAR
195	200.6	14.0	3.0	POPLAR
196	0.6	14.0	3.0	POPLAR
197	0.6	14.0	3.0	POPLAR
198	0.6	14.0	3.0	POPLAR
199	0.6	14.0	3.0	POPLAR
200	0.6	14.0	3.0	POPLAR

TREE	GRTH	HEIGHT	SPREAD	SPECIES
201	0.6	14.0	3.0	POPLAR
202	1.2	16.0	4.0	POPLAR
203	0.6	6.0	3.0	OKM
204	0.6	6.0	3.0	OKM
205	0.6	6.0	3.0	OKM
206	0.6	6.0	3.0	OKM
207	201.0	22.0	10.0	OKM
208	1.2	18.0	8.0	OKM
209	200.0	22.0	10.0	OKM
210	201.8	22.0	10.0	OKM
211	0.6	8.0	4.0	OKM
212	0.6	8.0	3.0	OKM
213	0.6	8.0	3.0	OKM
214	0.6	8.0	3.0	OKM
215	0.6	8.0	3.0	OKM
216	0.6	8.0	3.0	OKM
217	0.6	8.0	3.0	OKM
218	0.6	8.0	3.0	SILVER BIRCH
219	300.5	6.0	3.0	WILLOW
220	1.0	8.0	4.0	OKM
221	0.6	8.0	4.0	OKM
222	0.5	8.0	3.0	OKM
223	0.5	8.0	3.0	OKM
224	0.5	8.0	3.0	OKM
225	1.0	8.0	3.0	OKM
226	1.0	8.0	3.0	OKM
227	1.0	8.0	3.0	OKM
228	1.0	8.0	3.0	OKM
229	1.0	8.0	3.0	OKM
230	1.0	8.0	3.0	OKM
231	1.0	8.0	3.0	OKM
232	1.0	8.0	3.0	OKM
233	1.0	8.0	3.0	OKM
234	1.0	8.0	3.0	OKM
235	1.0	8.0	3.0	OKM
236	1.0	8.0	3.0	OKM
237	1.0	8.0	3.0	OKM
238	1.0	8.0	3.0	OKM
239	1.0	8.0	3.0	OKM
240	1.0	8.0	3.0	OKM
241	1.0	8.0	3.0	OKM
242	1.0	8.0	3.0	OKM
243	1.0	8.0	3.0	OKM
244	1.0	8.0	3.0	OKM
245	1.0	8.0	3.0	OKM
246	1.0	8.0	3.0	OKM
247	1.0	8.0	3.0	OKM
248	1.0	8.0	3.0	OKM
249	1.0	8.0	3.0	ASH
250	0.6	8.0	3.0	OKM

TREE SCHEDULE				
TREE	GRTH	HEIGHT	SPREAD	SPECIES
251	1.0	8.0	3.0	OKM
252	1.0	8.0	3.0	OKM
253	1.0	8.0	3.0	OKM
254	0.6	8.0	3.0	OKM
255	1.0	8.0	3.0	OKM
256	1.0	8.0	3.0	OKM
257	1.0	8.0	3.0	OKM
258	1.0	8.0	3.0	OKM
259	1.0	8.0	3.0	OKM
260	1.0	8.0	3.0	OKM
261	0.6	8.0	3.0	OKM
262	0.6	8.0	3.0	OKM
263	0.6	8.0	3.0	OKM
264	0.6	8.0	3.0	OKM
265	0.6	8.0	3.0	OKM
266	300.6	10.0	5.0	HAWTHORN
267				
268	0.8	10.0	5.0	OKM
269	0.8	10.0	5.0	OKM
270	0.8	10.0	5.0	OKM
271	3000.0	300.0	300.0	XXXXXX
272	0.8	10.0	5.0	OKM
273	0.8	10.0	5.0	OKM
274	0.8	10.0	5.0	OKM
275	0.8	10.0	5.0	OKM
276	0.8	10.0	5.0	OKM
277	1.1	10.0	5.0	OKM
278	0.8	10.0	5.0	OKM
279	0.8	10.0	5.0	OKM
280	0.8	10.0	5.0	OKM
281	0.8	10.0	5.0	OKM
282	1.0	10.0	5.0	OKM
283	1.1	10.0	5.0	OKM
284	0.9	10.0	5.0	OKM
285	0.9	10.0	5.0	OKM
286	1.1	10.0	5.0	OKM
287	1.0	10.0	5.0	OKM
288	1.0	10.0	5.0	OKM
289	1.0	10.0	5.0	OKM
290	1.0	10.0	5.0	OKM
291	1.0	10.0	5.0	OKM
292	1.2	10.0	5.0	MAPLE
293	1.0	10.0	5.0	OKM
294	MB	8.0	5.0	HAZEL
295	MB	8.0	5.0	HAZEL
296	MB	8.0	5.0	HAZEL
297	MB	8.0	5.0	HAZEL
298	0.8	10.0	5.0	OKM
299	0.8	10.0	5.0	OKM