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# FLOOD RISK ASSESSMENT AND DRAINAGE STATEMENT

## Scheme name:

**LAND ADJACENT TO 39 PRIORY TERRACE, LONDON, NW6 4DG**

Document reference: **3832-39PR-ICS-XX-RP-C-001**

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# Foreword

This document has been prepared solely as a Flood Risk Assessment and Drainage Statement for the Client. No responsibility or liability will be accepted for any use that is made of this document other than by the Client for the purpose it was written. The conclusions resulting from this study and contained within this report are not necessarily indicative of future conditions or operating practices at or adjacent to the site.



Some of the information presented within this report is based on third party information which is believed to be correct; no liability will be accepted for any discrepancies in accuracy, mistakes or omissions in such information. The report also assesses the flood risk in relation to the requirements of the Environment Agency and as such assesses the site for a specific flood event and not all flood events. The contents of this document must not be copied or reproduced in whole or in part without the written consent of Infrastruct CS Ltd.

# Table of Contents

# 1.0 Summary

A Flood Risk Assessment (FRA) and drainage strategy has been undertaken to accompany the planning application for the proposed redevelopment at 39 Priory Terrace, Camden, London. This report has been prepared by Infrastruct CS Ltd on behalf of the Client in accordance with the guidelines set out in the National Planning Policy Framework.

The following table is an overview of the flood risk and drainage strategy for the proposed development of the site, based upon currently available information and finds the following –

| ITEM | RESPONSE |
|---|---|
| Site Location | The site is in vacant land, at the junction of Priory Terrace with Abbey Road, London, NW6 4DG, approximately 800m south of West Hampstead Station and 300m east of Kilburn High Road.<br>The approximate grid reference 525685E, 183965N |
| *Size and Current Land Usage* | The current site is approximately 121m2 in plan and currently vacant. |
| *Flood Zone* | The development site falls entirely within Flood Zone 1, which is classified as low probability of flooding. |
| *Fluvial Flood Risk* | **Low** – Refer to Section 6.1 |
| *Overland Flood Risk* | **Low** – Refer to Section 6.2 |
| *Groundwater Flood Risk* | **Medium** – Refer to Section 6.3 |
| *Sewerage Flood Risk* | **Low** – Refer to Section 6.4 |
| *Artificial Flood Risk* | **Low** – Refer to Section 6.5 |
| *Proposed Development* | The architectural proposals are for the construction of a new 3-storey building including a basement, with a total Gross Internal Area of 143m2. |
| *SuDS Features proposed for this scheme* | The proposed SuDS features for this site include an attenuation tank and a flow control device to reduce the runoff flows to maximum of 2.0 l/s. A green roof will cover approximately 25% of the total roof area. |

**Based on this assessment, it is concluded that in accordance with the Flood risk vulnerability and flood zone compatibility table in Section 5.6 from the Planning Practice Guidance document, the report considers the proposed development appropriate.**

# 2.0 Introduction

## 2.1 Commission

Old West Hampstead Estates Ltd have commissioned Infrastruct CS Ltd, to prepare a Flood Risk Assessment (FRA) and drainage statement to support a planning application for the re-development at a land next to 39 Priory Terrace, NW6 4DG**.** The proposed planning layout drawings are contained in Appendix A.

## 2.2 Guidance

This flood risk assessment has been compiled in accordance with the recommendations of the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG).

## 2.3 Aims and Objectives

The purpose of this flood risk assessment is to assess the potential flood risks by and to the proposed development. It will identify the flood risk zone, potential sources of flood risk, consider the proposed drainage and will be used to support the proposed planning application.

# 3.0 Site Details

## 3.1 Location

The site is in vacant land, at the junction of Priory Terrace with Abbey Road, London, NW6 4DG, approximately 800m south of West Hampstead Station and 300m east of Kilburn High Road.

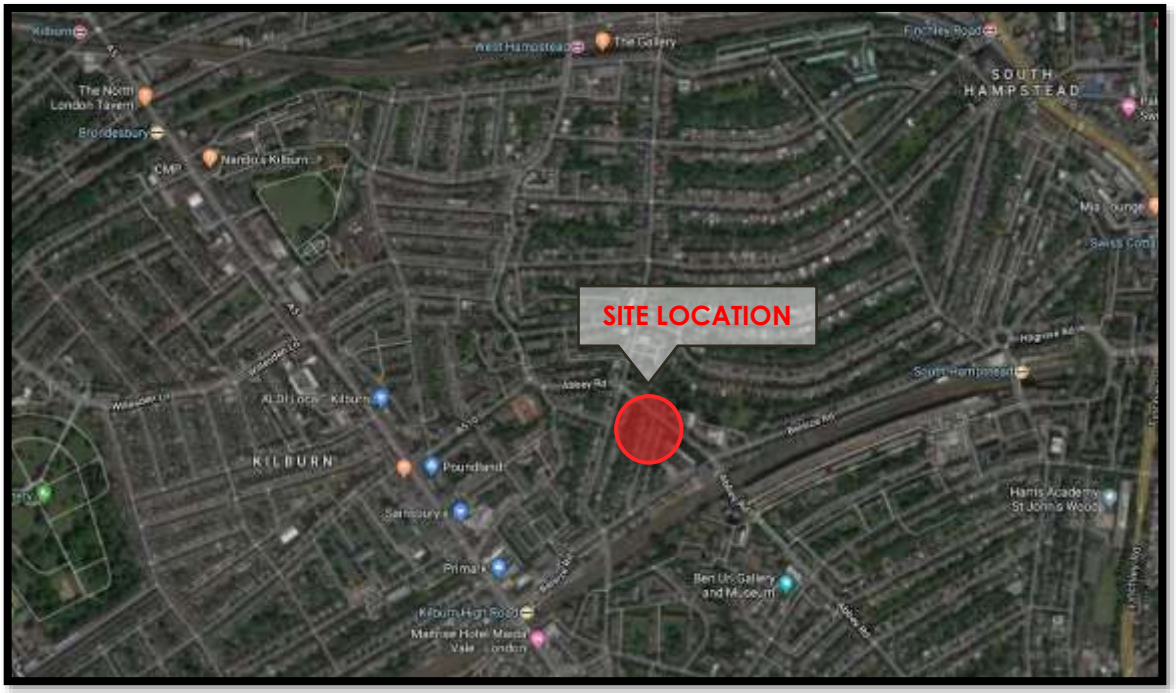



Figure 3.1.1 - Site Context


Figure 3.1.2 - Site location

## 3.2 Grid Reference

The Ordnance Survey National grid reference for the centre of the site is:

525685E, 183965N (Nat Grid TQ 25685 83965)

## 3.3 Topography and Site Description

The site covers an approximate brownfield area of 121m$^2$.

Levels are consistent around the site, approximately between 38.70mADO and 38.93mAOD. No topographic survey was available at the time of writing this report.

## 3.4 Ground Conditions

Reference to the Geological survey of Great Britain indicates the following strata:

**Superficial deposits:** N/A

**Bedrock geology:** London Clay Formation - Clay, Silt And Sand. Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period. Local environment previously dominated by deep seas. These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds.

Intrusive site investigations carried out adjacent/near the development and shown on the British Geological Survey database (BGS ID: TQ28SE380) confirmed the above mentioned.

## 3.5 Ground Water

Boreholes carried out in the vicinity of the site and shown in the BGS online maps, found no ground water within the trial pits at 15mbgl**.** In-situ testing is required to confirm the depth of groundwater.

A review of the maps within the Camden SFRA indicate that the site is at a low risk flooding.

## 3.6 Existing Site Drainage

The Thames Water wastewater plans show combined sewers in the vicinity of the site. There is a 1245x813mm sewer in Abbey Road, to the north and a Ø225mm sewer to the east, along Priory Terrace. The head of this latter network will be used, connecting the new system into manhole 6902. See Appendix B for Thames Water sewer records.

## 3.7 Existing Watercourses

The nearest main river watercourse to the site is the River Brent, a tributary of the River Thames, which is located 5.2 km to the northwest of the site. River Thames itself is 6Km to the southeast.

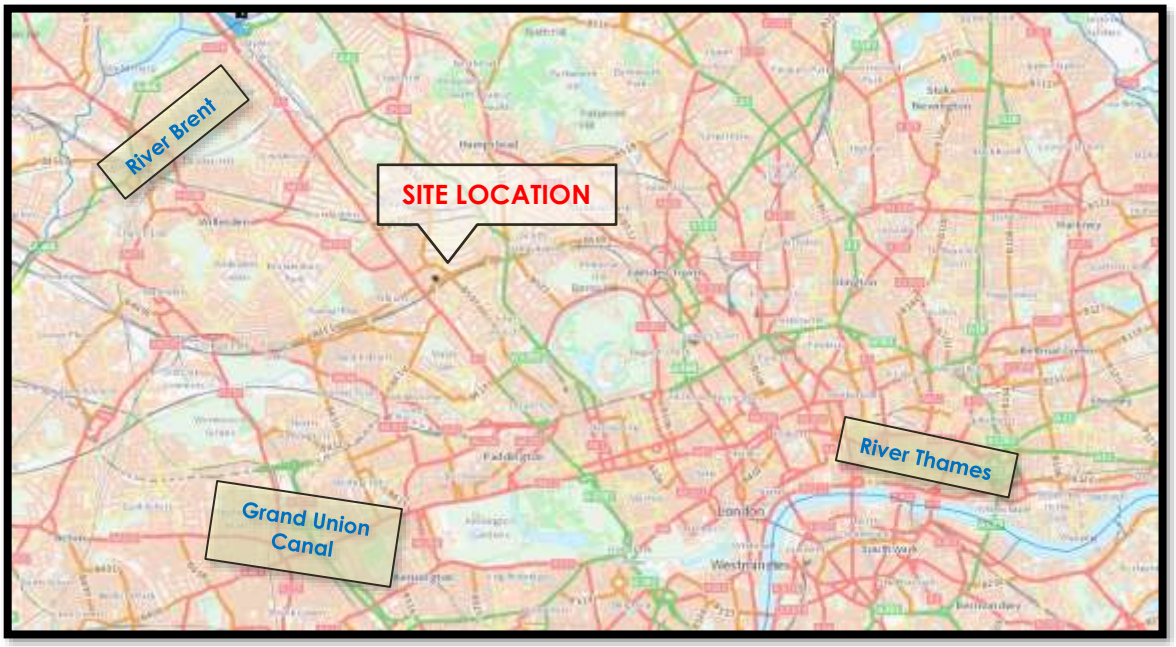



Figure 3.7.1 – Local Rivers

## 3.8 Environment Agency Groundwater and Aquifer Protection

Reference to the Environment Agency Groundwater protection zone map shows the area is sited outside all groundwater protection zone. The Environment Agency have defined Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes, and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.


Figure 3.8.1 – Groundwater Protection Zones

The Environment Agency use the zones to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

A study of the aquifer maps on the Environment Agency website revealed the site to be located outside any superficial or bedrock aquifer.

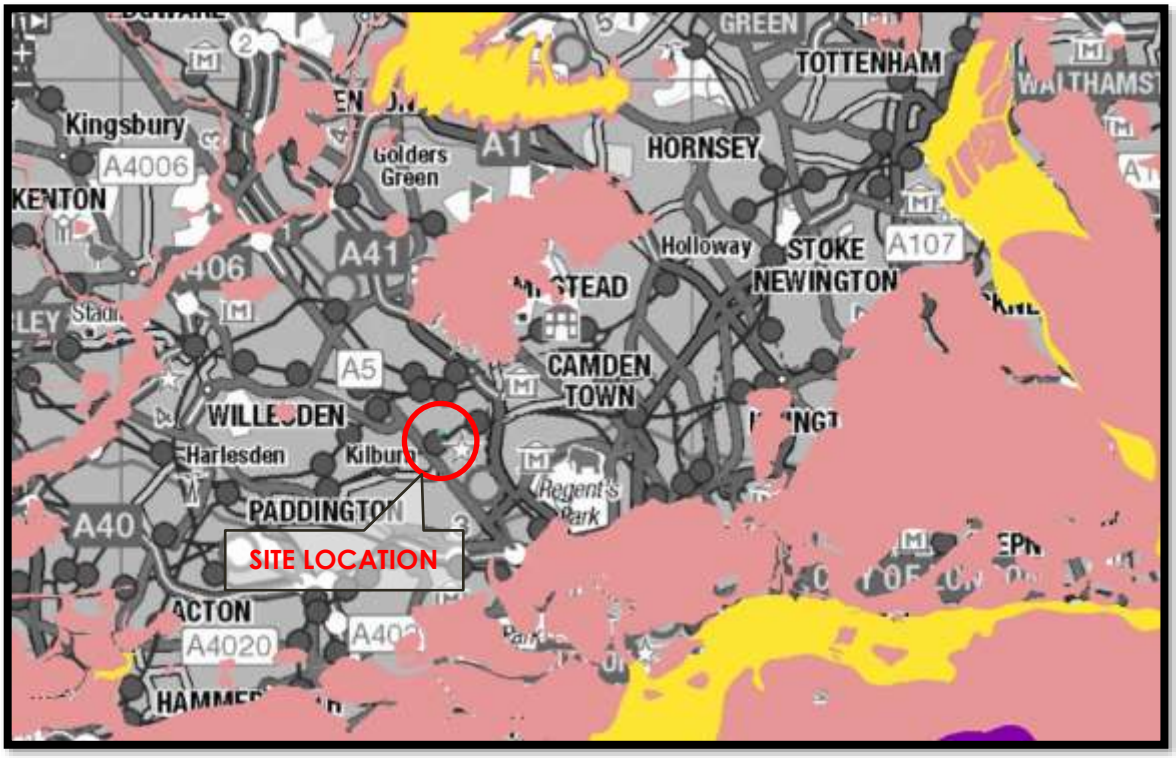



Figure 3.8.2 – Aquifer map from the Natural England MAGIC website.

# 4.0 Proposed Development

The proposals involve the construction of a 3-storey building including a basement, with a total Gross Internal Area of 143m2. The proposed development plans can be found in Appendix A.

# 5.0 Flood Risk Policy

## 5.1 Environment Agency Flood Map

The flood map for the development site shown below suggests that the site wholly falls within flood zone 1, which is defined as land assessed as having a less than 1 in 1000 annual probability of river flooding in any one year.


Figure 5.1 - Environment Agency Flood Zone map

## 5.2 The National Planning Policy Framework

The National Planning Policy Framework (NPPF) and the accompanying Planning Practice Guidance (PPG) gives direction for development with respect to flooding. These documents promote a sequential approach to encourage development away from areas that may be or are susceptible to flooding. In doing so it categorizes flood zones in the context of their probability of flooding, as shown in the table within Section 5.3 below.

## 5.3 Flood Zone Definition

The National Planning Policy Framework Definition of Flood Zones

| Flood zone | Fluvial | Tidal | Probability of flooding |
|---|---|---|---|
| **1** | < 1 in 1000 year | <1 in 1000 year | Low probability |
| **2** | Between < 1 in 1000 year and 1 in 100 year | Between <1 in 1000 year and 1 in 200 year | Medium Probability |
| **3a** | > 1 in 100 year | > 1 in 200 year | High probability |
| **3b** | Either > 1 in 20 or as agreed between the EA and the LPA | Either > 1 in 20 or as agreed between the EA and the LPA | Functional flood plain |

## 5.4 Flood Zones – Table 1 – Planning Practice Guidance

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

| **Zone 1 - Low Probability** |
|---|
| **Definition** |
| This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). |
| **Appropriate uses** |
| All uses of land are appropriate in this zone. |
| **FRA requirements** |
| For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements. |
| **Policy aims** |
| In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques. |

## 5.5 Flood Risk Vulnerability Classification - Extract from Table 2 - Planning Practice Guidance (PPG)

**More Vulnerable**

- Hospitals.
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels.
- Non–residential uses for health services, nurseries, and educational establishments.
- Landfill and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

## 5.6 Flood Risk Vulnerability & Flood Zone Compatibility Table

| Vulnerability classification flood zone | Essential infrastructure | Water compatible | Highly vulnerable | More vulnerable | Less vulnerable |
|---|---|---|---|---|---|
| **1** | √ | √ | √ | √ | √ |
| **2** | √ | √ | Exception test required | √ | √ |
| **3a** | Exception test required | √ | x | Exception test required | √ |
| **3b** | Exception test required | √ | x | x | x |

√ Development is appropriate x development is not appropriate

**The above table, taken from PPG (table 3), confirms that residential properties within flood zones 1 is appropriate development.**

## 5.7 Other Flooding Mechanisms

In addition to the potential for assessing flooding from fluvial and tidal sources NPPF also requires that consideration is given to other mechanisms for flooding:

- Flooding from land – intense rainfall, often in short duration, that is unable to soak into the ground or enter drainage systems, can run rapidly off land and result in local flooding.
- Flooding from groundwater – occurs when water levels in the ground rise above the surface elevations.
- Flooding from sewers – In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water sewers known as combined sewers. Flooding can result causing surcharging when the sewer is overwhelmed by heavy rainfall.
- Flooding from reservoirs, canals and other artificial sources – Non-natural or artificial sources of flooding can result from sources such as reservoirs, canals lakes etc, where water is held above natural ground levels.

## 5.8 Local Strategic Flood Risk Assessment SFRA and Local Policy

**London Plan:**

Policy 5.11 Green roofs and development site environs. Major development proposals should be designed to include roof, wall and site planting, especially green roofs and walls where feasible, to deliver as many of the following objectives as possible:

1. adaptation to climate change (i.e. aiding cooling)
2. sustainable urban drainage
3. mitigation of climate change (i.e. aiding energy efficiency)
4. enhancement of biodiversity
5. accessible roof space
6. improvements to appearance and resilience of the building
7. growing food.

Policy 5.13 of the London Plan is a key policy with regards to flood risk and water resource management. The policy provides the drainage hierarchy to ensure that reasonable measures are taken to sustainably manage and reduce the overall amount of rainfall being discharged from a development site. Developers should take measures to ensure that surface water management features higher up the drainage hierarchy are incorporated. The current London Plan drainage hierarchy is as follows:

1. Store rainwater for later use
2. Use infiltration techniques, such as porous surfaces in non-clay areas
3. Attenuate rainwater in ponds or open water features for gradual release
4. Attenuate rainwater by storing in tanks or sealed water features for gradual release
5. Discharge rainwater direct to a watercourse
6. Discharge rainwater to a surface water sewer/drain
7. Discharge rainwater to the combined sewer

Drainage should be designed and implemented in ways that deliver other policy objectives of this Plan, including water use efficiency and quality, biodiversity, amenity and recreation.

Developers should aim to achieve greenfield runoff rates via their proposed SuDS measures and ensure that surface water runoff is managed as close to the source as possible. The proposed measures should be incorporated in line with the Non-statutory technical standards for sustainable drainage systems, prepared by DEFRA in 2015

Policy SI12

Current and expected flood risk from all sources across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.

Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Surface Water Management Plan, where necessary, to identify areas where particular flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should co-operate and jointly address cross-boundary flood risk issues including with authorities outside London.

Development proposals which require specific flood risk assessments should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

Developments Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including authorities outside London, to safeguard an appropriate location for a new Thames Barrier.

Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.

Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Where possible, development proposals should set permanent built development back from flood defences to allow for any foreseeable future upgrades.

**LB Camden - Local Plan**

Policy CC2: Adapting to Climate Change: The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

- the protection of existing green spaces and promoting new appropriate green infrastructure;
- not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems
- incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate
- measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Policy CC3: Water and Flooding: The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible. We will require development to:

- incorporate water efficiency measures
- avoid harm to the water environment and improve water quality
- consider the impact of development in areas at risk of flooding (including drainage)
- incorporate flood resilient measures in areas prone to flooding
- utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible
- not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable. The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

# 6.0 Flood Risk to The Development

## 6.1 Flooding from Fluvial Sources

The proposed development site lies entirely within flood zone 1 which is classified as land assessed as having a less than 1 in 1000 annual probability of river or sea flooding and is appropriate to all uses of land.

***It is, therefore, the consideration of this FRA that the site has a low risk of flooding from fluvial sources.***

## 6.2 Flooding from Overland Flows

The risk of flooding due to overland flood flows is considered low by the Environment Agency. The surface water flood data for the site, shown below, indicates that there is medium flood risk immediately to the north of the site, near the garages and along Abbey Road, but very low risk within the site itself. There is currently a wall protection the site from water runoff.

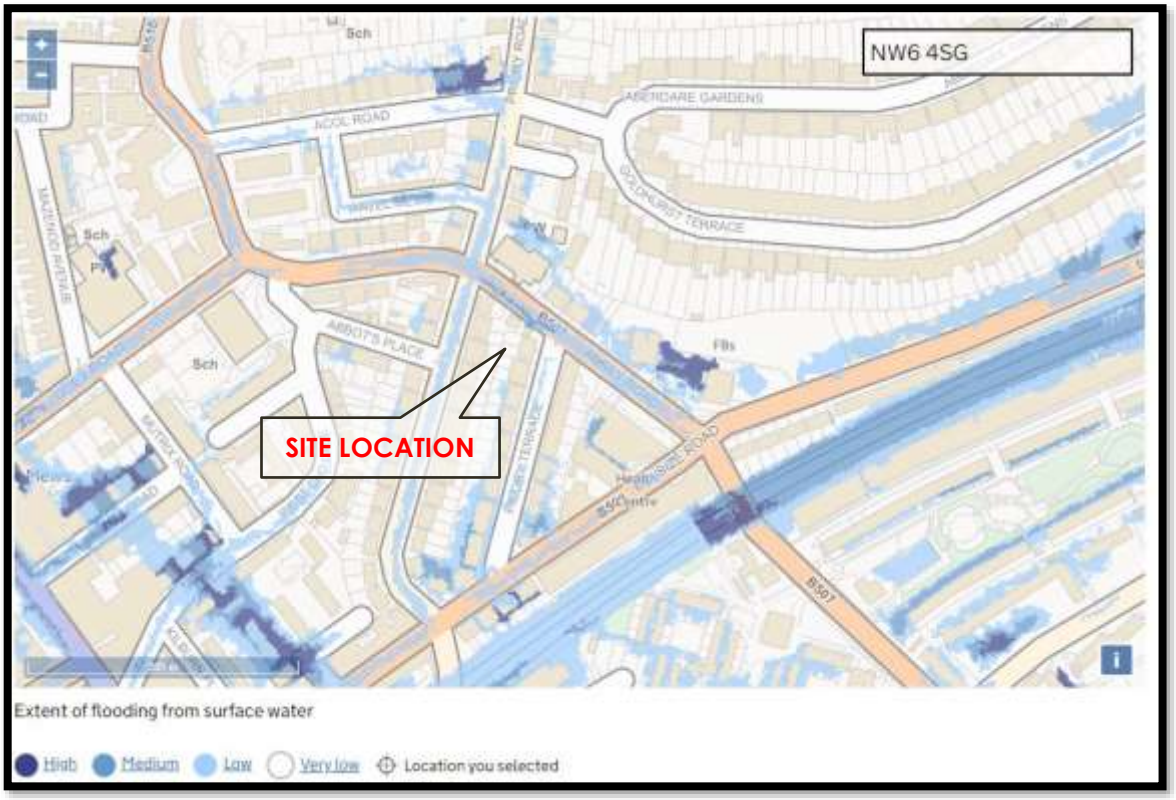



Fig 6.2 – Environment Agency Flood Risk from Surface Water map

***It is, therefore, the consideration of this FRA that the site has a low risk of flooding from overland flow.***

## 6.3 Flooding from Rising Groundwater

Groundwater flooding occurs because of the underground water table rising, which can result in water emerging through the ground and causing flooding in extreme circumstances. This source of flooding tends to occur after extensive periods of heavy rainfall. Groundwater flooding can occur in areas where the underlying soil and bedrock can become saturated with water. Therefore, ground composition and aquifer vulnerability are significant influences on the potential rate of groundwater flooding.

A majority of the sub-region is underlain by Thames Group (also referred to as London Clay) bedrock, a composition of silty clay/mudstone, sandy silts and sandy clayey silts of marine origin. This geological unit generally has a low hydraulic conductivity which means water does not easily move through it.

The proposals include a basement and therefore the potential for the water table to raise above the basement level is higher. Since the water table level is unknown, they must be confirmed via groundwater monitoring over a period of time, ideally in winter.

The site is shown outside the "Increased Susceptibility to Elevated Groundwater" area but nearby a location where a groundwater flood incident occurred in the past, identified by the Environment Agency. See map in Appendix E.

***It is, therefore, the consideration of this FRA that the site has a medium risk of flooding from rising groundwater levels.***

## 6.4 Flooding from the Local Sewerage Network

Sewer flooding can occur due to sewer infrastructure failure or due to an increased flow and volume of water entering a sewer system which exceeds its hydraulic capacity, causing the system to surcharge. If sewer outfall points are either blocked or submerged due to high water levels, water can back up in a sewer system and cause flooding. These issues can result in water overflowing from gullies and manholes, causing flooding in the local area. Blockages caused by sediment or debris can further exacerbate the probability of sewer flooding.

Drainage in the sub-region is serviced by Thames Water Utilities who provide surface water, foul and combined sewer systems. Modern sewer systems are designed to be separate surface water and foul water systems, typically accommodating up to 1 in 30-year rainfall events. However, sewer system segments across London vary in capacity due to age. Older segments have a smaller capacity and may not be designed to accommodate rainfall events as significant as 1 in 30-year events.

The Thames Water historical sewer flooding dataset provides details on the number of reported sewer flood incidents within a four-digit postcode area. Information on historical sewer flooding is shown in the SFRA indicates no flooding from sewers in the vicinity of the site. Moreover, the site is protected to overland flows with the existing wall, to be retained.

***It is, therefore, the consideration of this FRA that the site has a low risk of flooding by surcharging of the local sewer network.***

## 6.5 Flooding from Reservoirs, Canals & Other Artificial Sources

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

Flooding may result from the failure of engineering installations including flood defence, land drainage pumps, sluice gates and floodgates. Hard defences may fail through the slow deterioration of structural components such as the rusting of sheet piling, erosion of concrete reinforcement and toe protection or the failure of ground anchors. This deterioration can be difficult to detect, so that failure when it occurs is often sudden and unexpected. Failure is more likely when the structure is under maximum stress, such as extreme fluvial events when pressures on the structure are at its most extreme.

There are no known reservoirs, canals or other artificial sources in the vicinity of the site.

***It is, therefore, the consideration of this FRA that the site has a low risk of flooding by reservoirs, canals or other artificial sources.***

# 7.0 Flood Risk As A Result Of The Development

## 7.1 Effect of The Development Generally

Development by its nature usually has the potential to increase the impermeable area with a resultant increased risk of causing rapid surface water runoff to watercourses and sewers, thereby causing surcharging and potential flooding. There is also the potential for pollutants to be mobilised and consequently flushed into the receiving surface water system.

Increases in both the peak runoff rate (usually measured in litres per second l/s) and runoff volume (cubic metres $m^3$) can result.

## 7.2 Surface Water Drainage & Sustainable Drainage Systems

Sustainable Drainage techniques (SuDS) covers a range of approaches to manage surface water runoff so that-

*'Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. This should be demonstrated as part of the flood risk assessment.'*

## 7.3 Peak Storm Design Criteria

The proposed sustainable drainage techniques for the development should accommodate the peak rainfall event for a 1 in 100 year storm event with an additional allowance for climate change. Table 5 of NPPG recommends for developments that have a life expectancy beyond 2085 that an additional factor of 40% is applied to the peak volume of runoff.

## 7.4 Existing Surface Water Runoff Rates

The development site area is approximately 121m2. The site is currently vacant with no visible means of drainage. The existing runoff rates calculated for site are highlighted below:

| Return Period | Greenfield Runoff Rate l/s |
|---|---|
| **1 in 1 year** | 0.1 |
| **Qbar** | 0.1 |
| **1 in 30 year** | 0.2 |
| **1 in 100 year** | 0.2 |

Table 7.4 Existing Runoff rates

Greenfield runoff rates were calculated using the FSR Method within Microdrainage Software. Calculations can be found in Appendix D.

## 7.5 Infiltration Testing

It has been assumed, based on local geology information found on the British Geological Survey database, that infiltration is not feasible in this area. Moreover, there is no room for infiltration devices such as soakaways.

## 7.6 Sustainable Drainage Hierarchy

A hierarchical approach has been undertaken in consideration of the application of SuDS in relation to the development. This is in order to meet the design philosophy of ensuring that surface water run-off is managed as close to its source as possible and the existing situation is replicated as closely as possible.

The following drainage hierarchy has been undertaken with reference to the procedures set out in the SuDS Manual (CIRIA C753, 2015) to assess the viability of the application of SuDS techniques to this scheme:

- **Store rainwater for later use**: Storing rainwater for later use in water butts is recommended but it is not enough to accommodate the runoff volume from the whole development. After a period of continuous rain, these tanks can be full and therefore its efficacy reduced considerably.

- Use infiltration techniques, such as porous surfaces in permeable strata areas: Soakaways cannot be used due to the lack of space.

- Attenuate rainwater in ponds or open water features for gradual release to a watercourse. There are no watercourses in the vicinity of this site.

- Attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse. Not feasible because there are no watercourses in the close vicinity.

- Attenuate rainwater by storing in tanks or sealed water features for gradual release to a surface water sewer. There are no surface water sewers in the vicinity.

- **Discharge rainwater to the combined sewer.** Foul and surface water from the new house will be discharged into the main combined sewer in Priory Terrace.

The sustainable drainage hierarchy shown above is intended to ensure that all practical and reasonable measures are taken to manage surface water higher up the hierarchy (1 being the highest) and that the amount of surface water managed at the bottom of the hierarchy is minimised.

Storing rainwater for later use might be an option but it is not sufficient to accommodate the runoff from the whole development.

The site-specific drainage hierarchy checklist considered for the drainage design for this development is detailed in Table 7.6.

| *SUDS OPTIONS* | Comments | Potential for flow | Volume reduction | Maintenance requirement | Space requirement | Cost | Included in final detailed design |
|---|---|---|---|---|---|---|---|
| **Rainwater harvesting** | Rainwater from roof runoff collected for re-use. Cost-benefit considerations | L | M | H | L | H | N |
| **Water butts** | Rainwater collection from roof runoff. Included in final design | L | L | L | L | L | Pos |
| **Living roofs** | Vegetated roofs that reduce runoff volume and rate | M | L | M | L | H | Y |
| **Bio-retention** | Shallow vegetated areas to retain and treat runoff. | L | L | M | M | L | N |
| **Constructed wetlands** | Waterlogged areas that can support aquatic vegetation. Replicates existing conditions and provides ecological benefit. | M | L | H | H/M | M | N |
| **Swales** | Shallow grassed drainage channels. Replicates existing conditions | H | M | L | M/H | L | N |
| **Soakaways** | Subsurface structures that dispose of water via infiltration. | H | H | L | L | M | N |
| **Permeable pavements** | Surface that infiltrate through surface. Retains pollutants. | H | H | M | L | M | N |
| **Tanked storage systems** | Oversized pipes or cellular storage. | H | L | L | M | M/H | Y |
| **Infiltration basins** | Depressions in the ground to store and release water through infiltration | H | H | H/M | H | M/L | N |
| **Detention basins** | Temporary retention of runoff with controlled discharge | H | L | M | H | M/L | N |

Table 7.6 Drainage design hierarchy (SuDS techniques considered for use in this scheme)

It should be noted that where the SuDS techniques are noted as feasible or possible it does not necessarily follow that they will all be used. Reference should be made to the drainage strategy drawing in Appendix C which indicates the drainage proposals.

## 7.7 SUDS Techniques Employed

Runoff from the roof will be collected and conveyed via a pipe network into cellular attenuation tank, from where it will be discharged into the combined sewer at a limited flow rate of 2l/s. The flow control device can be an orifice plate of Ø34mm diameter or a vortex system. A weir wall is recommended so water can leave the site in case of a blockage.

Runoff from the basement patio will be pumped to ground level. Potential sediments will be trapped using catchpits. Urban creep has not been considered as there is little room for extensions.

Approximately 25% of the total will be green roof, which will help to attenuate and also reduce the runoff. Since the sewer is combined, a non-return valve will be installed before the demarcation chamber to prevent backflows in case the system surcharges.

Calculations for the attenuation device can be found in Appendix D.

| Return Period | Existing Runoff Rate l/s | Proposed Runoff Rate l/s |
|---|---|---|
| **1 in 1 year** | 0.1 | 2.0 |
| **Qbar** | 0.1 | 2.0 |
| **1 in 30 year** | 0.2 | 2.0 |
| **1 in 100 year** | 0.2 | 2.0 |

Table 7.7.B Existing and proposed runoff rates

## 7.8 Residual Flood Risk & Exceedance

The proposed surface water drainage measures will however be designed to contain the peak storm event that can be expected for a 1 in 100 year situation. A 40% allowance has already been applied to the site to account for future climate change.

## 7.9 Dry Means of Escape

For basement development it is necessary to provide safe access and egress during a flood. A safe access or exit route must be appropriate for use by occupiers to escape flooding without the intervention of the emergency services.

Based on the Environment Agency flood maps, the main entrance to the building is in Flood Zone 1. Therefore, a safe access/egress will be available through the internal stairs.

# 8.0 Proposed Foul Water Drainage System

The development proposals will seek to discharge foul water from the development site into the existing combined drainage network running along Priory Terrace, to the east of the property. This will be subject to a Section 106 consents from Local Water Authority, Thames Water. Flows into this system will be via a gravity fed connection.

A pre-development enquiry has been made to Thames Water although at the time of writing no response has been received. No capacity issues are envisaged as it is the head of the line.

# 9.0 Recommendations and Conclusion

The development proposals together with the site layout have been assessed in relation to the provision of SuDS drainage associated with the works.

The report has assessed the feasibility of implementing the SuDS hierarchal approach and has confirmed that this development is likely to be able to install suitable drainage measures into the design proposals.

Therefore, in line with the recommendations of the National Planning Policy Framework, the development site lies within land classified as Flood Zone 1, which is considered at a low risk of flooding, and therefore appropriate for a development of this nature. Having assessed the other forms of flood risk to and from the development site, this report finds that the site is not considered at high risk from any other sources of flooding.

## 9.1 Flood Resistant measures

Provided that the drainage system is appropriately maintained, the risk of flooding from overland flows is low. However, as part of the works associated with the new development it is the recommendation of the report that consideration should be given to flood resistant measures, in particular at the basement level. These are mechanisms which can be implemented by the occupier to provide additional defences against flood water ingress should the drainage system fails. More information can be gained from the CIRIA document 'Improving the flood performance of new buildings'.

## 9.2 Flood Resilient measures

It is also the recommendation of the report that flood resilient measures are used within the design to minimize the impact an extreme flood event would have on the property. As these works are associated with the construction of the residential dwelling it would mainly involve the sighting of sockets and fuse boxes away from floor level. More information can be gained from the CIRIA document 'Improving the flood performance of new buildings'.

# 10.0 References & Bibliography


- The National Planning Policy Framework July 2018
- Planning Practice Guidance.
- Environment Agency - Rainfall-Runoff Management for Developments
- Environment Agency indicative flood maps https://flood-map-for-planning.service.gov.uk/
- Environment Agency indicative groundwater source protection zone maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- Environment Agency indicative Aquifer designation maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- CIRIA 2007, The Sustainable Drainage Systems (SUDS) Manual C753
- Sewers for adoption 7th edition
- DEFRA Non-statutory technical standards for sustainable drainage
- The London Plan sustainable design and Construction Supplementary Planning Guidance
- Preliminary FRA for London Borough of Camden – 2011 by Halcrow
- London Borough of Camden SFRA – 2014 by URS
- Managing Flood Risk in Camden – 2013 by Camden Council
- Camden Planning Guidance 4 – Basements - 2018
- Flood Estimation Handbook
- Environment Agency - Adapting to Climate Change: Advice for the Flood and Coastal Erosion Management Authorities March 2016

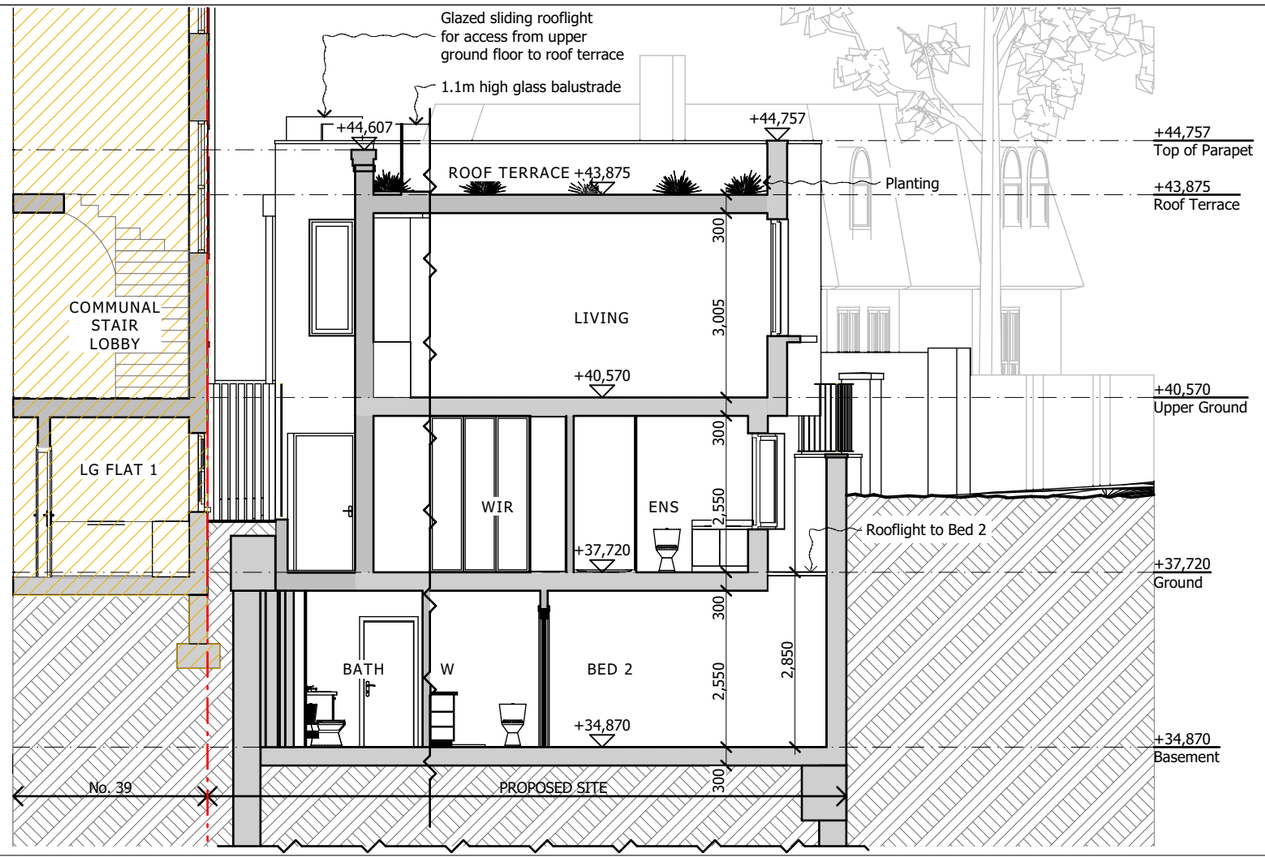
# Appendix A - Development Proposals

# Perspective Views

RIBA Chartered Practice

MEMBER

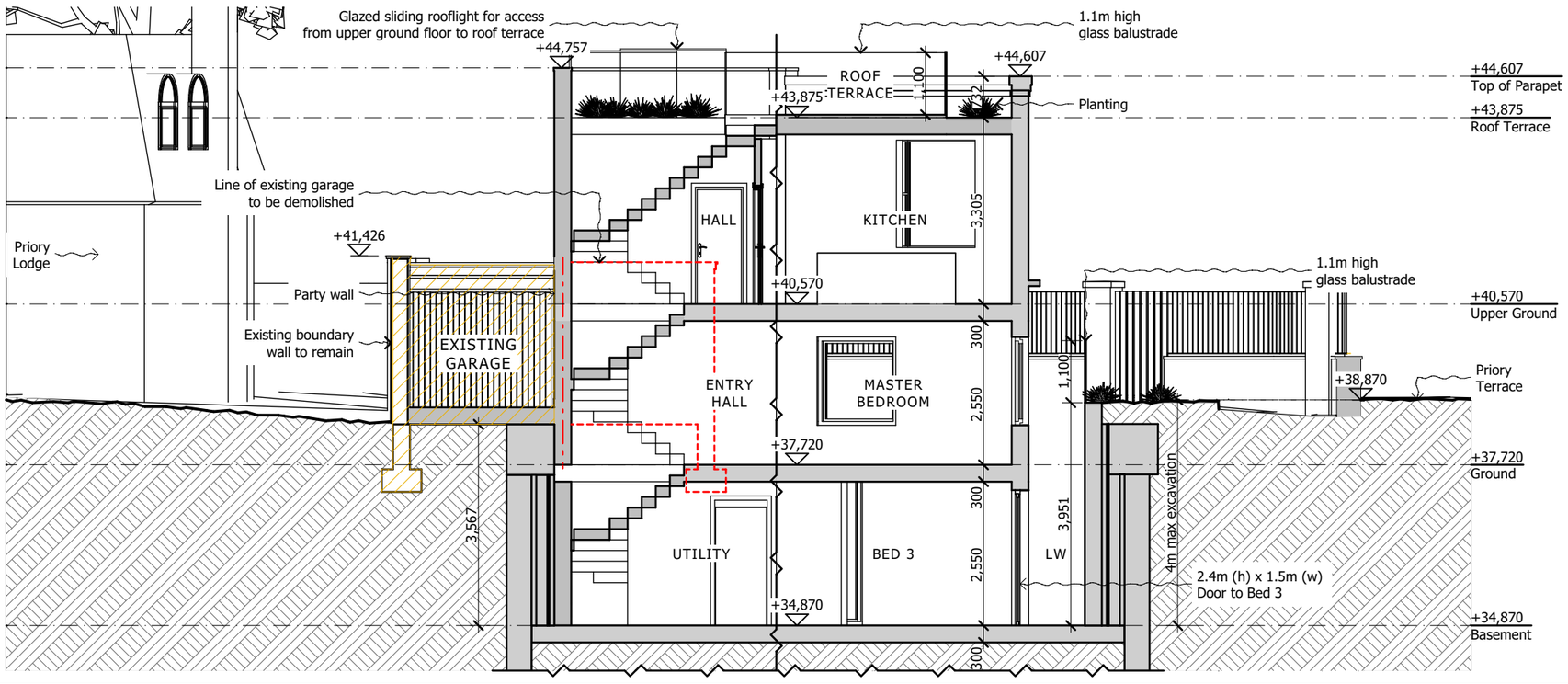
Date: 04/02/2020




1

SCALE 1:100 @ A3

## PROPOSED SECTION A-A




2

SCALE 1:100 @ A3

## PROPOSED SECTION B-B

**DO NOT SCALE FROM THIS DRAWING**

Figured dimensions only are to be taken from this drawing. All dimensions are to be checked on site before any work is put in hand.

If in doubt, ask.



Legends & Notes:

BOUNDARY LINE

NOT IN THE OWNERSHIP OF THE APPLICANT

LW LIGHTWELL

| Rev | Date | Descriptor | |
|---|---|---|---|
| P01 | 04/02/2020 | Consultants Issue | BKS |

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RIBA Chartered Practice
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Project:

**Abbey Road**

Land and garage adjacent to 39 Priory Terrace
London, NW6 4DG

Client:

Old West Hampstead Estates Ltd.

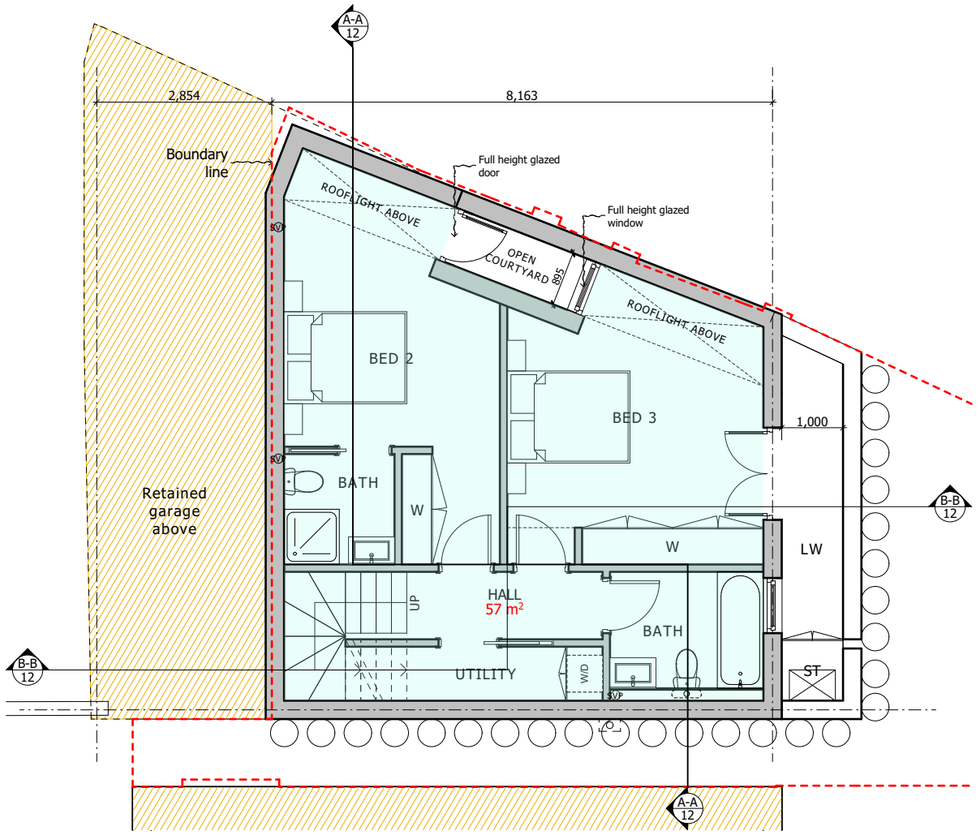
Drawing Title:

Pre Planning Application

**Section A-A & B-B**

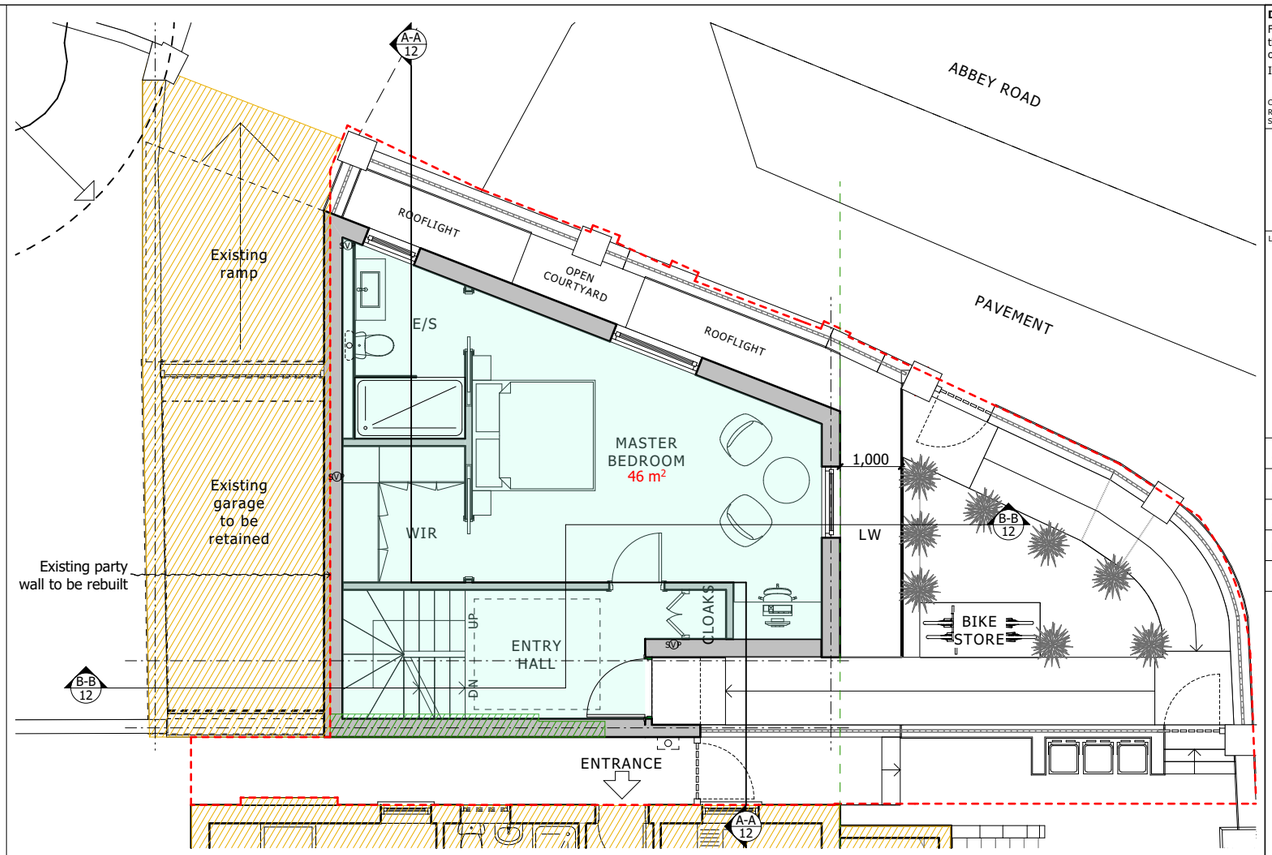
(Project number)DWG number_Revision

**(919)310_P01**



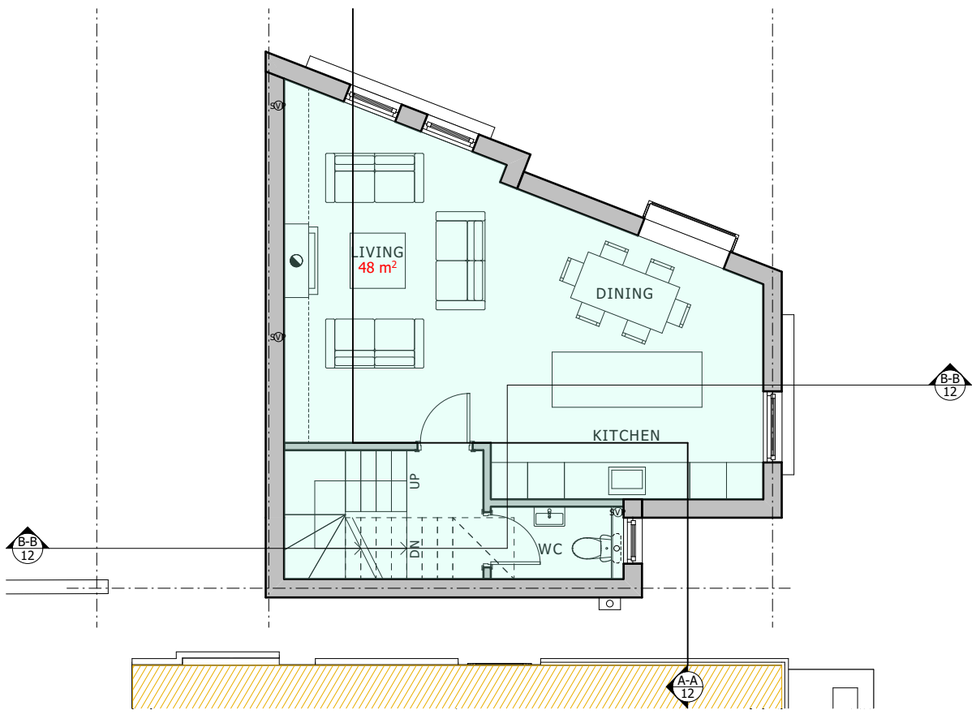

1 SCALE 1:100 @ A3

## PROPOSED BASEMENT FLOOR PLAN



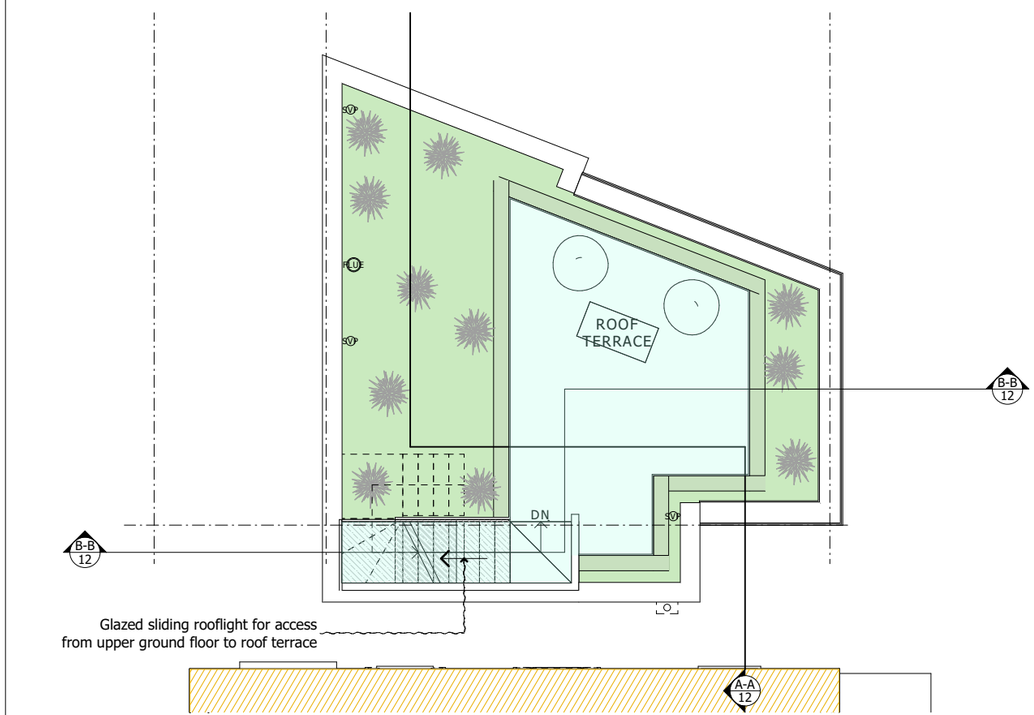

2 SCALE 1:100 @ A3

## PROPOSED GROUND FLOOR PLAN




3 SCALE 1:100 @ A3

## PROPOSED UPPER GROUND FLOOR PLAN




4 SCALE 1:100 @ A3

## PROPOSED ROOF PLAN



0 1 2 3m

Legends & Notes:

N

| AREA SCHEDULE | |
|---|---|
| BASEMENT | 57m² (614ft²) |
| GROUND | 46m² (495ft²) |
| UPPER GROUND | 48m² (517ft²) |
| TOTAL GIA | 151m² (1625ft²) |

BOUNDARY LINE

NOT IN THE OWNERSHIP OF THE APPLICANT

LW LIGHTWELL

| Rev | Date | Descriptor | |
|---|---|---|---|
| P01 | 04/02/2020 | Consultants Issue | BKS |

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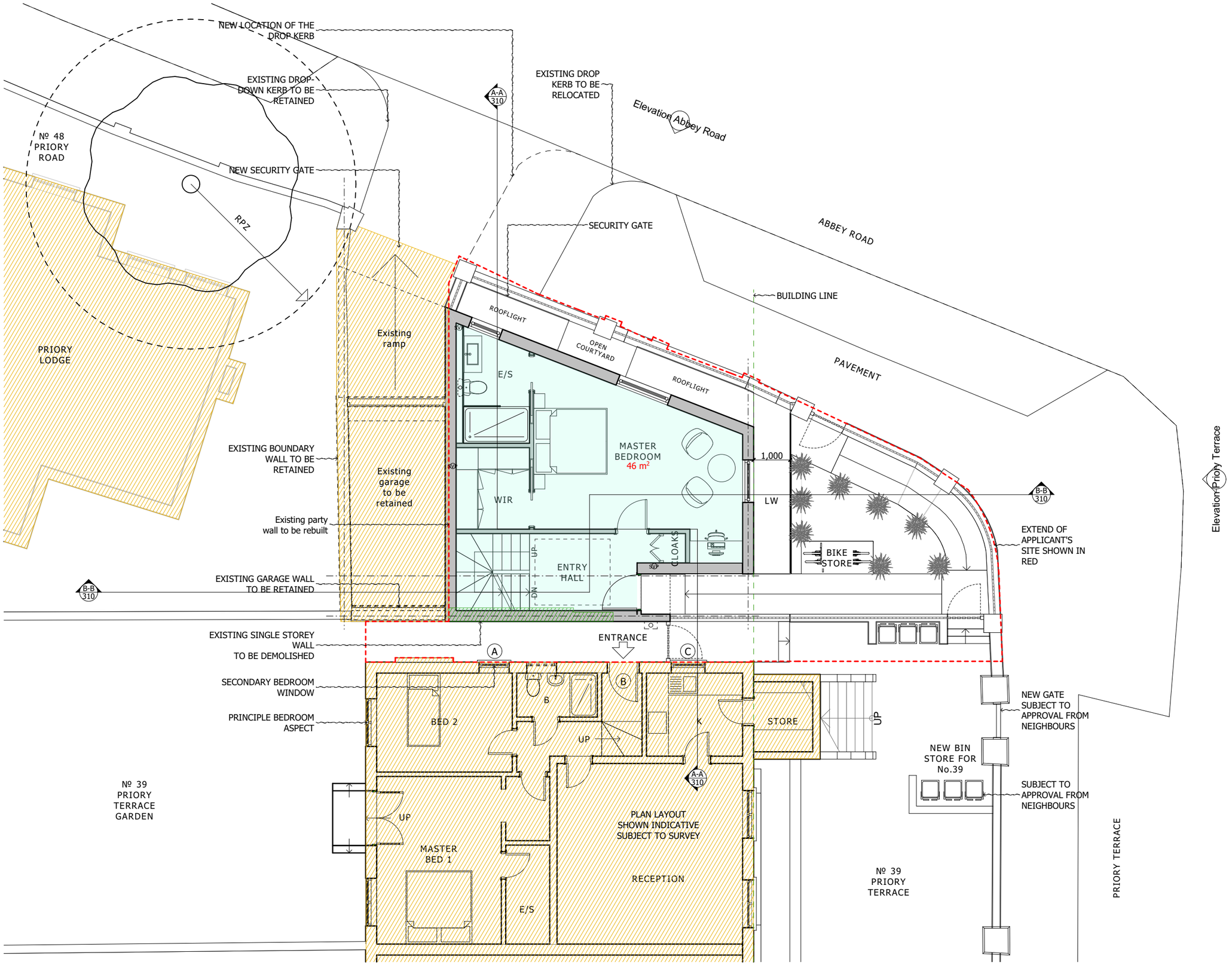
Project:
**Abbey Road**
Land and garage adjacent to 39 Priory Terrace
London, NW6 4DG

Client:
Old West Hampstead Estates Ltd.

Drawing Title:
Pre Planning Application
**Proposed Floor Plans**

(Project number)DWG number_Revision
**(919)020_P01**




**DO NOT SCALE FROM THIS DRAWING**

Figured dimensions only are to be taken from this drawing. All dimensions are to be checked on site before any work is put in hand.

If in doubt, ask.



0 1 2 3m

Legends & Notes:

N

BOUNDARY LINE

NOT IN THE OWNERSHIP OF THE APPLICANT

LW LIGHTWELL

| Rev | Date | Descriptor | Athr. |
|---|---|---|---|
| P01 | 04/02/2020 | Consultants Issue | BKS |

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Project:

**Abbey Road**

Land and garage adjacent to 39 Priory Terrace
London, NW6 4DG

Client:

Old West Hampstead Estates Ltd.

Drawing Title:

Pre Planning Application

**Proposed Site Plan**

(Project number)DWG number_Revision

**(919)001_P01**

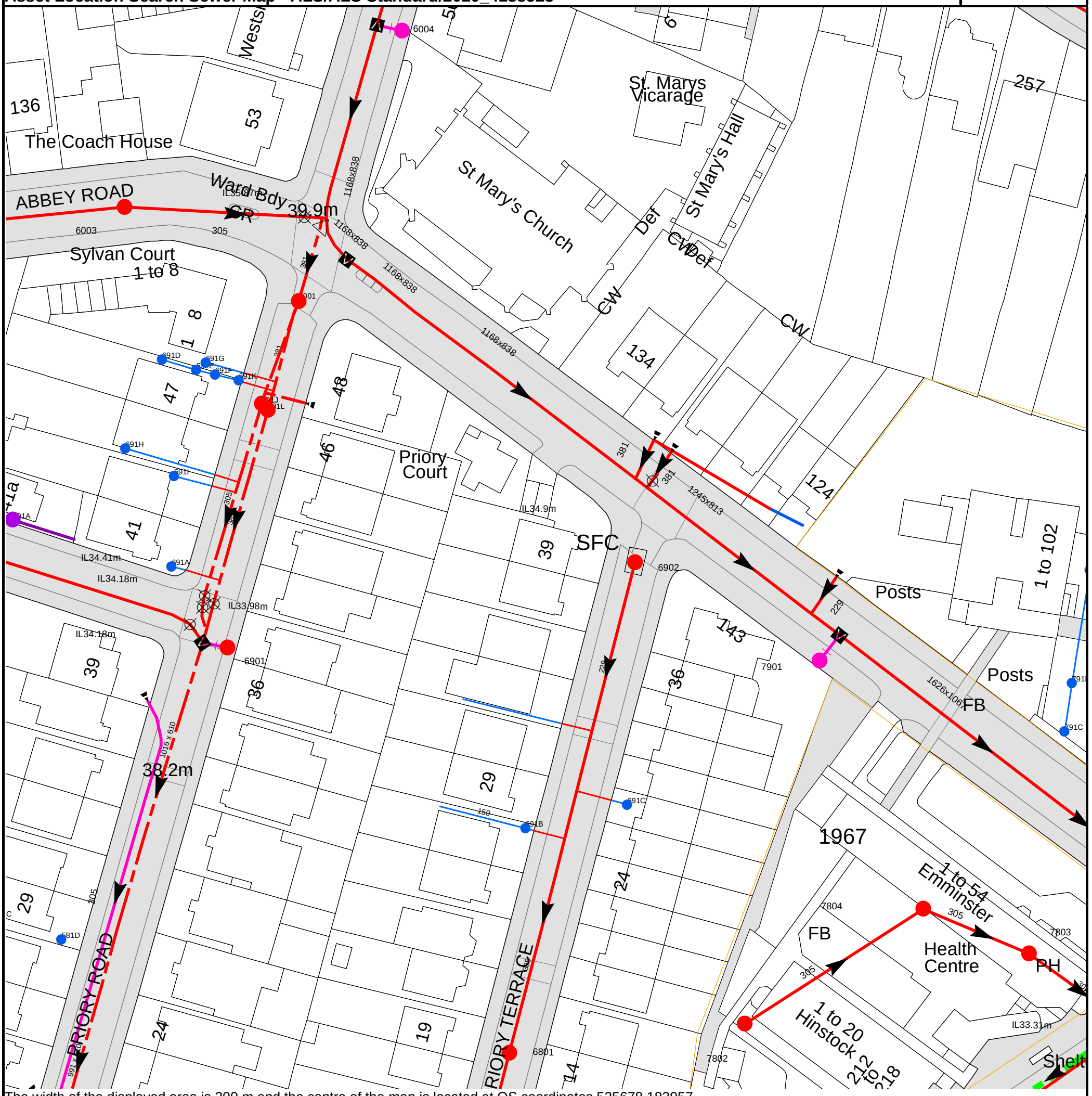
1

SCALE 1:100 @ A3

# PROPOSED SITE PLAN

# Appendix B - Thames Water Sewer Records

**Asset Location Search Sewer Map - ALS/ALS Standard/2020_4138523**




The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 525678,183957

**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.**

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

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 |
|---|---|---|
| 6004 | n/a | n/a |
| 6003 | 40.11 | n/a |
| 691E | n/a | n/a |
| 691G | n/a | n/a |
| 691F | n/a | n/a |
| 6901 | n/a | n/a |
| 691K | n/a | n/a |
| 691J | n/a | n/a |
| 691L | n/a | n/a |
| 6001 | 39.34 | 35.05 |
| 6801 | 36.62 | 32.66 |
| 691B | n/a | n/a |
| 691C | n/a | n/a |
| 6902 | 38.55 | 34.35 |
| 7802 | 36.8 | 34.48 |
| 7901 | n/a | n/a |
| 7804 | 36.84 | 33.81 |
| 7803 | 37.01 | 33.48 |
| 791C | n/a | n/a |
| 791B | n/a | n/a |
| 791A | n/a | n/a |
| 591A | n/a | n/a |
| 581D | n/a | n/a |
| 691H | n/a | n/a |
| 691D | n/a | n/a |
| 691A | n/a | n/a |
| 691I | 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.**

# ALS Sewer Map Key

## Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

## 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

Dam Chase

Fitting

Meter

Vent Column

## Operational Controls

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

Control Valve

Drop Pipe

Ancillary

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.

Outfall

Undefined End

Inlet

## Other Symbols

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

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

**Areas**

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

## Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

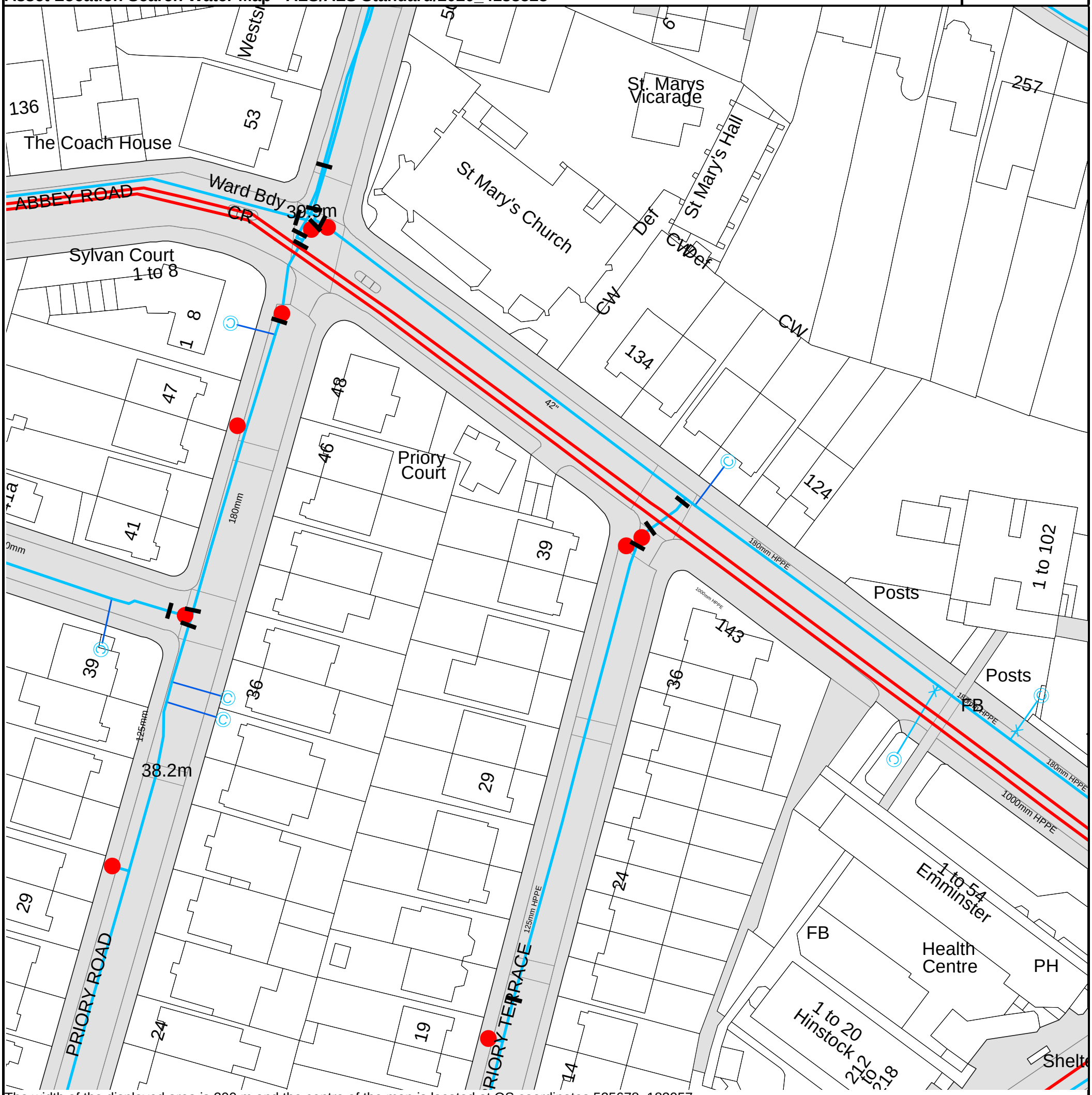
Proposed

Abandoned Sewer

**Notes:**

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate 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 level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. 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 present on the plan, please contact a member of Property Insight on 0845 070 9148.

**Asset Location Search Water Map - ALS/ALS Standard/2020_4138523**




The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 525678, 183957.

# ALS Water Map 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.

## Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- 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

| 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') |

## 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.

# Appendix C - Drainage Strategy

BURIED UTILITIES RISK NOTE

- Buried utilities are present on and in the vicinity of the site.
- The Contractor must satisfy themselves that they have seen utility returns for the area and that appropriate Risk Assessment Method Statement (RAMS) are in place and implemented to ensure that buried and/or overhead services are located prior to any works taking place.
- Any RAMS shall address safe procedures for protection and working in the proximity of services.

DESIGNERS CDM NOTE - RESIDUAL RISKS IDENTIFIED

The design Engineer(s) have analysed this design as the scheme has been developed, in order to identify if there are any significant residual risk hazards (i.e. unusual, unexpected, abnormal or difficult).

Residual risks **HAVE** been identified and are therefore shown on this drawing. These risks have not been possible to remove by design.

This statement assumes that a competent Contractor with the appropriate qualified staff will be employed for the works, and that they will be familiar with site wide construction risks and hazards that they can reasonably be expected to encounter as part of their work.

N

W E

S

NOTE:

1. DO NOT SCALE, IF IN DOUBT ASK.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT STRUCTURAL ENGINEER'S DRAWINGS AND DETAILS, THE SPECIFICATION FOR THE WORKS, THE RELEVANT ARCHITECT'S DRAWINGS AND ANY OTHER SPECIALIST'S DRAWINGS.

**Construction Note**
It is essential that new drainage associated with the development is laid from the outfall(s) into the site. This is essential to avoid unforeseen obstructions where encountered (such as services). If the drainage is laid from the site out to the outfall it can result in significant abortive works to relay and overcome such obstructions.

Location of Public Sewers have been taken from record drawings which should be fully substantiated by the contractor prior to commencing works on site

All manholes covers located within carriageways shall have no slip covers to prevent motorcycles/cycles losing control

NOTES
- All street lights in verge to have 150mm concrete collar surround
- Tree root barrier required to any tree within 5m of the carriageway/footway
- Permeable paving to be laid at 45° herringbone pattern. Stretcher course should be used when pattern can't be continued. 1 No stretcher course channel either side of road
- No doors or windows are to open onto the highway at any level. No gas boxes or porches are to be located within highway land
- All private footways to be side hung so no runoff into public highway
- No railings or fences to be in highway or 600mm from front face of kerb

**Drainage Key**
**Sewers**

| | |
|---|---|
| | Foul water drain (private/non adoptable) |
| | Surface water drain (private/non adoptable) |
| | Foul water drain - Basement (private) |
| | Proposed combined water sewer (Adopted) |
| | Existing combined water sewer (Adopted) |
| | Surface Water Rising Main (private) |
| | Foul Water Rising Main (private) |

**Chamber Key**
**FW/SW**

| | |
|---|---|
| FWMC / SWMC | Mini access chamber (mac) - 300mmØ |
| | PPIC - 475mmØ* |
| DM / DM | Adoptable demarcation manhole within 1m of boundary |
| | Manhole<br>Depth: 1.25m to 1.5m*<br>Depth: 1.55m to 3.0m* |

* General note
(Refer to standard details & longitudinal sections for chamber sizes. Size may need to increase dependant on number of incoming pipes/size of incoming pipes)

| | |
|---|---|
| RE | Surface water rodding eye |
| | Rain water down pipe (roddable access) |
| | Soil vent pipe/soil stack - Ground Floor |
| | Soil vent pipe/soil stack - Basement |
| ST | Silt Trap (ST) with removable silt bucket |
| S1/F1 | Manhole reference number |
| yg | Yard gully (150mm - 200mmØ trapped) |
| S | Surface water sump unit |
| | Linear drainage channel |
| | Cellular storage (refer to drawing for sizes) |
| FFL XX.XX | Finished Floor Level (FFL) |
| | Green Roof |

EXISTING COMBINED SEWER - 1245x813

EXISTING COMBINED SEWER - 380Ø

EXISTING COMBINED SEWER - 380Ø

EXISTING COMBINED SEWER - 225Ø

NO 48 PRIORY ROAD

PRIORY LODGE

ABBEY ROAD

PAVEMENT

Existing garage to be retained

Green Roof

SVP to Below

SVP's to be taken to the east of the building by gravity where possible

FFL 37.72

MASTER BEDROOM

ENTRY HALL

E/S

WIR

LW

**Cellular Attenuation Tank**
Size = 2.0m x 2.0 m x 0.8
Invert Level = 37.45m
Cover Level =38.85m
Polystorm Lite (PSM2) or similar.
Sized to accommodate 1 in 100 year event + 40% Climate Change

**Flow Control Device**
Max. Flow = 2l/s
Cover Level =38.85m
Invert Level = 37.40m
Polystorm Lite (PSM2) or similar.
Sized to accommodate 1 in 100 year event + 40% Climate Change
Weir Level = 38.40m

Online non-return valve to be installed

S/1

DM

Proposed connection with existing sewer subject to a S106 Consent from Thames Water.

**Thames Water Combined Water MH**
Ref: 6902/
CL = 38.55m
IL = 34.55m

NO 39 PRIORY TERRACE GARDEN

BED 2

B

UP

K

STORE

MASTER BED 1

PLAN LAYOUT SHOWN INDICATIVE SUBJECT TO SURVEY

RECEPTION

NO 39 PRIORY TERRACE

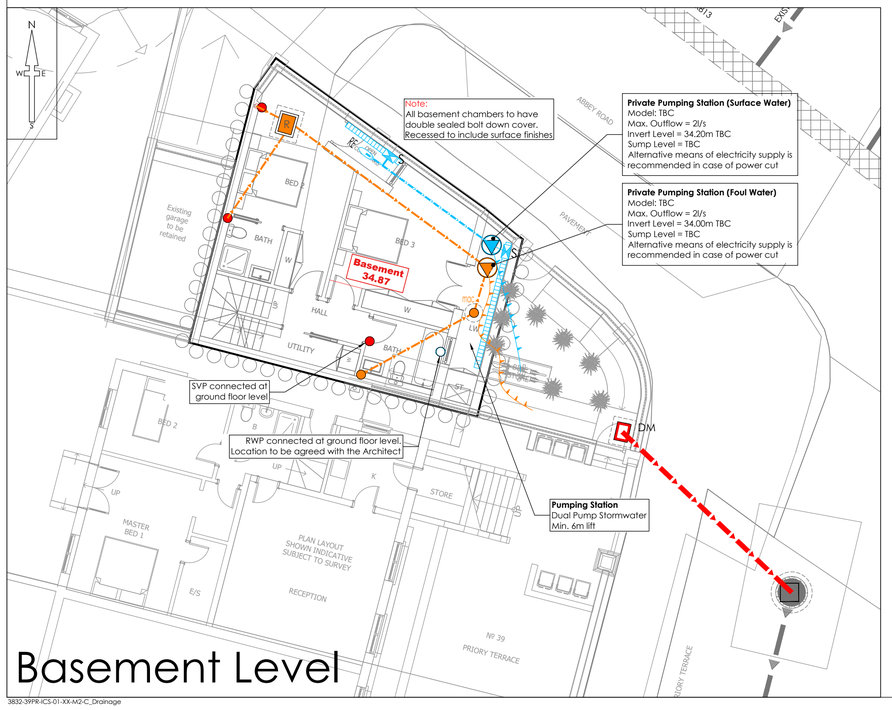
PRIORY TERRACE

CDM RESIDUAL RISK ITEM
Existing services likely within working area.
Danger to site personnel and general public

CDM RESIDUAL RISK ITEM
Contact with waste water when making drainage connections.
Risk of infection from Weils disease etc.

CDM RESIDUAL RISK ITEM
Works within confined spaces.

# Ground Floor Level




# Basement Level

| Rev | Date | Amendments | By | Chk'd |
|---|---|---|---|---|
| P01 | 12/02/20 | Initial Issue | MBD | DJ |

engineersHRW
London 0207 407 9575 Oxford 01865 251 206 www.ehrw.co.uk

Project:
**39 Priory Terrace, London, NW6 4DG**

Drawing title:
**Drainage Design**

| Scale at A1: | Drawn by: | Date: | Chk'd by: |
|---|---|---|---|
| 1:100 | SNN | Feburary 2020 | MBD |

Status: S2 Purpose For Issue: **PRELIMINARY**

Drawing Number: **2015-HRW-XX-XX-DR-C-0500** Rev: **P01**

# Appendix D - MicroDrainage Calculations

## ICP SUDS Mean Annual Flood

Input

| | | | |
|---|---|---|---|
| Return Period (years) | 100 | Soil | 0.450 |
| Area (ha) | 0.012 | Urban | 0.250 |
| SAAR (mm) | 600 | Region Number | Region 6 |

**Results l/s**

| | |
|---|---|
| QBAR Rural | 0.0 |
| QBAR Urban | 0.1 |
| Q100 years | 0.2 |
| Q1 year | 0.1 |
| Q30 years | 0.1 |
| Q100 years | 0.2 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 38.073 | 0.623 | 2.0 | 2.5 | O K |
| 30 min Summer | 38.123 | 0.673 | 2.0 | 2.7 | O K |
| 60 min Summer | 38.083 | 0.633 | 2.0 | 2.5 | O K |
| 120 min Summer | 37.955 | 0.505 | 1.8 | 2.0 | O K |
| 180 min Summer | 37.852 | 0.402 | 1.6 | 1.6 | O K |
| 240 min Summer | 37.773 | 0.323 | 1.4 | 1.3 | O K |
| 360 min Summer | 37.668 | 0.218 | 1.2 | 0.9 | O K |
| 480 min Summer | 37.604 | 0.154 | 1.0 | 0.6 | O K |
| 600 min Summer | 37.562 | 0.112 | 0.9 | 0.4 | O K |
| 720 min Summer | 37.532 | 0.082 | 0.8 | 0.3 | O K |
| 960 min Summer | 37.496 | 0.046 | 0.7 | 0.2 | O K |
| 1440 min Summer | 37.461 | 0.011 | 0.5 | 0.0 | O K |
| 2160 min Summer | 37.450 | 0.000 | 0.4 | 0.0 | O K |
| 2880 min Summer | 37.450 | 0.000 | 0.3 | 0.0 | O K |
| 4320 min Summer | 37.450 | 0.000 | 0.2 | 0.0 | O K |
| 5760 min Summer | 37.450 | 0.000 | 0.2 | 0.0 | O K |
| 7200 min Summer | 37.450 | 0.000 | 0.1 | 0.0 | O K |
| 8640 min Summer | 37.450 | 0.000 | 0.1 | 0.0 | O K |
| 10080 min Summer | 37.450 | 0.000 | 0.1 | 0.0 | O K |
| 15 min Winter | 38.073 | 0.623 | 2.0 | 2.5 | O K |
| 30 min Winter | 38.111 | 0.661 | 2.0 | 2.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 147.288 | 0.0 | 3.7 | 14 |
| 30 min Summer | 95.147 | 0.0 | 4.8 | 23 |
| 60 min Summer | 58.456 | 0.0 | 5.8 | 40 |
| 120 min Summer | 34.696 | 0.0 | 6.9 | 72 |
| 180 min Summer | 25.247 | 0.0 | 7.6 | 104 |
| 240 min Summer | 20.040 | 0.0 | 8.0 | 134 |
| 360 min Summer | 14.437 | 0.0 | 8.7 | 194 |
| 480 min Summer | 11.439 | 0.0 | 9.1 | 254 |
| 600 min Summer | 9.544 | 0.0 | 9.5 | 314 |
| 720 min Summer | 8.227 | 0.0 | 9.9 | 372 |
| 960 min Summer | 6.505 | 0.0 | 10.4 | 492 |
| 1440 min Summer | 4.665 | 0.0 | 11.2 | 734 |
| 2160 min Summer | 3.341 | 0.0 | 12.0 | 0 |
| 2880 min Summer | 2.635 | 0.0 | 12.6 | 0 |
| 4320 min Summer | 1.883 | 0.0 | 13.6 | 0 |
| 5760 min Summer | 1.482 | 0.0 | 14.2 | 0 |
| 7200 min Summer | 1.230 | 0.0 | 14.8 | 0 |
| 8640 min Summer | 1.057 | 0.0 | 15.2 | 0 |
| 10080 min Summer | 0.929 | 0.0 | 15.6 | 0 |
| 15 min Winter | 147.288 | 0.0 | 3.7 | 15 |
| 30 min Winter | 95.147 | 0.0 | 4.8 | 24 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 38.038 | 0.588 | 1.9 | 2.4 | O K |
| 120 min Winter | 37.866 | 0.416 | 1.6 | 1.7 | O K |
| 180 min Winter | 37.746 | 0.296 | 1.4 | 1.2 | O K |
| 240 min Winter | 37.664 | 0.214 | 1.2 | 0.9 | O K |
| 360 min Winter | 37.569 | 0.119 | 0.9 | 0.5 | O K |
| 480 min Winter | 37.519 | 0.069 | 0.8 | 0.3 | O K |
| 600 min Winter | 37.491 | 0.041 | 0.7 | 0.2 | O K |
| 720 min Winter | 37.473 | 0.023 | 0.6 | 0.1 | O K |
| 960 min Winter | 37.453 | 0.003 | 0.5 | 0.0 | O K |
| 1440 min Winter | 37.450 | 0.000 | 0.3 | 0.0 | O K |
| 2160 min Winter | 37.450 | 0.000 | 0.2 | 0.0 | O K |
| 2880 min Winter | 37.450 | 0.000 | 0.2 | 0.0 | O K |
| 4320 min Winter | 37.450 | 0.000 | 0.1 | 0.0 | O K |
| 5760 min Winter | 37.450 | 0.000 | 0.1 | 0.0 | O K |
| 7200 min Winter | 37.450 | 0.000 | 0.1 | 0.0 | O K |
| 8640 min Winter | 37.450 | 0.000 | 0.1 | 0.0 | O K |
| 10080 min Winter | 37.450 | 0.000 | 0.1 | 0.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 58.456 | 0.0 | 5.8 | 42 |
| 120 min Winter | 34.696 | 0.0 | 6.9 | 76 |
| 180 min Winter | 25.247 | 0.0 | 7.6 | 108 |
| 240 min Winter | 20.040 | 0.0 | 8.0 | 138 |
| 360 min Winter | 14.437 | 0.0 | 8.7 | 196 |
| 480 min Winter | 11.439 | 0.0 | 9.1 | 256 |
| 600 min Winter | 9.544 | 0.0 | 9.5 | 314 |
| 720 min Winter | 8.227 | 0.0 | 9.9 | 374 |
| 960 min Winter | 6.505 | 0.0 | 10.4 | 492 |
| 1440 min Winter | 4.665 | 0.0 | 11.2 | 0 |
| 2160 min Winter | 3.341 | 0.0 | 12.0 | 0 |
| 2880 min Winter | 2.635 | 0.0 | 12.6 | 0 |
| 4320 min Winter | 1.883 | 0.0 | 13.6 | 0 |
| 5760 min Winter | 1.482 | 0.0 | 14.2 | 0 |
| 7200 min Winter | 1.230 | 0.0 | 14.8 | 0 |
| 8640 min Winter | 1.057 | 0.0 | 15.2 | 0 |
| 10080 min Winter | 0.929 | 0.0 | 15.6 | 0 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 1.000 |
| Region | England and Wales | Cv (Winter) | 1.000 |
| M5-60 (mm) | 20.600 | Shortest Storm (mins) | 15 |
| Ratio R | 0.438 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.010

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.010 |

## Time Area Diagram

Total Area (ha) 0.000

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.000 |

## Model Details

Storage is Online Cover Level (m) 38.850

## Tank or Pond Structure

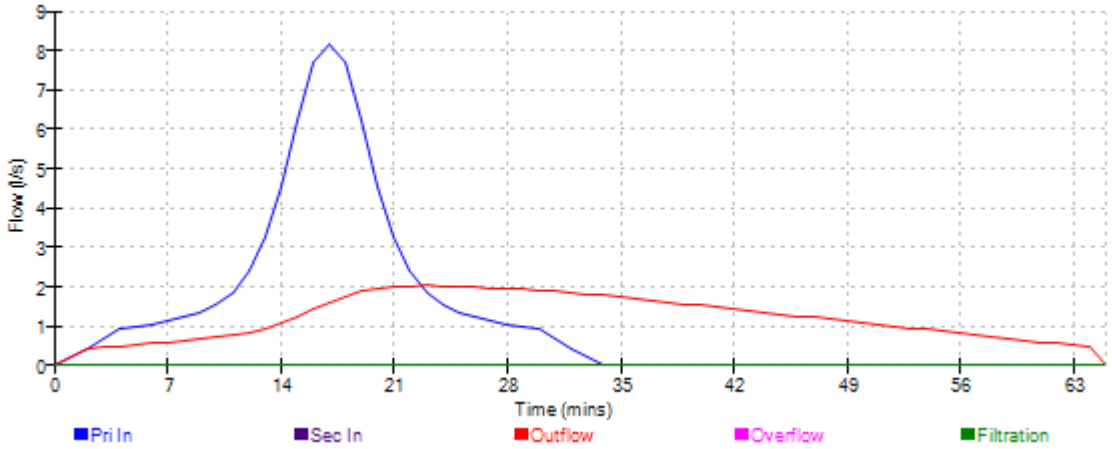
Invert Level (m) 37.450

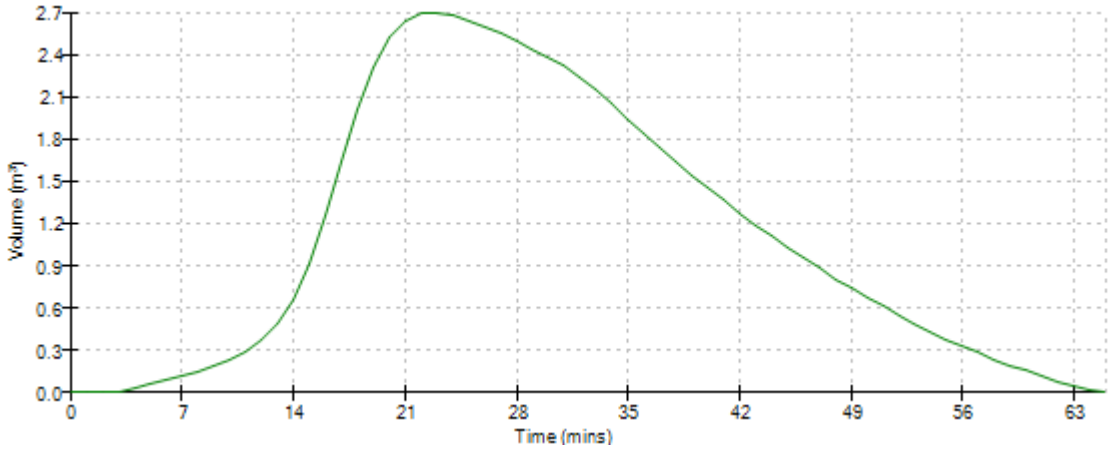
| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 4.0 | 0.800 | 4.0 | 0.801 | 0.0 |

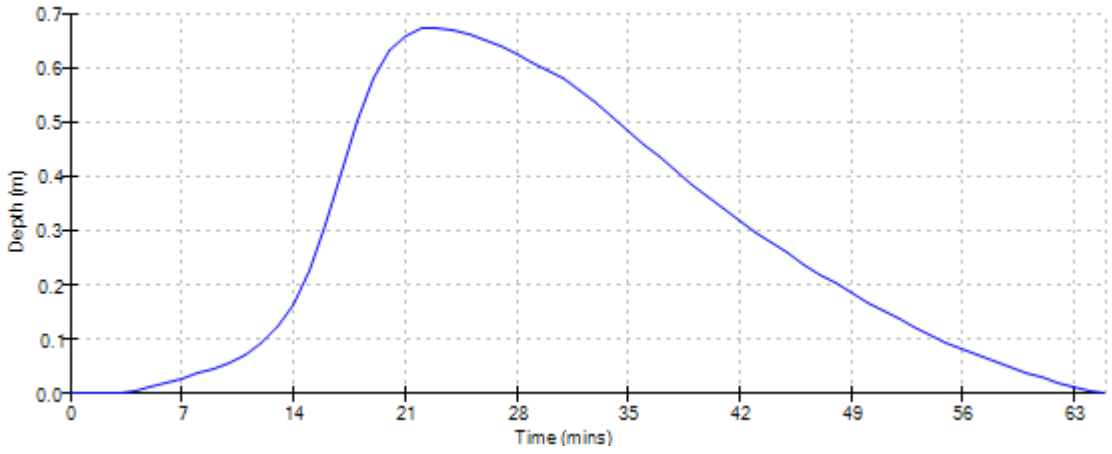
## Orifice Outflow Control

Diameter (m) 0.034 Discharge Coefficient 0.600 Invert Level (m) 37.400

Event: 30 min Summer



# Appendix E - L.B. of Camden - Susceptibility to Elevated Groundwater Map

NORTH

0 1

KILOMETRES

THIS DRAWING IS TO BE USED ONLY FOR THE PURPOSE OF ISSUE THAT IT WAS ISSUED FOR AND IS SUBJECT TO AMENDMENT

**LEGEND**

- London Borough Camden Boundary
- LBC Historic GW Flooding Record
  No. Properties affected
  - 1
  - 6
  - 7
  - 8
- Increased Susceptibility to Elevated Groundwater
- Environment Agency groundwater flood incidents



| Revision Details | By / Check | Check Date | Suffix |
|---|---|---|---|
| | | | |

Purpose of Issue: FINAL

Client: Camden

Project Title: LONDON BOROUGH OF CAMDEN STRATEGIC FLOOD RISK ASSESSMENT

Drawing Title: Increased Susceptibility to Elevated Groundwater

| Drawn | Checked | Approved | Date |
|---|---|---|---|
| CB | JS | MT | 03/07/2014 |

| URS Internal Project No. | Scale at A3 |
|---|---|
| 47070547 | 1: 40,000 |



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Drawing Number: **FIGURE 4e**

Rev: **Rev 1**

N:\Water\Current Projects\47070547 Camden SFRA Update (ghost)\0700 WIP\0705 GIS_Data\01-WIP\01_03-Project_Files\WORs