


Client: Angela McDonald

Flood Risk Assessment and Surface Water Management Strategy for the Proposed Development at 50 Station Road, Barnes

November 2024

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Contents Amendment Record

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Issue	Revision	Description	Date
1	0	Draft report issued by email	27 September 2024
2	1	SWMS added to report. Revised draft issued by email	22 November 2024
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1 Background and Scope of Appraisal

Herrington Consulting has been commissioned by Angela McDonald to prepare a Flood Risk Assessment (FRA) for the proposed development at **50 Station Road, Barnes, SW13 0LP**.

This report has been prepared to accompany a full planning application and has been prepared in accordance with the requirements of the National Planning Policy Framework (2023) and the National Planning Practice Guidance Suite (August 2022) that has been published by the Department for Communities and Local Government. In addition, reference has also been made to Local Planning Policy and the appraisal has been carried out in line with CIRIA Report C753 'The SuDS Manual' and the CIRIA Report C624 'Development and flood risk - guidance for the construction industry'.

Flooding is a major issue in the United Kingdom. The impacts can be devastating in terms of the cost of repairs, replacement of damaged property and loss of business. The objectives of the Flood Risk Assessment (FRA) are therefore to establish the following:

- whether a proposed development is likely to be affected by current or future flooding from any source.
- whether the development will increase flood risk elsewhere within the floodplain.
- whether the measures proposed to address these effects and risks are appropriate.
- whether the site will pass Part B of the Exception Test (where applicable).

A FRA appraises the risk of flooding to development at a site specific scale and recommends appropriate mitigation measures to reduce the impact of flooding to both the site and the surrounding area.

New development also has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

2 Development Description and Planning Context

2.1 Site Location and Development

The site is located at OS coordinates 521817, 176214, off Station Road in Barnes. The site covers an area of approximately 325m^2 and currently comprises a two-storey dwelling, with associated landscaping and garage to the rear of the property. The location of the site in relation to the surrounding area and the River Thames is shown in Figure 2.1.

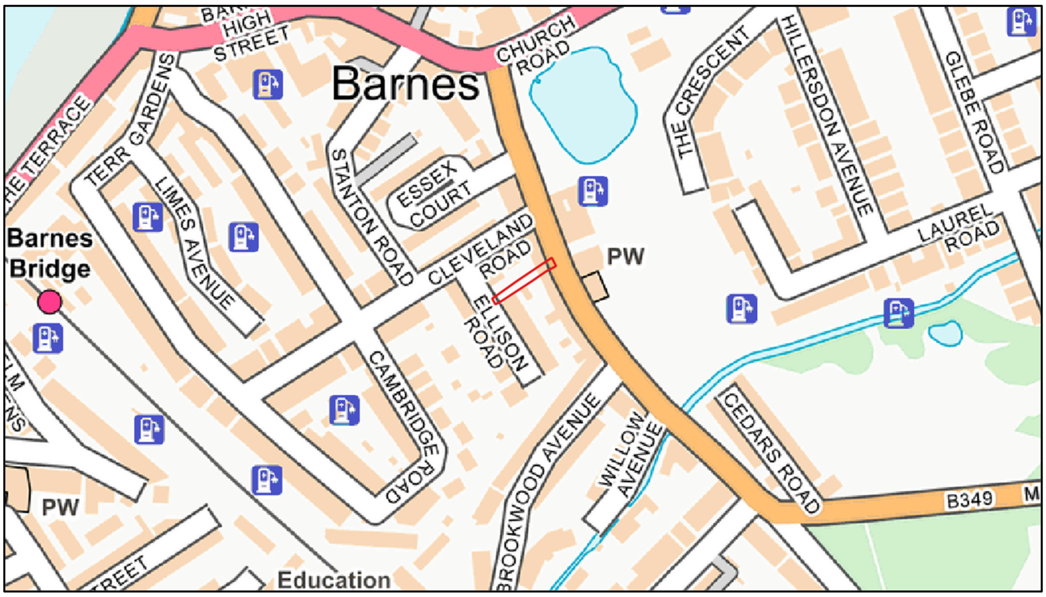

Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2024).

The site plan included in Appendix A.1 of this report provides more detail in relation to the site location and layout.

2.2 Proposed Development

The proposals for development comprise the replacement of the existing garage building with a two-storey dwelling and associated car parking facilities (Figure 2.2).

Figure 2.2 – Proposed site layout.

Drawings of the proposed scheme are included in Appendix A.1 of this report.

2.3 The Sequential Test

The National Planning Policy Framework (NPPF) requires the Sequential Test to be applied at all stages of the planning process and generally the starting point is the Environment Agency's (EA) 'Flood Map for Planning' (Figure 2.3). These maps and the associated information are intended for guidance and cannot provide details for individual properties. They do not take into account other considerations such as existing flood defences, alternative flooding mechanisms and detailed site-based surveys. They do, however, provide high level information on the type and likelihood of flood risk in any particular area of the country. The Flood Zones are classified as follows:

Zone 1 – *Low probability of flooding* – This zone is assessed as having less than a 1 in 1000 annual probability of river or sea flooding in any one year.

Zone 2 – *Medium probability of flooding* – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1000 annual probability of sea flooding in any one year.

Zone 3a – *High probability of flooding* - This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding or 1 in 200 or greater annual probability of sea flooding in any one year.

Zone 3b – *The Functional Floodplain* – This zone comprises land where water has to flow or be stored in times of flood and can be defined as land which would flood during an event having an annual probability of 1 in 30 or greater. This zone can also represent areas that are designed to flood in an extreme event as part of a flood alleviation or flood storage scheme.

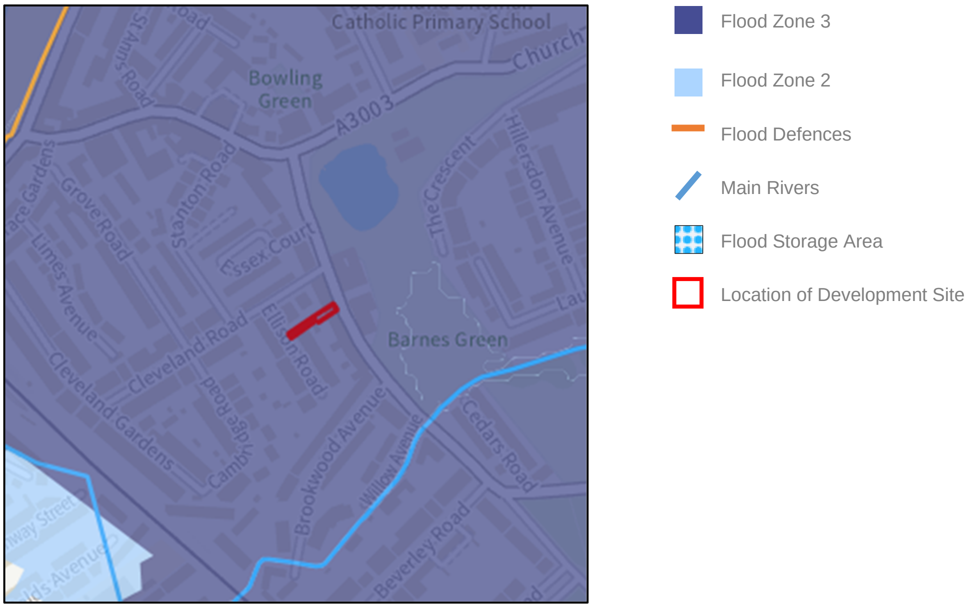

Figure 2.3 – EA's 'Flood Map for Planning' (© Environment Agency, mapping contains Ordnance Survey Data © Crown copyright and database right 2024)

Figure 2.3 shows the development site is located within Flood Zone 3. This mapping does not distinguish between high risk areas and the functional floodplain, i.e., Zones 3a and 3b. This is an important differentiation that needs to be made by the FRA because the NPPF states that no development, other than essential transport and utilities infrastructure, should be located within the functional floodplain.

The NPPG states that the Functional Floodplain is land where water has to flow or be stored in times of flood. The NPPG provides the following definition:

> *The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters.*

Based on information provided by the EA and that derived as part of this appraisal, the following Functional Floodplain test is applied:

Do predicted flood levels show that the site will be affected by an event having a return period of 1 in 30 years or less?	**X**
Is the site defended by flood defence infrastructure that prevents flooding for events having a return period of 1 in 30 years or greater?	✓
Does the site provide a flood storage or floodwater conveyance function?	**X**
Does the site contain areas that are 'intended' to provide transmission and storage of water from other sources?	**X**
Is site within the functional floodplain (Zone 3b)?	**No**

Table 2.1 – Functional floodplain test.

The flood zone mapping and associated information has been summarised in Table 2.2 below.

Flood Zone (percentage of site within zone)		**Source of Flooding**	**Benefiting from existing flood defences**
Zone 1	**0%**		
Zone 2	**0%**		
Zone 3a	**100%**	River (Tidal)	Yes
Zone 3b	**0%**		

Table 2.2 – Flood zone classification.

The NPPF states that the Local Planning Authority (LPA) should apply the sequential approach as part of the identification of land for development in areas at risk from flooding. The overarching objective of the Sequential Test is to ensure that lower risk sites are developed before sites in higher risk areas. When applying the Sequential Test, it is also necessary to ensure that the subject site is compared to only those sites that are available for development and are similar in size.

In this case within the London Borough of Richmond upon Thames Local Plan Publication (Regulation 19) June 2023, Section 16.59 states that *'The Sequential Test will not be required if the development proposal meets at least one of the following:*

- *It is within a town centre or local centre boundary;*
- *It is for residential development or a mixed-use scheme and within the 800m buffer area identified within the town centre or local centre'*.

Based on the above and given that the proposed development site is located within 300m of the Barnes local centre, it is considered that the Sequential Test is not required.

2.4 The Exception Test

According to the NPPF, if it is not possible, consistent with wider sustainability objectives, for the development to be located in areas at lower risk, the Exception Test may have to be applied. The application of the Exception Test will depend on the type and nature of the development, in line with the Flood Risk vulnerability classification set out in the NPPG. This has been summarised in Table 2.3 below.

Flood Risk Vulnerability Classification	Zone 1	Zone 2	Zone 3a	Zone 3b
Essential Infrastructure – Essential transport infrastructure, strategic utility infrastructure, including electricity generating power stations.	✓	✓	e	e
High Vulnerability – Emergency services, basement dwellings, caravans and mobile homes intended for permanent residential use.	✓	e	×	×
More Vulnerable – Hospitals, residential care homes, buildings used for dwelling houses, halls of residence, pubs, hotels, non-residential uses for health services, nurseries and education.	✓	✓	e	×
Less Vulnerable – Shops, offices, restaurants, general industry, agriculture, sewerage treatment plants.	✓	✓	✓	×
Water Compatible Development – Flood control infrastructure, sewerage infrastructure, docks, marinas, ship building, water-based recreation etc.	✓	✓	✓	✓

Key :

✓ Development is appropriate

× Development should not be permitted

e Exception Test required

Shaded cell represents the classification of this development

Table 2.3 - Flood risk vulnerability and flood zone incompatibility.

From Table 2.3 above it can be seen that the development falls into a classification that requires the Exception Test to be applied. For the Exception Test to be passed it should be demonstrated that:

A. *the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*

B. *the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

Both parts of the test will have to be passed for development to be allocated or permitted.

Demonstrating that the development provides wider sustainability benefits to the community that outweigh flood risk is outside the scope of this report. Nevertheless, reference is made to the SFRA to establish the key risks associated with flooding and to help demonstrate that this objective can be achieved. The key focus of this FRA is therefore to establish whether the site is likely to pass Part B of the Exception Test.

3 Definition of Flood Hazard

3.1 Site Specific Information

Information from a wide range of sources has been referenced to appraise the true risk of flooding at this location. This section summarises the additional information collected as part of this FRA.

Site specific flood level data provided by the EA – The EA has provided detailed flood level data as part of the Thames Tidal Upriver Breach Inundation Assessment (completed in 2017) and Maximum Likely Water Levels (MLWLs) as part of the Thames Upstream Inundation Modelling Study (2015). The EA has also provided the flood level data from the Beverley Brook Modelling Study (2009). These studies have been referenced as part of this assessment.

Information contained within the SFRA – The London Borough of Richmond-upon-Thames SFRA (2021) contains detailed mapping showing historic flood records for a wide range of sources. This document has been referenced as part of this site-specific FRA.

Information on localised flooding contained within the SWMP – A Surface Water Management Plan (SWMP) is a study to understand the risk of flooding that arises from local surface water flooding, which is defined by the Flood and Water Management Act 2010 as flooding from surface runoff, groundwater, and ordinary watercourses. Such a document has been prepared for London Borough of Richmond-upon-Thames (2021) and has therefore been referenced as part of this site-specific FRA.

Information provided by Thames Water – Thames Water has provided the results of an asset location search for the site. The response is included in Appendix A.2.

Site specific topographic surveys – A topographic survey has been undertaken for the site and a copy of this is included in Appendix A.1. From the survey, it can be seen that the level of the site varies between 4.51m and 4.71m Above Ordnance Datum Newlyn (AODN). The land levels across the site are relatively flat, with the land levels within the surrounding area falling towards the northeast.

Geology – Reference to the British Geological Survey (BGS) map shows that the underlying solid geology in the location of the subject site is London Clay Formation (clay and silt). Overlying this are superficial deposits of Kempton Park Gravel Member (sand and gravel).

Historic flooding – Mapping contained within the SFRA shows that the site is located in a postcode area where 0-10 sewer flooding incidents have been recorded, although there are no specific records of the site itself having been affected from sewer flooding or any other sources. The EA's 'Recorded Flood Outlines' GIS layer also shows that there are no records of flooding on site from rivers or the sea.

3.2 Potential Sources of Flooding

The main sources of flooding have been assessed as part of this appraisal. The specific issues relating to each one and its impact on this development are discussed below. Table 3.1 at the end of this section summarises the risks associated with each of the sources of flooding.

Flooding from Rivers (Tidal) – The site lies within Flood Zone 3 of the tidal reaches of the River Thames (main river) as shown on the EA's 'Flood Map for Planning' (Figure 2.3). The flood zone maps are used as a consultation tool by planners to highlight areas where more detailed investigation into the risk of flooding is required. Consequently, the risk of flooding from this source has been examined further in Section 5 of this report, with suitable mitigation measures succeeding this, therefore any risk of flooding from this source will be mitigated.

Flooding from Rivers, Ordinary or Man-Made Watercourses (Fluvial) – OS mapping shows that the Beverley Brook is located approximately 141m southeast of the site. However, inspection of the model outputs from the Beverley Brook Modelling Study (2009) shows that the site remains unaffected during the design flood event (1 in 100 year event, including an allowance for climate change). Furthermore, the Barnes Pond is located 89m northeast of the site, however, in the event floodwater were to emerge from this watercourse, aerial height data indicates that the land levels within the surrounding area fall towards the east of the site, where the land levels are approximately 1m lower than the levels on site. As such, floodwater would likely be directed here, away from the site. Consequently, flooding from these sources is considered to be *low*.

Flooding from the Sea – The site is a significant distance inland and whilst the River Thames is still tidally influenced at this location, the risk of flooding from the sea is considered to be *low*.

Flooding from Surface Water – Surface water, or overland flooding, typically occurs in natural valley bottoms as normally dry areas become covered in flowing water and in low spots where water may pond. This mechanism of flooding can occur almost anywhere but is likely to be of particular concern in any topographical low spot, or where the pathway for runoff is restricted by terrain or man-made obstructions.

The EA's 'Flood Risk from Surface Water' map (Figure 3.1) shows the development site is located in an area classified as having a 'very low' to 'low' risk of surface water flooding. The majority of the site is located within an area considered to be at 'very low' risk from surface water flooding, however there is a small area of shallow surface water accumulation within the garden of the existing dwelling on site. Given the isolated nature of this accumulation this would likely be down to rain falling on site and as such the proposed SuDS features on site should capture this rainwater (refer to Section 8). Taking this into consideration and given there are no records of surface water flooding on site, the risk of flooding from this source is considered to be *low*.

Notwithstanding the low risk of flooding from this source, the EA's mapping indicates that surface water accumulation could occur within the access road to the site. Therefore, it is recommended that residents sign up to the Met Office Weather Warnings, which could indicate when access to the site might be restricted following an extreme rainfall event (refer to Section 7.4).

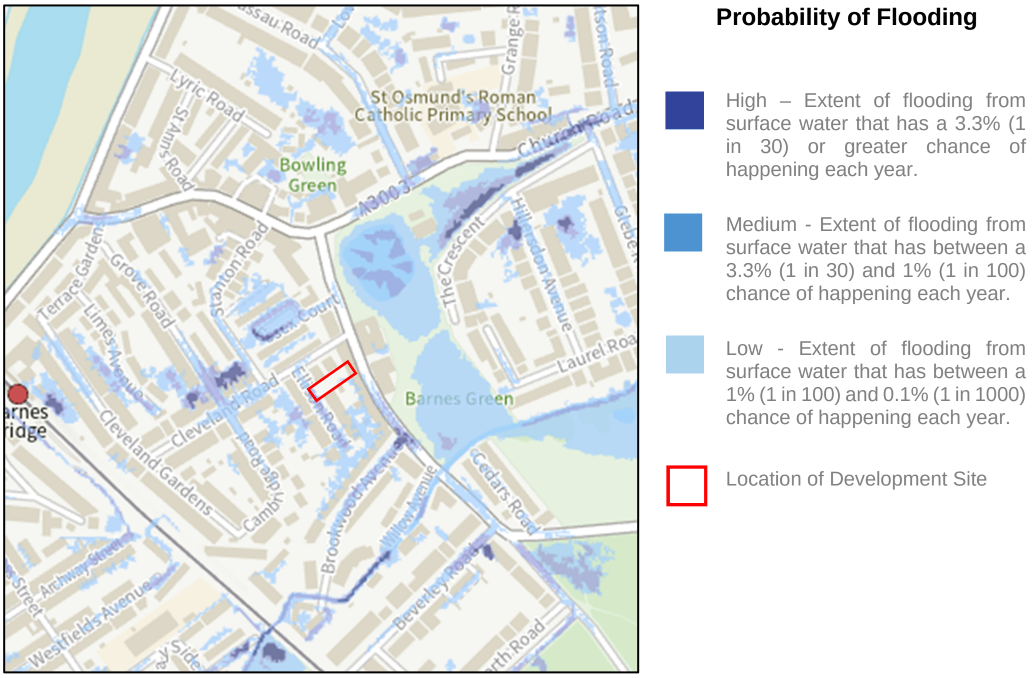

Figure 3.1 – EA's 'Flood Risk from Surface Water' map (© Environment Agency).

Flooding from Groundwater – Water levels below the ground rise during wet winter months, and fall again in the summer as water flows out into rivers. In very wet winters, rising water levels may lead to the flooding of normally dry land, as well as reactivating flow in 'bournes' (streams that only flow for part of the year).

The underlying geology in this location is London Clay Formation (clay and silt), overlain by superficial deposits of Kempton Park Gravel Member (sand and gravel). Whilst under certain circumstances the gravel deposits can be associated with groundwater emergence, the clay bedrock is typically impermeable. In this case, the Mapping on groundwater emergence provided as part of the Defra Groundwater Flood Scoping Study (May 2004) shows that the site itself is not located within an area where groundwater emergence is predicted. Furthermore, no groundwater flooding events were recorded during the very wet periods of 2000/01 or 2002/03 and there are no records of groundwater flooding at, or near to the site, contained within the SFRA. It is therefore concluded that the risk of flooding from this source is *low*.

Flooding from Sewers – In urban areas, rainwater is typically drained into surface water sewers or sewers containing both surface and wastewater known as "combined sewers". Flooding can result when the sewer is overwhelmed by heavy rainfall, becomes blocked, or has inadequate capacity; this will continue until the water drains away.

Inspection of the asset location mapping provided by Thames Water (Figure 3.2) identifies that the sewers in this area are separate foul and surface water sewers. The historic records set out in the SFRA identify that the site falls within a postcode area which has experienced 0-10 incidents of flooding from sewers in the past. However, the sewer flooding data used in the SFRA (provided by Thames Water) is relatively coarse and is limited to postcode data. Consequently, the area shown by the SFRA to have been affected by sewer flooding in the past is comparatively large, when in reality these recorded flood events are likely to be smaller isolated incidents.

When considering the localised risk of flooding, aerial height data reveals that the land levels within the area surrounding the development fall towards the northeast. As a result, if water was to exit the sewer network in this area (i.e. as a result of a blockage or following an extreme rainfall event) it would likely be contained within the highways and flow away from this area towards the lower lying land. Consequently, it is considered that the risk of flooding from this source is *low*.

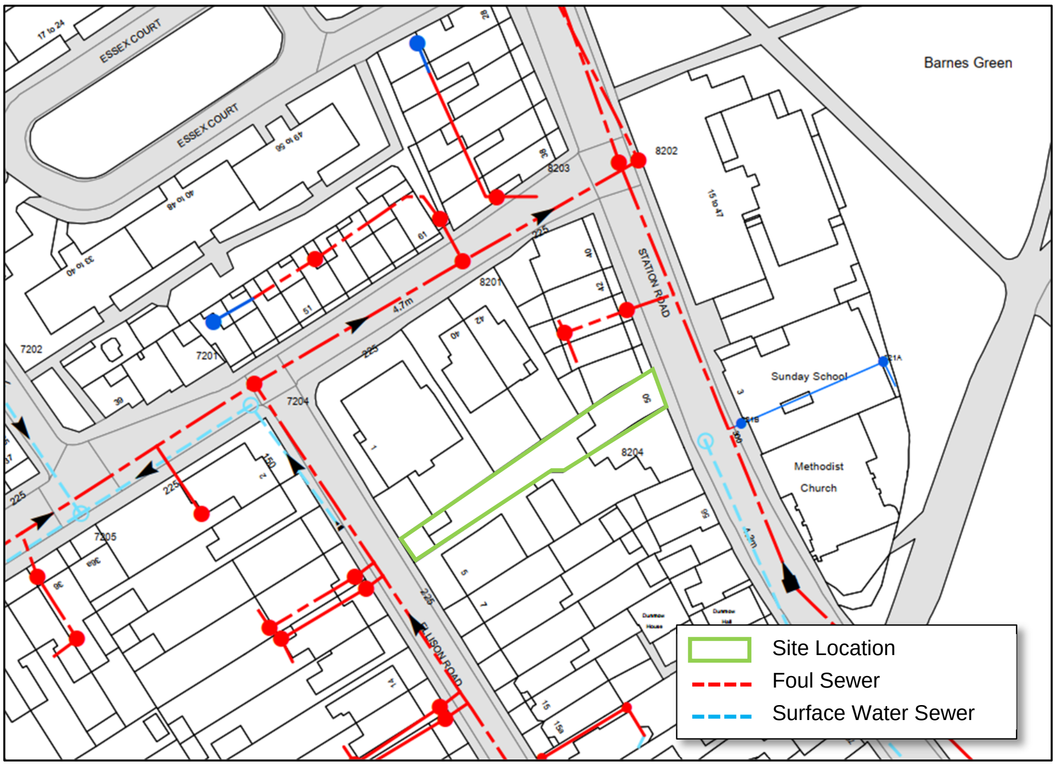

Figure 3.2 - Asset location mapping provided by Thames Water (a full scale copy can be found in Appendix A.2).

Flooding from Reservoirs, Canals and Other Artificial Sources – Non-natural or artificial sources of flooding can include reservoirs, canals, and lakes, where water is retained above natural ground level. In addition, operational and redundant industrial processes including mining, quarrying, and sand or gravel extraction, may also increase the depth of floodwater in areas adjacent to these features.

The potential effects of flood risk management infrastructure and other structures also needs to be considered. For example, reservoir or canal flooding may occur as a result of the facility being overwhelmed and/or as a result of dam or bank failure.

The EA's 'Flood Risk from Reservoirs' website (*Figure 3.3*) shows that the site is located within an area considered to be at risk of flooding from the failure of a number of reservoirs including the: Pen Pond Upper Lake, Richmond, Serpentine, Brent (aka Welsh Harp Reservoir), King George VI, Pen Pond Lower Lake, Richmond, Queen Elizabeth II, Queen Mary, Queen Mother, Staines North, Staines South, Walton -Bessborough, Walton – Knight, Wimbledon Park Lake and Wraybury.

When considering the risk of flooding from this source it is necessary to take into account the fact that these reservoirs are located a significant distance from the site and are owned and operated by the relevant water companies, who have a duty under the Reservoirs Act to ensure that they are maintained in a good working order and are inspected regularly. Consequently, due to the high standard of protection, the risk of flooding from these man-made water bodies is considered to be *low*.

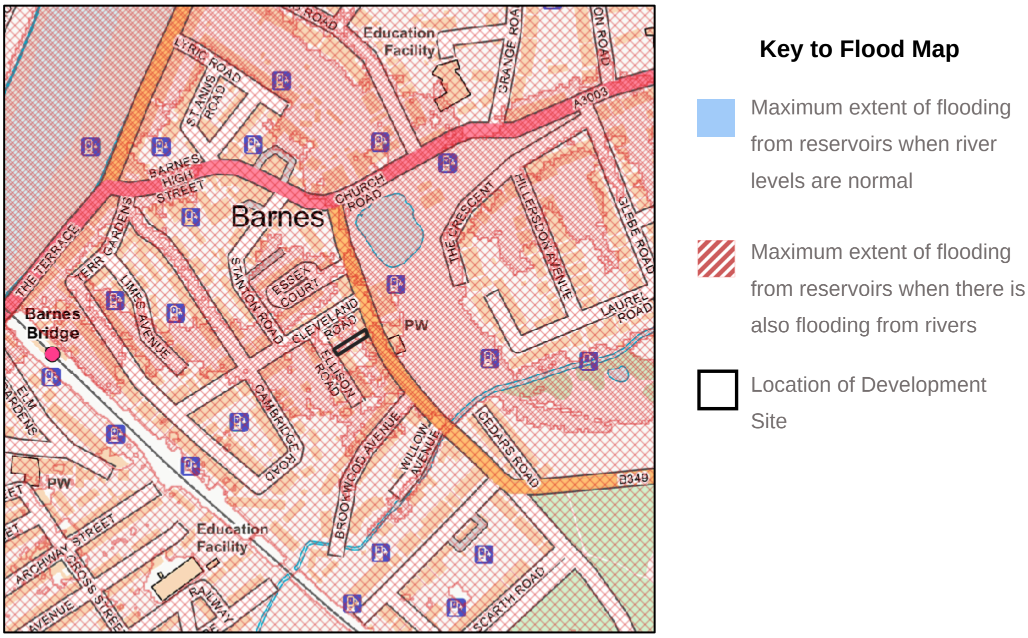

Figure 3.3 – EA's 'Risk of Flooding from Reservoirs' map (© Environment Agency).

A summary of the overall risk of flooding from each source is provided in Table 3.1 below.

Source of Flooding	Initial Level of Risk	Appraisal method applied at the initial flood risk assessment stage
Rivers (tidal)	Appraised further in Section 5	OS mapping and the EA's 'Flood Map for Planning'
Rivers, Ordinary and Man-made Watercourses (Fluvial)	Low	OS mapping, aerial height data and Beverley Brook Modelling (2009)
Sea	Low	OS mapping
Surface Water	Low	EA's 'Flood Risk from Surface Water' map, site-specific topographic survey and historic records contained within the SFRA and SWMP
Groundwater	Low	BGS Geology of Britain Map, Defra Groundwater Flood Scoping Study and mapping contained within the SFRA
Sewers	Low	Site-specific topographic survey, asset location data provided by Thames Water and historic sewer records contained within the SFRA
Artificial Sources	Low	OS mapping and EA's 'Flood Risk from Reservoirs' map

Table 3.1 – Summary of flood sources and risks.

3.3 Existing Flood Risk Management Measures

The flood defences in this area of the River Thames provide a 1 in 1000 year standard of protection and are all raised, man-made and privately owned. The EA inspects them twice a year to ensure that they remain fit for purpose, although they must be maintained by their owners to a crest level of 5.94m AODN (the Statutory Flood Defence Level in this reach of the Thames). The current condition grade for defences in this area is 2 (good), on a scale of 1 (very good) to 5 (very poor).

The Thames Barrier is a significant feature of the Thames Tidal Defences and is located between Newham and Greenwich. It became operational in October 1982 and was closed for the first time in February 1983. The Barrier is part of a system of tidal defences that currently protect London to extremely high standards. However, this level of protection is expected to decline in the future.

The Thames Estuary 2100 (TE2100) project sets out the strategic direction for managing flood risk in the Thames Estuary up to the year 2100. The TE2100 plan is now live and forms the overarching flood management strategy for the Thames Estuary. The TE2100 takes into account operation of the Thames Barrier when considering future levels. The Thames Barrier requires regular maintenance and with additional closures the opportunity for maintenance will be reduced. When this happens, river levels for which the barrier would normally be shut, will have to be allowed through to ensure that the barrier is not shut too often. For this reason, levels upstream of the barrier will increase and the tidal walls will need to be heightened to match (Table 3.2).

	Present Day	2065 to 2100	2100
Defence Level (m AODN)	5.94	6.00	6.40

Table 3.2 – Future defence levels for the River Thames tidal defences.

The 'Thames Estuary 2100' document can be found on the EA's website for the short, medium and long term Flood Risk Management strategy for London:

http://www.environment-agency.gov.uk/homeandleisure/floods/125045.aspx

4 Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential changes in the future and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present, and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary: for the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall and more frequent periods of long-duration rainfall could be expected.

These effects will tend to increase the size of Flood Zones associated with rivers, and the amount of flooding experienced from other inland sources. The rise in sea level will change the frequency of occurrence of high water levels relative to today's sea levels. It will also increase the extent of the area at risk should sea defences fail. Changes in wave heights due to increased water depths, as well as possible changes in the frequency, duration and severity of storm events are also predicted.

4.1 Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on the extreme flood level that is commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite state that residential development, such as the proposed development, should be considered for a minimum of 100 years.

4.2 Potential Changes in Climate

Extreme Sea Level

Global sea levels will continue to rise, depending on greenhouse gas emissions and the sensitivity of the climate system. The relative sea level rise in England also depends on the local vertical movement of the land, which is generally falling in the south-east and rising in the north and west.

Reference to guidance published by the EA specifies allowances for different epochs and regions across England. The predicted rates of relative sea level rise for the 'South East' region, relevant to the subject site, are shown in Table 4.1. These values which correspond with the Higher Central and Upper End percentiles (the 70th and 90th percentile respectively).

Administrative Region	Allowance Category	Net Sea Level Rise (mm/yr) (Relative to 2000)			
		2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2125
South East	Higher Central	5.7	8.7	11.6	13.1
	Upper End	6.9	11.3	15.8	18.2

Table 4.1 – Recommended contingency allowances for net sea level rise.

The development site is not subject to coastal flooding, however, the River Thames is a tidal river and therefore the figures above are still applicable. Although the River Thames is tidal and would have an increase in water level over time, due to climate change, the maximum likely water level (MLWL) within the Thames will be dependent on the operation of the Thames Barrier. The MLWLs are discussed further in Section 5 of this report.

It is recognised that both the MLWLs provided as part of the Thames Tidal Breach Modelling Study (2015) and the Thames Tidal Upriver Breach Inundation Assessment (2017) are based on data which was produced before the latest guidance on climate change was published. The models are therefore based on previous estimates of sea level rise as opposed to the values stated in Table 4.1. However, the EA has confirmed that the previous climate change allowances, which have been used within these models, '*represent the high end of the range of sea level rise projected by UKCP18*' (i.e. the new 'Upper End scenario'). Consequently, in the absence of detailed modelling which references the latest guidance, this modelling has been referenced in Section 5 of this report in order to quantify the risk of flooding at the site.

Peak Rainfall Intensity

Recognising that the impact of climate change will vary across the UK, the allowances were updated in May 2022 to show the anticipated changes to peak rainfall across a series of management catchments. The proposed development site is located in the **London Management Catchment**, as defined by the 'Peak Rainfall Allowance' maps, hosted by the Department for Environment, Food and Rural Affairs. Guidance provided by the EA states that this mapping should be used for site-scale applications (e.g. drainage design), in small catchments (less than 5km^2), or urbanised drainage catchments. For large rural catchments, the peak river flow allowances should be used.

The proposed development will include a surface water management strategy and the Peak Rainfall Allowances for the London Management Catchment should be applied to the hydraulic calculations undertaken as part of this.

For each Management Catchment, a range of climate change allowances are provided for two time epochs and for each epoch, there are two climate change allowances defined. These represent different levels of statistical confidence in the possible scenarios on which they are calculated. The two levels are as follows:

- Central: based on the 50th percentile
- Upper End: based on the 90th percentile

The EA has provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process. The range of allowances for the Management Catchment in which the development site is located are shown in Table 4.2 below.

Management Catchment Name	Annual exceedance probability	Allowance Category	2050s	2070s
London	3.3 %	Central	20%	20%
		Upper End	35%	35%
	1 %	Central	20%	25%
		Upper End	40%	40%

Table 4.2 – Recommended peak rainfall intensity allowances for each epoch for the London Management Catchment.

For a development with a design life of 100 years the Upper End climate change allowance is recommended to assess whether:

- there is no increase in flood risk elsewhere, and;
- the development will be safe from surface water flooding.

From Table 4.2 above, it can be seen that the recommended climate change allowance for this site is a 40% increase in peak rainfall. Therefore, this increase has been applied to the hydraulic drainage model constructed to inform the surface water management strategy. Where this allowance has been applied the abbreviation "+40%cc" has been used.

5 Probability and Consequence of Flooding

When appraising the risk of flooding to new development it is necessary to assess the impact of the 'design flood event'. Flood conditions can be predicted for a range of return periods, and these are expressed in either years or as a probability, i.e., the probability that the event will occur in any given year, or Annual Exceedance Probability (AEP). The design flood event is taken as the 1 in 200 year (0.5% AEP) event for sea or tidal flooding, including an appropriate allowance for climate change (refer to Section 4.2).

5.1 The Likelihood of Flooding

As identified in Section 3.3, development within the Thames basin area is protected by the Thames Barrier. Water levels upstream of the Barrier are controlled by closure rules depicted in the Thames Estuary 2100 (TE2100) plan, rather than being dictated by extreme weather events with a certain return period. In the absence of flood return period data, Maximum Likely Water Levels (MLWL) have been calculated (by others) for a number of time epochs, chosen to represent the impact of climate change on the water levels in the River Thames for the years 2014, 2065, and 2100. These time epochs are commensurate with the planning horizons defined by the NPPF for each type of development, e.g., residential development (2100) and commercial development (2065).

The development site for which this FRA has been prepared is classified as residential, and therefore the development has been appraised for a lifetime of 100 years (refer to Section 4.1). In the absence of flood level data in respect to event return periods, the site has been appraised to the 2100 epoch MLWLs, and this is henceforth termed the 'design event'.

The MLWLs have been calculated (by others) as part of the Thames Upstream Inundation Modelling Study (2015) for a number of time epochs, chosen to represent the impact of climate change. The MLWLs have been taken from the for the closest node point to the development site (2.17d) (Table 5.1).

Epoch	Maximum Likely Water Levels (2115) (m AODN)
Present Day	5.17
2065 to 2100	5.55
2100	5.81

Table 5.1 – Maximum likely water levels (at Node 2.17d) showing the highest levels permitted by the Thames Barrier for the year 2115.

As outlined in Section 3.3 of this report, the development site benefits from existing defence infrastructure along the River Thames, which provides a 1 in 1000 year standard of protection and have a crest height of 5.94m AODN in this area. Consequently, as shown in Table 5.1, the water level under current day conditions would remain below the crest height of the defences and the site would remain dry.

When taking into account future climate change scenarios, the MLWLs will increase to 5.81 AODN by the year 2100 (refer to Table 5.1). As part of the TE2100 Plan, the tidal defences are to be raised and adapted where required to keep the barrier closures within operational constraints. It is anticipated that by 2100, the tidal walls along both banks of the river will be raised to a minimum of 6.40m AODN in this area of the River Thames. As a consequence, the crest height of the defences will remain above the MLWL permitted by the barrier and therefore, the site would be protected by the defences and would continue to remain dry in the future. The actual risk of flooding to the site is concluded to be *low*.

Residual Risk of Flooding

Whilst the Thames tidal defences do provide a very high standard of protection, and are also maintained to a safe and serviceable standard, there is always the risk that a small section of this infrastructure could fail; either as a result of structural failure, or through less predictable mechanism such as ship impact or an act of terrorism. This is known as the *residual risk* of flooding.

The only way that the impact of such a scenario can be quantified is through the use of detailed numerical breach modelling. This type of modelling has been undertaken as part of the Thames Upriver Breach Inundation Modelling study completed in May 2017. The model simulates 5679 continuous tidal breaches along the River Thames from Teddington to the Thames Barrier.

Inspection of the model results provided by the EA shows that the maximum predicted flood level on site during a breach event is **5.06m AODN**. In this scenario, it is predicted that the entire site could be flooded, with floodwater predicted to reach a maximum depth of 0.55m (Figure 5.1).

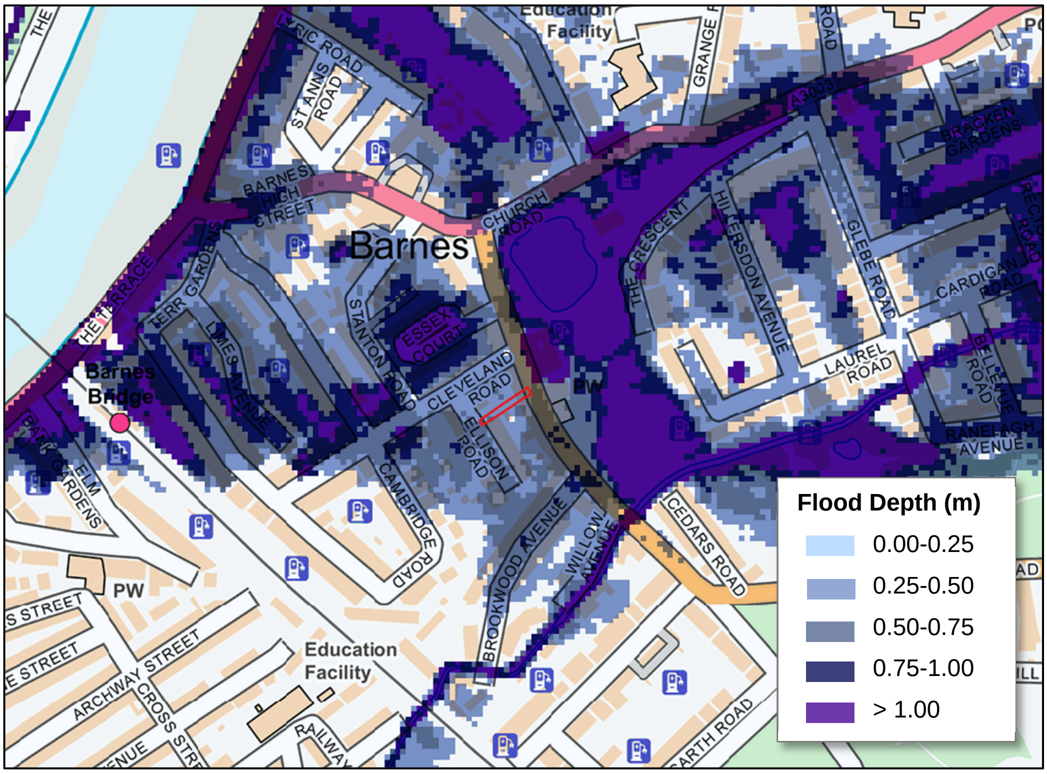

Figure 5.1 – Extract from the Thames Tidal Upriver Breach Inundation Modelling Study delineating the maximum flood depth and extent for the year 2100. (contains Ordnance Survey data © Crown copyright and database right 2024 - © Environment Agency).

6 Offsite Impacts and Other Considerations

6.1 Displacement of Floodwater

The construction of a new building within the floodplain has the potential to displace water and to increase the risk elsewhere by raising flood levels. A compensatory flood storage scheme can be used to mitigate this impact, ensuring the volume of water displaced is minimised. However, where development is proposed in tidal floodplains such as is the case here, it is generally accepted by the EA that raising the ground or building on the floodplain is unlikely to impact on maximum tidal levels. Consequently, it is concluded that compensatory floodplain storage is not required.

6.2 Public Safety and Access

The NPPF states that safe access and escape should be available to/from new developments located within areas at risk of flooding. The Practice Guide goes on to state that access routes should enable occupants to safely access and exit their dwellings during design flood conditions and that vehicular access should be available to allow the emergency services to safely reach the development.

When the proposed development is considered, it can be seen that the site is currently protected from tidal flooding under the design flood event, and consequently safe access and escape from the dwelling can be achieved.

However, during the extremely unlikely event that a breach should occur in the Thames defence infrastructure (residual risk event), that the site could be flooded. During a breach event, it is considered that safe access/egress to/from the dwelling will not be available. Therefore, it is recommended that the residents of the dwelling sign up to receive the EA's flood warning to ensure that they are aware of conditions which could result in flooding (Refer to Section 7.4). If it is not possible to evacuate the site before the onset of flooding, residents will have safe refuge within the dwelling which is elevated above the maximum predicted depth of flooding.

It should also be noted that the access roads to the site could be subject to surface water flooding following an extreme rainfall event, which could impact accessibility to the site. As such, it is recommended residents monitor the Met Office Weather Warnings (refer to Section 7.4), which would provide a forewarning for when this could occur.

6.3 Proximity to Watercourse and Flood Defence Structures

Under the Water Resources Act 1991 and Land Drainage Byelaws, any proposals for development in close proximity to a 'main river' would need to take into account the EA's requirement for an 8m buffer zone between the river bank and any permanent construction such as buildings or car parking etc. This buffer zone increases to 16m for tidal waterbodies and sea defence infrastructure.

The development site is located more than 300m from the tidal river Thames and the defence infrastructure. As such, the proposed development will not compromise any of the EA's maintenance or access requirements.

7 Flood Mitigation Measures

The key objectives of flood risk mitigation are:

- to reduce the risk of the development being flooded.
- to ensure continued operation and safety during flood events.
- to ensure that the flood risk downstream of the site is not increased by increased runoff.
- to ensure that the development does not have an adverse impact on flood risk elsewhere.

The following section of this report examines ways in which the risk of flooding at the development site can be mitigated.

Mitigation Measure	Appropriate	Comment
Careful location of development within site boundaries (i.e., Sequential Approach)	✓	Refer to Section 7.1
Raising floor levels	✓	Refer to Section 7.2
Land raising	x	Not required
Compensatory floodplain storage	x	Not required
Flood resistance & resilience	✓	Refer to Section 7.3
Alterations/ improvements to channels and hydraulic structures	x	Not required
Flood defences	x	Not required
Flood warning	✓	Refer to Section 7.4
Surface water management	✓	Refer to Section 8

Table 7.1 – Appropriateness of mitigation measures.

7.1 Application of the Sequential Approach at a Local Scale

The sequential approach to flood risk management can also be adopted on a site based scale and this can often be the most effective form of mitigation. For example, on a large scheme this would mean locating the more vulnerable dwellings on the higher parts of the site and placing parking, recreational land or commercial buildings in the lower lying and higher risk areas.

Given the site is located entirely within the residual tidal breach scenario there is limited opportunity to apply this approach in this instance. However, it can be seen that the development proposals have addressed this, locating the most vulnerable elements (sleeping accommodation) on the highest area of the ground floor and the first floor of the proposed dwelling.

7.2 Raising Floor Levels

The EA recommends that the minimum floor level of buildings at risk of flooding should be 300mm above the design flood level, which is the 1 in 200 year extreme water level plus the appropriate allowance for climate change. The EA's guidance also requires that all sleeping accommodation be raised a minimum of 600mm above the design flood level.

In this instance the maximum predicted flood level on site during a residual tidal breach scenario is 5.06m AODN. As such, the floor level requirements are 5.36m AODN for living accommodation and 5.66m AODN for sleeping accommodation. The applicant has confirmed that these floor level requirements will be met and the floor levels are indicated on the scheme drawings.

7.3 Flood Resistance and Resilience

The floor level of the proposed dwelling will be elevated above the maximum predicted flood level on site, however it is recommended that flood resilient construction techniques are employed on site to increase the flood resilience of the building.

Details of flood resilience and flood resistance construction techniques can be found in the document '*Improving the Flood Performance of New Buildings; Flood Resilient Construction'*, which can be downloaded from www.gov.uk.

A Code of Practice (CoP) for Property Flood Resilience (PFR) has been put in place to provide a standardised approach for the delivery and management of PFR. Further information on the CoP and guidance on how to make a property more flood resilient can be accessed, and downloaded, from the Construction Industry Research and Information Association (CIRIA) Website:

https://www.ciria.org/Resources/Free_publications/CoP_for_PFR_resource.aspx

7.4 Flood Warning

The EA operate a flood forecasting and warning service in areas at risk of flooding from rivers or the sea, which relies on direct measurements of rainfall, river levels, tide levels, in-house predictive models, rainfall radar data and information from the Met Office. This service operates 24 hours a day, 365 days a year. Whilst it is not possible to predict the occurrence of a breach, it is possible to receive forewarning of extreme flood conditions within the River Thames which could result in a failure of the defences. It is therefore recommended that the residents sign up to the EA's Flood Warning Service either by calling 0345 988 1188, or by visiting;

www.gov.uk/sign-up-for-flood-warnings

Inspection of the EA's 'Flood Risk from Surface Water' map (Figure 3.1) suggests that the site and surrounding area could also experience surface water flooding following an extreme weather event. Occupants of the dwelling are therefore recommended to monitor the Met Office's Weather Warnings to provide forewarning of weather conditions which could result in surface water flooding:

www.metoffice.gov.uk/weather/uk/uk_forecast_warnings.html

8 Existing Drainage

8.1 Existing Surface Water Drainage

The existing site drainage has not been surveyed, however, it is assumed that there is an existing connection to the public sewer system. Surface water runoff is discharged at an unrestricted rate from the existing site and this rate of discharge has been calculated for a range of rainfall events with varying return periods. These rates are outlined in Table 8.1 below. These hydrological calculations have been undertaken using the Modified Rational Method, and synthetic rainfall data derived using the variables obtained from the Flood Estimation Handbook (FEH) online web service.

Return Period (years)	Peak runoff from the existing site (l/s)
2	1.3
30	3.9
100	5.0

Table 8.1 – Summary of peak runoff rates for the existing site.

Thames Water (TW) has provided sewer mapping as part of their asset location data for the site and surrounding area. An extract of this mapping is provided in Figure 3.2 above and shows the location of public sewers in close proximity to the site.

From Figure 3.2 (above) it is evident that the sewers in this area are typically separated into dedicated surface water and foul water networks. The nearest surface water sewer to the site located approximately 12m northwest of the site within Ellison Road.

9 Sustainable Drainage Assessment

9.1 Site Characteristics

The important characteristics of the site that have the potential to influence the surface water drainage strategy are summarised in Table 9.1 below.

Site Characteristic	Development Site	
Total area of site	325 m^2	
Current site condition	Developed (Brownfield)	
Greenfield runoff rates (based on the FEH methodology)	1:1yr = 0.79 l/s/ha Qbar = 0.93 l/s/ha 1:30yr = 2.14 l/s/ha 1:100yr = 2.97 l/s/ha	
Infiltration	Assumed unavailable based on typical characteristics of underlying geology	
Current surface water discharge method	Assumed to drain to public sewer unattenuated	
Is there a watercourse nearby?	No	
Impermeable area *(excluding existing dwelling)*	**Existing** **~ 70 m^2**	**Proposed** **~ 176 m^2**

Table 9.1 – Site characteristics affecting rainfall runoff.

Based on the table above, it is evident that the development proposals will increase the total impermeable area across the site. As a result, the rate at which the surface water runoff is discharged from the site is likely to increase. Consequently, measures will need to be put in place to ensure that the impact of this additional surface water runoff is appropriately managed.

9.2 Opportunities to Discharge Surface Water Runoff

Policy SI 13 of the London Plan (2021) summaries a hierarchy of options for discharging surface water runoff from developments. Policy SI 13 favours managing surface water runoff at source, by either storing it for later **re-use** or allowing it to **infiltrate** into the ground. If this option is not viable, runoff should ideally be discharged into a watercourse. Water should only be conducted into the public sewer system if neither of these options are possible, with a connection into a surface water sewer being preferred over the discharge into either a combined or foul sewer.

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Water Re-Use – Water re-use systems should ideally be considered to reduce the reliance on the demand for potable water. However, such systems can rarely manage 100% of the surface water runoff discharged from a development, as this requires the yield from the building and hardstanding area to balance perfectly with the demand from the proposed development. Consequently, whilst rainwater recycling systems can be considered for inclusion within the scheme, an alternative solution for attenuating storm water will still be required.

Infiltration – Mapping hosted by the British Geological Survey (BGS) shows that the bedrock geology of the site is made up of London Clay Formation, with overlying superficial deposits of Kempton Gravel Member. The bedrock geology in this location is unlikely to be sufficiently permeable to support the use of infiltration SuDS. Furthermore, there is insufficient space on site to comply with Building Regulations (Part H) that requires a 5m easement between infiltration features and structures. As such, the use of infiltration is not considered suitable and an alternative solution for managing surface water runoff from the development will be required.

Discharge to Watercourses – There are no watercourses located within close proximity to the site. As a result, there is no opportunity to discharge surface water runoff from the development to an existing watercourse.

Discharge to Public Sewer System – With no alternative options available, it is assumed that a connection to the public sewer system will present the most viable solution for managing the surface water runoff discharged from the development.

9.3 Constraints and Further Considerations

The key constraints that are relevant to this development are listed below:

- There is limited open space to incorporate SuDS that require very large areas of land such as wetlands and large infiltration basins.
- Due to the poor infiltration rate, it will not be possible to reduce or maintain the volume of surface water runoff discharged from the development site.
- If additional surface water runoff is to be discharged into the public sewer system, or if a new connection is required, it will be necessary to gain consent for this connection from the sewerage undertaker (Thames Water).
- Ideally post development runoff rates should be restricted to greenfield runoff rates. However, on small sites where discharge rates are exceptionally low (less than 2.0l/s) higher rates are generally considered acceptable.

9.4 Proposed Surface Water Management Strategy

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with the results from a numerical drainage model constructed for the site, which can be used to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF can be met at the planning stage.

Existing Dwelling

There are no proposed changes to the existing dwelling in the northeast of the site. Therefore, this area of the site has been excluded from this assessment as it is assumed that this will continue to drain surface water runoff via the existing method.

Water Butts

To reduce the developments reliance on potable water supplies for external use there is the potential to incorporate water butts within the garden area. Typical sizes and dimensions of water butts are outlined below.

Typical house water butt options	Dimensions of a typical house water butt	Volume of storage provided (litres)
Type 1 (wall mounted – small)	1.22m high x 0.46m x 0.23m	100
Type 2 (standard house water butt)	0.9m high x 0.68m diameter	210
Type 3 (large house water butt)	1.26m high x 1.24m x 0.8m	510
Type 4 (column tank – very large)	2.23m high x 1.28m diameter	2,000

Table 9.2 – Estimated storage capacity of available water butts.

In this case the demand for potable water from the garden is likely to be relatively small and as a result, standard house water butts (typical 210 litre units) are likely to be the most appropriate size for inclusion within the scheme.

It is recognised that each of the water butts will need to overflow into the main drainage system for the site, to ensure that in the event the water butt is full prior to the onset of the design rainfall event, water can be discharged away from the properties without increasing the risk of flooding.

Green Roof

A green roof is proposed for inclusion on the rear flat roof of the dwelling. Rain landing on the roof, as well as the runoff from the rear of the pitched roof. will be intercepted by the green roof, which during low return period events will store and filter runoff within the soil substrate of the planted areas. The design of the green roof should include an adequate drainage layer to avoid stagnation and an overflow system, should the primary discharge pipe become blocked.

Although the inclusion of a green roof will provide a significant benefit to the quality of water discharged from the roof area under higher return period events, it is unlikely that a green roof can be designed to restrict the overall runoff rate. As such, additional SuDS will be required to attenuate surface water runoff from the development proposals.

Permeable Surfacing (tanked)

Runoff from the hardstanding areas across the site, in addition to overflow from the water butts and green roof will be directed via underground pipes into series of interconnected permeable surfacing systems located on the courtyard, rear hardstanding, and parking to the front of the development. The permeable surfacing on the courtyard, and parking is proposed to be underlain with a granular subbase. While the permeable surfacing on the rear hardstanding is proposed to be underlain with geo-cellular storage crates.

Both systems will be lined with an impermeable geo-textile liner and the rate at which runoff is permitted to exit the permeable surfacing systems will be restricted through the use of a complex flow control device. The permeable surfacing system can contain an overflow pipe which will direct water from the top of the paving system directly into the public sewer system, in the event that the flow control device fails or becomes blocked. Check valves should be specified to prevent backflow into the drainage system, should the public sewer system surcharge.

A summary of the Causeway Flow+ analysis for permeable surfacing is shown in Table 9.3 below.

Parameter	**Value (1:100yr+40%cc event)**		
SuDS	Permeable Surfacing A	Permeable Surfacing B	Permeable Surfacing C
Total area draining to permeable surfacing, including overflow from other SuDS and a 10% allowance for urban creep	~ 113 m^2	-	~ 84 m^2
Area of permeable surfacing	~ 13 m^2	~ 9 m^2	~ 16 m^2
Infiltration	Not permitted		
Sub-base depth	300 mm *(granular)*	500 mm *(geo-cellular)*	600 mm *(granular)*
Porosity	30 %	95 %	30 %
Flow control device	-	-	Complex flow control chamber: Vortex flow control device (Hydro-Brake or similar) at IL 24 mm orifice plate 400mm above IL
Limiting discharge rate	-	-	1.8 l/s
Critical storm duration	15 minutes	120 minutes	120 minutes
Overflow device	-	-	Pipe *Connects directly to the public sewer system*

Table 9.3 – Summary of permeable surfacing SuDS.

Runoff rates have been calculated for a range of annual return probabilities, including the 100 year return period event with a 40% increase in rainfall intensity to account for future climatic changes. These values are summarised in Table 9.4 for a range of return periods.

Return Period	**Existing Discharge Rate**	**Peak Discharge Rate**	**% Change**
1 in 2yr	1.3 l/s	1.1 l/s	15 %
1 in 30yr	3.9 l/s	1.3. l/s	66 %
1 in 100yr	5.0 l/s	1.3 l/s	74 %
1 in 100yr+cc	-	1.8 l/s	64 %

Table 9.4 – Summary of Causeway Flow+ *analysis for peak discharge rates for a range of return period events (+40%cc).*

In summary, it is evident that, with the inclusion of the proposed SuDS, there is the potential to accommodate all of the surface water runoff from the site up to, and including, the design rainfall event. This assumes the rate at which water is discharged to the public sewer system will be attenuated to a rate which is no greater than 1.8 l/s.

9.5 Indicative Drainage Layout Plan

Figure 9.1 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

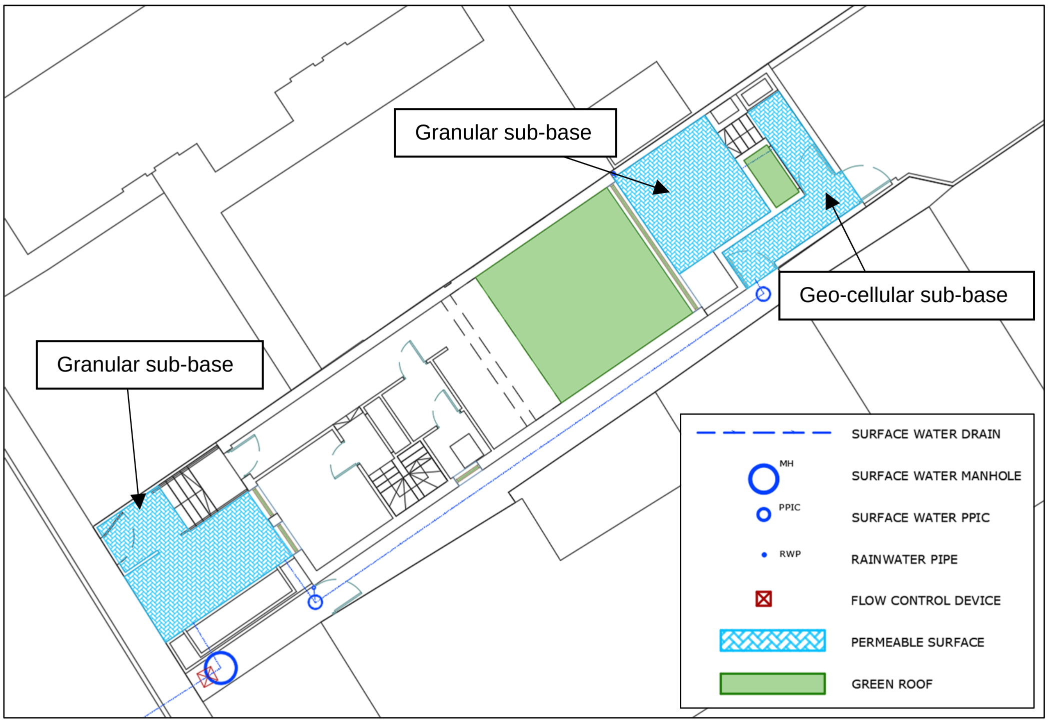

Figure 9.1 – Indicative drainage layout plan showing the proposed location of SuDS.

A full-scale copy of this layout is located in Appendix A.3 of this report.

9.6 Management and Maintenance

For any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime. Therefore, over the lifetime of a development there is a possibility that the performance of the system could be reduced, or could fail if it is not correctly maintained. This is even more important when SuDS form a part of the surface water management system, as these require a more onerous maintenance regime than a typical piped network.

The key requirements of any management regime are routine inspection and maintenance. When the development is taken forward to the detailed design stage, an 'owner's manual' will need to be prepared. This should include:

- A description of the drainage scheme.

- A location plan showing all of the SuDS features and equipment, such as flow control devices etc.
- Maintenance requirements for each element, including any manufacturer specific requirements.
- An explanation of the consequences of not carrying out the specified maintenance.
- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS recommended by this assessment, the most obvious maintenance tasks will be desilting and cleaning the permeable surfacing. General maintenance schedules have been included within the Appendix A.5 of this report, which demonstrate the maintenance requirements of the proposed SuDS.

For developments such as this that rely to some extent on the ongoing inspection and maintenance of SuDS, it will be necessary to ensure that measures are in place to maintain the system for the lifetime of the development. For this site, it is likely that the maintenance will be the responsibility of the site owner.

For some elements of the drainage system, including the flow control device, it may be necessary to use specialist contractors or have the original manufacturer inspect the features. If this is the case the owner will need to make allowances for these inspections and works to be carried out.

Further details of the maintenance and management strategy should be confirmed following the completion of a detailed drainage design for the development.

9.7 Sensitivity Testing and Residual Risk

When considering residual risk, it is necessary to consider the impact of a flood event that exceeds the design event, or the implications if the proposed drainage system was to become blocked.

For the water butts, there is the potential for a small amount of localised flooding to occur if the overflows from these features were to become blocked. Given the small catchment area draining to each of these features, the volume of floodwater will be relatively small, and it is unlikely to present a risk to the properties or occupants.

To minimise the risk of the uncontrolled discharge of floodwater from the permeable surfacing system, an overflow pipe has been incorporated into the design of this drainage feature. If the primary flow control device becomes blocked, this pipe will be used to bypass the flow control device, allowing excess water to drain directly to the public sewer system.

If a rainfall event was to occur that exceeds the design parameters of this assessment, or the outlet to the public sewer were to become blocked, it is likely that surface water runoff would exit the permeable surfacing system and flow overland. Any resultant overland flows are likely to follow the topography of the surrounding area and flow around the proposed dwelling, and away from the building towards Ellison Road, where any runoff would be intercepted by the highway drainage system.

This assessment also includes the provision of a large volume of storage for stormwater that is not currently provided on site. Taking the above into consideration, it is therefore concluded that the proposed drainage system outlined within this strategy will not result in an increased risk of flooding to properties at the site or within the surrounding area.

10 Conclusions and Recommendations

The overarching objective of this report is to appraise the risk of flooding at 50 Station Road, Barnes, to ensure that the proposals for development are acceptable and that any risk of flooding to the occupants of the proposed residential dwelling is appropriately mitigated.

The proposals for development are for the replacement of the existing garage building with a two-storey dwelling and associated car parking facilities. In this case the London Borough of Richmond upon Thames Local Plan states that the Sequential Test is not required given the location of the development site within 800m of the Barnes local centre. Notwithstanding this, given the location of the site within Flood Zone 3, it is required to apply the Exception Test and part of the aim of this report is the determine if the development passes Part B of the Exception Test.

The risk of flooding has been considered across a wide range of sources and it has been identified that the site is only at risk from flooding only during the extremely unlikely event of a breach within the Thames tidal flood defences. To manage the risk of internal flooding from this source and to ensure that the development does not result in an increased risk of flooding offsite, the following mitigation measures are recommended:

- **The floor level of the proposed dwelling will be elevated above the maximum predicted flood level on site.** During a breach in the Thames tidal flood defences, the site could be subject flooding. As such, the floor levels will be raised to meet the EA's floor level requirements of 300mm above the flood level for living accommodation and 600mm above the flood level for sleeping accommodation.

- **The ground floor of the building should be constructed using flood resistant and resilient design techniques.** This will increase the flood resilience of the building and reduce the impact of flooding in the unlikely event of a breach in the defences.

- **The residents should sign up to the EA's Flood Warning Service and Met Office Weather Warnings.** The EA's flood warnings will provide forewarning of extreme weather conditions which may result in flooding occurring. This forewarning will enable the residents to evacuate to an area located outside the predicted extent of flooding. If it is not possible to evacuate before floodwater reaches the site, safe refuge will be available within the dwelling, which is located above the design flood level. Additionally, residents should sign up to the Met Office Weather Warnings, which could provide a forewarning for when access roads to the site could be subject to surface water accumulation following an extreme rainfall event.

Section 9 of this report demonstrates how the peak discharge rate from the site can be reduced in line with local policies, and the aspirational targets of the London Plan. The preferred solution that has been identified comprises the use of water butts, a green roof, and a permeable surfacing system, which discharges to the public sewer, limiting the peak discharge rate to 1.8 l/s.

In conclusion, following the recommendations of this report, the occupants of the development will be safe and the development will not increase the risk of flooding elsewhere. Consequently, it has been demonstrated that the development can pass Part B of the Exception Test and will therefore meet the requirements of the NPPF.

11 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Thames Water Asset Location Data

Appendix A.3 – Indicative Drainage Layout

Appendix A.4 – Surface Water Management Calculations

Appendix A.5 – Maintenance Schedules

Appendix A.1 – Drawings

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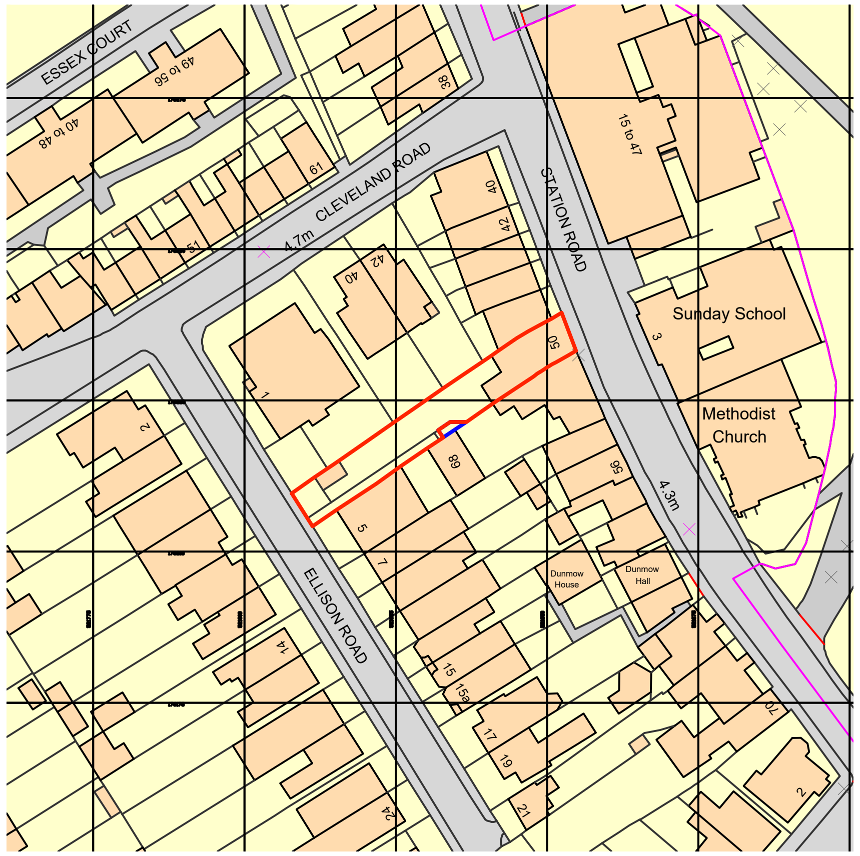


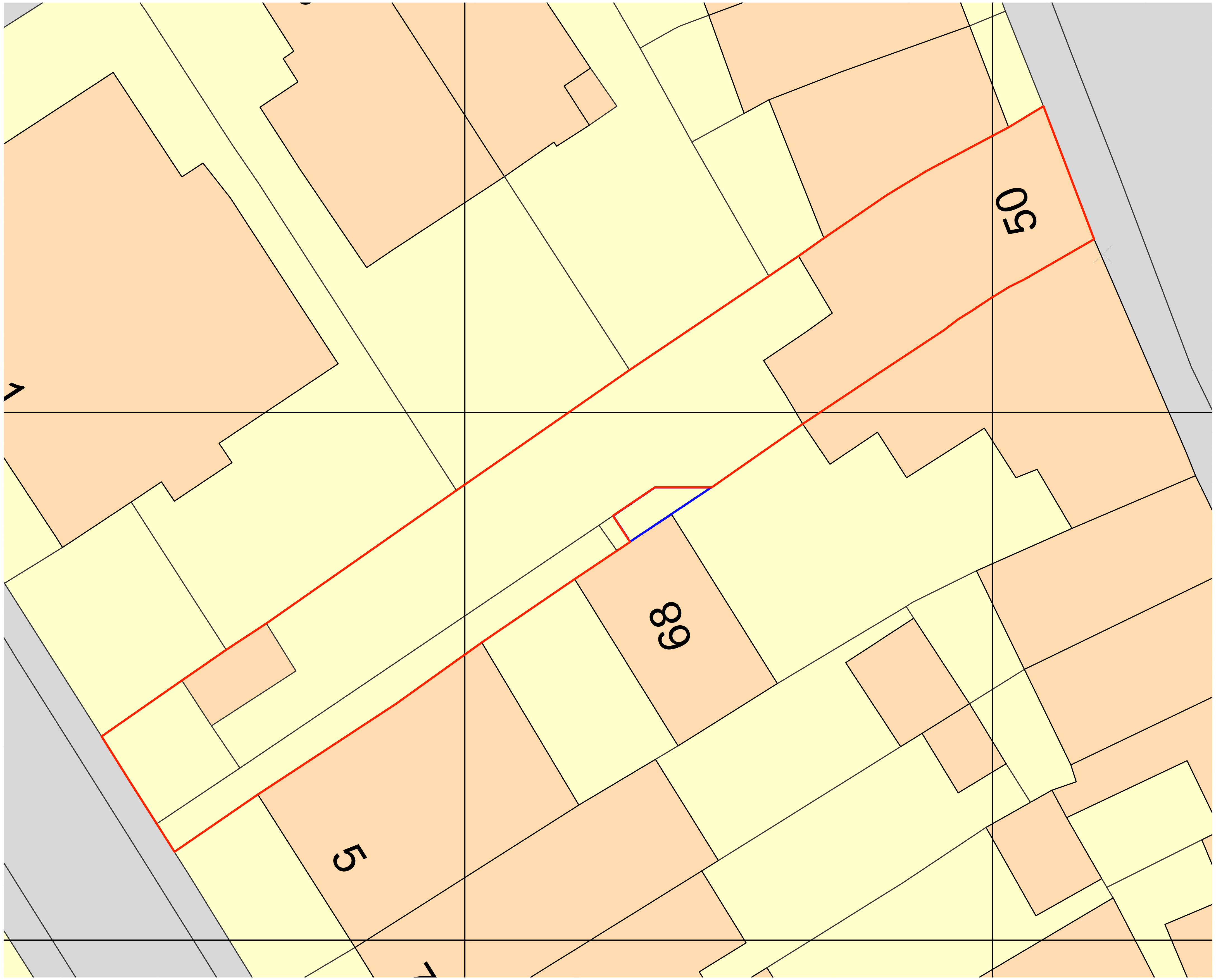
LOCATION PLAN

12.5m 25m 37.5m 50m 62.5m 75m 87.5m 100m

1:1250 scale

DEMISE LINE

NEIGHBOUR'S DEMISE



BLOCK PLAN

2m 4m 6m 8m 10m 12m 14m 16m

1:200 scale

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e: office@paperproject.co.uk
w. www.paperproject.co.uk

Revisions:		
Date:	Rev:	Revision description:

Job: 50 Station Rd, Barnes, London, SW13 0LP
Job No: 23581
Date: November 25, 2024
Scale: 1:1250 / 1:200 at A3
Status: PRE APPLICATION ADVICE
Dwg Name: Location / Block Plan
Dwg No: 23581_PL_001

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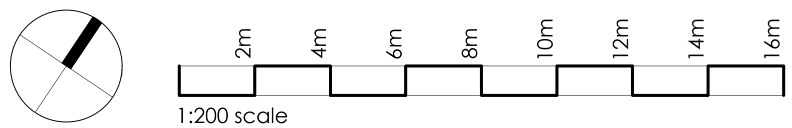

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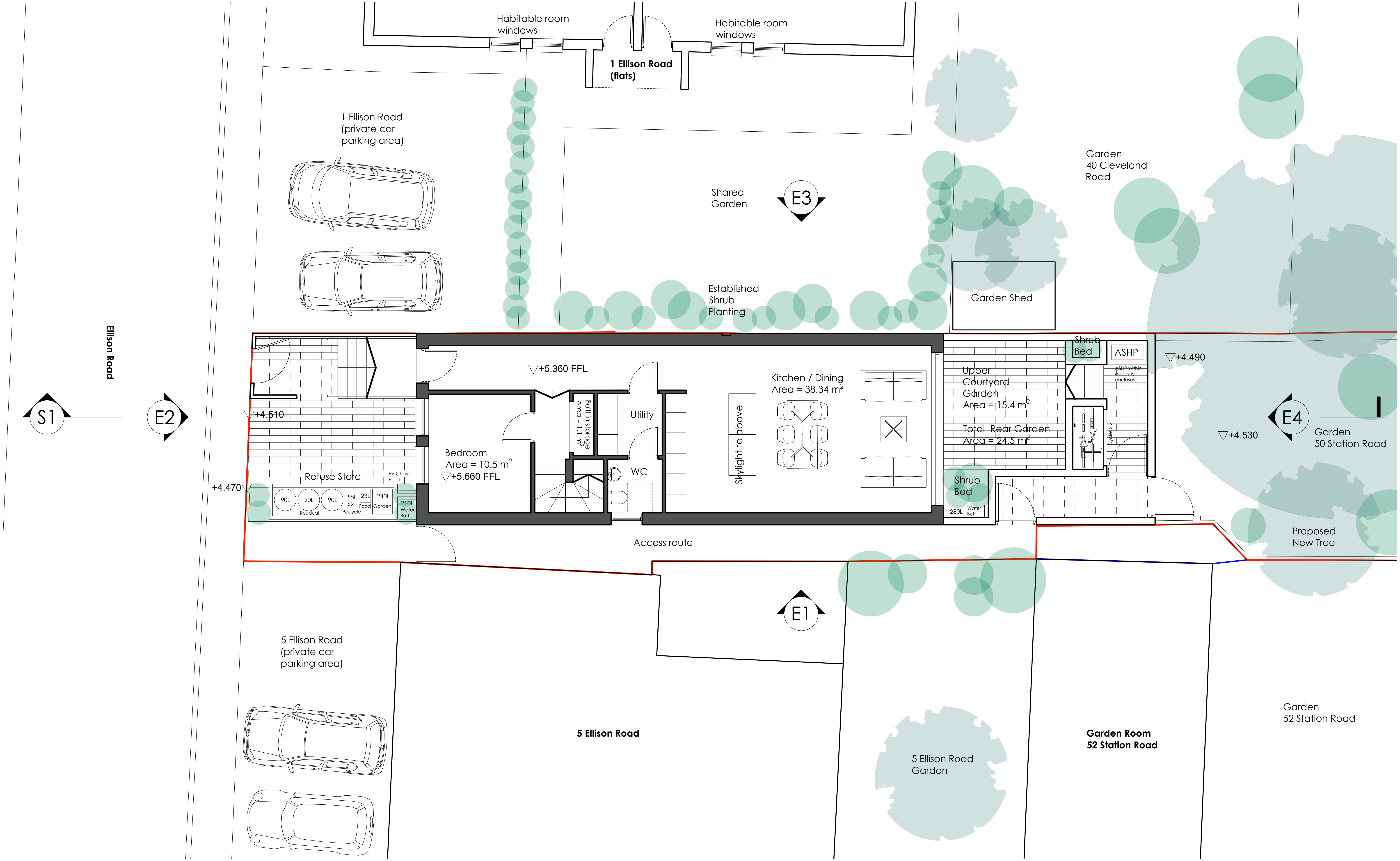
Revisions:

Date:	Rev:	Revision description:

Job: 50 Station Rd, Barnes, London, SW13 0LP
Job No: 23581
Date: November 25, 2024
Scale: 1:200 at A3
Status: **PLANNING APPLICATION**
Dwg Name: Proposed GA - Site Plan
Dwg No: 23581_PL_010



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Revisions:

Date:	Rev:	Revision description:

PROP SITE AREA = 142.7m2
HOUSE AREA = 113.5m2 GIFA
EXTERNAL SPACE = 52.18m2

1m 2m 3m 4m 5m 6m 7m 8m
1:100 scale

Job: 50 Station Rd, Barnes, London, SW13 0LP
Job No: 23581
Date: November 26, 2024
Scale: 1:100 at A3
Status: PLANNING APPLICATION
Dwg Name: Proposed GA - Ground Floor Plan
Dwg No: 23581_PL_011

Appendix A.2 – Thames Water Asset Location Data

Asset Location Search

Thames Water Property Searches

Herrington Consulting Limited
Barham Business Park,Unit 6 Barham Business Park

CANTERBURY
CT4 6DQ

Search address supplied	50 Station Road London SW13 0LP
Your reference	4101/JA
Our reference	ALS/ALS Standard/2024_5052636
Search date	19 September 2024

Notification of Price Changes

From 1st April 2024 Thames Water Property Searches will be increasing the prices of its CON29DW Residential and Commercial searches along with the Asset Location Search. Costs will rise in line with RPI as per previous years, which is sat at 6%.

Customers will be emailed with the new prices by February 28th 2024.

Any orders received with a higher payment prior to the 1st April 2024 will be non-refundable. For further details on the price increase please visit our website at www.thameswater-propertysearches.co.uk.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW

searches@thameswater.co.uk
www.thameswater-propertysearches.co.uk

0800 009 4540

Search address supplied: 50, Station Road, London, SW13 0LP

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.

For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

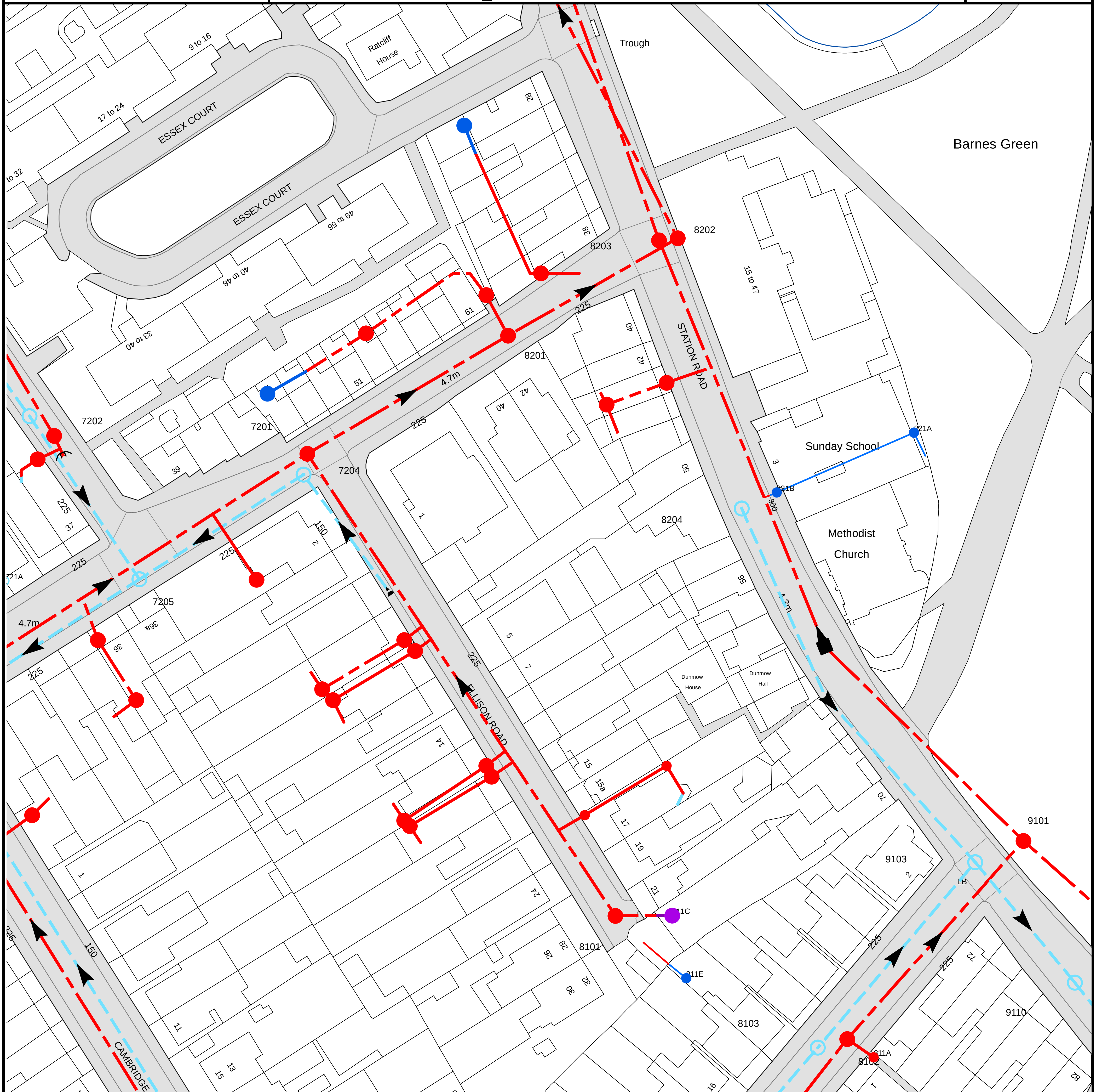
Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Asset Location Search Sewer Map - ALS/ALS Standard/2024_5052636



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 521827,176220

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9110	4.38	2.96
9101	4.32	1.58
81XR	n/a	n/a
81XX	n/a	n/a
8101	4.41	2.36
811C	n/a	n/a
811E	n/a	n/a
8103	4.28	3.29
8102	4.33	2.09
811A	n/a	n/a
9103	4.19	3.13
71YQ	n/a	n/a
81WZ	n/a	n/a
81XQ	n/a	n/a
81XY	n/a	n/a
81WY	n/a	n/a
71XY	n/a	n/a
71ZR	n/a	n/a
71ZP	n/a	n/a
82YP	n/a	n/a
72ZQ	n/a	n/a
82XY	n/a	n/a
721A	n/a	n/a
72ZY	n/a	n/a
7205	4.43	3.59
8204	4.28	n/a
821B	n/a	n/a
7204	4.71	3.67
72YW	n/a	n/a
7201	n/a	n/a
7202	4.7	2.1
821A	n/a	n/a
7207	4.51	3.63
82YT	n/a	n/a
72ZT	n/a	n/a
82YS	n/a	n/a
8201	4.76	1.53
72ZV	n/a	n/a
82XS	n/a	n/a
82YZ	n/a	n/a
8203	4.52	1.31
8202	4.47	n/a
82ZR	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Storm Sewer

Sludge Sewer

Foul Trunk Sewer

Surface Trunk Sewer

Combined Trunk Sewer

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Vacuum

Thames Water Proposed

Vent Pipe

Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

Sewer

Culverted Watercourse

Proposed

Decommissioned Sewer

Content of this drainage network is currently unknown

Ownership of this drainage network is currently unknown

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Meter

Dam Chase

Vent

Fitting

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Ancillary

Drop Pipe

Control Valve

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Inlet

Outfall

Undefined End

Other Symbols

Symbols used on maps which do not fall under other general categories.

Change of Characteristic Indicator

Public / Private Pumping Station

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Chamber

Operational Site

Ducts or Crossings

Casement

Ducts may contain high voltage cables. Please check with Thames Water.

Conduit Bridge

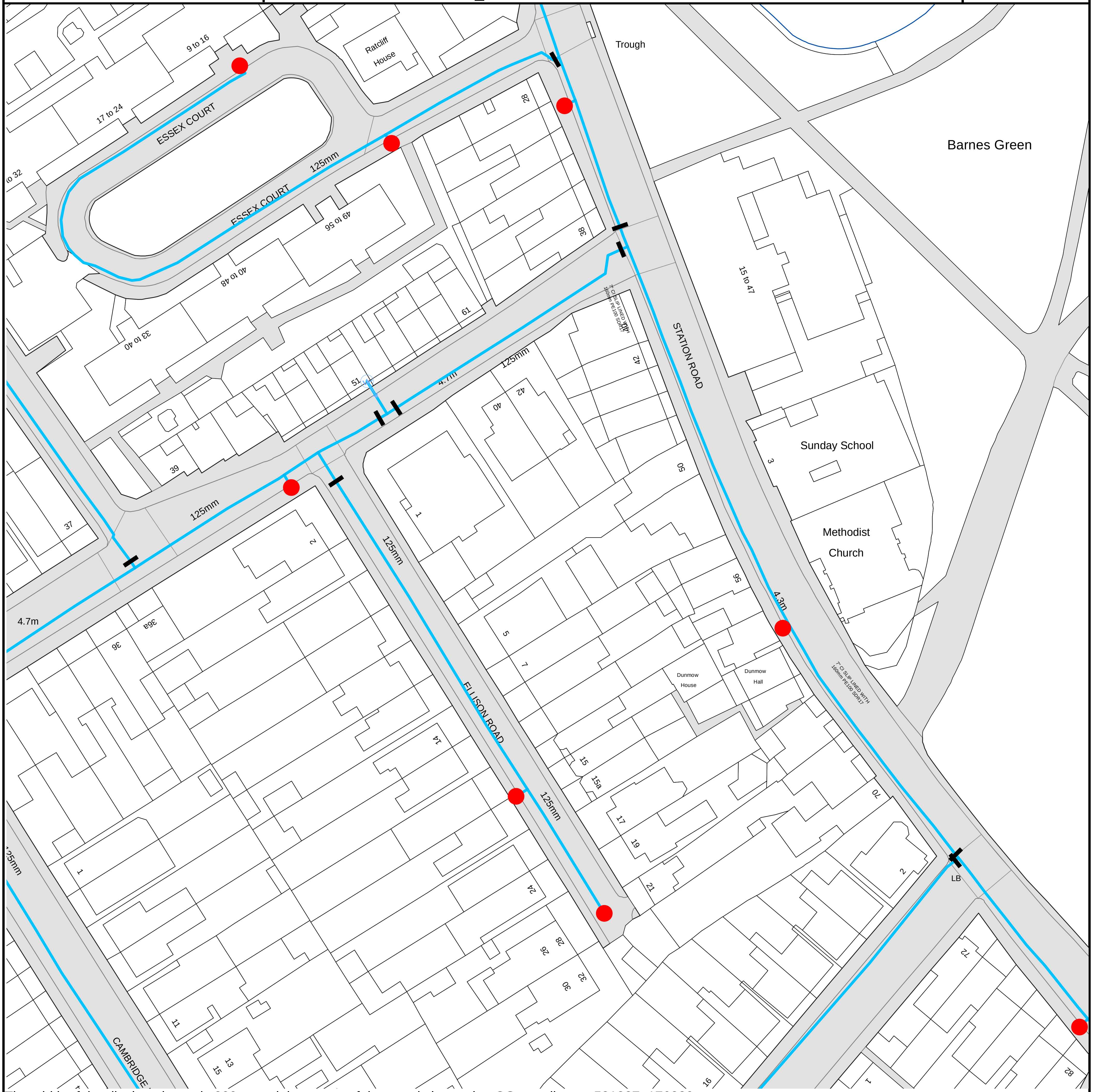
Subway

Tunnel

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters.
Text next to a manhole indicates the manhole reference number and should not be taken as a measurement.
If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Asset Location Search Water Map - ALS/ALS Standard/2024_5052636



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 521827, 176220.

Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

4"

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

16"

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

3" SUPPLY

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

3" FIRE

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

3" METERED

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General PurposeValve
- Air Valve
- Pressure ControlValve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger
- **Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

Payment Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment within 14 days of the date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service or will be held to be invalid.
4. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
5. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
6. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 980 8800.

If you are unhappy with our service, you can speak to your original goods or customer service provider. If you are still not satisfied with the outcome provided, we will refer the matter to a Senior Manager for resolution who will provide you with a response.

If you are still dissatisfied with our final response, and in certain circumstances such as you are buying a residential property or commercial property within certain parameters, The Property Ombudsman will investigate your case and give an independent view. The Ombudsman can award compensation of up to £25,000 to you if he finds that you have suffered actual financial loss and/or aggravation, distress, or inconvenience because of your search not keeping to the Code. Further information can be obtained by visiting www.tpos.co.uk or by sending an email to admin@tpos.co.uk.

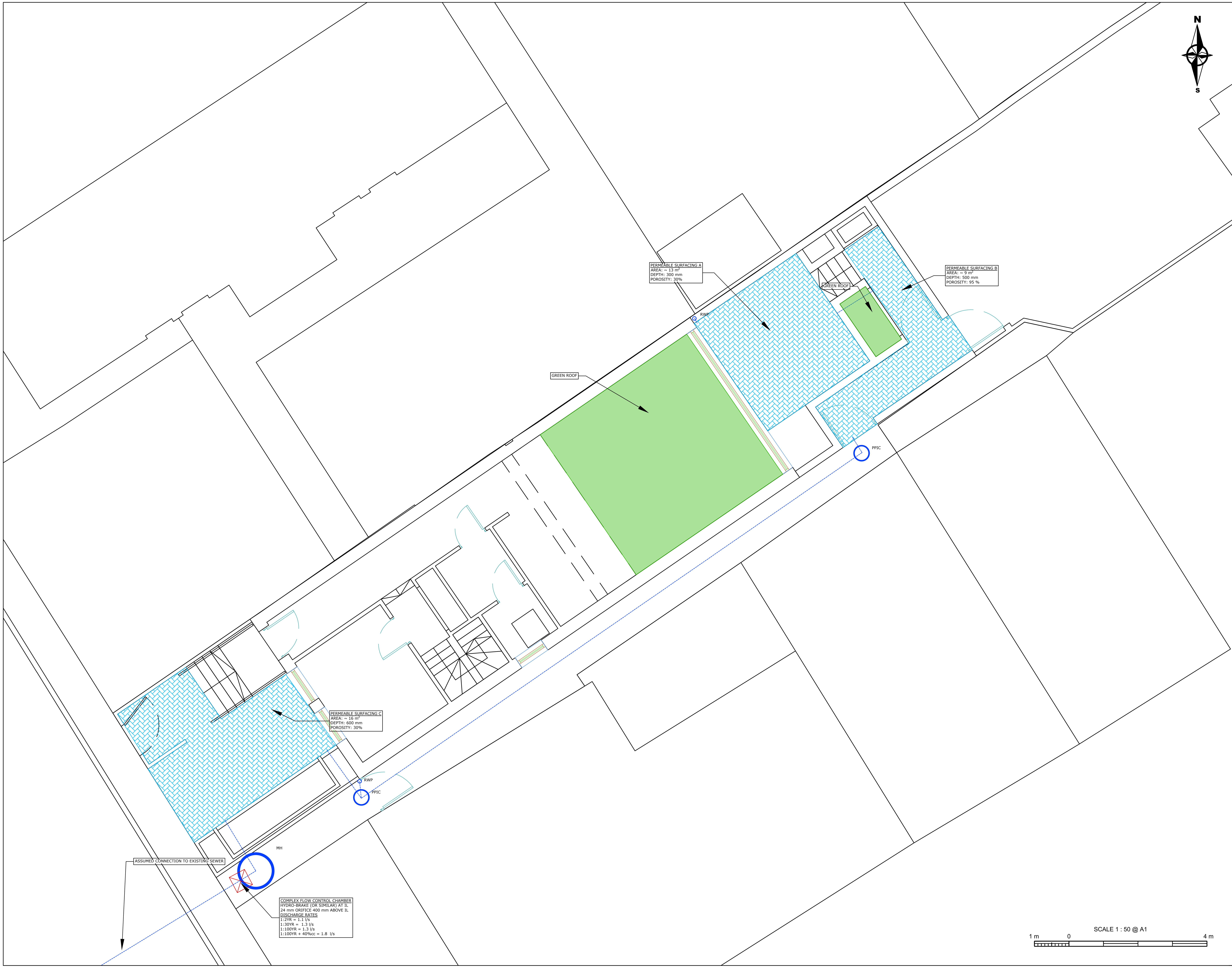
If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0300 034 2222 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**
Please Call **0800 009 4540** quoting your invoice number starting CBA or ADS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.

Appendix A.3 – Indicative Drainage Layout



GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
2. ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, EUROPEAN NORMS, CODES OF PRACTICE AND BUILDING PRACTICE.
3. ALL DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING THE WORKS ON SITE. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
4. ALL DRAINAGE SYSTEMS WILL NEED TO BE INSTALLED AND DESIGNED FOR SUITABLE LOADING REQUIREMENTS.
5. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL AND ALL NECESSARY LICENCES FROM THE HIGHWAY AUTHORITY AND/OR SEWERAGE UNDERTAKER BEFORE CARRYING OUT ANY WORKS.
6. THIS DRAWING WAS PRODUCED FOR USE IN CONJUNCTION WITH A PLANNING SUBMISSION AND SHOULD NOT BE USED FOR OTHER PURPOSES. A MORE DETAILED DESIGN INCLUDING PRODUCT SPECIFICATIONS WILL NEED TO BE PRODUCED PRIOR TO CONSTRUCTION.

KEY:

- SURFACE WATER DRAIN
- MH SURFACE WATER MANHOLE
- PPIC SURFACE WATER PPIC
- RWP RAINWATER PIPE
- FLOW CONTROL DEVICE
- PERMEABLE SURFACE
- GREEN ROOF

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Rev	Description	Author	Checked	Date
P0	First issue	NA	SMB	22/11/24

CLIENT: ANGELA MCDONALD

PROJECT: 50 STATION ROAD, LONDON

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:50	4101	NA	SMB

HC DWG REF: 4101_DWG_r0

DWG TITLE: INDICATIVE SURFACE WATER DRAINAGE LAYOUT

DWG No.: HC-4101-501

Appendix A.4 – Surface Water Management Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	0.350
Return Period (years)	100	Maximum Rainfall (mm/hr)	200.0	Include Intermediate Ground	✓
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Inverts		
Time of Entry (mins)	4.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Roof (rear)	0.010	4.00	5.360	1200	13.831	4.788	0.450
PP A			5.360		13.958	3.361	0.600
PP B			4.500		14.086	1.740	0.600
Roof (front)	0.008	4.00	5.360	1200	7.093	3.482	1.210
PP C			4.500		6.833	1.725	0.700
MH			4.470	1200	5.052	1.901	0.688
SEWER			4.400	1200	2.622	1.984	0.643
Existing	0.007	4.00	10.000	1000	-1.111	6.481	1.000
Existing 1			10.000	1000	10.286	6.147	2.000

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	Roof (rear)	PP A	1.433	0.600	4.910	4.880	0.030	47.8	100	4.02	187.8
1.001	PP A	PP B	2.000	0.600	4.760	4.400	0.360	5.6	100	4.03	187.8
1.002	PP B	PP C	19.000	0.600	3.900	3.800	0.100	190.0	150	4.47	187.8
2.000	Roof (front)	PP C	1.776	0.600	4.150	4.050	0.100	17.8	100	4.02	187.8
1.003	PP C	MH	1.790	0.600	3.800	3.782	0.018	99.4	150	4.50	187.8
1.004	MH	SEWER	2.431	0.600	3.782	3.757	0.025	97.3	150	4.54	187.8
Existing	Existing	Existing 1	10.000	0.600	9.000	8.000	1.000	10.0	1000	4.02	159.1

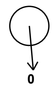
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.118	8.8	9.5	0.350	0.380	0.010	0.0	100	1.148
1.001	3.302	25.9	9.5	0.500	0.000	0.010	0.0	42	3.046
1.002	0.725	12.8	9.5	0.450	0.550	0.010	0.0	96	0.794
2.000	1.841	14.5	7.6	1.110	0.350	0.008	0.0	51	1.859
1.003	1.008	17.8	17.1	0.550	0.538	0.018	0.0	118	1.144
1.004	1.019	18.0	17.1	0.538	0.493	0.018	0.0	117	1.156
Existing	10.602	8327.0	5.6	0.000	1.000	0.007	0.0	19	1.553

Pipeline Schedule

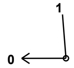
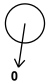
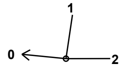
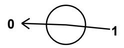
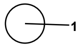
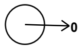
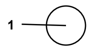
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	1.433	47.8	100	Circular	5.360	4.910	0.350	5.360	4.880	0.380
1.001	2.000	5.6	100	Circular	5.360	4.760	0.500	4.500	4.400	0.000
1.002	19.000	190.0	150	Circular	4.500	3.900	0.450	4.500	3.800	0.550
2.000	1.776	17.8	100	Circular	5.360	4.150	1.110	4.500	4.050	0.350
1.003	1.790	99.4	150	Circular	4.500	3.800	0.550	4.470	3.782	0.538
1.004	2.431	97.3	150	Circular	4.470	3.782	0.538	4.400	3.757	0.493
Existing	10.000	10.0	1000	Circular	10.000	9.000	0.000	10.000	8.000	1.000

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Roof (rear)	1200	Manhole	Adoptable	PP A		Junction	
1.001	PP A		Junction		PP B		Junction	
1.002	PP B		Junction		PP C		Junction	
2.000	Roof (front)	1200	Manhole	Adoptable	PP C		Junction	
1.003	PP C		Junction		MH	1200	Sealed Manhole	Adoptable
1.004	MH	1200	Sealed Manhole	Adoptable	SEWER	1200	Manhole	Adoptable
Existing	Existing	1000	Manhole	Adoptable	Existing 1	1000	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections		Link	IL (m)	Dia (mm)	Link Type
Roof (rear)	13.831	4.788	5.360	0.450	1200	Manhole	Adoptable		0	1.000	4.910	100	Circular
PP A	13.958	3.361	5.360	0.600		Junction			1	1.000	4.880	100	Circular
									0	1.001	4.760	100	Circular

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Node Type	MH Type	Connections		Link	IL (m)	Dia (mm)	Link Type
PP B	14.086	1.740	4.500	0.600		Junction			1	1.001	4.400	100	Circular
									0	1.002	3.900	150	Circular
Roof (front)	7.093	3.482	5.360	1.210	1200	Manhole	Adoptable		0	2.000	4.150	100	Circular
PP C	6.833	1.725	4.500	0.700		Junction			1	2.000	4.050	100	Circular
									2	1.002	3.800	150	Circular
									0	1.003	3.800	150	Circular
MH	5.052	1.901	4.470	0.688	1200	Sealed Manhole	Adoptable		1	1.003	3.782	150	Circular
									0	1.004	3.782	150	Circular
SEWER	2.622	1.984	4.400	0.643	1200	Manhole	Adoptable		1	1.004	3.757	150	Circular
Existing	-1.111	6.481	10.000	1.000	1000	Manhole	Adoptable		0	Existing	9.000	1000	Circular
Existing 1	10.286	6.147	10.000	2.000	1000	Manhole	Adoptable		1	Existing	8.000	1000	Circular

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	10080	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m^3/ha)	20.0	Check Discharge Volume	x
Summer CV	1.000	Skip Steady State	x	Starting Level (m)			

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0	100	0	0	0
30	0	0	0	100	40	10	0

Node MH Online Hydro-Brake® Control

Flap Valve	✓	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	3.782	Product Number	CTL-SHE-0056-1300-0800-1300
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.3	Min Node Diameter (mm)	1200

Node MH Online Orifice Control

Flap Valve	x	Invert Level (m)	4.182	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.024		

Node PP C Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	4.000	Depth (m)	0.600
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	3.800	Length (m)	4.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	98	Slope (1:X)	1000.0		

Node PP B Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Width (m)	3.000	Depth (m)	0.500
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	3.900	Length (m)	3.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	90	Slope (1:X)	1000.0		

Node PP A Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	6.500	Depth (m)	0.300
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	4.760	Length (m)	2.000	Inf Depth (m)	
Safety Factor	2.0	Time to half empty (mins)	0	Slope (1:X)	1000.0		

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof (rear)	10	4.944	0.034	1.9	0.0535	0.0000	OK
15 minute summer	PP A	10	4.778	0.018	1.9	0.0679	0.0000	OK
15 minute summer	PP B	12	3.933	0.033	1.9	0.2677	0.0000	OK
15 minute summer	Roof (front)	10	4.173	0.023	1.5	0.0290	0.0000	OK
30 minute summer	PP C	24	3.881	0.081	2.3	0.3792	0.0000	OK
30 minute summer	MH	22	3.887	0.105	3.5	0.1184	0.0000	OK
15 minute summer	SEWER	1	3.757	0.000	1.1	0.0000	0.0000	OK
15 minute summer	Existing	10	9.011	0.011	1.3	0.0098	0.0000	OK
15 minute summer	Existing 1	10	8.008	0.008	1.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof (rear)	1.000	PP A	1.9	0.850	0.216	0.0032	
15 minute summer	PP A	1.001	PP B	1.9	1.919	0.073	0.0020	
15 minute summer	PP B	1.002	PP C	1.4	0.301	0.106	0.1082	
15 minute summer	Roof (front)	2.000	PP C	1.5	1.149	0.104	0.0023	
30 minute summer	PP C	1.003	MH	3.5	0.375	0.195	0.0200	
30 minute summer	MH	Hydro-Brake®	SEWER	1.1				1.7
30 minute summer	MH	Orifice	SEWER	0.0				0.0
15 minute summer	Existing	Existing	Existing 1	1.3	1.056	0.000	0.0124	0.5

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof (rear)	10	4.974	0.064	5.5	0.1009	0.0000	OK
15 minute summer	PP A	10	4.791	0.031	5.5	0.1189	0.0000	OK
30 minute summer	PP B	27	4.061	0.161	6.6	1.3632	0.0000	SURCHARGED
15 minute summer	Roof (front)	10	4.191	0.041	4.4	0.0523	0.0000	OK
30 minute summer	PP C	26	4.061	0.261	6.7	1.2428	0.0000	SURCHARGED
30 minute summer	MH	26	4.061	0.279	4.1	0.3152	0.0000	SURCHARGED
15 minute summer	SEWER	1	3.757	0.000	1.3	0.0000	0.0000	OK
15 minute summer	Existing	10	9.018	0.018	3.9	0.0165	0.0000	OK
15 minute summer	Existing 1	10	8.016	0.016	3.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof (rear)	1.000	PP A	5.5	1.105	0.626	0.0071	
15 minute summer	PP A	1.001	PP B	5.5	2.618	0.212	0.0042	
30 minute summer	PP B	1.002	PP C	2.7	0.282	0.211	0.3345	
15 minute summer	Roof (front)	2.000	PP C	4.4	1.522	0.304	0.0051	
30 minute summer	PP C	1.003	MH	4.1	0.409	0.231	0.0315	
30 minute summer	MH	Hydro-Brake®	SEWER	1.3				5.0
30 minute summer	MH	Orifice	SEWER	0.0				0.0
15 minute summer	Existing	Existing	Existing 1	3.9	1.434	0.000	0.0272	1.5

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof (rear)	10	4.988	0.078	7.2	0.1229	0.0000	OK
15 minute summer	PP A	10	4.796	0.036	7.2	0.1374	0.0000	OK
120 minute summer	PP B	82	4.160	0.260	2.9	2.2139	0.0000	SURCHARGED
15 minute summer	Roof (front)	10	4.198	0.048	5.7	0.0611	0.0000	OK
120 minute summer	PP C	82	4.160	0.360	3.3	1.7190	0.0000	SURCHARGED
120 minute summer	MH	82	4.160	0.378	3.3	0.4274	0.0000	SURCHARGED
15 minute summer	SEWER	1	3.757	0.000	1.3	0.0000	0.0000	OK
15 minute summer	Existing	10	9.020	0.020	5.0	0.0185	0.0000	OK
15 minute summer	Existing 1	10	8.019	0.019	5.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof (rear)	1.000	PP A	7.2	1.167	0.820	0.0088	
15 minute summer	PP A	1.001	PP B	7.2	2.822	0.277	0.0051	
120 minute summer	PP B	1.002	PP C	1.4	0.272	0.113	0.3345	
15 minute summer	Roof (front)	2.000	PP C	5.7	1.619	0.394	0.0063	
120 minute summer	PP C	1.003	MH	3.3	0.384	0.186	0.0315	
120 minute summer	MH	Hydro-Brake®	SEWER	1.3				10.3
120 minute summer	MH	Orifice	SEWER	0.0				0.0
15 minute summer	Existing	Existing	Existing 1	5.0	1.525	0.001	0.0328	2.0

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof (rear)	10	5.051	0.141	11.0	0.2292	0.0000	SURCHARGED
15 minute summer	PP A	10	4.806	0.046	11.0	0.1739	0.0000	OK
120 minute summer	PP B	84	4.397	0.497	4.6	4.2341	0.0000	FLOOD RISK
120 minute summer	Roof (front)	84	4.396	0.246	3.7	0.3144	0.0000	SURCHARGED
120 minute summer	PP C	84	4.396	0.596	3.9	2.8517	0.0000	FLOOD RISK
120 minute summer	MH	84	4.396	0.614	3.2	0.6942	0.0000	FLOOD RISK
15 minute summer	SEWER	1	3.757	0.000	1.3	0.0000	0.0000	OK
15 minute summer	Existing	10	9.024	0.024	7.7	0.0227	0.0000	OK
15 minute summer	Existing 1	10	8.024	0.024	7.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof (rear)	1.000	PP A	11.0	1.400	1.247	0.0111	
15 minute summer	PP A	1.001	PP B	10.9	3.157	0.421	0.0069	
120 minute summer	PP B	1.002	PP C	1.4	0.260	0.111	0.3345	
120 minute summer	Roof (front)	2.000	PP C	3.8	1.377	0.261	0.0139	
120 minute summer	PP C	1.003	MH	3.2	0.375	0.182	0.0315	
120 minute summer	MH	Hydro-Brake®	SEWER	1.3				13.9
120 minute summer	MH	Orifice	SEWER	0.5				2.0
15 minute summer	Existing	Existing	Existing 1	7.7	1.711	0.001	0.0450	3.0

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Natasha Ames
Site name:	50 London Road
Site location:	Barnes

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.47175° N
Longitude:	0.24751° W
Reference:	2129199727
Date:	Nov 19 2024 18:09

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.728
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm):	597	606
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates 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 consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		0.93
1 in 1 year (l/s):		0.79
1 in 30 years (l/s):		2.14
1 in 100 year (l/s):		2.97
1 in 200 years (l/s):		3.48

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix A.5 – Maintenance Schedules

Operation and Maintenance Schedule – Green Roofs		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Routine Inspection	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Routine maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (i.e. year one), replace all dead plants as required	Monthly (usually the responsibility of the manufacturer)
	Post establishment replace dead plants as required (where >5% of coverage)	Annually (in Autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow gasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial Actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

General Operation and Maintenance Table for Green Roofs.

Operation and Maintenance Schedule – Water Butts		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Inspections and Maintenance	Inspection and cleaning of debris and sedimentation at the base of the tank.	At least once per year and following any noticeable deterioration in performance (e.g. observation of sediment entrained within water).
	Cleaning out of house guttering	As frequently as advised by maintenance plan for the property. Must be cleaned as soon as possible if blockage of guttering occurs.
	Inspection and repair of areas receiving overflow from the tank in the event of erosion	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
	inspection and repair of the inlet, outlet and overflows.	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
	cleaning of the tank, inlets, outlets, filters (if present) and removal of debris.	Inspected at least once every 3 months for the first year following installation, reduced inspection frequencies thereafter, at least once per year.
Remedial Maintenance	Repairing of any erosive damage or damage to the tank	As required, whenever damage leaks or erosion is detected.
	Inspection of the tank for debris, leaks or other damage and repair where necessary.	
	Inspection of area receiving overflow from the tank in the event of erosion	
Occasional maintenance	Replacement of any filters	When Required, due to clogging, or manufacturer specific instructions.

Typical Maintenance Requirements for Water Butts.

Operation and Maintenance Schedule – Pervious paving / surfacing		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Brushing and vacuuming (for driveways this can be a standard cosmetic sweep over whole surface).	At minimum once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – particular attention must be payed to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using a suitable weed killer which will not adversely affect water quality. Weed killer should be applied directly into the weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements.
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving / surfacing.	As required when damage or erosion is detected following inspection. For block paving systems jointing material to be replaced shortly after installation and subsequently when required.
	Remedial work to any depressions. Rutting and cracked or broken blocks and replace lost jointing material (where block paving is used).	
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

General Maintenance Requirements for Permeable Surfacing (additional requirements may apply depending on type of surfacing material used).

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Operation and Maintenance Schedule – Geo-Cellular Storage System		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months then annually
	Remove debris and sediment from the catchment surface, wherever is presents a risk to the performance of the drainage system,	Monthly, or as required based on inspection frequencies.
	Remove sediment from pre-treatment structurers (e.g. sediment traps) and from internal forebays	Annually or as required based on inspection frequencies
Remedial Actions	Repair; inlets, outlets, overflow pipes, and vent mechanisms	As required, based on inspections
	Replace tank or geotextile if significant damage is observed or geotextile is torn.	As required
Monitoring	Inspect and check all inlets, outlets, vents, and overflows to ensure that they are in good condition and operating as designed.	Following installation, and annually hereafter
	Survey inside of tank, and at any sediment trap mechanisms, for sediment build-up and remove sediment if necessary. Use inspections to develop a regular maintenance and inspection procedure for sediment removal.	Every 5 years, or as required if inspections show high siltation rates.

General Operation and Maintenance Table for Geo-Cellular Storage Systems