Land adjacent to 37 Latham Road

Flood Risk and SuDS Assessment

Job Number: 1439

Date	Version	Notes/Amendments
March 2024	1	Issued for Information

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Acronyms	
AOD	Above Ordnance Datum
CIRIA	Construction Industry Research and Information Association
EA	Environment Agency
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
SFRA	Strategic Flood Risk Assessment
NSTS	DEFRA's Non-statutory technical standards for sustainable drainage systems

Executive Summary

Flume Consulting Engineers have conducted a Flood Risk and SuDS Assessment for the proposed development at 37 Latham Road, Twickenham, TW1 1BN.

The site, situated in Flood Zone 1, requires a combined Flood Risk and SuDS Assessment due to its location within a Critical Drainage Area. Despite being in a flood zone, the development is not at risk of flooding according to EA's floodplain map. The report addresses potential flood risks from groundwater, surface water, overland flows, and reservoir failure.

Groundwater flooding is deemed low risk due to the site's geological composition and location outside identified risk areas. Surface water flooding is also low risk, with the site located in an area of very low risk according to the Environment Agency's map.

To manage surface water runoff, SuDS features like permeable paving and rain garden planters are proposed. These features aim to mimic natural drainage, reduce runoff rates, and promote water quality and biodiversity. The proposed development complies with national and local policies regarding flood risk mitigation and SuDS implementation.

A SuDS Maintenance Plan will ensure the efficient operation of the drainage system. Additionally, an application to Thames Water for consent to discharge foul and surface water from the development to public sewers is recommended.

In conclusion, the proposed development demonstrates acceptable flood risk levels and incorporates effective SuDS measures to manage surface water runoff responsibly.

Introduction

Flume Consulting Engineers have been appointed to undertake a Flood Risk and SuDS Assessment for the proposed development at Land adjacent to 37 Latham Road, Twickenham, TW1 1BN.

This report has been conducted in accordance with the National Planning Policy Framework (NPPF) and the Planning Practice Guidance 'Flood Risk and Coastal Change' (PPG). This report also incorporates advice and guidance from the Environment Agency (EA), the Strategic Flood Risk Assessment (SFRA) produced by the London Borough of Richmond Upon Thames, DEFRA's Non-statutory technical standards (NSTS) for sustainable drainage systems and CIRIA documents.

The EA's indicative floodplain map shows that the site is located in Flood Zone 1, however due to the site being within a Critical Drainage Area a combined Flood Risk Assessment / SuDS Assessment has been conducted. This will assess the flood risk on site and what are the available options for SuDS use for the proposed development.

Site Description and Location

The site is bordered by Latham Close which comprises mid-twentieth century bungalows. London Road is located south of the site and Whitton Road is located to the west.

The site is located 0.3km north of Twickenham, which includes local amenities such as Twickenham station, King Street and riverside embankment. Other large settlements in the area include Teddington, located 3km south of the site and Kingston upon Thames, located 6km south east of the site.

The River Crane runs 0.2km south of the site with the River Thames a further 0.7km south. Neither water course is expected to impact the site in terms of associated flood risk. The A461 is located 0.3km north, with the M3 running a further 7km south west of the site, connecting London to the south coast.

The site postcode is TW1 1BN and the OS grid reference is TQ 16031 73886.

FIGURE 1. SITE LOCATION

Development Proposal

The development proposals involve the erection of an attached two storey dwelling, accommodation in roof space, within a vacant plot of land on the inside corner of Latham Road and Latham Close. The site was formerly part of the garden of No.37/No.37a Latham Road which borders the site to the west and is the last house in a terrace on the north side of Latham Road.

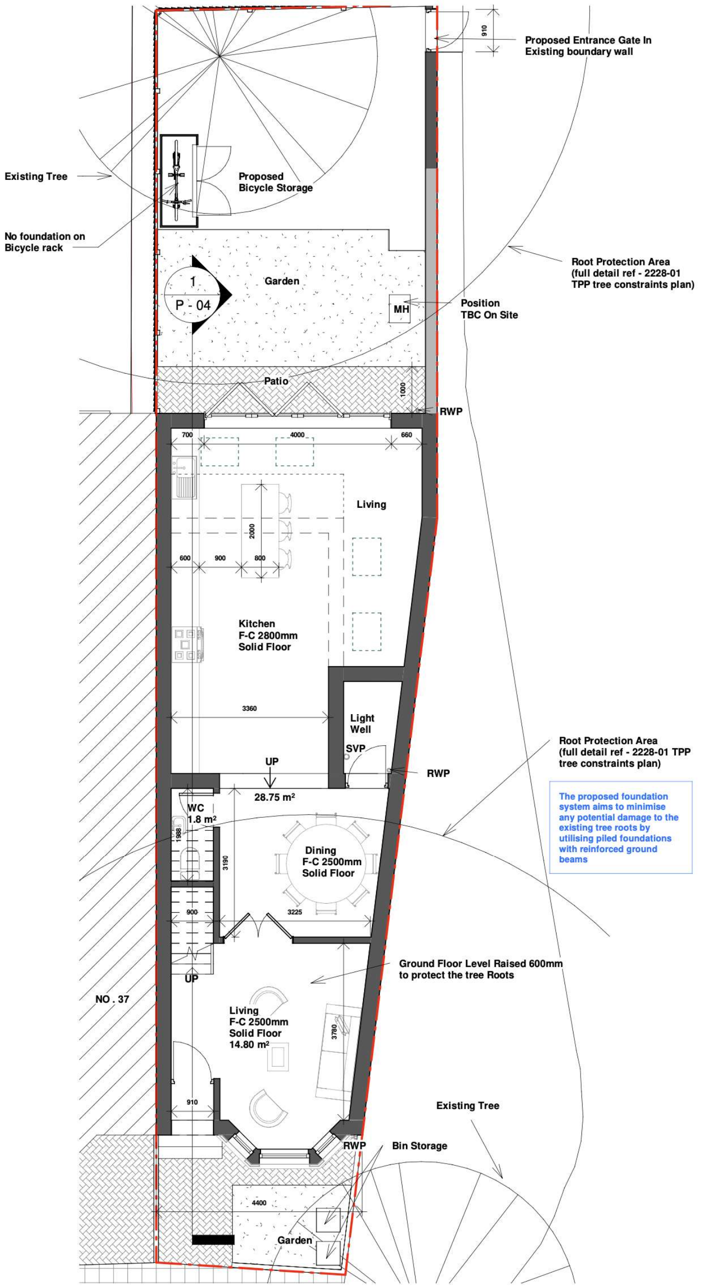

FIGURE 2. PROPOSED SITE LAYOUT

Flood Risk

The EA's indicative floodplain map shows that the site is located in Flood Zone 1 and is not at risk of flooding (Figure 3). Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere. The site has been identified as being within a critical drainage area, therefore a flood risk assessment is required as part of the planning application.

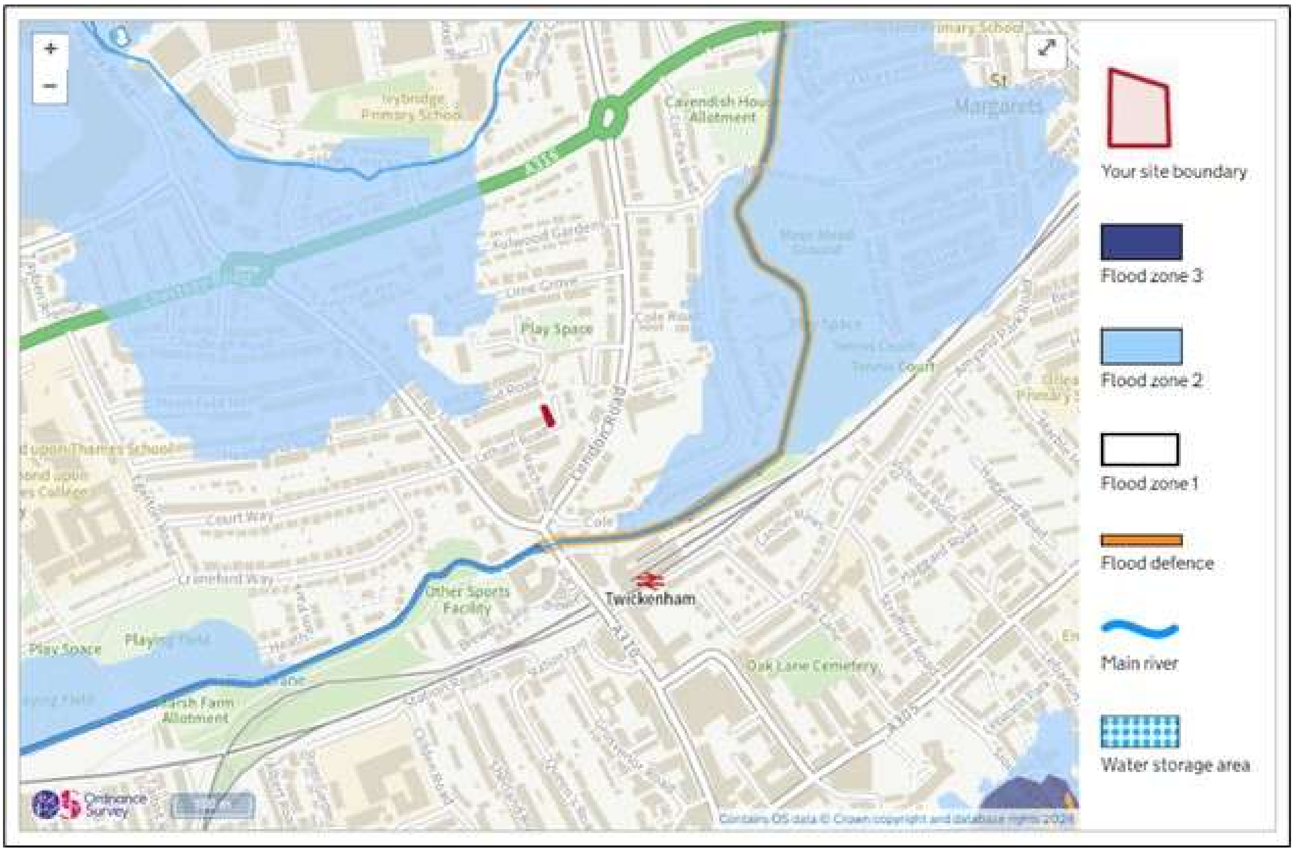

FIGURE 3. ENVIRONMENT AGENCY FLOOD RISK FROM RIVERS OR SEA MAP (GOV.UK, 2024)

The EA's indicative floodplain map shows that the site is in Flood Zone 1. This assessment will therefore focus on the flood risk to the building from overland flows and groundwater, as well as from other sources. The London Borough of Richmond upon Thames Strategic Flood Risk Assessment (SFRA) asks developers to assess the impact new developments have within Critical Drainage Areas. The EA refer developers to their Standing Advice for developments in Critical Drainage Areas. A CDA is a discrete geographic area where multiple and interlinked sources of flood risk cause flooding in one or more Local Flood Risk Zones during severe weather. However, the proposed development is outside of these regions which are subject to higher levels of flood risk.

Flood Risk from Groundwater

Flooding from groundwater typically occurs following prolonged periods of wet weather within low laying areas underlain by permeable aquifers. When aquifers are fully saturated, flooding at surface level can occur from the sub-surface strata.

According to Figure 4, the development resides in an area of having the *'limited potential for groundwater flooding to occur'*. Furthermore, according to the SFRA there are no recorded instances of flooding relating to groundwater in the vicinity of the proposed site. Therefore the likelihood of groundwater flooding at ground level is considered to be relatively low risk.

The bedrock geology for the entirety of the London Borough of Richmond upon Thames is London Clay, a geology type comprised of clay and silt, and one with very low permeability. This stratum generally has low hydraulic conductivity, which means water does not easily migrate through.

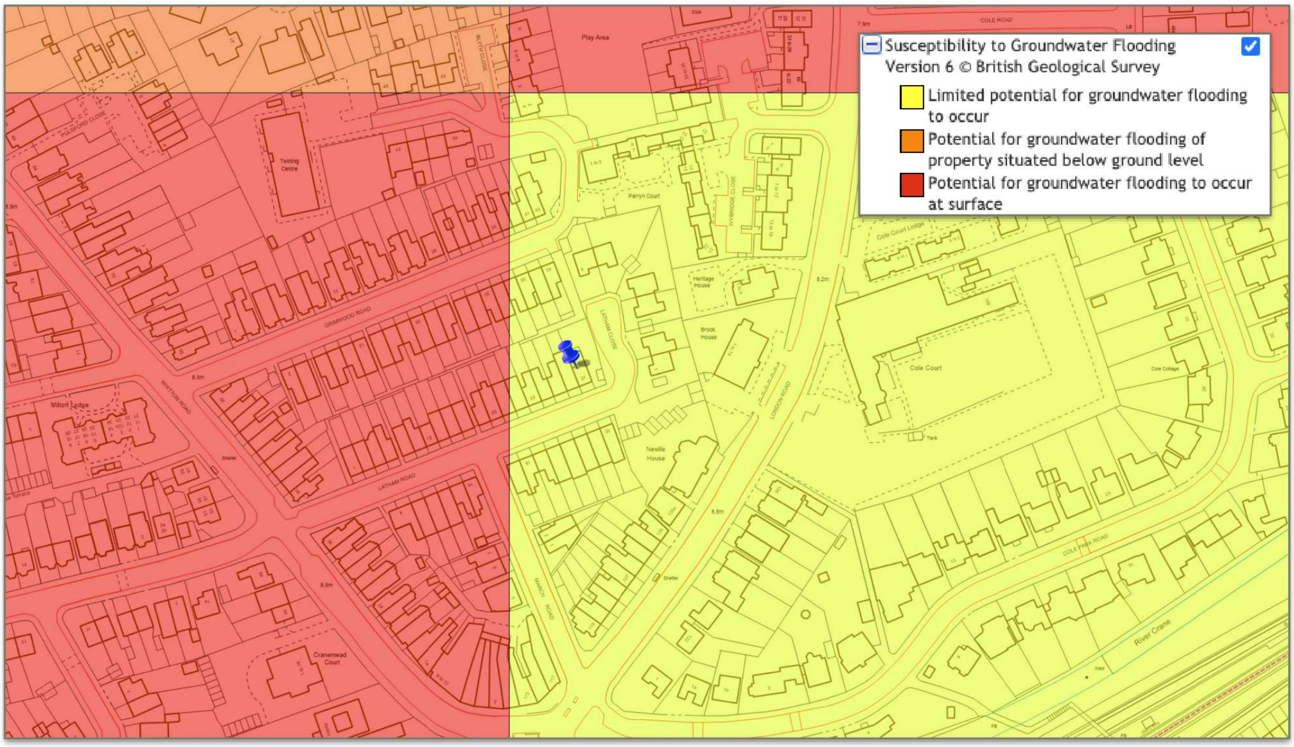

FIGURE 4. SUSCEPTIBILITY TO GROUNDWATER FLOODING VERSION 6 © BRITISH GEOLOGICAL SURVEY

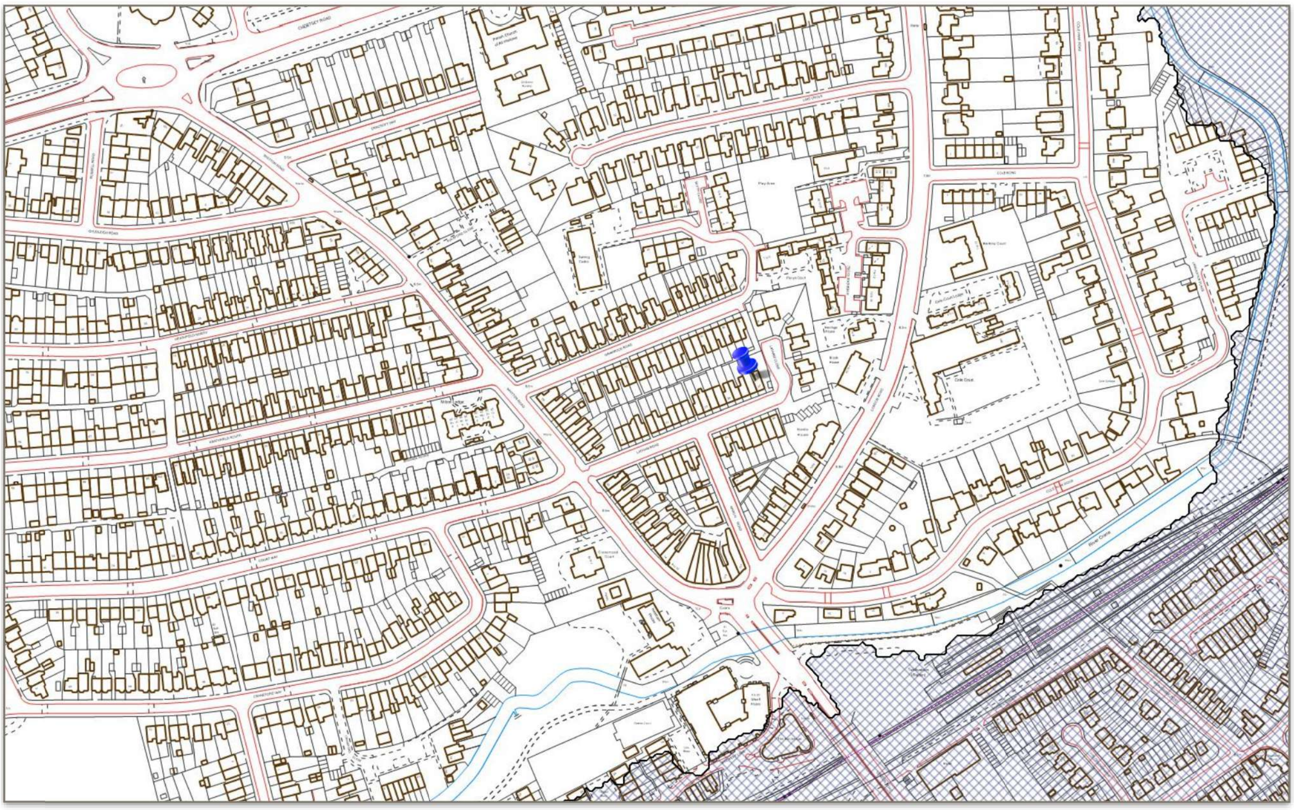

FIGURE 5. THROUGHFLOW CATCHMENT AREA MAP (SFRA, 2024)

The SFRA also notes that *"Subterranean conditions in certain areas throughout the London Borough of Richmond upon Thames are also at risk of groundwater influenced flooding via throughflow"*. However, as shown in Figure 5, the site is outside of this catchment area. Furthermore, no basements are proposed for the new development.

In consideration of the available maps provided in the SFRA and the EA/DEFRA's recorded datasets, the site is considered to have a low risk of groundwater flooding by integrating additional flood mitigation measures in the relevant chapter, whilst adhering to the advice of the appointed structural engineer.

Flood Risk from Surface Water and Overland Flows

Surface water flooding occurs when intense rainfall is unable to infiltrate into the ground or overwhelms the drainage system. This surface water runs across the surface of the ground causing flooding. The Environment Agency's Surface Water Flood Risk Map can also reflect surface water flooding along the line of small ordinary watercourses. Overland flows can also be generated by burst water mains, failed dams and any failure in a system storing or transferring water.

The Environment Agency's indicative Surface Water Flooding Map, Figure 6, shows that the site is at *Very Low* risk of surface water flooding.

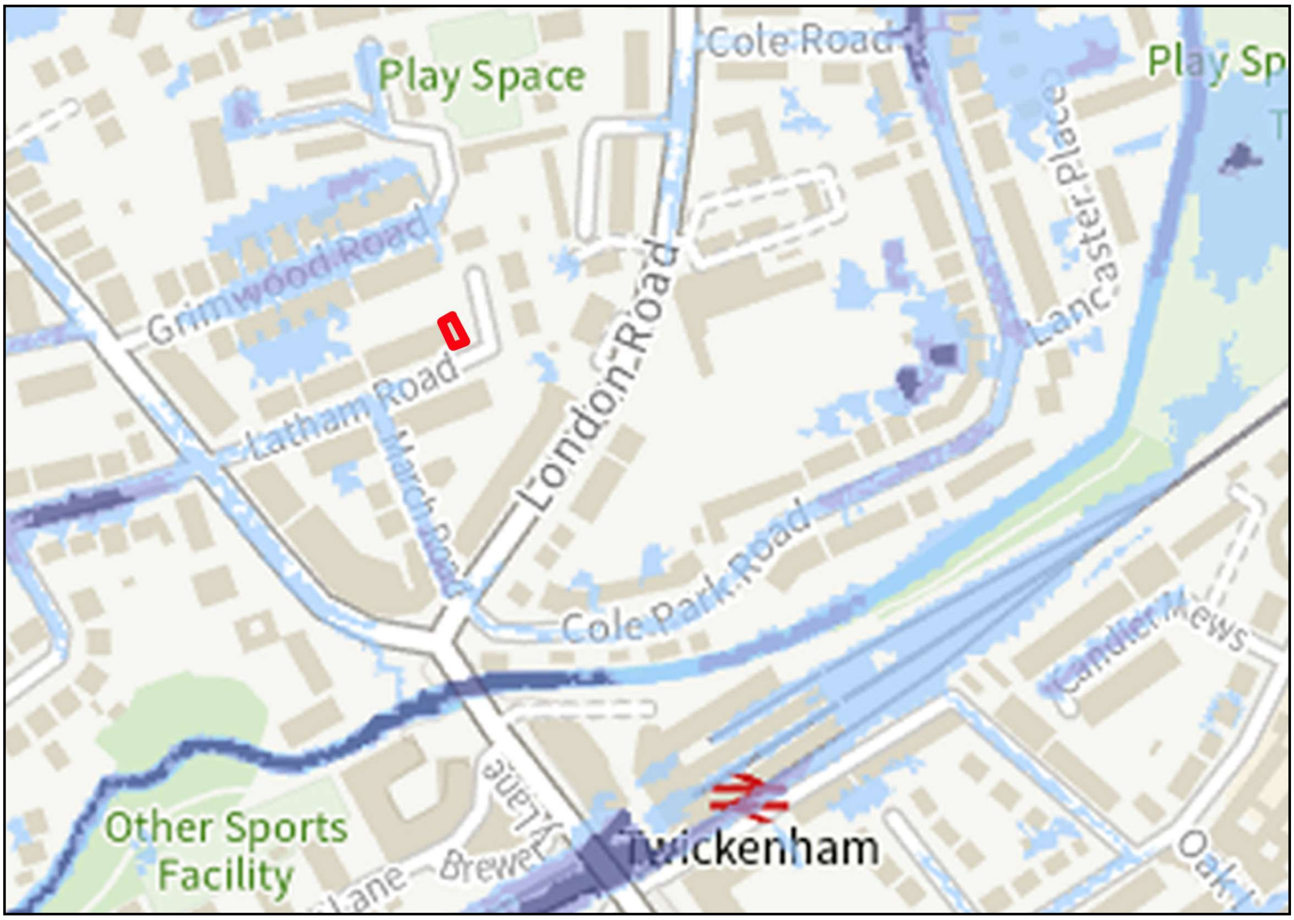

FIGURE 6. ENVIRONMENT AGENCY FLOOD RISK FROM SURFACE WATER MAP (GOV.UK, 2024)

Flood Risk from Reservoir Failure

The EA's information states that reservoir flooding is extremely unlikely to happen and there has been no loss of life in the UK from reservoir flooding since 1925. The Reservoir Act of 1975 ensures that reservoirs are inspected regularly and essential safety work is carried out.

The Environment Agency dataset 'Risk of Flooding from Reservoirs' identifies areas that could be flooded if a large reservoir were to fail and release the water it holds. The site is identified as having the potential to be inundated should a reservoir fail when there is also flooding from rivers (Figure 7).

Reservoirs in the UK have an extremely good safety record. The Environment Agency is the enforcement authority for the Reservoirs Act 1975 in England and Wales. All large reservoirs must be inspected and supervised by reservoir panel engineers. It is assumed that these reservoirs are regularly inspected and essential safety work is carried out. These reservoirs therefore present a minimal risk.

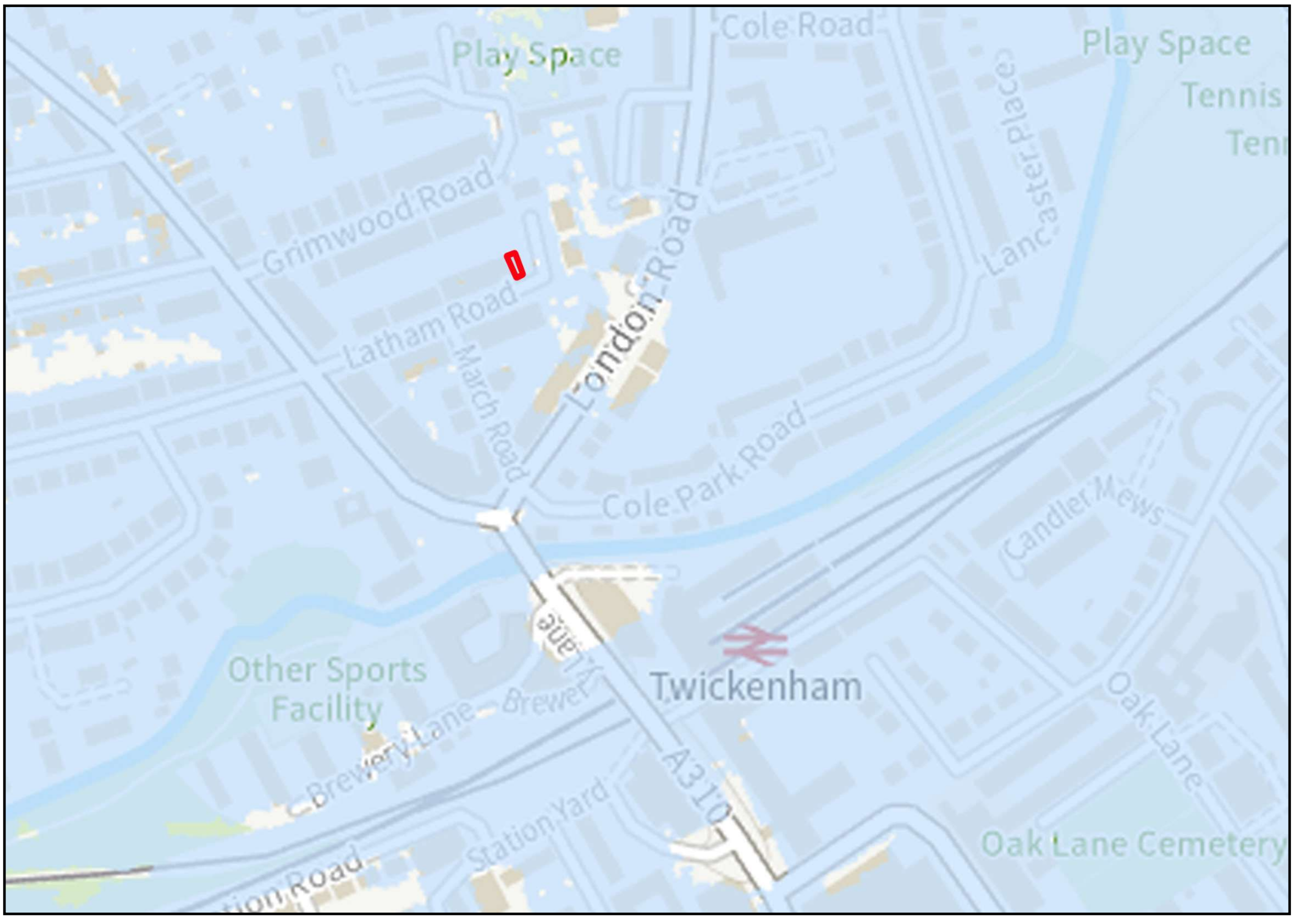

FIGURE 7. ENVIRONMENT AGENCY FLOOD RISK FROM RESERVOIRS MAP (GOV.UK, 2024)

Flood Mitigation Measures

The proposed development resides in Flood Zone 1 and is not at risk of flooding. Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere.

Surface Water Flood Risk is considered low. As part of the proposals, permeable paving and other SuDS features should be promoted within the design. External ground levels immediately outside the building will fall away from the building thresholds, ensuring the minimisation of storm water ingress. This can be achieved by either reducing the external ground levels below internal floor levels, and/or incorporating channel drainage system along the entrance into the building to positively drain overland flows. Finally, all drainage systems should be routinely maintained to reduce the risk of blockage and surface water flood risk.

Groundwater flooding as a sole source is deemed to be relatively low risk to the site. Any adjustment in external proposed levels will be designed to ensure surface water is directed away from building thresholds, should groundwater migrate to surface level. Appropriate consideration of this risk should be included within the design due to the possible elevated groundwater levels. It is recommended that, where feasible and practical, additional mitigation measures are incorporated in the proposed design. To mitigate the possibility of any groundwater emergence at ground level, the EA notes that a replacement floor constructed to a high standard with reinforced concrete and with a continuous damp proof membrane can be an effective solution where groundwater pressures are low.

Surface Water Run-off Assessment

Existing Run-off

The total site area encompasses approximately 144m² or 0.014 hectares. Of this, the existing impermeable surfaces, which include paved and hardstanding areas, account for 95m² or 0.01 hectares. This impermeable versus permeable land is critical for understanding the baseline conditions for surface water runoff and the potential for infiltration. The presence of these impermeable surfaces significantly influences the site's hydrological response to rainfall, directing surface water flow and affecting the overall runoff characteristics.

The existing peak run-off rate for the design storm event (1 in 1, 1 in 30 and 1 in 100 year) was calculated using the Modified Rational Method | Wallingford Procedure as shown below:
$Q = 2.78 \times i \times A$

Where ‘A’ is the catchment area in ha and ‘i’ is the rainfall intensity in mm/hr as estimated using the relevant maps presented in the Flood Studies Report.

$Q_{1ex} = 2.78 \times 32 \times 0.01 =$ **0.89 l/s**
$Q_{30ex} = 2.78 \times 80 \times 0.01 =$ **2.22 l/s**
$Q_{100ex} = 2.78 \times 104 \times 0.01 =$ **2.90 l/s**

Proposed Run-off

According to Planning Practice Guidance (PPG), *“generally the aim should be discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable: 1. Into the ground (infiltration) 2. To a surface water body; 3. To a surface water sewer, highway drain or another drainage system; 4. To a combined sewer”,* whilst ensuring that surface water run-off is managed as close to its source as possible.

The following chapters aims to outline the possibility of incorporating SuDS features in the design. Figure 4 outlines the possibility of incorporating SuDS into the scheme to reduce the surface water run-off and volumes further.

SuDS Assessment

It is recommended that SuDS be introduced to mimic natural drainage pathways as close to source as possible, reducing the impact of urbanisation on watercourse flows, and ensures the protection and enhancement of water quality, while encouraging the recharge of groundwater.

In accordance with the EA's guidelines, DEFRA's Non-Statutory Technical Standards for Sustainable Drainage Systems (NSTS), Building Regulations and Water Authorities advice, surface water run-off should be managed as close to its source as possible. The proposed SuDS will aim to reduce surface water run-off to the required rates where possible and practical, in line with national and local policy.

The NSTS states stormwater flows off site should achieve the greenfield runoff rate as best practicably possible, or are at least a 50% betterment of the existing flow rates for all periods.

CIRIA SuDS Manual (C753) states that a development should utilise SuDS unless there are practical 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 to its source as possible in line with the following drainage hierarchy:

I. Use infiltration techniques, such as porous surfaces in non-clay areas,
II. attenuate rainwater in ponds or open water features for gradual release,
III. attenuate rainwater by storing in tanks or sealed water features for gradual release,
IV. discharge rainwater direct to a watercourse,
V. discharge rainwater to a surface water sewer / drain,
VI. discharge rainwater to the combined sewer.

The possibility of implementing SuDS at the site was assessed using a hierarchy of preferred surface water management methods. The following paragraphs discuss the various methods in order of that hierarchy and evaluate the site's suitability for each method. The SuDS site suitability table, in Figure 8, has been used to determine the suitability for each SuDS element for this development.

SuDS Component	Site Suitability	Comments
Green Roofs & Rainwater Reuse	✓	A Rain Garden Planter was incorporated contributing to an 20m^2 reduction in small-medium storm events.
Soakaways	✗	Not feasible in this instance due to the requirement for a minimum 5m easement from adjacent structures and 2.5m easement from boundaries which restricts their use.
Filter Strips	✗	Not feasible in this instance due to the requirement for a minimum 5m easement from adjacent structures and 2.5m easement from boundaries which restricts their use.
Infiltration Trenches	✗	Not feasible in this instance due to the requirement for a minimum 5m easement from adjacent structures and 2.5m easement from boundaries which restricts their use.
Swales	✗	Not suitable due to site layout and size of the development.
Bioretention	✗	Not suitable due to site layout and size of the development.
Porous Pavements	✓	Permeable Paving will be introduced to existing impermeable hard landscaped areas, helping reduce overall surface water run off by 35m^2.
Geocellular Systems	✗	Other SuDS features are preferred in this instance.
Detention basins	✗	Not suitable due to site layout and size of the development.
Ponds	✗	Not suitable due to site layout and size of the development.
Stormwater wetlands	✗	Not suitable due to site layout and size of the development.

FIGURE 8. SUDS SITE SUITABILITY

Expected Ground Conditions

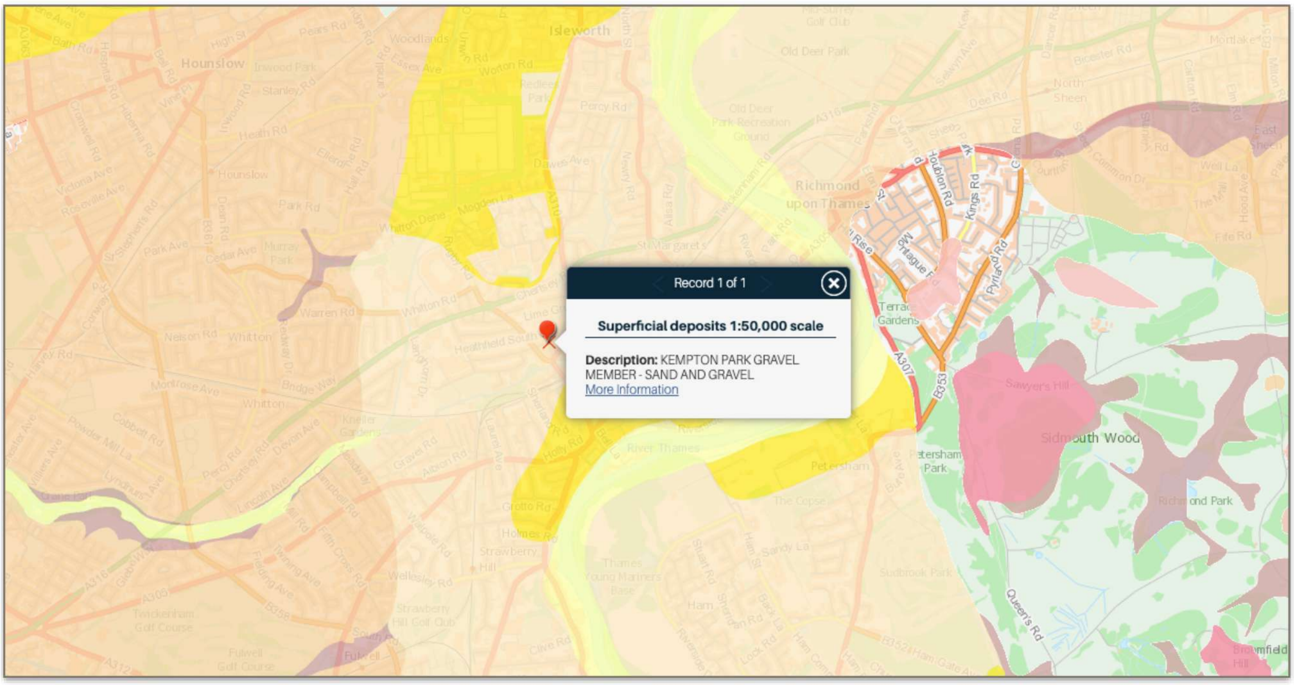

FIGURE 9. BGS GEOLOGICAL MAPS

The development site is situated within the geological setting of the Kempton Park Gravel Member, characterised by its composition of sand and gravel. This stratum is distinguished by its coarse-grained texture, which influences the hydrological properties and ground conditions prevalent in the area. The characteristics of sand and gravel, such as their higher porosity and enhanced infiltration capacity, offer distinct advantages for surface water management. Unlike finer-grained soils, such as those found in the London Clay Formation, the Kempton Park Gravel Member facilitates a much greater degree of water permeation. This natural permeability presents an opportunity to implement water management strategies that utilise the ground's ability to absorb and filter surface water runoff. Such strategies could include the integration of sustainable drainage systems (SuDS) that not only manage surface runoff effectively but also contribute to groundwater recharge and the enhancement of local biodiversity.

The application of the soil texture classification system, as outlined in the CIRIA SuDS Manual (C753), provides a foundational understanding of the expected infiltration rates within this geological context. Given the permeable nature of the Kempton Park Gravel Member, the site is anticipated to exhibit good infiltration rates, which are suitable for infiltration-based SuDS features, where appropriate.

Soil Texture	ISO 14688-1	Lower (m/s)	Upper (m/s)
Gravel	Sandy GRAVEL	$3x10^{-4}$	$3x10^{-2}$
Sand	Slightly silty slightly clayey SAND	$1x10^{-5}$	$5x10^{-5}$
Loamy Sand	Silty slightly clayey SAND	$1x10^{-4}$	$3x10^{-5}$
Sandy Loam	Silty clayey SAND	$1x10^{-7}$	$1x10^{-5}$
Loam	Very silty clayey SAND	$1x10^{-7}$	$5x10^{-6}$
Silt Loam	Very sandy clayey SILT	$1x10^{-7}$	$1x10^{-5}$
Sandy Clay Loam	Very clayey silty SAND	$3x10^{-10}$	$3x10^{-7}$
Silty Clay Loam	-	$1x10^{-8}$	$1x10^{-6}$
Clay	-	0	$3x10^{-8}$
Till	-	$3x10^{-9}$	$3x10^{-5}$

Living Roofs & Rainwater Re-use

The SFRA states that any SuDS features incorporated into the design *“should mimic natural drainage approaches as closely as possible, providing an alternative to ‘hard engineered’ traditional drainage”*.

Green Roofs have not been incorporated as part of the proposed scheme, as this would not be consistent with the surrounding dwellings in the area. The SuDS Manual C753 states *“Green roofs can provide benefits in terms of reducing peak flow rates to the site drainage system – principally for small and medium-sized events.”.* However, the SuDS Manual also goes further to say that they behave like traditional roofs during storm events or return periods greater than this, limiting their effectiveness for these types of occurrences.

However, Rain Garden Planters will be used to drain surface water run-off from part of the roof. An overflow will be provided, which will drain back into the existing surface water drainage system. Figure 10 provides a schematic of the Rain Garden Planter.

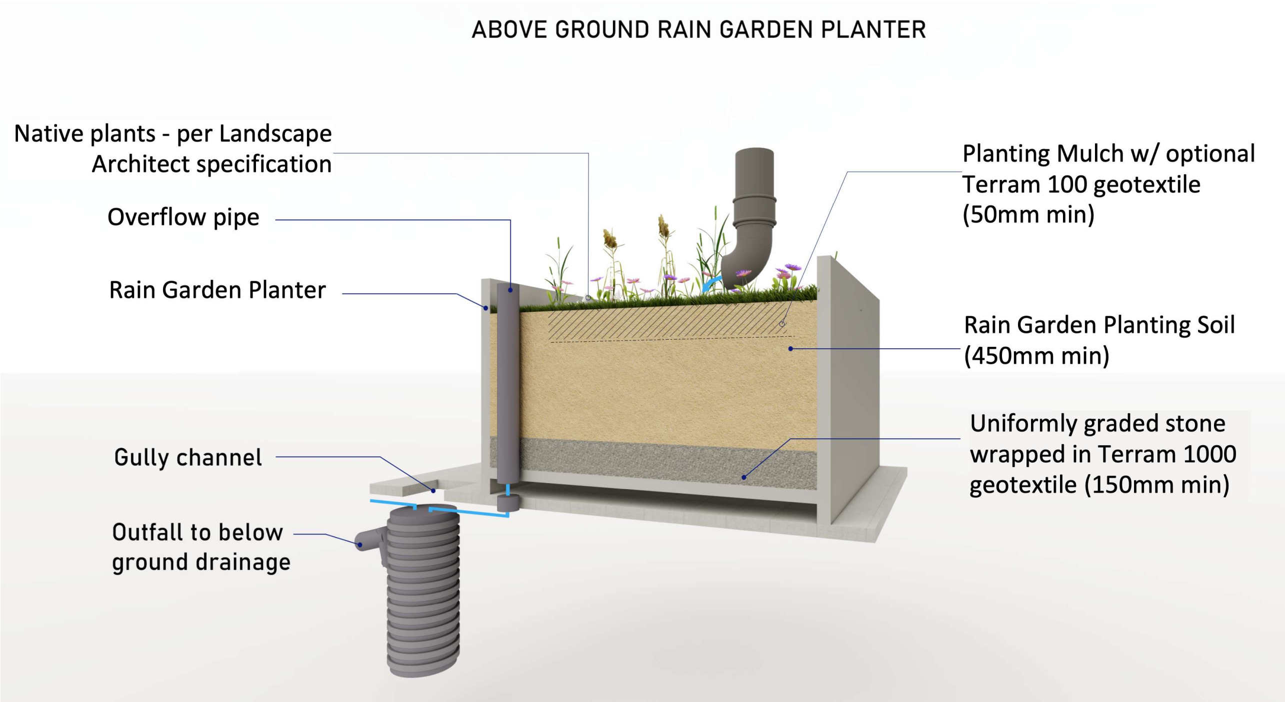

FIGURE 10. RAIN GARDEN RAISED PLANTER DETAIL

Watering Butts will also be introduced to reduce both water demand, and can also reduce surface water run-off for smaller storm events.

Infiltration

The preferred means of surface water drainage for any new development is into a suitable soakaway or infiltration system. However, the requirement for a minimum 5m easement from adjacent structures and 2.5m from any adjacent boundary restricts their use.

Rain Garden Planters will be incorporated to reduce the surface water run-off for the small-medium storm events (1 in 2 year return period according to the LLFA's pro-forma). Based on a small portion of the proposed new development's roof discharging into these planters, will reduce the surface water run-off by an additional **20m^2** during these events.

Attenuation capacity of Raingarden Planters

Design Standard	Depth of Rainfall
First Flush	5mm
1 in 5 year event	20mm
1 in 20 year event	50mm

Rainfall design events, based on a 60 minute duration storm in the London area

For Rain Gardens Planters, good practice is to aim to store the first 20mm of rainfall – in London this is the estimated depth of rainfall for an hour storm with an annual probability of 1 in 5.

Area of Rain Garden Planter= 2m^2

Catchment Area = 20m^2 *(Approximate area run-off served by RWP)*

Depth of Freeboard = 0.10m

Depth of Sub-base = 0.30m

Depth of Storage = Depth of Freeboard (m) + 30% Depth of Sub-base (m)

= 0.10m + 30% of 0.30m

= 0.19m

Volume of Storage = Depth of Storage x Area of Rain Garden Planter

= 0.19m x 2m^2 = 0.38m^3

Volume of Rainfall = Depth of Rainfall x Catchment Area

1 in 5 year storm event = 20mm x 20m^2 = 0.40m^3

In this instance a 20mm 1 in 5 year event is exceeded but only just. All other less frequent storm events would be retained within the Rain Garden Planter.

Permeable Pavements

Infiltration through permeable paving is considered to be a practical solution to reduce surface water run-off rates and volumes. Infiltration through Permeable Pavements (2D plane only) can also be utilised closer to structures. Permeable Pavements serving themselves behave in a similar way to soft landscaping and can be placed directly against the edge of structures.

Given infiltration rates have not been confirmed by a site-specific infiltration test, as a worst-case scenario, an overflow from the sub-base will be connected to the drainage system.

Capacity of the Permeable Pavement

The surface water run-off from the proposed hardstanding areas will self-attenuate through the sub-base of the permeable pavement prior to connecting to the adjacent surface water system. Although the permeable paving will remain unlined and permit infiltration through the base, as a conservative approach, the permeable pavement is assumed to only partially infiltrate and therefore an overflow is proposed to account for this potential variability.

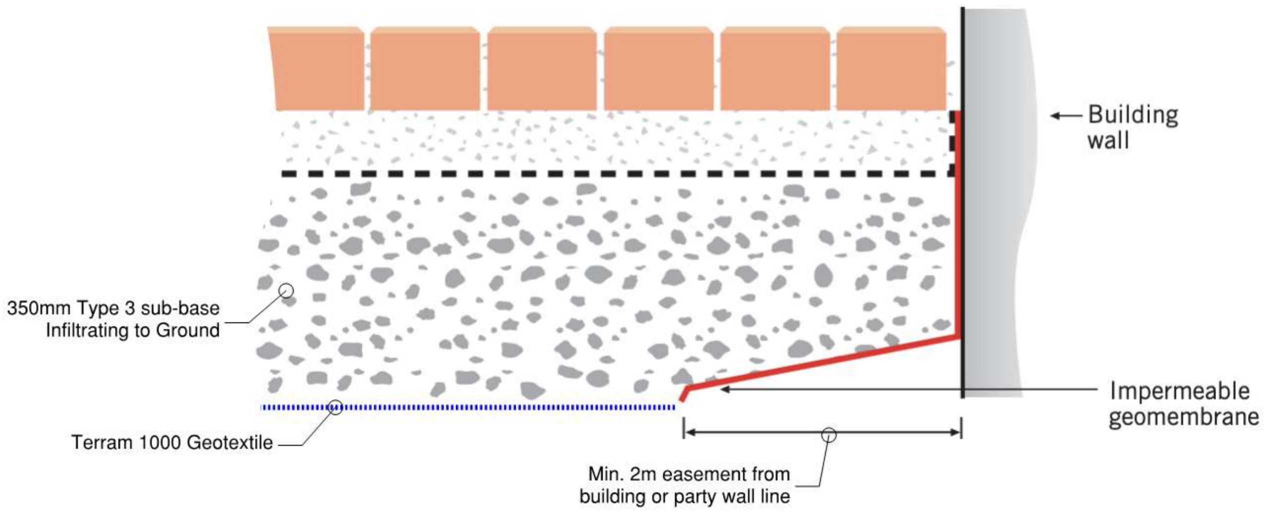

FIGURE 11. PERMEABLE PAVEMENT USED FOR THE HARDSTANDING AREAS

The surface water run-off from the permeable paving will self-attenuate and infiltrate into the ground. A conservative infiltration rate of 1×10^{-7} m/s was used to define the minimum paving thicknesses. The proposed thickness of 350mm deep sub-base exceeds this minimum requirement.

Infiltration rate = 1×10^{-7} m/s

		1 in 10	1 in 30	1 in 100	1 in 100 + 20%	1 in 100 + 30%
M5-60	r	10	3.33	1	0.5	0.25
20	0.4	90	120	160	210	225
	0.3	100	140	190	240	270
	0.2	135	180	250	310	370
17	0.4	70	100	140	180	190
	0.3	80	110	160	210	225
	0.2	105	150	210	270	305
14	0.4					
	0.3	60	90	130	170	180
	0.2	75	110	160	220	245

FIGURE 12. MINIMUM PAVING THICKNESSES REQUIRED - HYDRAULIC CAPACITY (INTERPAVE, 2018)

Attenuation

Attenuation via modular attenuation tanks, ponds or swales is not considered a feasible option due to the development proposals (constrained site and blockage risk associated with restricting surface water run-off rates).

Reducing surface water run-off rates further will increase blockage risk and the associated flood risk to the development. Building regulations require a minimum diameter outlet of 75mm for all below ground drainage elements. A drainage design restricting flow rates further would not comply with their requirements, and therefore not be approved. HR Wallingford's Run-off tool (and similarly EA/DEFRA's guidance) recommends that *"where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible"*.

Furthermore, considering the overall reduction in drained areas, and the inclusion of Rain Garden Planters, in this instance would be considered more appropriate for the size and scale of the development proposals.

Surface Water Maintenance Strategy

The drainage design will be designed to be fully maintainable in accordance with building regulations and the recommendations of CIRIA C753 – SuDS Manual, outlined below. The SuDS and drainage will be maintained by the owner of the property.

Rainwater Garden Planters

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Weed spray with environmentally friendly chemicals	Half yearly
	Clear leaves and litter	Half yearly
	Plants to be pruned	Half yearly
Occasional maintenance	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Remove silt build-up from outlets and surface and replace mulch as necessary	Annually, or as required
Remedial Actions	Repair of overflow erosion damage or damage to outfall	As required

Permeable Paving

Maintenance Schedule	Required Action	Typical Frequency
Monitoring/Inspections	Initial Inspection.	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth - if required take remedial action.	Annually (and after severe storms)
Regular Maintenance	Rubbish and litter removal	As required
	Brushing and vacuuming - standard cosmetic sweep across surface	Once a year after Autumn leaf fall
Remedial Actions	Remedial work to any depressions or rutting considered detrimental to the structural performance.	As required
	Rehabilitation of surface with remedial sweeping	Every 10-15 years or as required.

Effective SuDS design must assess all foreseeable risks during construction and maintenance. These must be mitigated during the detailed design stages where effective design will aim to avoid, reduce and mitigate risks. The CDM Regulations place specific Health and Safety duties on those commissioning, planning and undertaking construction works. If you are uncertain what this means you should seek the advice of your architect, builder or other competent professional. Flume does not provide health and safety advisory services, but we are required to advise you of your general responsibilities under CDM.

SuDS Run-off Summary

Return Period	Greenfield	Existing	Proposed (with SuDS Measures)
1 in 1 Year	0.13	0.89	0.59
1 in 30 Year	0.35	2.22	1.47
1 in 100 Year	0.48	2.90	1.92
1 in 100 Year + 40%cc	N/A	N/A	2.69

Source control features including above ground Rain Garden Planters and Permeable Paving have been incorporated into the scheme. The incorporation of Rain Garden Planters, Permeable Paving and Watering Butts, will reduce the development's surface water run-off rates compared to the existing scenario. The surface water will discharge via a new proposed connection to the surface water sewer in the road.

The proposed development will incorporate Permeable Paving alongside a Rain Garden Planter to reduce the overall area of impermeable hardstanding compared with the existing case from 95m^2 to 63m^2. This will not only to decrease the extent of impermeable surfaces but also to enhance the site's capacity for surface water infiltration and management. The introduction of these features represents a proactive approach to mitigating surface water runoff, thereby contributing to the reduction of flood risks. Furthermore, the decision to retain the existing areas of amenity grass and soft landscaping plays a vital role in this water management strategy. These permeable areas are essential in absorbing rainwater, further reducing the potential for runoff and promoting natural groundwater recharge.

Conclusions

• The site resides in Flood Zone 1 where there is less than 1 in 1000 annual probability of river or sea flooding (<0.1%). Developments in this flood zone have no restrictions other than ensuring surface water drainage proposals do not increase the flood risk on site and the surrounding areas.

• The site would be classified as having a *Low* flood risk from all other sources, including surface water flooding.

• The FRA has further demonstrated that the proposed development has an acceptable flood risk within the terms and requirements of NPPF and accompanying technical guidance. The development proposals are acceptable, as the flood risk from all sources is considered low.

• Permeable Paving ('2d' Infiltration) and Rain Garden Planters will reduce the overall development's surface water run-off rates in line with national and local policy. These SuDS elements provide an overall reduction in surface water run-off rates for all storm events up to the 1 in 100 year plus 40% allowance for climate change.

• Rain Water Planters and Permeable Pavements are placed highly in the SuDS Hierarchy, and will ensure that water quality, water quantity, amenity and biodiversity are all promoted in the SuDS design.

• A SuDS Maintenance Plan will also be in place to ensure efficient operation and prevent failure of the system.

• A completed Section 106 of the Water Industry Act 1991 application (providing details on proposed flows), requesting consent for discharging foul and surface from the proposed development to the public sewers should be submitted to Thames Water for approval.

Note:

This report has been prepared for the purposes of submitting for planning to the local planning authority for review in relation to the associated flood risk and SuDS for the proposed development, and uses the most up-to-date information available to us at the time. It should not be relied upon by anyone else or used for any other purpose. This report is confidential to our Client; it should only be shown to others with their permission. We retain copyright of this report which should only be reproduced with our permission.

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Signature	MS	TQ	TQ
Date	22 March 2024	22 March 2024	22 March 2024

Appendix A - SuDS Strategy

Job No.	1439	Page	SK 001	Rev	2
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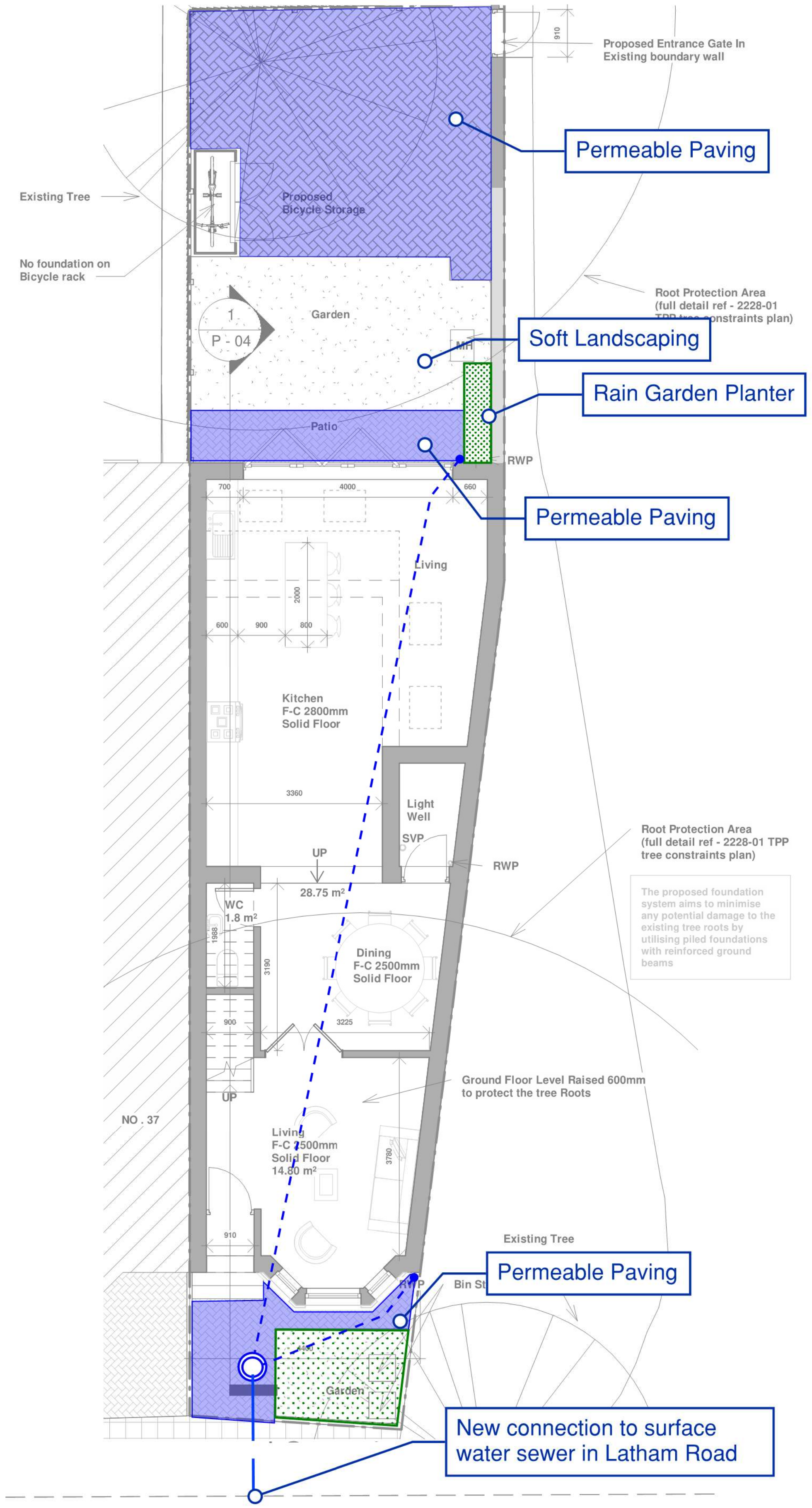
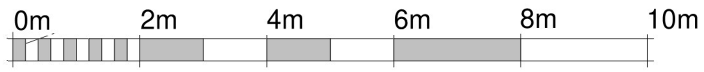
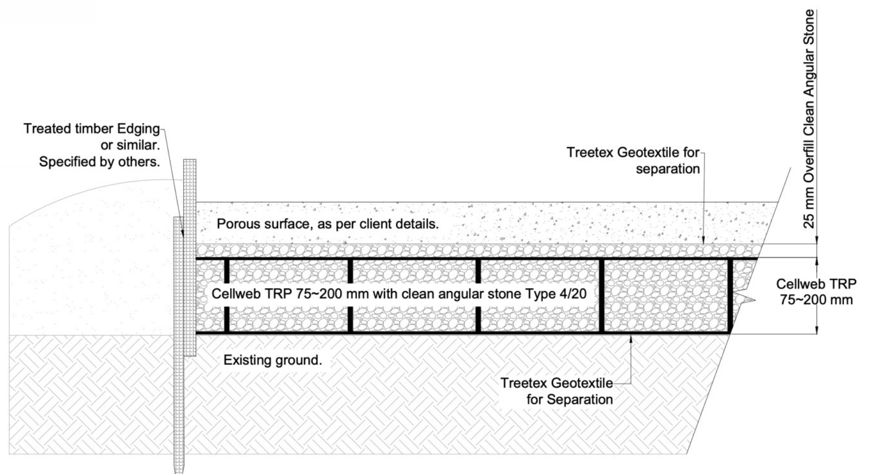
Job	Land adjacent to 37 Latham Road - SuDS Strategy				

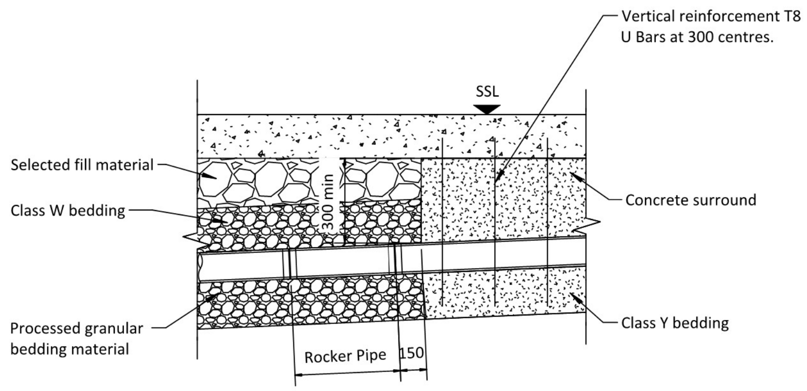






Cellweb® TRP

Refer to Cellweb Technical Support for further details



Class Y/W Pipe Bedding

Refer to Civil Engineering Drawings for further details

Appendix B - Hydraulic Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	150.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)
Permeable Paving	0.004	5.00	0.500	450	0.500
Outfall	0.000		0.500	450	0.500

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Permeable Paving	Outfall	3.000	0.600	0.000	0.000	0.000	0.0	100	5.05	54.5

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.000	7.9	0.6	0.400	0.400	0.004	0.0	0	∞

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	3.000	0.0	100	Circular	0.500	0.000	0.400	0.500	0.000	0.400

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Permeable Paving	450	Manhole	Adoptable	Outfall	450	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Permeable Paving	0.500	0.500	450	0	1.000	0.000	100
Outfall	0.500	0.500	450	1	1.000	0.000	100

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	1440
FSR Region	England and Wales	Winter CV	0.840	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.400	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	40	0	0

Node Permeable Paving Online Depth/Flow Control

Flap Valve	x	Invert Level (m)	0.000	Design Flow (l/s)	0.2
Replaces Downstream Link	✓	Design Depth (m)	1.000		

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.001	0.000	1.000	0.000

Node Permeable Paving Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03600	Safety Factor	10.0	Invert Level (m)	0.000
Side Inf Coefficient (m/hr)	0.03600	Porosity	0.30	Time to half empty (mins)	672

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	35.0	35.0	0.350	35.0	35.0	0.351	0.0	35.0

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
360 minute winter	Permeable Paving	344	0.231	0.231	0.3	2.4661	0.0000	FLOOD RISK
15 minute summer	Outfall	1	0.000	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Discharge Vol (m^3)
360 minute winter	Permeable Paving	Depth/Flow	Outfall	0.0	0.0
360 minute winter	Permeable Paving	Infiltration		0.0	