

Preliminary Surface Water Drainage Strategy

Site Address

Land at Thorpe House
Colliers Way / Waverley Road
Reading
RG30 2QS

Client

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Prepared By

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Date

29/03/2018



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1 Document Control



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Site Address: Land at Thorpe House
Colliers Way / Waverley Road
Reading
RG30 2QS

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2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone

3 Disclaimer

This report and any information or advice which it contains, is provided by STM Environmental Consultants Ltd (STM) and is solely for use by Thames Valley Retirement Homes Ltd (Client).

STM has exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant when undertaking works of this nature. However, STM gives no warranty, representation or assurance as to the accuracy or completeness of any information, assessments or evaluations presented within this report. STM accepts no liability for the performance of any drainage system based upon the recommendations of this report. Furthermore, STM accepts no liability whatsoever for any loss or damage arising from the interpretation or use of the information contained within this report. Any party using or placing reliance upon any information contained in this report, do so at their own risk.

4 Executive Summary

Location	Land at Thorpe House, Colliers Way / Waverley Road Reading, RG30 2QS Grid reference: 469016, 173270	
Proposed Development	Residential redevelopment to provide approximately 14 units.	
Hydrology	River Thames 1.5km north.	
Geology	Lambeth Group – Clays, Sands and Gravels	
Hydrogeology	Secondary A aquifer. No source protection zone.	
Permeability	Highly variable.	
Infiltration Potential	Good infiltration potential	
Fluvial Flood Risk	Very low. Flood Zone 1.	
Surface Water Flood Risk	Very low.	
Groundwater Flood Risk	No classified. Low groundwater table.	
Site Area	2820m ²	
Site Layout	Impermeable m²	Permeable m²
Existing	0	2822
Proposed	760	2062
Difference in impermeable area	+ 760	
Run-Off Rates	Greenfield (GF) (l/s)	Post Development (PD) (l/s)
Qbar	0.4620	1.0252
1 in 30	1.0626	2.3581
1 in 100	1.4738	3.2705
1 in 100 + CC (40%)	2.1848	4.8483

Planning Requirement	The proposed scheme shall ensure that the peak run-off rate for the 1 in 100 year 6-hour rainfall event (plus climate change) will be as close as reasonably practicable to and no more than 3 times the calculated greenfield run-off rate for the same event, and ensure a minimum discharge rate of 5 litres per second per outfall
Storage Required to meet Planning Requirement	Using the IH124 method the total storage volume required to match greenfield discharges was calculated to be 57 m ³ .
Preliminary SuDS Strategy	The proposed development will attempt to employ a range of techniques in line with the SuDS hierarchy including permeable paving, soakaways, living roofs, tree planters and swales. The precise configuration will be subject to the preparation of a Detailed Surface Water Management Strategy and consultation with the LLFA.
Conclusion	With the proposed SuDS mitigation measures in place, we believe that the proposed development will reduce local flood risk and therefore be in compliance with core Strategy Policies CS1, CS35 and Sites and Detailed Policies Document Policy DM1, which were outlined in the decision notice on the outline planning application.

5 Introduction

STM Environmental Consultants Limited have been appointed by Mr Andrew Andersson to undertake a Preliminary Surface Water Drainage Strategy for a proposed development at Land at Thorpe House, Colliers Way / Waverley Road, Reading RG30 2QS.

5.1 Proposed Development

The SWDS is required to support a planning application (Reference: 171219) for the residential redevelopment to provide a maximum of 18 dwelling units. Demolition of dwelling at 16 Kirton Close to provide access. (Appearance, Landscaping, Layout and Scale reserved for future consideration). The application was refused on the 07th of December 2018. Since the application was made the number of proposed units has dropped to 14.

The condition on the refusal decision notice of the outline planning application No.9 states; Due to the absence of an acceptable Sustainable Drainage Strategy, the application has failed to demonstrate its acceptability in terms of sustainable drainage and attenuating localised flooding, contrary to Core Strategy Policies CS1, CS35 and Sites and Detailed Policies Document Policy DM1.

A copy of the decision notice is available in [Appendix 6](#). Copies of the proposed development plans are presented in [Appendix 1](#).

5.2 Report Aims and Objectives

This report sets out the proposed drainage strategy that will be employed in the designs to meet the requirements of the planning condition and the National Planning Policy Framework.

5.3 Legislative and Policy Context

5.3.1 Legislative Context

Section H3 of the Building Regulations 2010 requires that adequate provision is made for rainwater to be carried from the building, roofs and paved areas. There is

preferentially discharged to soakaways or some other adequate infiltration system. Where that is not reasonably practicable, a watercourse; or sewer can be used.

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called "local flood risk management strategy".

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

According to the Act, one of the major tasks that the LLFA is required to undertake is being a SuDS Approving Body.

As per Schedule 3 of the Act, LLFAs are designated the SuDS Approving Body (SAB) for any new sustainable drainage system. Therefore, it must approve, adopt and maintain new sustainable drainage systems (SuDS) within its area. Highways authorities will continue to be responsible for maintaining SuDS in public roads. All SuDS must conform with the National Standards for SuDS.

5.3.2 Policy Context

Paragraph 103 of the National Planning Policy Framework (NPPF) states that:

When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

-  within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location
-  development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely

managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems.

In addition, the requirements of this report are laid out in the London Plan [2] and the LBS Local Plan [3].

The Sustainable Drainage Hierarchy set out in Policy 5.13 of the Greater London Authority's (GLA) London Plan (2011) [2] stipulates that developments should utilize Sustainable Drainage Systems (SuDS), unless there are particular reasons for not doing so; and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close as possible in line with the following drainage hierarchy:

-  Store rainwater for later use;
-  Use infiltration techniques, such as porous surfaces in non-clay areas;
-  Attenuate rainwater in ponds or open water features for gradual release;
-  Attenuate rainwater by storing in tanks or sealed water features for gradual release;
-  Discharge directly to a water course;
-  Discharge rainwater directly to a surface water sewer/drain;
-  Discharge to a combined sewer.

Additionally, the relevant schedules from Policy CC4 – Minimizing Surface Water Run-off with Sustainable Drainage Systems – are:

-  Major developments must implement SUDS to enable a reduction in peak run-off to greenfield rates for a 1 in 100 event + CC;
-  Major developments will be required to provide a sustainable drainage strategy that demonstrates how SuDS will be integrated to reduce peak flow volumes and rates in line with the requirements of this policy;
-  All other developments must maximize attenuation levels, achieving greenfield rates where possible;
-  All new car parks and hard standing areas should be rainwater permeable with no run-off directed in to the sewer network;
-  All flat roofs should be green or brown roofs to contribute to reducing surface water run-off.

In addition, Policy 5.15 – Water Use and Supply – promotes the minimisation of mains water use through rainwater harvesting when cost effective; while Policy 5.11 – Green roofs and Development Site Environments – requires that “Major development proposals should be designed to include roof, wall and site planting, especially, green roofs and walls where feasible”. The proposed development is not considered to be “major” and thus compliance with this policy is not mandatory but may be advised in light of potential infiltration limitations associated with the underlying geology.

6 Site Characteristics

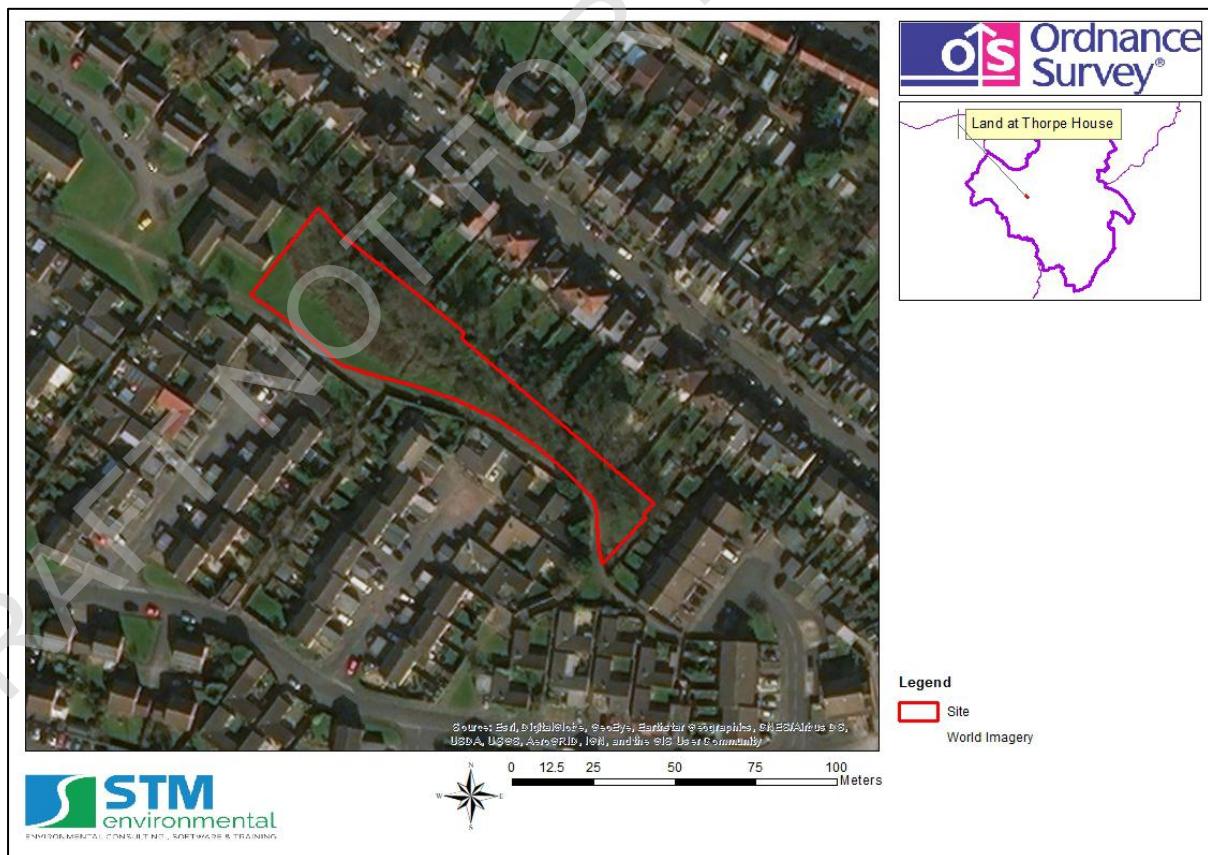
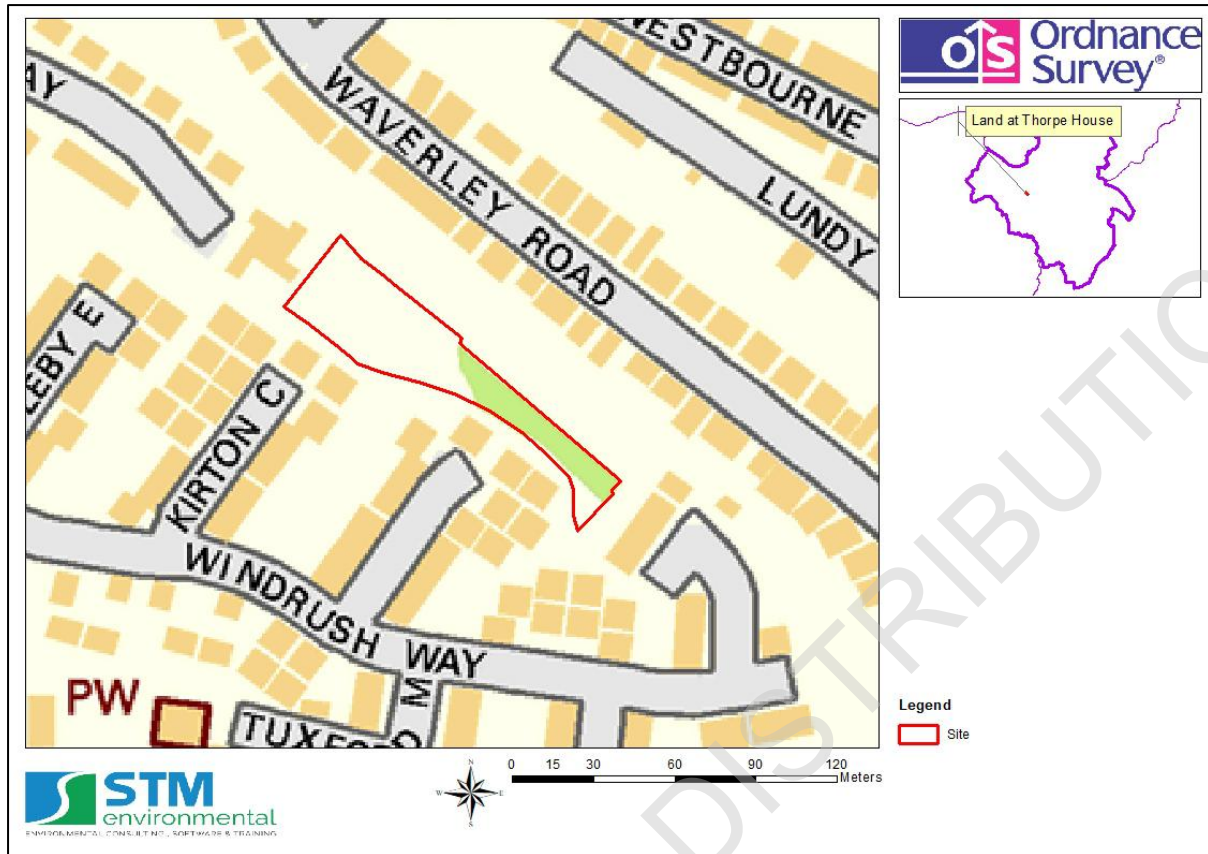
6.1 Location and Area

The site is centred at national grid reference 469016, 173270 and has an area of 2822m².

It falls within the jurisdiction of Reading Borough Council in terms of the planning consultation process on flood risk and surface water management. The LLFA is also Reading Borough Council.

Figure 1 provides the site location map and aerial imagery.

Figure 1: Site location map and aerial photo



6.2 Current Site Use

The site is currently used as undeveloped land. The site is formed of a long irregular land parcel that consists of a narrow woodland/bramble area in the southern section of the site, trees and brambles occupy the norther boundary. The north west is a mostly a grass field. Footpaths connect Kirton Close, Verney Mews and Windrush way to Colliers Way just off the north of the site.

6.3 Site Topography

The mapping provided in [Appendix 2](#) shows that the topography within the site. LIDAR data was not available for the site in question.

6.4 Hydrology

The nearest main watercourse is the River Thames, located 1.5km north of the site.

6.5 Geology

[Appendix 2](#) presents BGS mapping showing the geology in the area of the site.

Data from the British Geological Survey (BGS) indicates no underlying superficial geology. The bedrock geology is characterized as the Lambeth Group which consists of clay, silt and sands.

6.6 Hydrogeology

[Appendix 2](#) presents mapping from the BGS with indications of the hydrogeological characteristics of the site.

The site lies upon a clay, silt and sand substrate. The site does not lie within a groundwater source protection zone. The bedrock is a secondary A aquifer.

The permeability of the bedrock geology is considered to be highly variable.

The BGS infiltration potential map suggests that there is likely to be good potential for infiltration methods at the site.

The maps also indicate that the groundwater table is more than 5mbgl.

6.7 Flood Risk

6.7.1 Fluvial Flood Risk

Fluvial and tidal risk is assessed using flooding maps produced by the Environment Agency (EA). These maps use available historic data and hydraulic modelling to define zones of flood risk. The maps allow a site to be defined in terms of its Flood Zone (e.g. 1, 2, 3a or 3b) and in terms of the overall flood risk (very low, low, medium or high).

The EA Flood Zones are defined as:

-  Flood zone 1: Less than a 1 in 1000 annual probability of fluvial and/or tidal flooding;
-  Flood zone 2: Between 1 in 100 and 1 in 1000 annual probability of fluvial flooding and/or between 1 in 200 and 1 in 1000 annual probability of tidal flooding;
-  Flood zone 3a: Greater than 1 in 100 annual probability of fluvial flooding and/or greater than 1 in 200 annual probability of tidal flooding;
-  Flood zone 3b: functional flood plain (definition specific to the LLFA). Less than a 1 in 20 annual probability of fluvial and/or tidal flooding;

The site is designated as being within Flood Zone 1 and is therefore considered to have a less than a 1 in 1000 annual probability of fluvial and/or tidal flooding risk of flooding. This equates to a potential yearly risk of flooding of 0.1% (<0.1% Annual Expected Probability).

6.7.2 Surface Water Flood Risk

Surface water flooding occurs when high intensity rainfall leads to run-off which flows over the ground surface, causing ponding in low-lying areas when the precipitation rate or overland flow rate is greater than the rate of infiltration, or return into watercourses. Surface water flooding can be exacerbated when the underlying soil and geology is saturated (as a result of prolonged precipitation or a high-water table) or when the drainage network has insufficient capacity.

The chief mechanisms for flooding can be divided into the following categories:

-  Runoff from higher topography – the areas of greatest flood depths tend to be at the base of the steeper land;
-  Localised surface water runoff – within the central parts of the borough, surface water flooding tends to be a result of localised ponding of surface water;
-  Sewer Flooding – areas where extensive and deep surface water flooding is likely to be influenced by sewer flooding. Where the sewer network has reached capacity, and surcharged, this will exacerbate the flood risk in these areas.
-  Low Lying Areas – areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
-  Railway Cuttings – leading to internal ponding and transport disruption;
-  Railway Embankments – discrete surface water flooding locations along the up-stream side of the raised network rail embankments where water flows are interrupted and ponding can occur.

A map showing the site and the modelled prediction of surface water flood risk and depth provided by the EA is available in [Appendix 3](#). This indicates that the site is at very low risk of surface water risk of flooding across the site.

6.7.3 Groundwater Flood Risk

Groundwater flooding occurs when water rises from the underlying aquifer at the location of a spring – where the underlying impermeable geology meets the ground surface. This tends to occur after much longer periods of intense precipitation, in often low-lying areas where the water table is likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels.

Groundwater susceptibility mapping provided by BGS is presented in [Appendix 3](#). The potential for groundwater flooding to occur at the surface has not been classified for this area.

6.8 Existing Surface Water Drainage Features

Drainage plans showing the existing surface water drainage system at the site were not available at the time of writing/are presented in Appendix XXX

A utility search was undertaken which identified XXX.

7 Hydrological Run-off Assessment

To minimise the impact of the new development on local flood risk, the NPPF requires that the water drainage arrangements for any development site are that the volumes and peak flow rates leaving the site post-development are improved upon those of the existing conditions. The following run-off assessment predicts the Greenfield, pre- and post-development run-off rates and provides the required SuDS necessary for complying with the relevant planning policies.

7.1 Existing and Proposed Ground Cover

A summary of the existing and proposed site ground cover is shown below in Table 1.

Table 1: Existing and proposed site ground cover.

	Impermeable Area (m ²)	Permeable Area (m ²)	Total Area (m ²)
Existing Site	0	2822	2822
Proposed Site	760	2062	2822

The ground cover for the proposed development is summarised in Table 2 below.

Table 2: Approximate Ground Cover in the Proposed Development

Ground Cover	Type	Existing Area (m ²)	Proposed Area (m ²)
Buildings	Impermeable	0	455
Driveways	Impermeable/Permeable	0	305
Patios	Impermeable	0	0
Gardens/ landscaping	Soft Permeable	2822	2062
Total		2822	2822

7.2 Drainage Catchment

The following hydrological criteria were used to characterise the site.

Hydrological Region – 6

	SAAR – 643 mm
	SOIL – 2
	SPR – 0.53
	R Ratio (M5-60/M5-2 day) – 0.4

7.3 Run-off Calculations

The IH124 method was applied to calculate the Greenfield and post-development run-off rates including 40% allowances for climate change. The full calculations and results are presented in [Appendix 4](#). Table 3 below gives a summary of the results.

Table 3: Calculation of post-development run-off rates for the site.

Total site area (ha)	0.28	
Proposed Impermeable area (ha)	0.14	
Proposed Permeable area (ha)*	0.14	
Event	Greenfield Run-off Rate (l/s)	Post Development Run-off Rate (l/s)
Q_{bar}	0.4620	1.0252
Peak 1 in 30	1.0626	2.3581
Peak 1 in 100	1.4738	3.2705
Peak 1 in 100 + 40% CC	2.1848	4.8483

*The proposed permeable area has been increased to half of of the site to enable the SuDUK caluclations to be conducted.

8 Storage Requirements

The requirement (condition 9) for the proposed development is to ensure that the peak run-off rate for the 1 in 100 years 6-hour rainfall event (plus climate change) will be as close as reasonably practicable to and no more than 3 times the calculated greenfield run-off rate for the same event and ensure a minimum discharge rate of 5 litres per second per outfall.

The required storage volumes were obtained using the surface water storage volume estimation tool on the [UKSUDS website](#). The calculations are presented in [Appendix 4](#). The estimated storage requirements are summarised below.

Table 4: Calculated Estimated Storage Requirements

Storage Type	Estimated Storage Volumes (m ³)	Comment
Interception storage	6	Aims to achieve zero discharge from the site for rainfall depths up to 5mm.
Attenuation storage	52	Aims to limit the post development runoff rates to greenfield rates.
Long term storage	0	Similar to attenuation storage, but aims to specifically address the additional volume of runoff caused by the development
Treatment storage	17	Aims to ensure the water quality of the stormwater is sufficiently improved to minimise its impact on the flora and fauna in the receiving water. This is normally provided as the dry period volume of one or more ponds.
Total storage (m ³)	57	

9 SuDS Implementation

As mentioned above, planning policies require that SuDS strategies consider source control (i.e. disposal of runoff within the plot boundary), followed by site control (site wide disposal) and then regional control (appropriate for larger development with strategic drainage infrastructure). They also require that those methods that give the most benefits in terms of sustainability are prioritised for employment (generally known as the SuDS Hierarchy) as further described below.

9.1 SuDS Hierarchy

The SuDS Hierarchy sets out the preferred method of selecting which Sustainable Drainage System should be used. Generally 'soft SuDS' such as ponds and swales are the preferred drainage systems as they mimic natural drainage and provide a number of benefits including attenuation of surface water flows and flow rates as well as pollution.

Smaller developments which may not have the physical room for pond and swales would need to consider other options. In these cases preference should be given to infiltration systems. However care should be taken if implementing infiltration systems near aquifer protection zones, close to buildings or structural foundations or in areas where soils may be polluted.

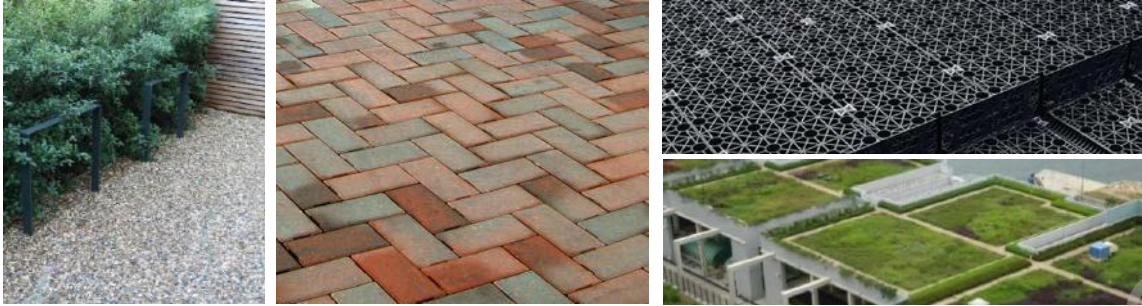
The SuDS hierarchy is summarised in Figure 3 below.

Figure 2: SuDS Hierarchy

<i>Most Sustainable</i>	<i>SUDS technique</i>	<i>Flood Reduction</i>	<i>Pollution Reduction</i>	<i>Landscape & Wildlife Benefit</i>
	Living roofs	✓	✓	✓
	Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices - soakaways - infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paviers	✓	✓	
	Tanked systems - over-sized pipes/tanks - storms cells	✓		
<i>Least Sustainable</i>				

Figure 3 - Surface water storage facilities and potential SuDS features – rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual).





9.2 Assessment of SuDS Options

An assessment was made of the suitability of a range of potential SuDS techniques that could be implemented as part of the development. The results of the assessment are summarised in [Appendix 5](#) and are further discussed below.

9.2.1 Living Roofs

As buildings will cover more than 15% of the site, living roofs are considered to be a viable SuDS technique.

There is potential to implement a small green roof over the bike and bin storage area. This has the potential to provide 1.35m³ of rainwater storage.

There may be potential for living roofs on the residential building developments although this would depend on the design of roofs.

9.2.2 Basins, Ponds, Filter Strips and Swales

There is potential to included onsite surface water features, but consideration would need to be made with regards to the current vegetation on site as it has been highlighted that there are several protected tree species on site.

Due to the size of the site and overall soft landscaping there is good potential to implement a swale on site along the northern boundary of the site. A swale could be constructed north of the proposed developments, this has the potential to provide 25m³ of storage and treatment.

9.2.3 Infiltration Devices

Infiltration techniques should be given priority in any SuDS design as they deal with discharge on the site returning water to the aquifer and subsequently rivers via baseflow.

However, care must be taken to ensure that contamination of groundwater is prevented. The Environment Agency publication 'Groundwater protection: Policy and practice (GP3) Section G, 2012, states that the Environment Agency will support sustainable drainage systems for new discharges to ground, subject to an appropriate risk assessment to demonstrate that ground conditions are suitable and infiltration systems do not present an unacceptable risk of promoting mobilisation of contaminants or creating new pathways for contaminant migration.

Mapping provided by the BGS showing the infiltration potential of the site is presented in [Appendix 2](#). The map indicates that although there is probably potential for infiltration SuDS in the area, the groundwater may be vulnerable to contamination, so infiltrating water should be free of contaminants. The groundwater water level is thought to be greater than 5mbgl.

It is therefore considered likely that infiltration devices will be suitable for the site. We recommend that the site groundwater levels and soil permeability are confirmed by undertaking a site investigation.

9.2.4 Permeable Surfaces and Filter Drains

Over 17% (500m²) of the development will consist of car parking and driveways which is already designed to be permeable.

9.2.5 Tanked Systems

A tanked system incorporating a hydrobrake restricting flow to the would be suitable for the site, however it is ranked as being the least sustainable in the SuDS hierarchy.

9.3 Preliminary SuDS Strategy

9.3.1 Preferred SuDS Options

Based on all the above considerations a preliminary SuDS strategy consisting of a potential mix of options was formulated. This is summarised in Table 5 below.

The large size (2822m²) of the site give good potential to the different options that can be explored. Subject to the production of a Detailed Surface Water Management Strategy, a summary of the preliminary SuDS measures that will be employed are discussed below.

Driveways and Patios form a total of 500m² of the impermeable area of the proposed development. Laying permeable paving in these areas would give a total of approximately 50-300m³ (depending on the materials used) for use as interception and attenuation storage. Table 5. gives a breakdown of the impermeable areas of the proposed development.

Table 5: Preliminary SuDS Strategy

Storage Type	Estimated Storage Volume (m ³)	Potentially Suitable SuDS Options
Interception storage	1.35	Living Roofs SuDS Planters
Attenuation storage	60 - 270	Rainwater Harvesting Permeable Surfaces Swales
Long term storage	15.6	Tree Planters
Total storage (m3)	76	

Table 6 gives a breakdown of the proposed impermeable areas with possible SuDS options and the resulting storage that could be provided.

Table 6: Breakdown of Impermeable Areas of the Proposed Development

Location	Proposed Area (m ²)	SuDS Option	Estimated Storage Provided (m ³)
Buildings	455	Green Roof???	

Bike Storage	45	Small Scale Green Roof	1.35
Driveways/Patio/ Car Parking	500	Pervious surfaces with geocellular	273
OR			
Driveways/Patio/Car Parking	500	Pervious grid paving	50
Tree Storage	42	Tree Planters	15.6
Total	182		66 - 289

Depending on the results of the aforementioned site investigation to ascertain infiltration rates at the site, consideration will need to be given to the use of membranes to prevent infiltration from the various SuDS options employed.

Detailed descriptions of some of the proposed SuDS techniques are available in [Appendix 7](#).

9.3.2 Surface Water Discharge Points

It is possible to discharge to the surface water sewer identified in XXX.

At the time of writing the sewers had not been identified.

9.3.3 Treatment of Run-off

Treatment of roof water runoff will be provided through the provision of trapped gullies and water butts to intercept gross solids and sediment, guidance will be provided to householders on appropriate maintenance requirements including regular cleaning of gullies.

9.3.4 Exceedance Flows

Exceedance flows are those in excess of the design storm event (i.e. > 1 in 100+CC).

Insert description of how this will be managed.

9.4 Maintenance and Adoption of SuDS

All SuDS features will be properly installed by competent persons. They will be maintained regularly to ensure that their design capacity and attenuation characteristics provide the required storage volume.

Landscaping and adjacent areas will be designed such that they do not cause soil, mulch and other materials to be washed onto the permeable surfaces and into drains causing clogging.

Owners of the properties/persons responsible for maintenance of SuDS components will be provided with operation and maintenance manuals which will include information such as:

- the location of SuDS components;
- an explanation of design intent and objective of the SuDS;
- the requirements for regular and occasional inspection and maintenance;
- visual indicators that may trigger maintenance.

Regular maintenance of SuDS components is relatively straightforward with the main tasks consisting of:

- Regular visual inspections – checking inlets are not blocked and verifying that clogging has not occurred;
- Litter and debris removal;
- Grass cutting;
- Preventive sweeping;
- Weeding and invasive plant control;
- Oil and stain removal;

Occasional maintenance activities to ensure the long term performance of the SuDS features include:

-  Sediment removal
-  Vegetation and plant replacement

These simple measures will ensure that the storage capacity of the system is maintained and that the need for reconstruction and replacement of components is minimised.

10 Conclusion and Recommendations

The proposed development has the opportunity to employ a range of techniques in line with the SuDS hierarchy in order to achieve the objective of ensuring that the peak run-off rate for the 1 in 100 year 6-hour rainfall event (plus climate change) is reduced to greenfield rate for the same event, and to ensure a minimum discharge rate of 5 litres per second.

Potential SuDS options include soakaways (requires a site investigation), permeable paving, living roofs (bike sheds), attenuation storage tanks and rain gardens. In line with the drainage hierarchy, the soakaway option is the preferred solution, but initial information suggests that the site geology may not be suitable. Infiltration and contaminant leachability tests would need to be conducted if required, there is also limited space available on site due to how narrow the site parcel is. Should the soakaway option prove not to be feasible, then permeable paving in combination with one or more other methods will offer an effective solution and would provide above the recommended storage.

The exact configuration of SuDS measures adopted will be subject to a detailed drainage strategy which will include a site investigation in order to determine the soil permeability and groundwater levels.

With the proposed SuDS mitigation measures in place, it is considered that the proposed development will reduce local flood risk and enhance the local environment and will therefore be in compliance with the LLFA's current planning policy and the NPPF.

XXX, the LLFA's current planning policy and the NPPF.

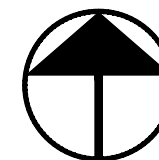
11 References

1. Communities and Local Government - National Planning Policy Framework NPPF, March 2012.
2. Greater London Authority – London Sustainable Drainage Action Plan, 2015.
3. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
4. Greater London Authority – London Sustainable Drainage Action Plan, 2015.

12 Appendices

12.1 Appendix 1 – Development Plans

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jsa

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KEY

- Existing TPO Trees (Subject to Tree Survey)
- Indicative Landscaping
- Existing trees to be retained
- Existing trees to be removed
- Existing Building to be removed
- Shared Surface / Path / Permeable Surface
- Soft Landscaping / Rear Gardens
- Existing buildings
- The Proposal
- The Proposed Bank
- Pathway

15 Parking Spaces
3 Visitor Parking Spaces
18 Total Parking Spaces
1:1 Bike spaces



Accommodation Schedule

10 x 2 Bed Apartments @ 67m²
4 x 1 Bed Apartments @ 55m²

0 5 10 20 30m
1:500

PRELIMINARY for discussion purposes only

K:\Projects\Residential Developers\The Cardiff Property\PCPW - Land at Colliers Way\2-FEASIBILITY\03-scheme\Drawings\PCPW- Scheme 3.dwg
3/8/2018A-Planning.ctb

Subject to:
Full Site and Building Survey
Planning and Highways

Any easements, covenants and contractual agreements restricting, limiting or preventing potential development of the site to be brought to the immediate attention of jsa architects.

■ The Cardiff Property
Land at Colliers Way
■ Proposed Site Layout

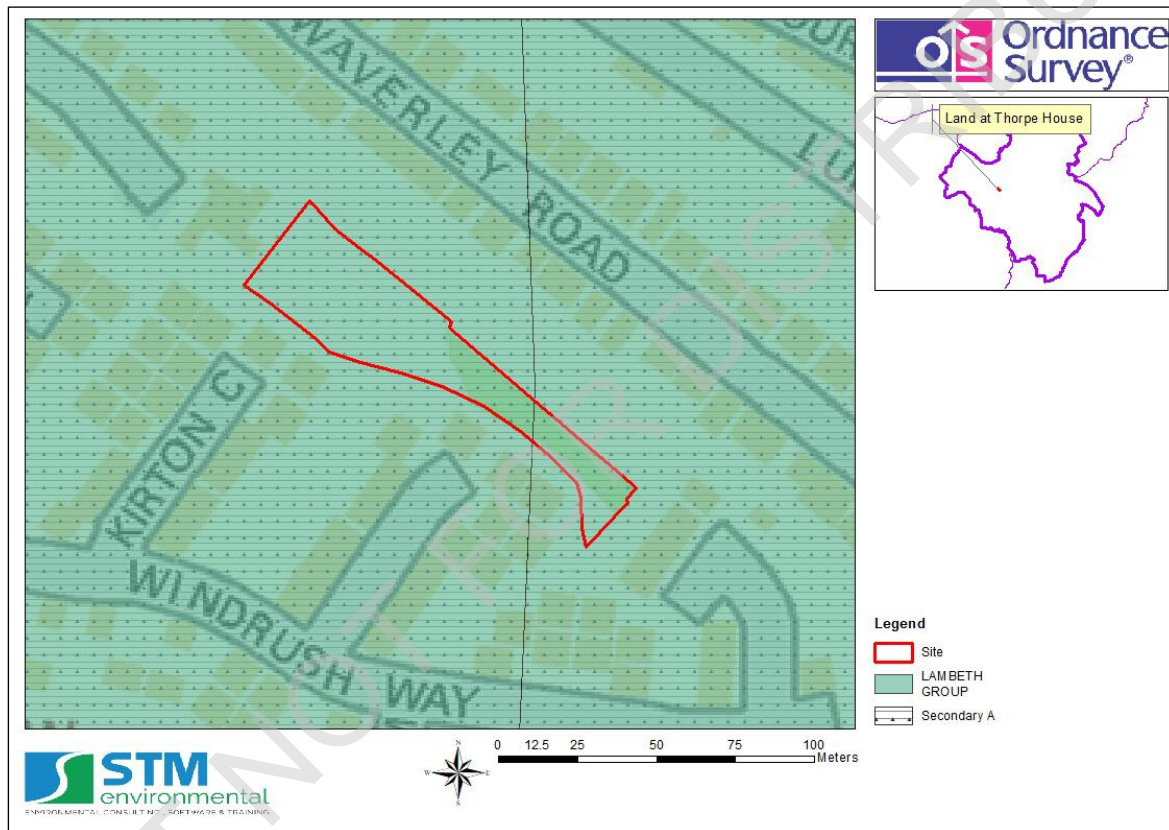
■ Project CPCW
■ Dwg No/rev. SK-101C
■ Scale 1:500@A3
■ Date MAR 2018
■ Checked by AC

12.2 Appendix 2– Site Topography and Drainage Characteristics

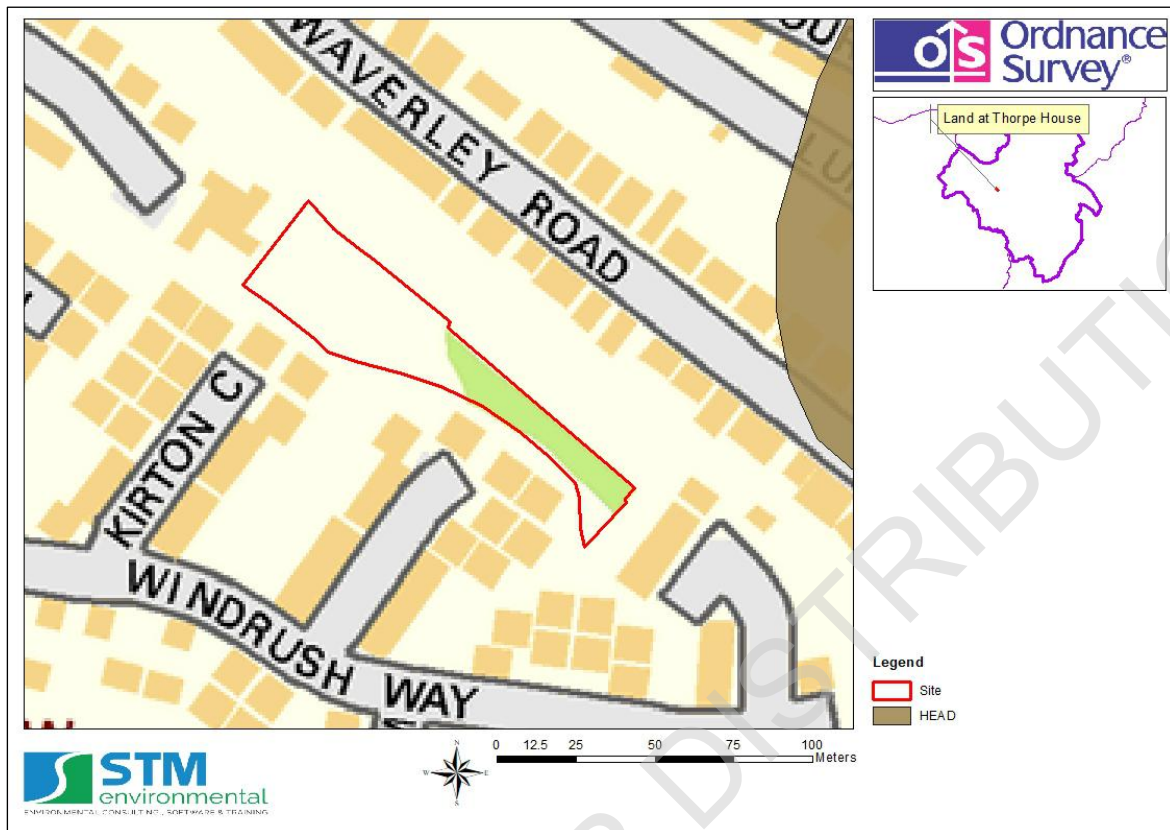
12.2.1 LIDAR Mapping showing Site Topography - (Source: OS 2017)

No LIDAR was available for the site.

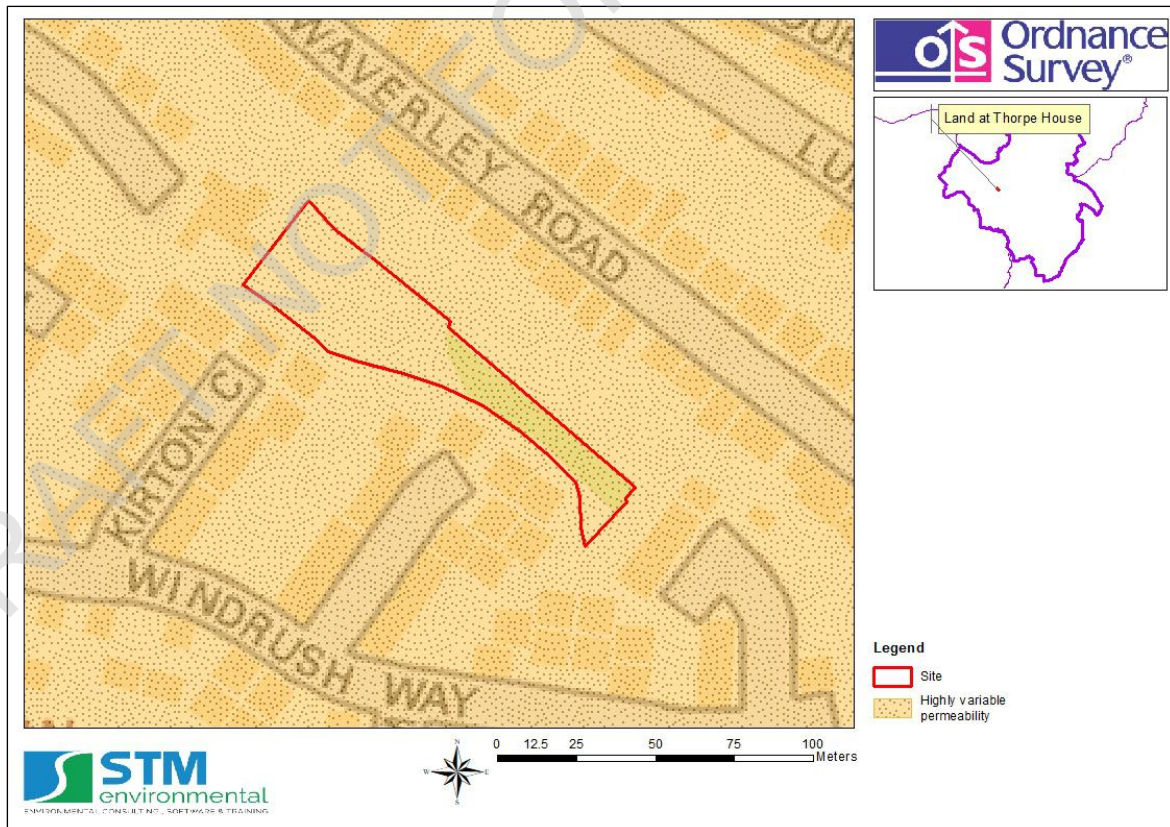
12.2.2 Bedrock geology and Hydrogeology (Source: BGS, 2016)



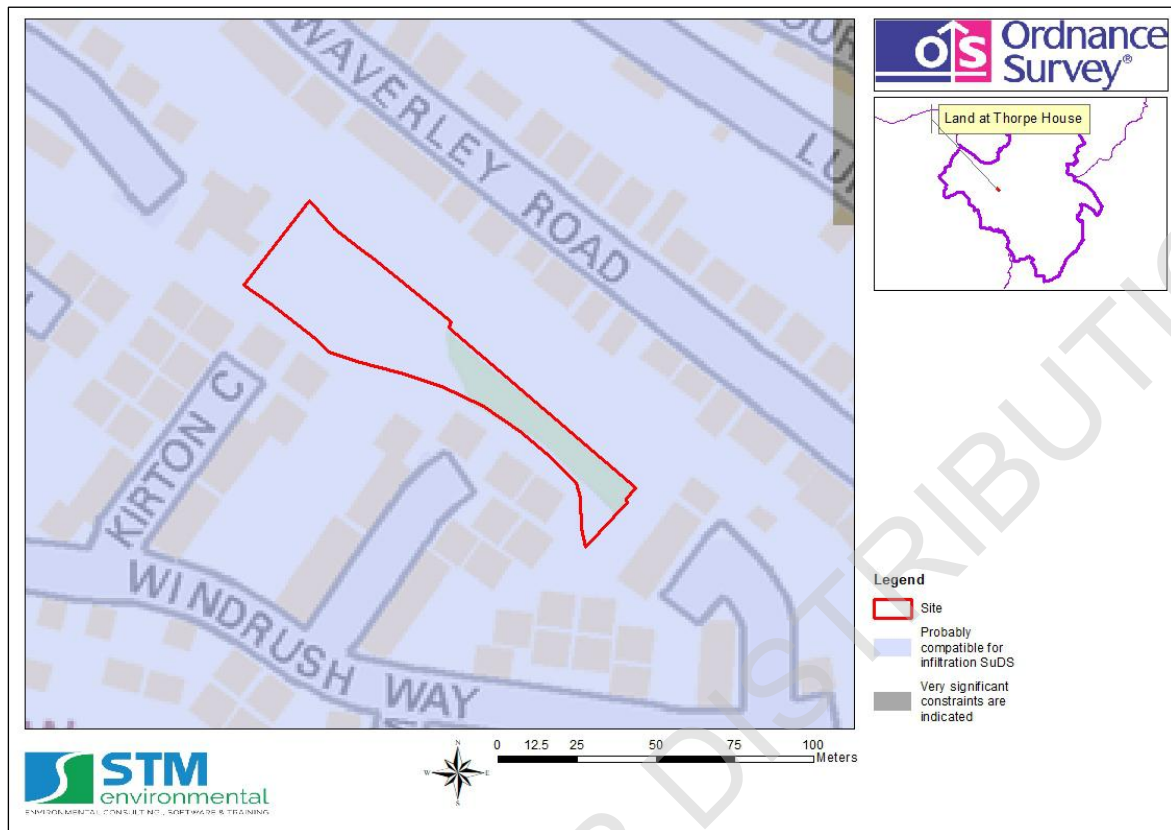
12.2.3 Superficial Geology (Source: BGS, 2016)



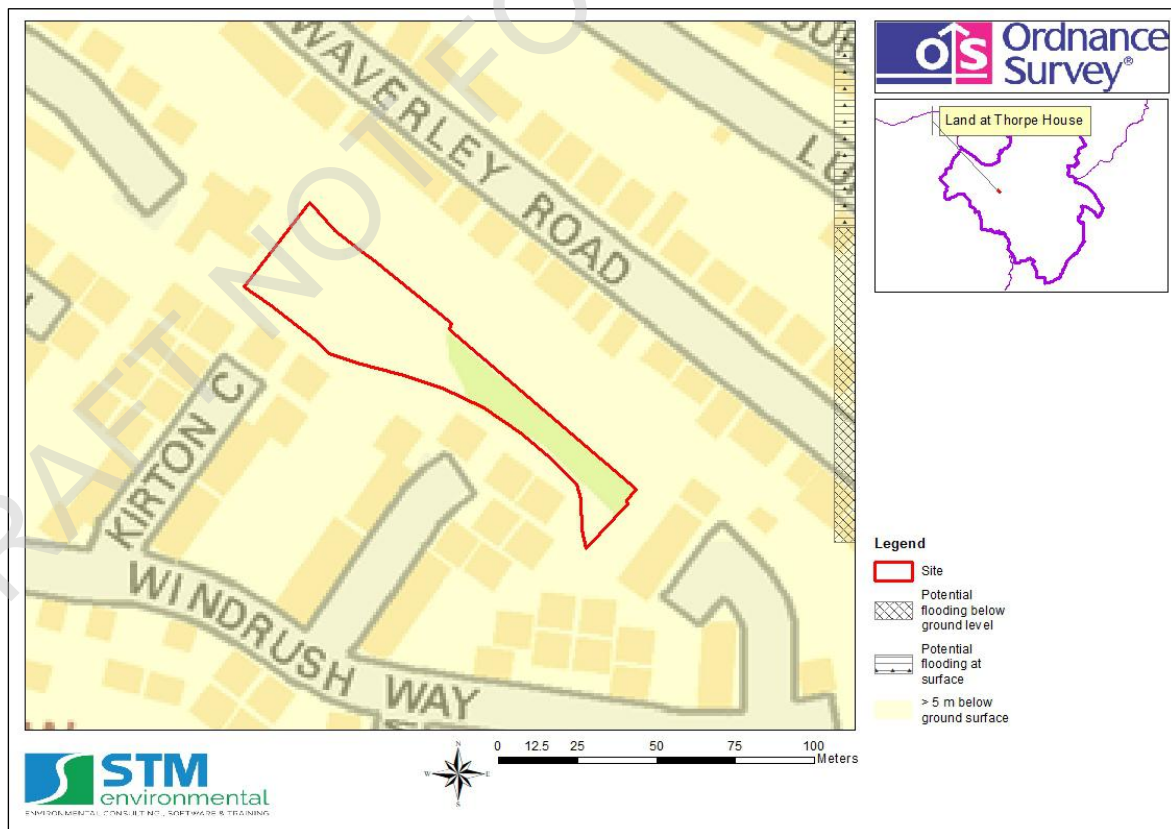
12.2.4 Bedrock Permeability (Source BGS 2016)



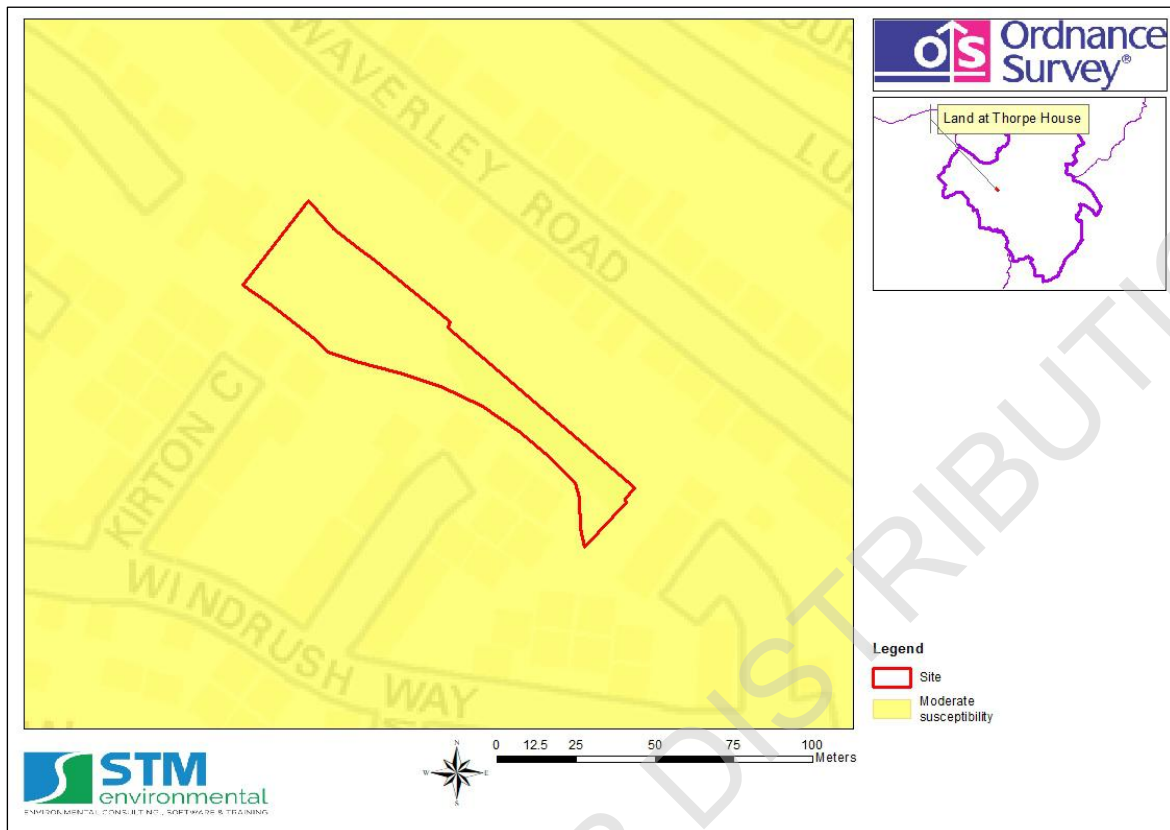
12.2.5 Infiltration Drainage Potential (Source: BGS, 2016)



12.2.6 Groundwater Table Depth (Source: BGS 2016)

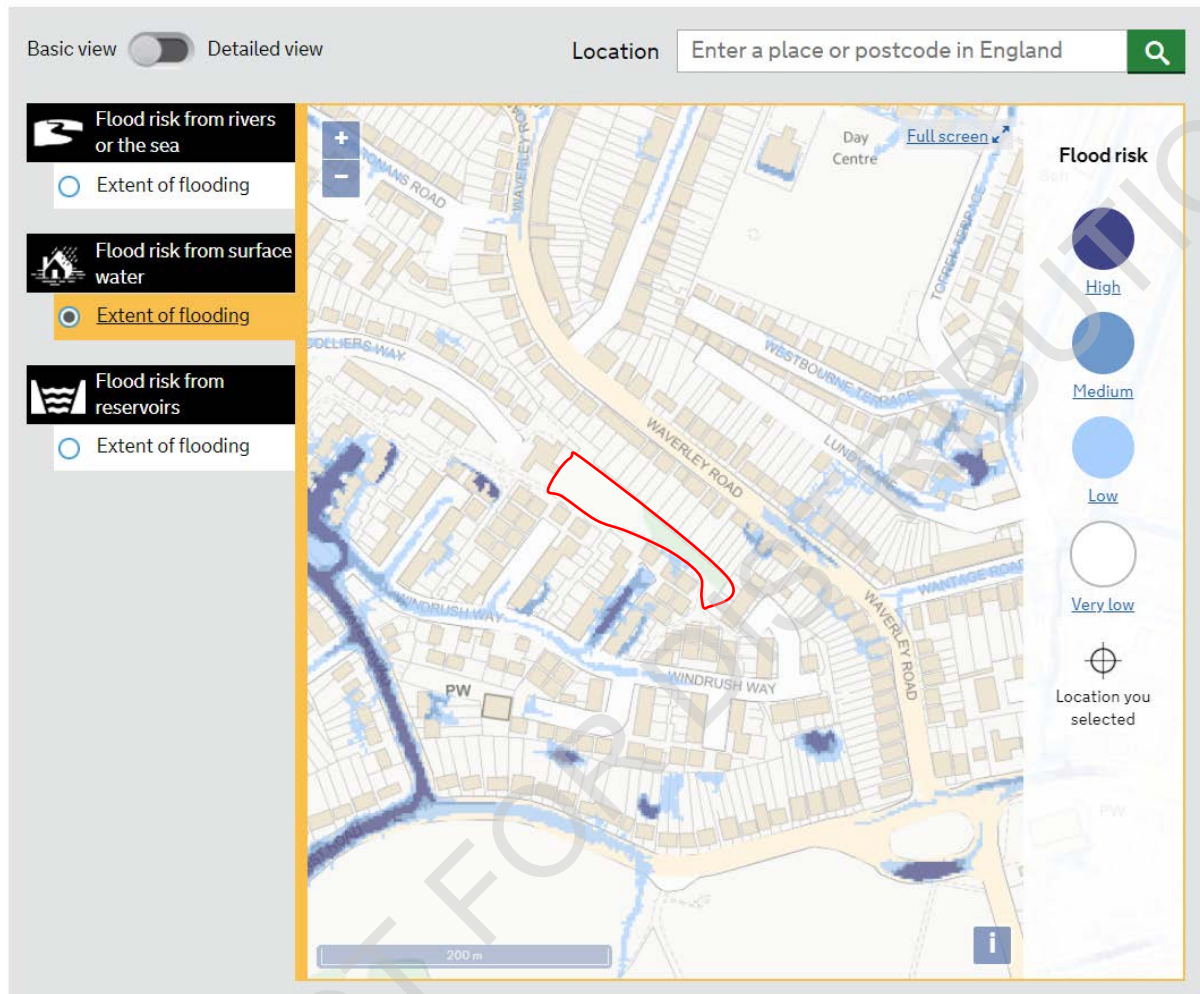


12.2.7 Groundwater Protection Summary (Source: BGS, 2016)

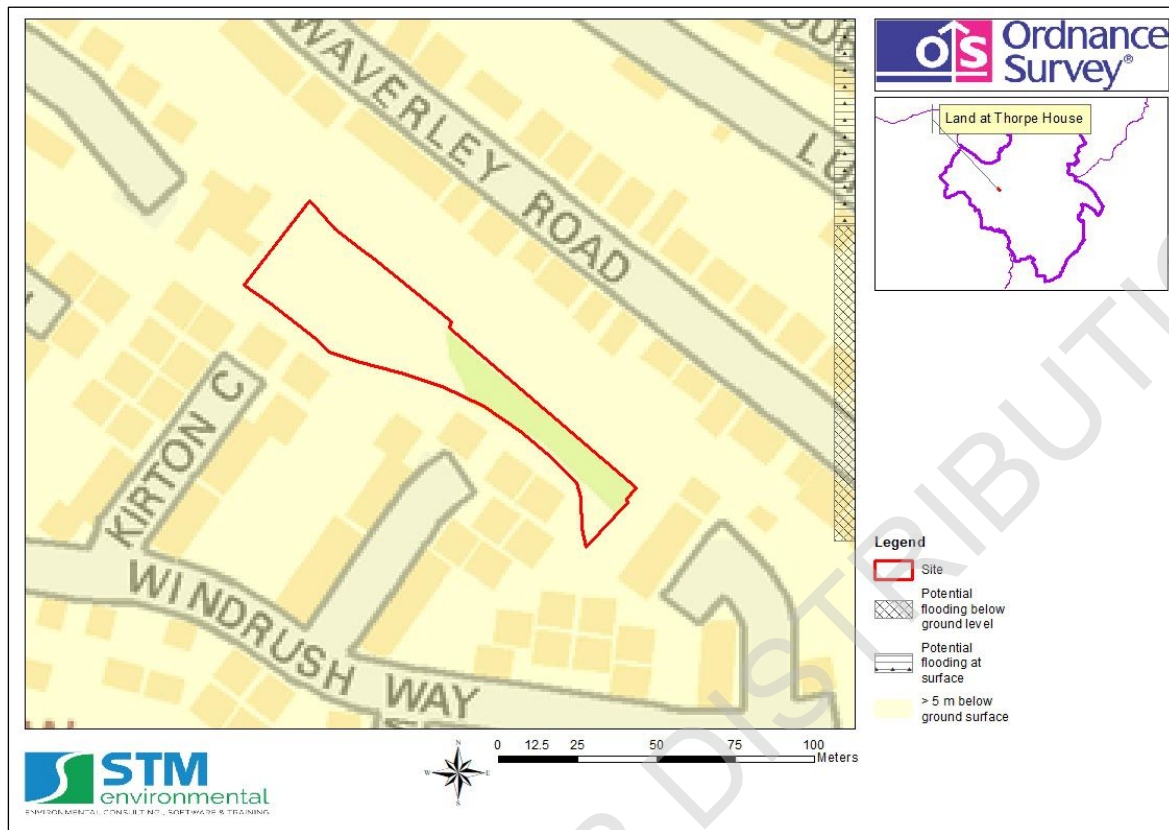


12.3 Appendix 3 – Flood Risk Mapping

12.3.1 Surface water flood risk zones by rainfall return periods (Source: EA, 2016).



12.3.2 Groundwater flooding susceptibility (Source: BGS, 2016).



12.4 Appendix 4 – UKSUDS Greenfield Run-Off Rate and Storage Calculations

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Calculated by: Matthew Ashdown

Site name: Land Adjacent to Colliers Way

Site location: Land at Thorpe House, Colliers Way / Waverley F

Site coordinates

Latitude: 51.45427° N

Longitude: 1.00788° W

Reference: 6336944

Date: 2018-03-28T17:16:38

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the drainage scheme.

Methodology

IH124

Site characteristics

Total site area (ha)	.28
Significant public open space (ha)	0
Area positively drained (ha)	0.28
Pervious area contribution (%)	30
Impermeable area (ha)	0.14
Percentage of drained area that is impermeable (%)	50
Impervious area drained via infiltration (ha)	0
Return period for infiltration system design (year)	10
Impervious area drained to rainwater harvesting systems (ha)	0
Return period for rainwater harvesting system design (year)	10
Compliance factor for rainwater harvesting system design (%)	66
Net site area for storage volume design (ha)	0.28
Net impermeable area for storage volume design (ha)	0.15

* Where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50 % of the 'area positively drained', the 'net site area' and the estimates of Qbar and other flow rates will have been reduced accordingly.

Design criteria

Volume control approach	Use long term storage	
	Default	Edited
Climate change allowance factor	1.4	1.4
Urban creep allowance factor	1.1	1.1
Interception rainfall depth (mm)	5	5
Minimum flow rate (l/s)	5	5
Qbar estimation method	Calculate from SPR and SAAR	
SPR estimation method	Calculate from SOIL type	
	Default	Edited
Qbar total site area (l/s)	0.46	--
SOIL type	2	2
HOST class	N/A	N/A
SPR	0.3	0.3

Hydrology

	Default	Edited
SAAR (mm)	643	643
M5-60 Rainfall Depth (mm)	17	17
'r' Ratio M5-60/M5-2 day	0.4	0.4
Rainfall 100 yrs 6 hrs	55	
Rainfall 100 yrs 12 hrs	74.97	
FEH/FSR conversion factor	1.19	1.19
Hydrological region	6	
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 10 year	1.62	1.62
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Site discharge rates

	Default	Edited
Qbar total site area (l/s)	0.46	0.46
Qbar net site area (l/s)	0.46	0.46
1 in 1 year (l/s)	5	5
1 in 30 years (l/s)	5	5
1 in 100 years (l/s)	5	5

Estimated storage volumes

	Default	Edited
Interception storage (m³)	6	6
Attenuation storage (m³)	52	52
Long term storage (m³)	0	0
Treatment storage (m³)	17	17
Total storage (excluding treatment) (m³)	57	57

Calculated by: Matthew Ashdown

Site name: Land Adjacent to Colliers Way

Site location: Land at Thorpe House, Colliers Way / Waverley F

Site coordinates

Latitude: 51.45430° N

Longitude: 1.00808° W

Reference: 6336913

Date: 2018-03-28T17:18:36

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Methodology

IH124

Site characteristics

Total site area (ha) 0.28

Methodology

Qbar estimation method Calculate from SPR and SAAR

SPR estimation method Calculate from SOIL type

	Default	Edited
SOIL type	2	2
HOST class	---	---
SPR/SPRHOST	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm)	643	643
Hydrological region	6	6
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

Normally limiting discharge rates which are less than 2.0 l/s/ha are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	0.46	0.46
1 in 1 year (l/s)	0.39	0.39
1 in 30 years (l/s)	1.06	1.06
1 in 100 years (l/s)	1.47	1.47

12.5 Appendix 5 – SuDS Suitability Assessment

SuDS Technique	Typical Uses	Potential Issues	Potential Suitability
Rainwater harvesting	Capture of rainwater into a tank(s) for use (usually non potable) such as irrigation, toilet flushing, vehicle or plant cleansing.	Care is needed to prevent the development of bacteria, algae and insect infestation.	Suitable on small scale for interception storage.
Infiltration: Soakaways Infiltrations trenches and basins	Infiltration components are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, into the groundwater.	Free draining chalk bedrock but groundwater table is potentially < 3m below surface. Could increase flood risk. Maintenance	Potentially suitable – subject to site investigation
Green/brown /blue roofs	Used on flat or shallow pitched roofs to provide a durable roof covering which also provides thermal insulation, amenity space, biodiversity habitat as well as attenuation of rainwater.	Maintenance - Ensuring safe access	Suitable on bike sheds. Potential implementation on roofs of flats??
Raingardens	Creation of planted landscaped areas to allow the diversion of a portion of rainwater from either downpipes or surrounding paved surfaces. Raingardens can either allow infiltration into the ground or have tanked systems for water retention.	Require maintenance	Suitable
Permeable pavements / surfaces	Permeable hard surfaces that allow rainwater to pass through either into the ground or to tanked systems. Good as interception storage.	Potential impact of saturation on pavement stability to be considered. May require extensive use of impermeable	Suitable

SuDS Technique	Typical Uses	Potential Issues	Potential Suitability
		membranes and under-drainage. Maintenance required.	
Swales	Dry ditches used as landscape features to allow the storage and infiltration of rainwater. Often used as linear features alongside roads, footpaths or rail lines but capable of being integrated into the design of many open spaces.	Finding available space in proposed site layout	Suitable
Detention basin/ponds	Landscape features designed to store and in some cases infiltrate rainwater. Detentions basins are usually dry, whereas a pond should retain water. These features need areas of open space but can often be combined with other sustainable drainage techniques.	Potential health and safety issues. Finding available space in proposed site layout	Potential would need detailed topography undertaken.
Storage tanks/ Geocellular storage	Usually below ground level, they attenuate rainwater for later slow release back into the drainage system.	Pumping may sometimes be required to empty the tank into the drainage system	Suitable
Oversized piping	Using larger than necessary pipework creates additional space to store rainwater.	Lacks the wider benefits of the green infrastructure based techniques	Suitable

Appendix 6 – Planning Decision Notice

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**TOWN AND COUNTRY PLANNING ACT 1990
PLANNING AND COMPENSATION ACT 1991
THE TOWN & COUNTRY PLANNING
(DEVELOPMENT MANAGEMENT PROCEDURE) (ENGLAND) ORDER 2015**

APPLICATION FOR FULL PLANNING PERMISSION

To: JSA Architects Ltd
Tavistock House
Waltham Road
Woodlands Park
Maidenhead
SL6 3NH

Application No: 171219
Application type: Outline Planning Approval

Applicant: Mr Anderson

READING BOROUGH COUNCIL as Local Planning Authority **REFUSE** planning permission for the following development.

Proposal: Outline application for residential redevelopment to provide a maximum of 18 dwelling units. Demolition of dwelling at 16 Kirton Close to provide access. (Appearance, Landscaping, Layout and Scale reserved for future consideration).

At: Land Adjacent Thorpe House Colliers Way Reading

For the attached reasons

PLEASE READ THE NOTES ISSUED WITH THIS DECISION NOTICE

Date: 7 December 2017



Head of Planning, Development
& Regulatory Services

Application At: Land Adjacent Thorpe House Colliers Way Reading

Application No: 171219

Application type: Outline Planning Approval

REASONS FOR REFUSAL

1. The proposed development would result in the loss of open space that has not been previously developed and which currently makes a positive contribution to the character, appearance and environmental quality of the area due to its visual attractiveness, openness, undeveloped character and green vegetated appearance. As such the proposed development would be contrary to Policies CS7 and CS28 of the Reading Borough LDF Core Strategy 2008 (altered 2015).
2. The amount of development proposed within the main body of the site would require a scale of building that would appear as an incongruous, jarring and poorly integrated feature within the context of the notably modest scale of development in adjacent streets. The minimal distance that would be likely to exist between the building and northern and southern site boundaries would result in an overly cramped appearance, further adding to the visual harm. For these reasons the development would represent an overdevelopment of the site, fail to respond positively to its local context, and fail to reinforce local character and distinctiveness. The proposal would therefore harm the character and appearance of the area, contrary to Policies CS7, CS15 and CS28 of the Reading Borough LDF Core Strategy 2008 (altered 2015).
3. The proposed removal of the dwelling at 16 Kirton Close and its replacement with an access roadway and vehicle parking area would result in the loss of continuity and enclosure within the established street scene which is characterised by a regular built form of a distinctive style and appearance. The proposed access would result in a disjointed and visually stark arrangement of access road and vehicle parking to the detriment of the existing streetscene and contrary to Policy CS7 of the Reading Borough LDF Core Strategy 2008 (altered 2015).
4. The layout does not comply with the Local Planning Authority's standards in respect of vehicle parking. This could result in on- street parking/reversing movements on the surrounding road network, adversely affecting road safety and the flow of traffic, and in conflict with Core Strategy Policy CS24 and Sites and Detailed Policies Document Policy DM12.
5. The proposal would generate traffic crossing an existing footpath / cycle path, without giving priority to pedestrians and cyclists. This would result in an increased

Date: 7 December 2017



Head of Planning, Development
& Regulatory Services

risk of accidents to users of the footpath and would be in conflict with Core Strategy Policy CS20 and Sites and Detailed Policies Document Policy DM12.

6. The application fails to demonstrate that:

- i) the amount of development proposed can be accommodated without harm to existing trees of amenity value, both within and adjacent to the site in terms of direct impacts on their root systems, stems and canopies
- ii) the proposal would not result in a future pressure to prune or fell trees of amenity value due to their proximity to new buildings; and
- iii) the amount of development proposed can be accommodated in combination with appropriate landscaping, including retained trees and new tree planting.

As such the proposal fails to demonstrate that it will preserve and not harm the character and appearance of the site and area within which it is located, including the wider contribution to visual amenity provided by mature trees. The proposals are therefore contrary to Core Strategy Policies CS7 & CS38 and Sites and Detailed Policies Document Policy DM18.

7. The application fails to demonstrate that the proposed amount of development can be accommodated without harm to the amenity of occupiers of neighbouring dwellings caused by a loss of privacy to windows and gardens due to overlooking; overbearing effects resulting from the likely scale and proximity of the building; and disturbance from vehicle movements adjacent to Thorpe House. As such the proposal is contrary to Sites and Detailed Policies Document Policy DM4 and Core Strategy Policy CS15.

8. The application fails to demonstrate that the proposed amount of development can be accommodated in a manner which provides adequate outlook, daylight, sunlight and private outdoor amenity space for future occupiers. As such the proposal would be harmful to the amenity of future occupiers, contrary to Sites and Detailed Policies Document Policy DM4.

9. Due to the absence of an acceptable Sustainable Drainage Strategy, the application has failed to demonstrate its acceptability in terms of sustainable drainage and attenuating localised flooding, contrary to Core Strategy Policies CS1, CS35 and Sites and Detailed Policies Document Policy DM1.

10. In the absence of a completed legal agreement to secure an acceptable contribution towards the provision of Affordable Housing, the proposal fails to contribute adequately to the housing needs of Reading Borough and the objective of creating mixed and balanced communities and as such is contrary to Core Strategy Policy CS16, Affordable Housing Supplementary Planning Document (2013) and para. 50 of the NPPF.



Date: 7 December 2017

Head of Planning, Development
& Regulatory Services

11. In the absence of a completed legal agreement to secure an acceptable mitigation plan or equivalent contribution towards the provision of Employment, Skills and Training for the construction phase of the development, the proposal fails to contribute adequately to the employment, skills or training needs of local people with associated socioeconomic harm, contrary to Core Strategy Policies CS3, CS9 and Sites and Detailed Policies Document Policy DM3 and the Employment Skills and Training SPD (2013).

INFORMATIVES

1. The Local Planning Authority has worked positively and proactively with the applicant at pre-application and application stages in order to appraise the development potential of the site and to set out clearly the constraints on development.

2. This decision relates to the following drawings:

PL-100 Site Location Plan, dated March 2017

PL-101 Proposed Site Layout, dated March 2017

PL-400 Proposed Front Elevation, dated March 2017

SK-02 Ground and First Floor dated February 2017

SK-03 Roof Plan dated February 2017

Date: 7 December 2017



Head of Planning, Development
& Regulatory Services

NOTES

APPEALS TO THE SECRETARY OF STATE

If you are aggrieved by the decision of the Council to refuse permission for the proposed development or to grant it subject to conditions, then you can appeal to the Secretary of State under section 78 of the Town and Country Planning Act 1990.

If this is a decision on a planning application relating to the same or substantially the same land and development as is already the subject of an enforcement notice, if you want to appeal against the Council's decision on the application you must do so within 28 days of the date of this notice.

If an enforcement notice is served relating to the same or substantially the same land and development as in your application and you want to appeal against the Council's decision on your application, you must do so within 28 days of the date of service of the enforcement notice, or within 6 months (or 12 weeks in the case of a householder appeal) of the date of this notice, whichever period expires earlier.

If the above circumstances do not apply, any appeal must be made within the following time limits.

If this is a householder application and you want to appeal against the Council's decision then you must do so within 12 weeks of the date of this notice. If this is an advertisement application and you want to appeal against your local planning authority's decision then you must do so within 8 weeks of the date of this notice. If you want to appeal against your local planning authority's decision for any other type of application (which is not a householder or advertisement application, or an application for a Certificate of Lawfulness) then you must do so within 6 months of the date of this notice.

The Secretary of State can allow a longer period for giving notice of an appeal, but he will not normally be prepared to use this power unless there are special circumstances which excuse the delay in giving notice of appeal. The Secretary of State need not consider an appeal if it seems to him that the Local Planning Authority could not have granted planning permission for the proposed development or could not have granted it without the conditions they imposed, having regard to the statutory requirements, to the provisions of any development order and to any directions given under a development order. In practice, the Secretary of State does not refuse to consider appeals solely because the Local Planning Authority based their decision on a direction given by him.

Appeals must be made using a form which you can get from the Planning Inspectorate at Temple Quay House, 2 The Square, Temple Quay, Bristol BS1 6PN, tel. 0303 444 5000, or online at www.planningportal.gov.uk/pcs.

Purchase Notices

If either the Local Planning Authority or the Secretary of State refuses permission to develop land or grants it subject to conditions, the owner may claim that he can neither put the land to a reasonably beneficial use in its existing state nor render the land capable of a reasonably beneficial use by the carrying out of any development which has been or would be permitted. In these circumstances, the owner may serve a purchase notice on the Council in whose area the land is situated. This notice will require the Council to purchase his interest in the land in accordance with the provisions of Part VI of the Town and Country Planning Act 1990.

12.6 Appendix 7 – Descriptions Of SuDS Techniques

12.6.1 Living/Green Roofs

Green roofs are multi-layered vegetated systems, built on roof covers. These systems are designed to return the surface water runoff from a building to the sites pre-construction level, and can be built into new build or retrofitted and are suitable for any building with flat to gently sloping roofs providing the existing roof can take the required load.



Figure 4: Green roof at the Queen Elizabeth Olympic Park (University of East London)

The topographical variation is incorporated into the substrate depth. It varies between 75 and 200 mm to create varied microclimates and hydrological regimes increasing habitat heterogeneity.

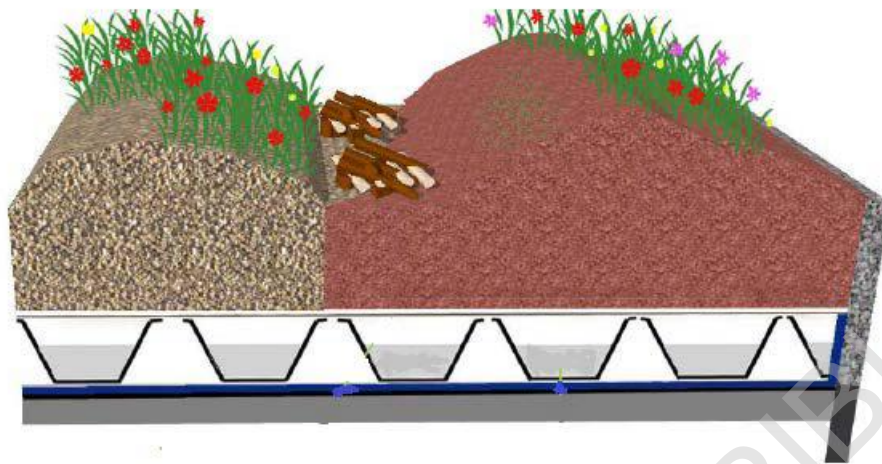


Figure 5: Biodiverse green roof diagram (University of East London)

Above the roof decking lies a standard waterproofing layer. The geocomposite drainage and water attenuation layers provide a water volume of 12 l/m². Geotextile filters are then placed to act as root barriers and prevent sediments being released from the roof.

The outlet will be sized appropriately in order to cope with storm events.

12.6.2 Soakaways

Soakaways are square or circular excavations either filled with rubble or lined with brickwork, pre-cast concrete or polyethylene rings/perforated storage structures surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. The supporting structure and backfill can be substituted by modular or geocellular units.

Soakaways provide stormwater attenuation, stormwater treatment and groundwater recharge:

- The hole where the soakaway will be placed has to be at least 300 mm away from any pipe and cable ducts.
- The base of the soakaway must be at least 1.0m above the water table.

The soakaway must be placed at least 5m away from any building.

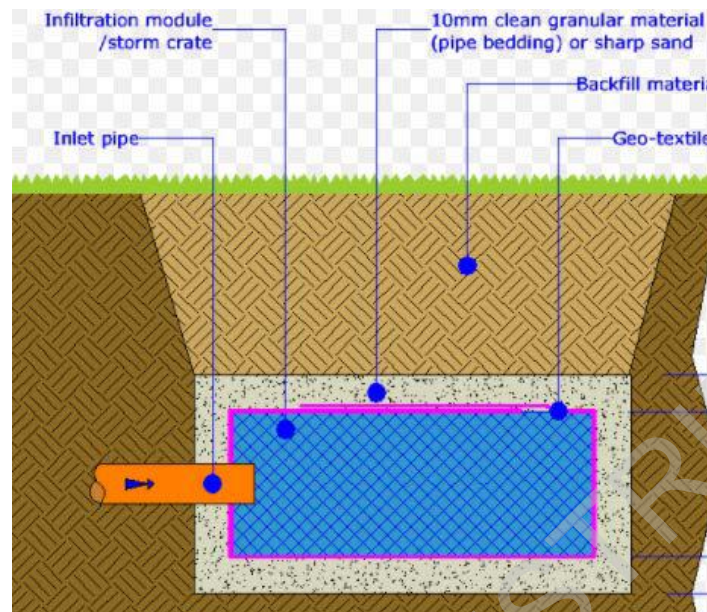
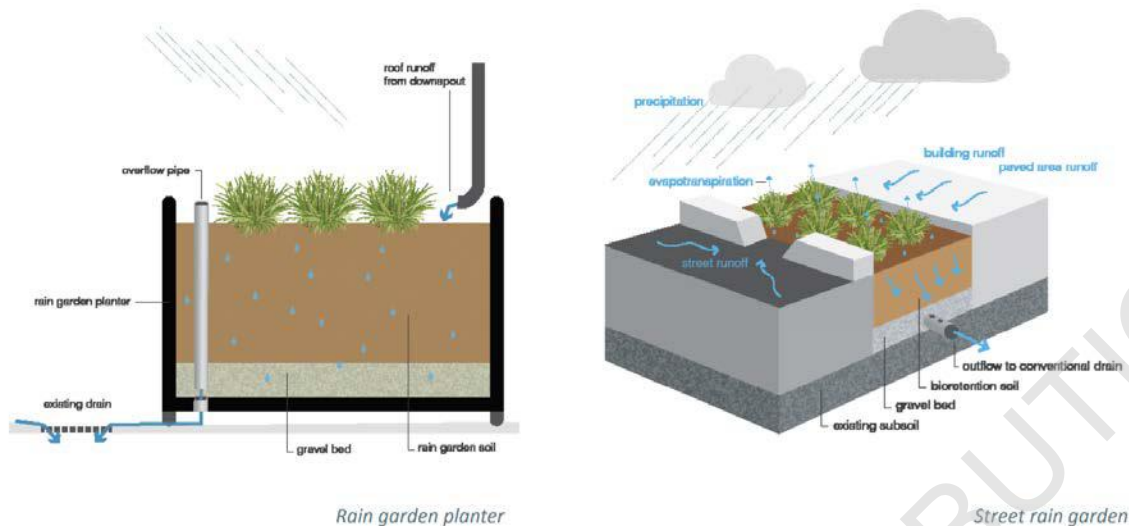


Figure 6: Cross section of a soakaway.

12.6.3 Rain Garden

A rain garden is a shallow depression, with absorbent, yet free draining soil and plants that can withstand occasional temporary flooding. Rain gardens are designed to mimic the natural water retention of undeveloped land and to reduce the volume of rainwater running off into drains from impervious areas and treat low level pollution.

Rain gardens usually absorb all the rainwater that flows into them, but when they do fill up following particularly heavy rainfall, any excess water is redirected to the existing drains. These simple rain gardens do not require any redesign of the existing drainage system and can be installed wherever space permits (see Planning and Design below) and in most soil types.



Rain gardens are usually situated some distance from buildings or site boundaries, although the exact location will depend on the local topography and available space. In order to reduce the likelihood of property damage to insignificant levels, it is recommended that rain gardens are situated at least 3m (10 feet) from any building.

A rain garden 150mm deep and 20% of the area of the area of the roof that it serves will be able to intercept all of the run-off from a typical summer storm where 10-15mm of rain might fall. Rain gardens on more permeable soils will be even more effective. Over the course of an average year, a rain garden of this size will intercept most of the rainfall that it receives, only overflowing after several days of persistent rainfall.

12.6.4 Permeable Paving

Various options are available for the type of permeable paving that can be installed. Permeable block paving allows for infiltration through gaps in the surface. This can be underlain by a geotextile membrane and fine gravel course followed by with a sub-base or geocellular crates as shown in the figures below.

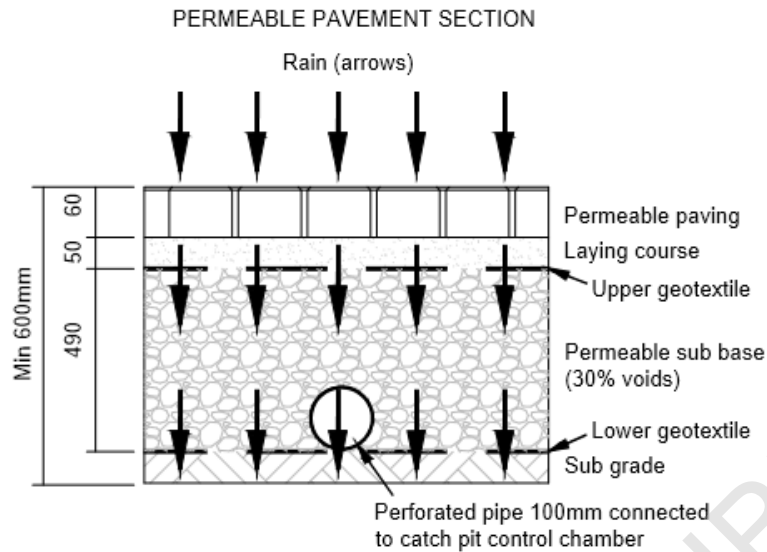


Figure 7: Block Permeable Paving with sub-base

The use of geocellular module storage provides structural strength (up to 400kN/m²) and high water storage capacity with void space of 95%+.

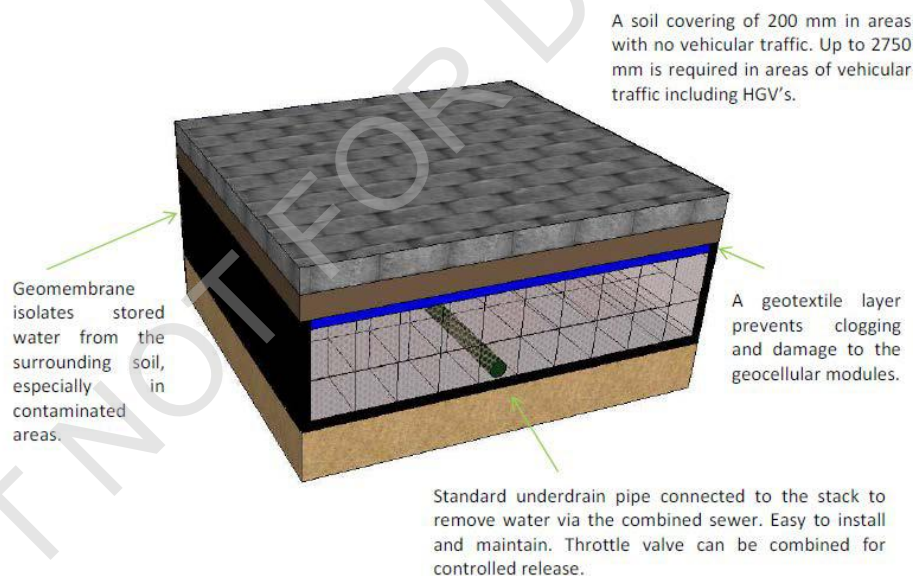


Figure 8: Block Permeable Paving with Geocellular Module

The plastic or concrete grid system is usually installed with a depth of 40 mm, with gaps between filled with an appropriate planting soil and seeded with a turf mix.

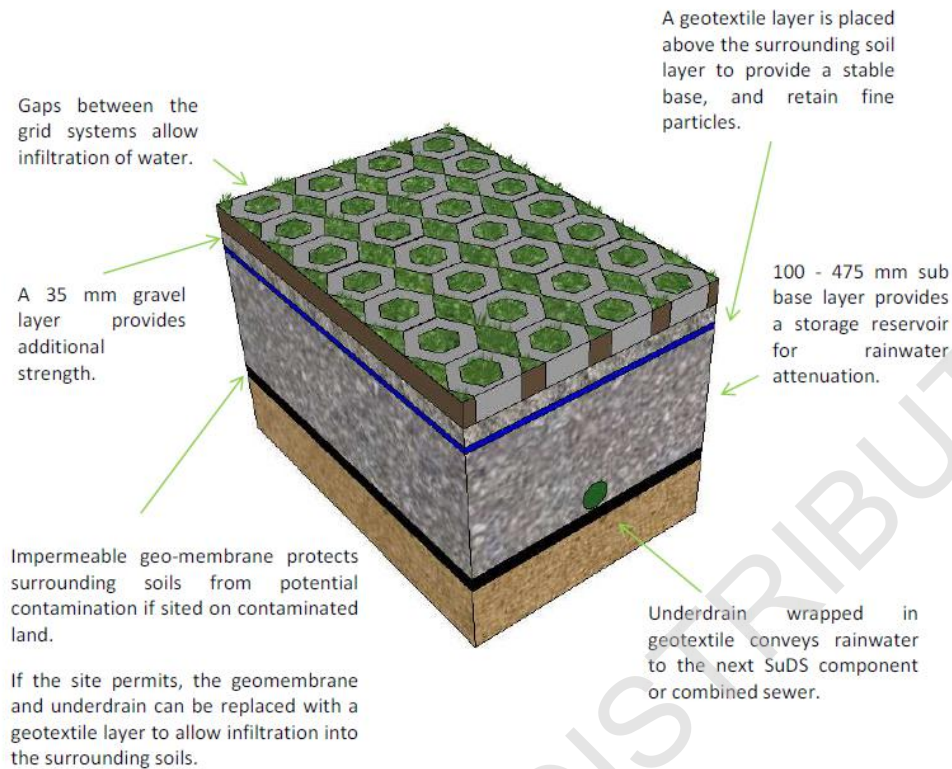


Figure 9: Plastic or Grid Permeable Paving with Sub-base

If the area is not suitable for permeable paving then either rainwater harvesting tanks, living roofs (19m³ potential storage) or rain gardens will be incorporated into the proposed development where possible in order to provide the required attenuation storage.