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re:shape

# Flood Risk Assessment and Sustainable Drainage Strategy

Tottenham





# whitby wood

## **ASHLEY PARK, TOTTENHAM HALE**

### FLOOD RISK ASSESSMENT

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PREPARED BY:



Matthew Sproat

Graduate Engineer - Civils

REVIEWED BY:



Sam Martin

Associate - Civils

APPROVED BY:



Sam Martin

Associate - Civils

whitby wood

+44 (0)20 7442 2216 | info@whitbywood.com | www.whitbywood.com

WHITBY WOOD LIMITED IS REGISTERED IN ENGLAND AND WALES REG NO. 07786822

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## **DISCLAIMER**

Whitby Wood Limited (WW) is appointed by Re:shape to provide Structural, Civil and Geotechnical consultancy services for the development of Ashley Park, Tottenham Hale.

This report has been produced for the exclusive use of Re:shape for the purposes set out herein only and it should not be used in whole or in part by any third parties without the express permission of WW in writing. WW neither owes nor accepts any duty to any third party whether in contract, tort or otherwise and shall not be liable for any loss, damage or expense of whatsoever nature which is caused by their reliance on the information contained in this report.

# 1 INTRODUCTION

This Flood Risk Assessment has been prepared by Whitby Wood on behalf of Re:shape T Ltd ('the Applicant') to support a full planning application for the following development:

Full planning permission for a phased mixed-use development comprising: (i) enabling works and operations; (ii) residential development (Use Class C3) including affordable housing; (iii) shared living accommodation (Sui Generis), (iv) commercial and community floorspace (Use Classes E and F2); and (v) site-wide and/or phase-specific access, servicing, public realm, blue-badge parking, cycle parking, open space, hard and soft landscaping, utilities, plant and all other associated works.

Whitby Wood have been commissioned to prepare this Flood Risk Assessment (FRA) in accordance with the National Planning Policy Framework (NPPF) to support the proposed development at the former Ashley House site, Tottenham Hale, London, hereby referred to as 'The Site'. This assessment has been undertaken to ascertain the constraints in order to redevelop The Site, and to assess the impact of the proposals, with respect to flood risk.

This Flood Risk Assessment assesses flood risk and demonstrates how the proposed development complies with relevant planning policies within the Development Plan.

## 1.1 SOURCES OF INFORMATION

A review of the relevant information from a range of sources has been undertaken and includes the following:

- Ministry of Housing Communities & Local Government, National Planning Policy Framework (NPPF) (2026);
- London Borough of Haringey, Strategic Flood Risk Assessment (2022);
- London Borough of Haringey, Local Flood Risk Management Strategy and 5-year Delivery Plan, 2025-2030 (2025);
- Envirocheck Landmark Information Group (2026);
- Greater London Authority, London Plan (2021);
- British Geology Survey [Accessed June 2026].

## 1.2 ENVIRONMENT AGENCY DATA

The following information has been gathered from DEFRA's Spatial Data Catalogue from data.gov.uk [Accessed June 2026].

- Flood Map for Planning (Rivers and Sea) – Flood Zone 2;
- Flood Map for Planning (Rivers and Sea) – Flood Zone 3;
- Risk of Flooding from Surface Water Extent (1%, 3.3% and 0.1% AEP + CC allowance);
- Risk of Flooding from Surface Water Depth (0.2m, 0.3m, 0.6m, 0.9m, 1.2m, + CC allowance);
- Risk of Flooding from Rivers and Seas Extent (1%, 3.3% and 0.1% AEP + CC allowance);
- Risk of Flooding from Rivers and Seas Depth (0.2m, 0.3m, 0.6m, 0.9m, 1.2m, + CC allowance);
- Risk of Flooding from Reservoirs – Maximum Flood Extent;
- Statutory Main River Map.
- Spatial Flood Defences Map; and
- Reduction in Risk of Flooding from Rivers and Sea due to Defences.

## 2 THE SITE

### 2.1 SITE LOCATION

The Site, as shown in Figure 1 and **Appendix A**, is located at the former Ashley House site, 4-14 Ashley Road, London, N17 9LZ, with a grid reference of 534344 Easting and 189663 Northing.

The Site is located within the administrative area of London Borough of Haringey and was formerly occupied by Ashley House complex, which featured low-rise warehouse buildings, offices and yards (Class B8 and E). The complex has now been demolished resulting in a brownfield site of approximately 0.715 ha.

The Site is located within a strategic area, falling under several key designations: Upper Lee Valley Opportunity Area, Tottenham Hale District Centre, Tottenham Area Action Plan and Tottenham Housing Zone. There are no listed buildings neighbouring The Site, with surrounding buildings primarily consisting of a mix of modern, high-rise apartment blocks, contemporary student and build-to-rent complexes and converted industrial and office spaces.



Figure 1. Site Location Map

### 2.2 WATERCOURSES

The nearest main watercourse to The Site is the River Lea, located approximately 400 metres to the east. Other smaller watercourses such as the Pymmes Brook, located 3km to the north, and culverted watercourse Moselle Brook, 2km to the north, feed into the River Lea.

There are also multiple artificial reservoirs located east of the River Lea, which are part of the Tottenham Hale reservoir network, with the closest reservoir to The Site being the Low Maynard reservoir at 800m away. In addition, there is a treatment plant located 1.7km southeast of The Site.

## 2.3 GEOLOGY

Information published by the British Geological Survey indicates that the bedrock geology of The Site consists of London Clay Formation - Clay, Silt and Sand. These sedimentary rocks are marine in origin and were formed between 47.8 and 56 million years ago during the Palaeogene period.

A superficial deposit is also present in the form of the Enfield Silt Member - Clay and Silt. These sedimentary deposits are aeolian in origin, ranging from medium- to fine-grained, and were formed between 0 and 116,000 years ago during the Quaternary period.

The geology of The Site and its surroundings are shown in Figure 2 and **Appendix B**.

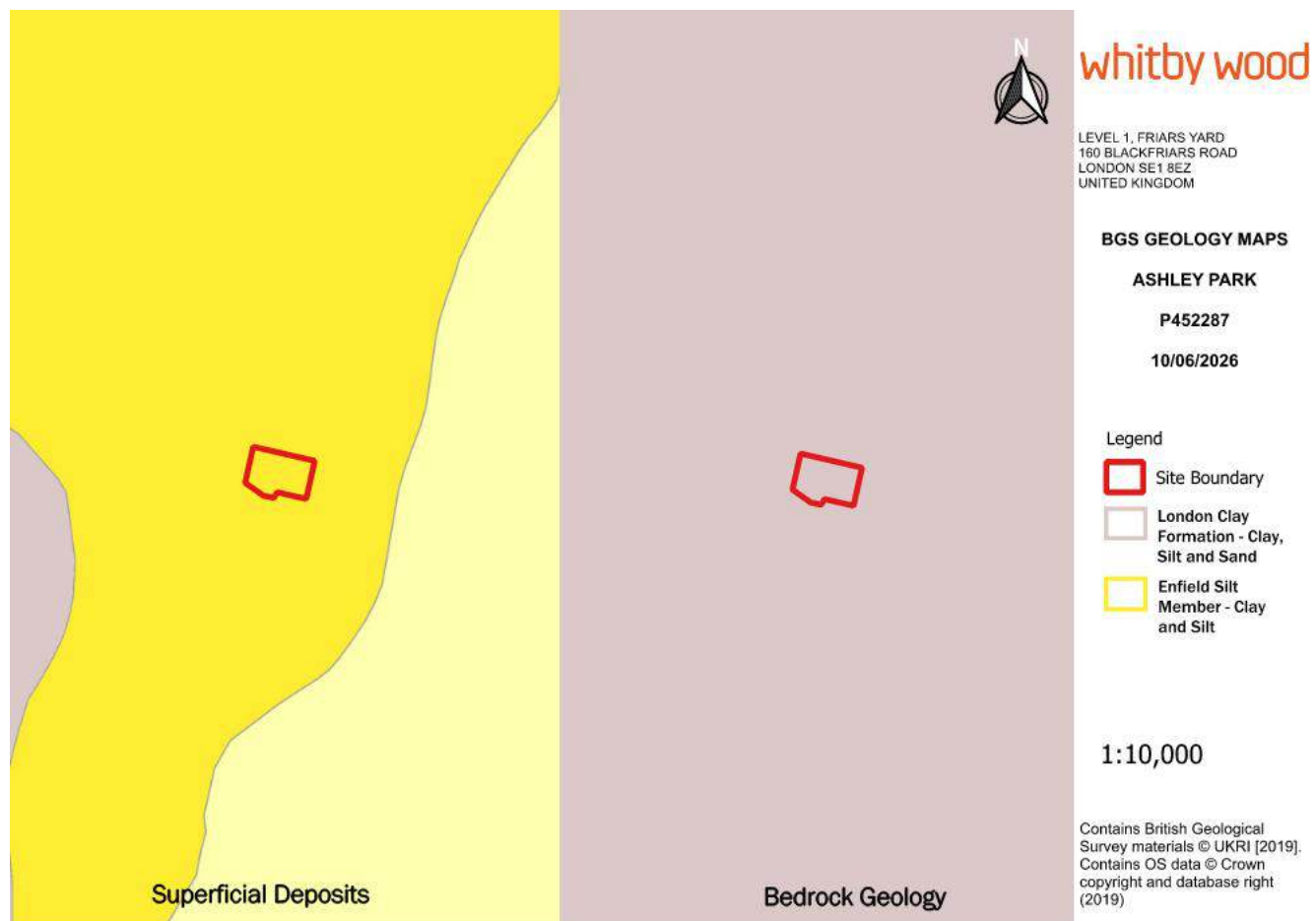


Figure 2. British Geology Survey (BGS) Map

## 2.4 PROPOSED DEVELOPMENT

Full planning permission for a phased mixed-use development comprising: (i) enabling works and operations; (ii) residential development (Use Class C3) including affordable housing; (iii) shared living accommodation (Sui Generis), (iv) commercial and community floorspace (Use Classes E and F2); and (v) site-wide and/or phase-specific access, servicing, public realm, blue-badge parking, cycle parking, open space, hard and soft landscaping, utilities, plant and all other associated works.

For the purposes of this Flood Risk Assessment, the positively drained area will be taken as the full 0.715 ha.

## 3 FLOOD RISK

### 3.1 FLUVIAL

The Environment Agency's Flood Risk Data presented in Figure 3 and **Appendix C** shows the entirety of The Site is situated within Flood Zone 2. The Site is protected by spatial flood defences on the River Lea. Therefore, the fluvial risk will be assessed in greater detail as shown in section 3.2. This will be kept in mind during the detailed design stage. The definition of each flood zone can be found below:

- Land in Flood Zone 1 has a 0.1% or less annual probability of river or sea flooding;
- Land in Flood Zone 2 has between 0.1% and 1% annual probability of river flooding and between 0.1% and 0.5% annual probability of sea flooding; and
- Land in Flood Zone 3 has a 1% or greater annual probability of river flooding and a 0.5% or greater annual probability of sea flooding.

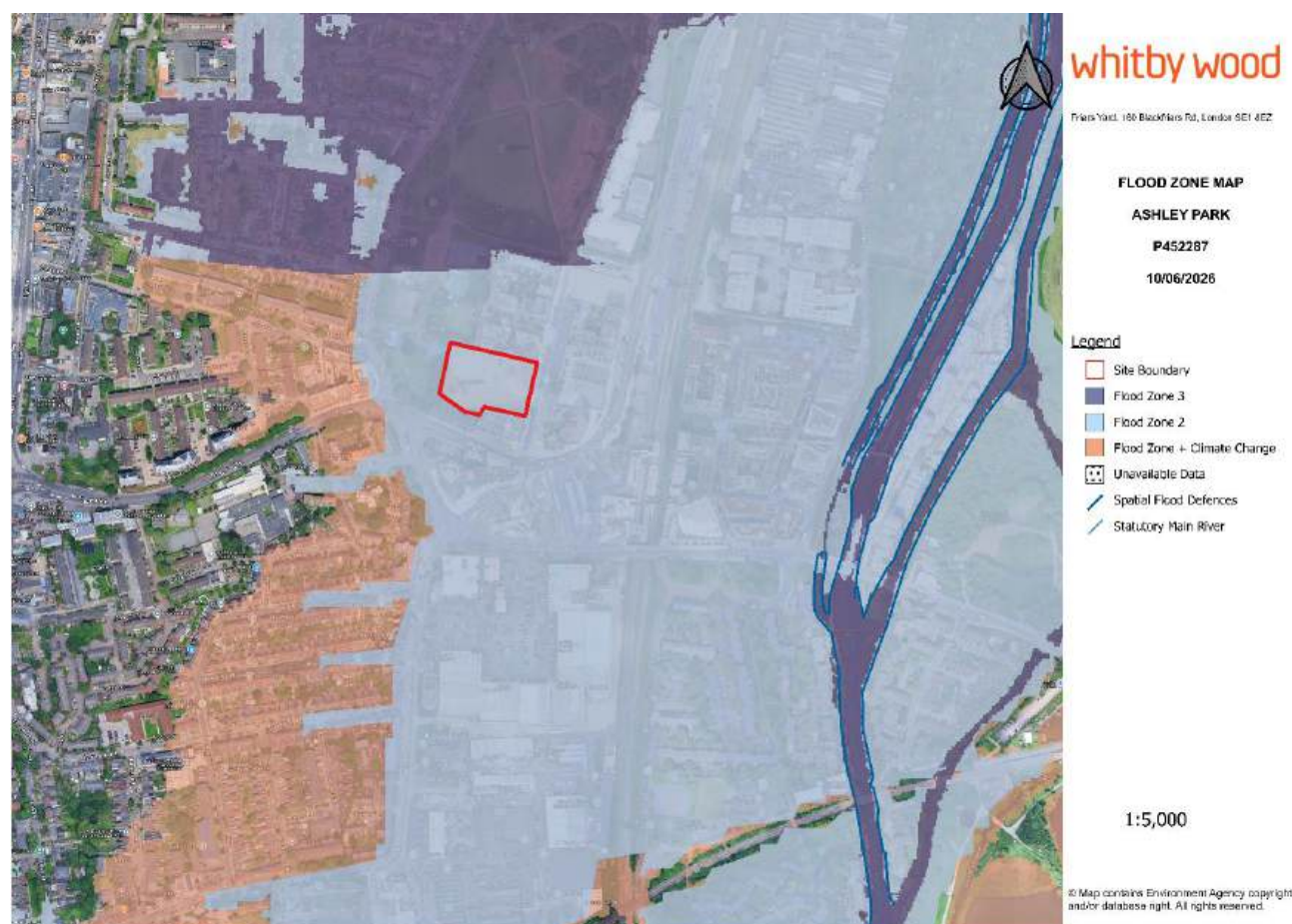


Figure 3. Flood Zone Map

### 3.2 RIVERS AND SEAS

The risk of flooding from rivers and seas has been assessed further by viewing the Risk of Flooding from Rivers and Seas maps (RoFRS), which have been replicated in Figure 4 and included in **Appendix C**. This dataset is provided by DEFRA and gives an overview of the long-term flood risk to a site via a broader, more comprehensive overview of a site's flood risk, accounting for climate change and the condition of any flood defences.

The definitions for each flood risk category have been detailed below:

- **Very low** risk means that each year this area has a chance of flooding of less than 0.1%.
- **Low** risk means that each year this area has a chance of flooding of between 0.1% and 1%.
- **Medium** risk means that each year this area has a chance of flooding of between 1% and 3.3%.
- **High** risk means that each year this area has a chance of flooding of greater than 3.3%.

For both present day and climate change extents, The Site has a 'Very Low' risk of flooding on a section of the western side and long the eastern boundary.

The present-day scenario shows only 'Very Low' risk surrounding The Site, however the climate change scenario shows an increase in risk from 'Very Low' to 'Low'. The northern boundary of The Site is the only boundary where no risk is present adjacently in both scenarios.

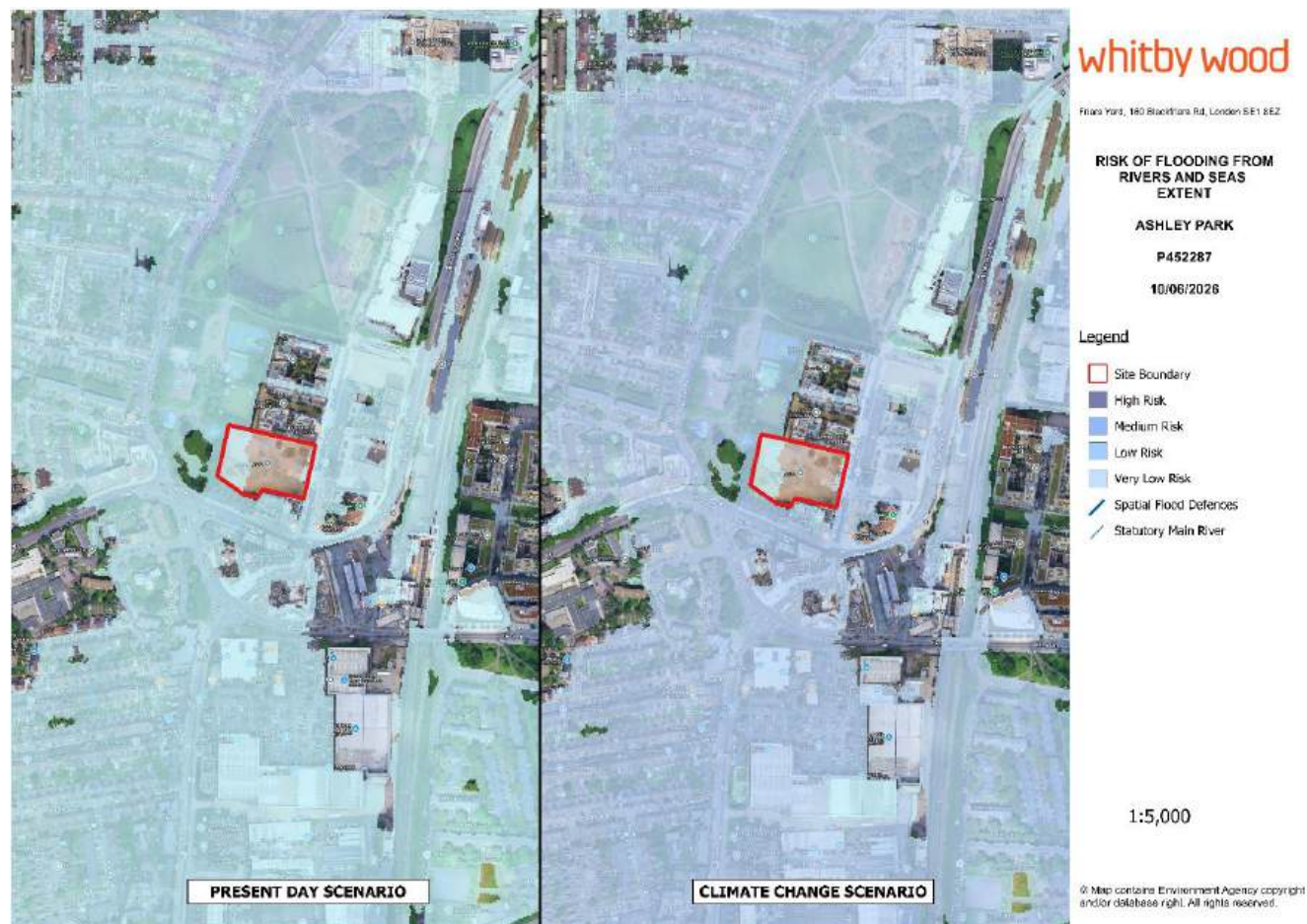


Figure 4. RoFRS Extent (Present Day & Climate Change)

The flood risk from rivers and seas has been assessed across the climate change scenarios for depth ranges exceeding 200mm, 600mm and 1,200mm, as illustrated in Figure 5 and included in **Appendix C**. All water ingress on the site is categorised 'Very Low' across all depth intervals within the western region of the site. Given that the risk is considered 'Very Low', and the threshold for compensation on this site would only be required for flooding events up to the 1:100yr + climate change, no flood compensation will be required.



Figure 5. RoFRS Extent including Climate Change Depth Map

### 3.3 SURFACE WATER

The risk of surface water flooding has been assessed by viewing the Risk of Flooding from Surface Water maps (RoFSW), which have been replicated in Figure 6 and included in **Appendix C**.

The definitions for each surface water flood risk category have been detailed below:

- **Very low** risk means that each year this area has a chance of flooding of less than 0.1%.
- **Low** risk means that each year this area has a chance of flooding of between 0.1% and 1%.
- **Medium** risk means that each year this area has a chance of flooding of between 1% and 3.3%.
- **High** risk means that each year this area has a chance of flooding of greater than 3.3%.

For both the present day and climate change extent, the majority of The Site is not situated within an area at risk of flooding from surface water, with a small area on near the eastern edge of the site being at 'Low' risk. For the climate change extent, there is another area of 'Low risk' at the northern boundary. It is noted that areas of surface water flood risk are present to the northwest, southwest and east of The Site boundary; however, given there is only limited creep onto The Site overall, it can be said that the risk of surface water flooding to The Site is 'Very Low'.

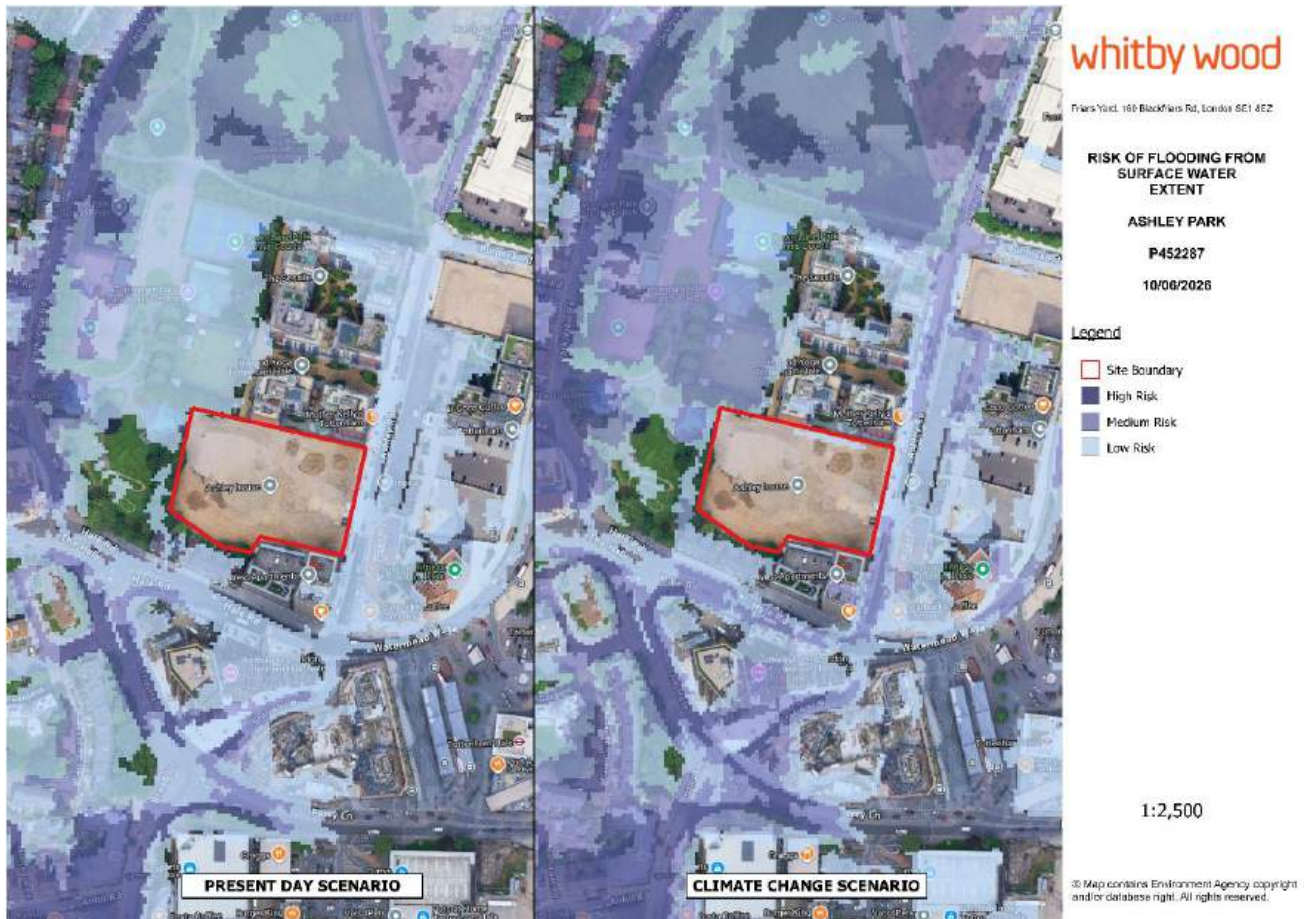


Figure 6. RoFSW Extent (Present Day & Climate Change)

### 3.4 GROUNDWATER

Groundwater flooding occurs when water emerges at the surface due to elevated groundwater levels. This type of flooding is typically associated with prolonged durations, potentially lasting several days to weeks, and may be exacerbated following extended periods of rainfall or high river levels.

According to the British Geology Society, the ground conditions expected to be encountered include superficial deposits in the form of Enfield Silt Member – clay and silt, with bedrock geology of the London Clay Formation. The strategic flood risk assessment shows the site is located within a zone that is classified as having no potential for groundwater flooding to occur. The nearest observed potential for groundwater flooding is approximately 0.8km away. Therefore, the risk of groundwater flooding can be classed as low. This map is shown in Figure 7 and has been included in **Appendix D**.

Based on the evidence available, the risk of groundwater flooding at The Site is deemed to be 'Low'.

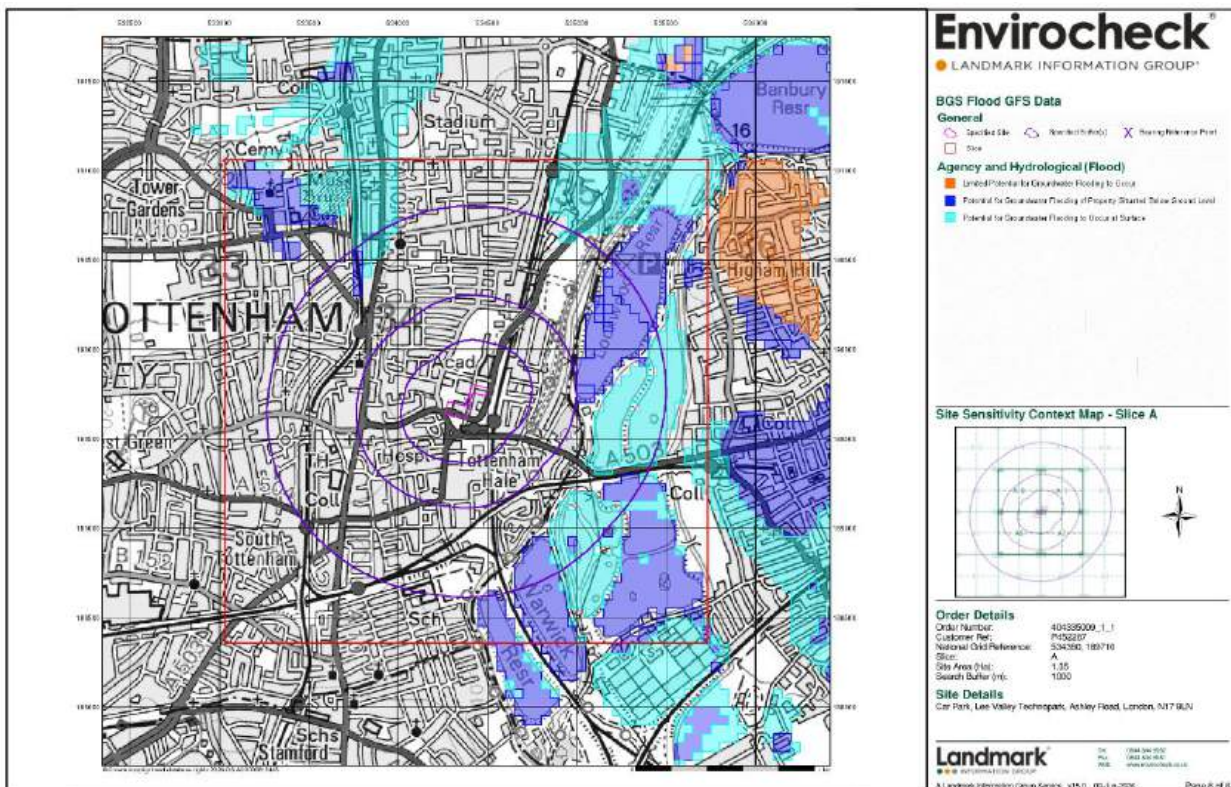


Figure 7 - Groundwater Extent

### 3.5 SEWER FLOODING

The London Borough of Haringey Strategic Flood Risk Assessment (SFRA) highlights areas within the borough where sewer flooding has been reported, in partial postcode format. However, the dataset does not specify where the flooding is occurring at property level.

The Site is situated in the postcode of N17 which reported 361 sewer flooding incidents between 2017 and 2021. No reported incidents of sewer flooding directly at The Site could be found. The number of surface water flooding and water main burst incidents in the four-digit postcode area of N17 9 was 1 during 2017 to 2021.

It should be noted that the flood records provided may not be a complete and accurate record of flood events over this period, as some minor flooding incidents may go unreported, particularly if no property is affected by such flooding.

Based on this evidence, the risk of sewer flooding at The Site is deemed to be 'Low'.

### 3.6 ARTIFICIAL SOURCES

Reservoirs across England are regulated by the Reservoirs Act 1975 which set stringent conditions for the operation of reservoirs to ensure high levels of safety. They are designed to operate in a way which ensures the likelihood of failure is incredibly low and therefore the risk of the Site flooding from a reservoir is low. For this reason, this source of flooding has not been considered further within this report.

### 3.7 SOURCE PROTECTION ZONES

The proposed development is located in Source Protection Zone 2 (SPZ2) as shown by Figure 8 and included in **Appendix C**. SPZ2 is defined by the Environment Agency as the zone within which 400 days of groundwater travel time to the abstraction point applies. Given that The Site falls within SPZ2, it is crucial that for any possible contaminants, during construction or once completed, there are suitable measures in place to minimise the risk of spillage and therefore any infiltration into the groundwater source.

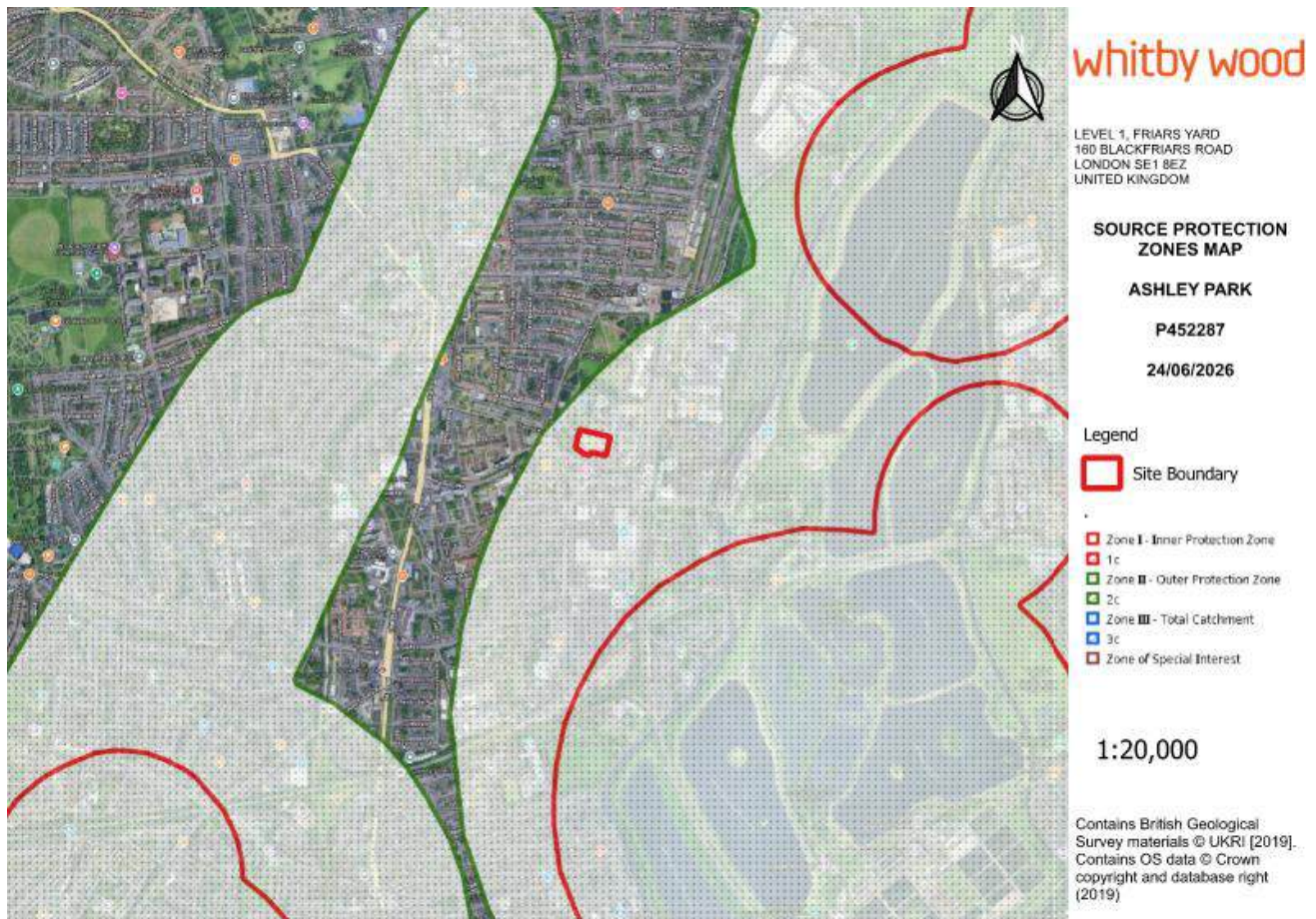


Figure 8. Source Protection Zone Map

### 3.8 SUMMARY

The table below provides a summary of the 5 sources of flood risk. Overall, The Site is considered to be at 'Low' risk from all the flood sources. Surface water flooding will be discussed further in Section 5 to identify mitigating measures where relevant.

Table 1 - Flood Risk Summary

| Flood Type  | Risk |        |      |
|-------------|------|--------|------|
|             | Low  | Medium | High |
| Fluvial     | ✓    |        |      |
| Pluvial     | ✓    |        |      |
| Groundwater | ✓    |        |      |
| Sewer       | ✓    |        |      |
| Artificial  | ✓    |        |      |

## 4 PLANNING POLICY GUIDANCE

### 4.1 NATIONAL PLANNING POLICY FRAMEWORK 2026

The National Planning Policy Framework (NPPF) provides the planning framework on which this FRA has been based. The NPPF states that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk. Where development is necessary, the development should be made safe and not increase flood risk elsewhere.

#### 4.1.1 Sequential Test

The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be permitted if there are reasonably available sites appropriate for development in areas at a lower risk of flooding.

A Sequential Test is required for major and non-major developments if any proposed, access and escape route, land-raising or other vulnerable elements will be:

- In Flood Zone 2 or 3;
- In Flood Zone 3b and the development is not incompatible;
- Within 'Flood Zones plus climate change', showing it is at increased risk of flooding from rivers or sea in future;
- Within Flood Zone 1 and the flood map for planning shows it at risk of flooding from surface water;
- In Flood Zone 1 and the LPA's SFRA shows it will be at increased risk of flooding during its lifetime; and
- Subject to sources of flooding other than rivers or sea.

A development is exempt from the sequential test if it is a:

- Householder development like residential extensions, conservatories or loft conversions
- Small non-domestic extensions with a footprint of less than 250 square metres
- Change of use (except changes of use to a caravan, camping or chalet site, or to a mobile home or park home site)

A development is also exempt from the sequential test if it is a development on a site allocated in the development plan through the sequential test and:

- The proposal is consistent with site's allocated use;
- There have been no significant changes to the known level of flood risk to the site, now or in the future, which would have affected the outcome of the test It is recommended that the development passes the sequential test as the development will seek.

As The Site is located entirely within Flood Zone 2, a Sequential Test is required. This would be undertaken as part of the planning application review process, supported by the flood risk evidence in this report. The Site is protected by spatial flood defences on the River Lea, so fluvial flood risk is considered low, and it is recommended that the Site passes the Sequential Test. The development also comprises redevelopment of a cleared brownfield site, following demolition of the former Ashley House complex, so the need to consider alternative sites is not considered critical. The Site is allocated for development, benefits from extant, implemented consents, and is anticipated to come forward as part of the Ashley Road South masterplan. Brownfield regeneration of this kind is a key aim of the London Plan and supports London's wider infrastructure growth.

#### 4.1.2 Flood Vulnerability Classification

Any proposed development on The Site will be subject to the planning requirements of the London Borough of Haringey Council, the Lead Local Flood Authority (LLFA), and the NPPF.

Flood risk vulnerability classification for all flood zones has been reproduced in Table 2 below. This has been extracted from Table 3 of the NPPF Planning Practice Guidance. Building types are classified depending on their use and are placed in a higher vulnerability class depending on flood risk sensitivity. Examples of typical building uses for each vulnerability classification have been included in Table 3. The NPPF guidance states that residential uses (Class C3) would fall under the category of 'More Vulnerable', whilst commercial uses would fall under the category of 'Less Vulnerable'. As The Site is situated within Flood Zone 2, the proposed development is deemed to be acceptable, and no Exception Test is required.

Table 2 - Flood Risk Vulnerability and Zone Compatibility

| Flood Zones | Essential infrastructure | Highly vulnerable       | More vulnerable         | Less vulnerable | Water compatible |
|-------------|--------------------------|-------------------------|-------------------------|-----------------|------------------|
| Zone 1      | ✓                        | ✓                       | ✓                       | ✓               | ✓                |
| Zone 2      | ✓                        | Exception Test required | ✓                       | ✓               | ✓                |
| Zone 3a     | Exception Test required  | X                       | Exception Test required | ✓               | ✓                |
| Zone 3b     | Exception Test required  | X                       | X                       | X               | ✓                |

Table 3 - Flood Risk Vulnerability Classification

| Vulnerability Classification    | Building Use Example                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Essential infrastructure</b> | <ul style="list-style-type: none"> <li>• Essential transport infrastructure (including mass evacuation routes) which must cross the area at risk.</li> <li>• Essential utility infrastructure which must be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood.</li> <li>• Wind turbines.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Highly vulnerable</b>        | <ul style="list-style-type: none"> <li>• Police stations, ambulance stations and fire stations and command centres and telecommunications installations required to be operational during flooding.</li> <li>• Emergency dispersal points.</li> <li>• Basement dwellings.</li> <li>• Caravans, mobile homes and park homes intended for permanent residential use.</li> <li>• Installations requiring hazardous substances consent.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>More vulnerable</b>          | <ul style="list-style-type: none"> <li>• Hospitals.</li> <li>• Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.</li> <li>• Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.</li> <li>• Non-residential uses for health services, nurseries and educational establishments.</li> <li>• Landfill and sites used for waste management facilities for hazardous waste.</li> <li>• Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.</li> </ul>                                                                                                                                                                                                                                                    |
| <b>Less vulnerable</b>          | <ul style="list-style-type: none"> <li>• Police, ambulance and fire stations which are not required to be operational during flooding.</li> <li>• Buildings used for shops, restaurants and cafes, offices, general industry, storage and distribution, non-residential institutions not included in "more vulnerable", and assembly and leisure.</li> <li>• Land and buildings used for agriculture and forestry.</li> <li>• Waste treatment (except landfill and hazardous waste facilities).</li> <li>• Minerals working and processing (except for sand and gravel working).</li> <li>• Water treatment works which do not need to remain operational during times of flood.</li> <li>• Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).</li> <li>• Car Parks</li> </ul>                                         |
| <b>Water compatible</b>         | <ul style="list-style-type: none"> <li>• Flood control infrastructure.</li> <li>• Water and sewage transmission infrastructure and pumping stations.</li> <li>• Sand and gravel working.</li> <li>• Docks, marinas and wharves.</li> <li>• Navigation facilities.</li> <li>• Ministry of Defence installations.</li> <li>• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.</li> <li>• Water-based recreation</li> <li>• Lifeguard and coastguard stations.</li> <li>• Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.</li> <li>• Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.</li> </ul> |

### 4.1.3 Exception Test

If after undertaking the Sequential Test, it is not feasible for the development to be in a zone at lower risk of flooding, the Exception Test can be applied as appropriate.

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk; and
- A site-specific flood risk assessment must demonstrate that 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.

As the proposed development is situated within Flood Zone 2 and the residential use (Class C3) falls under the 'More Vulnerable' classification, and the commercial use (Class E) falls under the 'Less Vulnerable' classification, both uses are compatible with Flood Zone 2 as shown in Table 2 above. Therefore, an Exception Test is not required.

## 4.2 CLIMATE CHANGE

In May 2022, climate change allowances were published by the Environment Agency. These allowances are based upon predicted changes in fluvial flows and rainfall intensities due to climate change.

### 4.2.1 Peak Rainfall Intensity

The peak rainfall intensity is expected to increase as a result of climate change; Table 4 below has been extracted from Table 2 within the climate change allowance guidance and applies across all of England. Both the upper end and central allowances of the associated epoch should be reviewed for a proposed development.

Table 4 - Peak Rainfall Intensity Allowance for London Management Catchment

| Allowance category | Total potential change anticipated for the '2050s' |                   | Total potential change anticipated for the '2070s' |                   |
|--------------------|----------------------------------------------------|-------------------|----------------------------------------------------|-------------------|
|                    | 3.3% rainfall event                                | 1% rainfall event | 3.3% rainfall event                                | 1% rainfall event |
| Central            | 20%                                                | 20%               | 20%                                                | 25%               |
| Upper              | 35%                                                | 40%               | 35%                                                | 40%               |

## 4.3 LONDON PLAN 2021

In addition to the requirements of the NPPF, the London Plan also sets out the principles for all London based developments with respect to Flood Risk and SuDS. These should be followed where local plan policies listed below don't supersede.

In particular, the following policies will apply:

- Policy SI 5 Water Infrastructure;
- Policy SI 12 Flood Risk Management; and
- Policy SI 13 Sustainable Drainage.

This list is not exhaustive, and other policies may be applicable.

## 4.4 LOCAL PLAN

Within the London Borough of Haringey Local Plan are relevant sections that are associated with Flood Risk and Drainage.

### 4.4.1 Policy DM24 : Managing and Reducing Flood Risk

A. The Council will ensure that all proposals for new development avoid and reduce the risk of flooding to future occupants and do not increase the risk of flooding.

B. All proposals for new development within Flood Zone 2 and 3a will be required to provide sufficient evidence for the Council to assess whether the requirements of the Sequential Test and Exception Test, where required, have been satisfied. Proposals must be informed by a site-specific Flood Risk Assessment (FRA) taking account of all potential sources of flooding and should:

- a. Demonstrate the application of a sequential approach for the development of individual sites to ensure that the most vulnerable land uses are located in areas of the site that are at lowest risk of flooding;

- b. Preserve overland flood and flow routes and ensure there is no net loss of flood storage. Adequate flood storage and compensation should be provided on site, or if this is not possible, provided off site where circumstances allow;

- c. Where appropriate, set out the mitigation measures that will be incorporated on site to manage residual flood risk including:

- i. Finished floor levels set no lower than 300mm above the 1 in 100 chance in any given year, including an allowance for climate change, flood level; and

- ii. Ensure safe access and egress for future users of the development or an appropriate emergency evacuation plan.

- d. Contribute to naturalising watercourses where opportunities arise.

C. All proposals for new development will be required to:

- a. Manage and reduce surface water run-off; and

- b. Manage water and wastewater discharges.

D. With the exception of water compatible uses and essential infrastructure, development in areas designated in Haringey's Strategic Flood Risk Assessment as being within Flood Zone 3b will not be permitted.

## 5 MANAGING FLOOD RISK

### 5.1 DETAILED DESIGN

It is recommended that during the progression of the detailed design, the proposed development is continued to be designed with flood risk and drainage implications in mind. The following sections outline the key principles and considerations that should be followed post planning.

### 5.2 FLOOD COMPENSATION

As The Site is located in Flood Zone 2, detailed flood mapping using the Environment Agency's data was reviewed as shown in Section 3. As there is a small extent on The Site of 'Low' and 'Very Low' risk of flooding from rivers and seas and surface water, this will not require further analysis, therefore no flood compensation is required.

### 5.3 MITIGATING THE RISK OF FLOODING

As identified in Section 3.3, The Site is considered to be at 'Low' risk of flooding from surface water.

#### 5.3.1 Attenuation Compensation

To ensure that The Site is not increasing the risk of surface water to any adjacent properties, appropriate attenuation compensation should be introduced into the SuDS design. The proposed implementation of permeable surfaces in the form of green roofs will help control surface water run-off and attenuate flows on site, helping to reduce the risk that surface water flooding poses to The Site.

### 5.4 GENERAL MITIGATION MEASURES

Whilst the overall flood risk to The Site has been assessed as Low or below across all sources, the following measures are recommended as standard good practice to manage residual flood risk (e.g. in the event of a defence breach) and to ensure resilience over the development's lifetime, including under future climate change scenarios. This should be considered, but not be limited to, during the detailed design stage of the Proposed Development:

- **Basement Waterproofing:** given the Site's basement extends below the anticipated groundwater table, the basement should be designed in accordance with BS 8102:2022 to achieve the required grade of protection against groundwater ingress, independent of the Site's overall groundwater flood risk classification.
- **Raising of Plant Room Levels:** critical plant and infrastructure should be positioned above predicted groundwater and flood levels where possible. This ensures critical infrastructure remains operational during a flood event and can be achieved through installing plant on raised plinths.
- **Flood Resistant Measures:** designing with low porous building materials and renders can resist penetration of flood waters. Covers for air vents and other openings into the building should also be considered to prevent flood water ingress.
- **Flood Resilient Measures:** internal walls and floors should be constructed using water resistant materials where possible to reduce long lasting damage. Expensive or porous flooring should be avoided at basement and ground floor level.
- **Raising of Electrical Outlets:** as per Building Regulations, the centre line of all switches and sockets serving habitable rooms should be positioned above anticipated flood levels. Ring mains for the ground floor can also be wired to the ceiling to further minimise impacts.
- **No infiltration:** as The Site is situated within a Source Protection Zone, no infiltration of contaminated surface water will be allowed. The surface water will discharge via an alternative method in accordance with the drainage hierarchy.

## 6 SURFACE WATER MANAGEMENT

### 6.1 GREENFIELD RUNOFF RATES AND VOLUME

Greenfield runoff rates have been calculated using FEH methodology which can be found in **Appendix E**. The table below shows the greenfield runoff rates for the development and factored to provide a runoff rate per hectare. For the purposes of this FRA, the full building footprint will be included in the calculations. The existing discharge rates have been calculated using the Modified Rational Method as presented in Equation 1, as recommended in Table 24.1 of the CIRIA SuDS manual. The percentage of impermeable area (PIMP) has been taken as 100%, as only the developed areas of The Site have been considered in the calculation. A time concentration of 5 minutes was assumed. A runoff coefficient of 1 has been used as only impermeable areas have been included in the calculation.

$$Q = 2.78 C_v C_r i A_i \quad (1)$$

Where;

$C_v$  is the volumetric runoff coefficient;

$C_r$  is the dimensionless routing coefficient, with a value of 1.3 used;

$i$  is the rainfall intensity; and

$A_i$  is the impermeable area.

Table 5 – Greenfield Runoff and Existing Discharge Rates

| Return Period | Greenfield runoff rates                  |                      | Existing Discharge Rates (l/s) |
|---------------|------------------------------------------|----------------------|--------------------------------|
|               | Positively Drained Area [0.715 ha] (l/s) | Per hectare (l/s/ha) |                                |
| QBAR          | 1.3                                      | 1.82                 | -                              |
| 2-year        | 1.2                                      | 1.68                 | 181.5                          |
| 30-year       | 3.2                                      | 4.48                 | 334.2                          |
| 100-year      | 4.2                                      | 5.87                 | 423.6                          |

### 6.2 DELIVERING A SUDS SCHEME

The philosophy of SuDS is about maximising the benefits and minimising the negative impacts of surface water runoff from developed areas throughout its life cycle. This is known as the treatment train philosophy and uses drainage techniques to systematically control the three elements of runoff; pollution, flow rates and volumes. The ‘four pillars’ of SuDS design as described by the SuDS Manual are;

- Water Quantity;
- Water Quality;
- Amenity; and
- Biodiversity.

SuDS can improve the quality of life in developments by making them more vibrant, visually attractive, sustainable and more resilient to change, by improving urban air quality, regulating building temperatures, reducing noise and delivering recreation and education opportunities.

The SuDS design should therefore as much as possible, be based around the following;

- Using surface water runoff as a resource;

- Managing rainwater close to where it falls;
- Managing runoff on the surface;
- Allowing rainfall to soak into the ground;
- Promoting evapotranspiration;
- Slowing and storing runoff to mimic natural runoff characteristics;
- Reducing contamination of runoff through pollution prevention and controlling the runoff at source; and
- Treating runoff to reduce the risk of urban contaminants causing environmental pollution.

Any proposed development on The Site has the potential to maximise SuDS and conform to SuDS best practice. Ultimately a well designed and constructed SuDS scheme will provide a robust and reliable surface water drainage network, whilst providing increased amenity and biodiversity.

## 6.3 DRAINAGE HIERARCHY

As stated in the National Planning Practice Guidance, the aim should be to discharge surface water run-off as high up the drainage hierarchy, as reasonably practicable. Local Authorities and Water Boards often require proof that each option is not feasible before considering the next.

The drainage hierarchy is as follows:

1. Discharge into the ground (infiltration);
2. Discharge to a surface water body;
3. Discharge to a surface water sewer, highway drain, or another drainage system;
4. Discharge to a combined sewer.

For this site the hierarchy should be followed. The method of which The Site fulfils these requirements should be detailed in a site-specific drainage strategy report.

## 7 CONCLUSION

The main conclusions from this flood risk assessment are detailed below;

- The Site is located entirely within Flood Zone 2; however The Site is protected by spatial flood defences on the River Lea and the risk of fluvial flooding is therefore deemed to be 'Low';
- The nearest main watercourse is the River Lea, located approximately 400 metres to the east of The Site;
- For both present day and climate change extents, The Site has a 'Very Low' to 'Low' risk of flooding from rivers and seas;
- The risk of surface water flooding to The Site is deemed to be 'Low';
- The risk of groundwater flooding is deemed to be 'Low';
- The risk of sewer flooding is deemed to be 'Low';
- The risk of flooding from artificial sources is deemed to be 'Low';
- The Site is situated in Source Protection Zone 2;
- A Sequential Test is required as The Site is located entirely within Flood Zone 2; however, given the Site's allocation, extant implemented consents, and anticipated delivery as part of the Ashley Road South masterplan, identifying alternative sites is not considered critical;
- An Exception Test is not required; and
- Mitigation measures for flooding have been identified and should be considered during the detailed design stage as outlined in Section 5.

## Appendix A – Site Location Map

REVISIONS

P01 Planning Drawings - Draft

14/08/2026

FOR PLANNING ONLY

These drawings reflect the currently proposed scheme at RIBA Stage 2. They should be read in conjunction with the Design and Access Statement prepared by DLA Architecture Ltd.

These should also be read in conjunction with the following information, prepared by other consultants, to demonstrate a coordinated design proposal at RIBA Stage 2:

- Structural Engineers Drawings and Specification (Whitby Wood)
- MEP Engineers Drawings and Specification (Meinhardt)
- Fire Report (Ashton Fire)
- Landscape Drawings and Specification (Bosk Studio)

EXTENTS AND BOUNDARIES:

Existing site information, context, surrounding infrastructure, neighbouring building extents and plots are derived from 2D Surveys, produced by:  
Cloud 10 Ltd  
Drawing numbers: 2049-T(2) Topographical Survey

NOTES

All workspace furniture layouts are indicative only  
All unit layouts are indicative only  
Cycle store layouts are indicative only  
Student and Shared Living amenity spaces are only indicative and subject to operator specifications

DRAFT

— Ashley House Application Boundary

NORTH



**dl**a

1 Naoroji Street Clerkenwell London WC1X 0GB  
0207 553 3030  
www.dla-architecture.co.uk

PROJECT

Ashley House Tottenham Hale

TITLE

**SITE LOCATION PLAN**

SCALE

As indicated @ A1

DATE

14/08/2026

DLA REF

2025-032

DRAWN REVIEWED

VLM CJ

DOCUMENT NUMBER

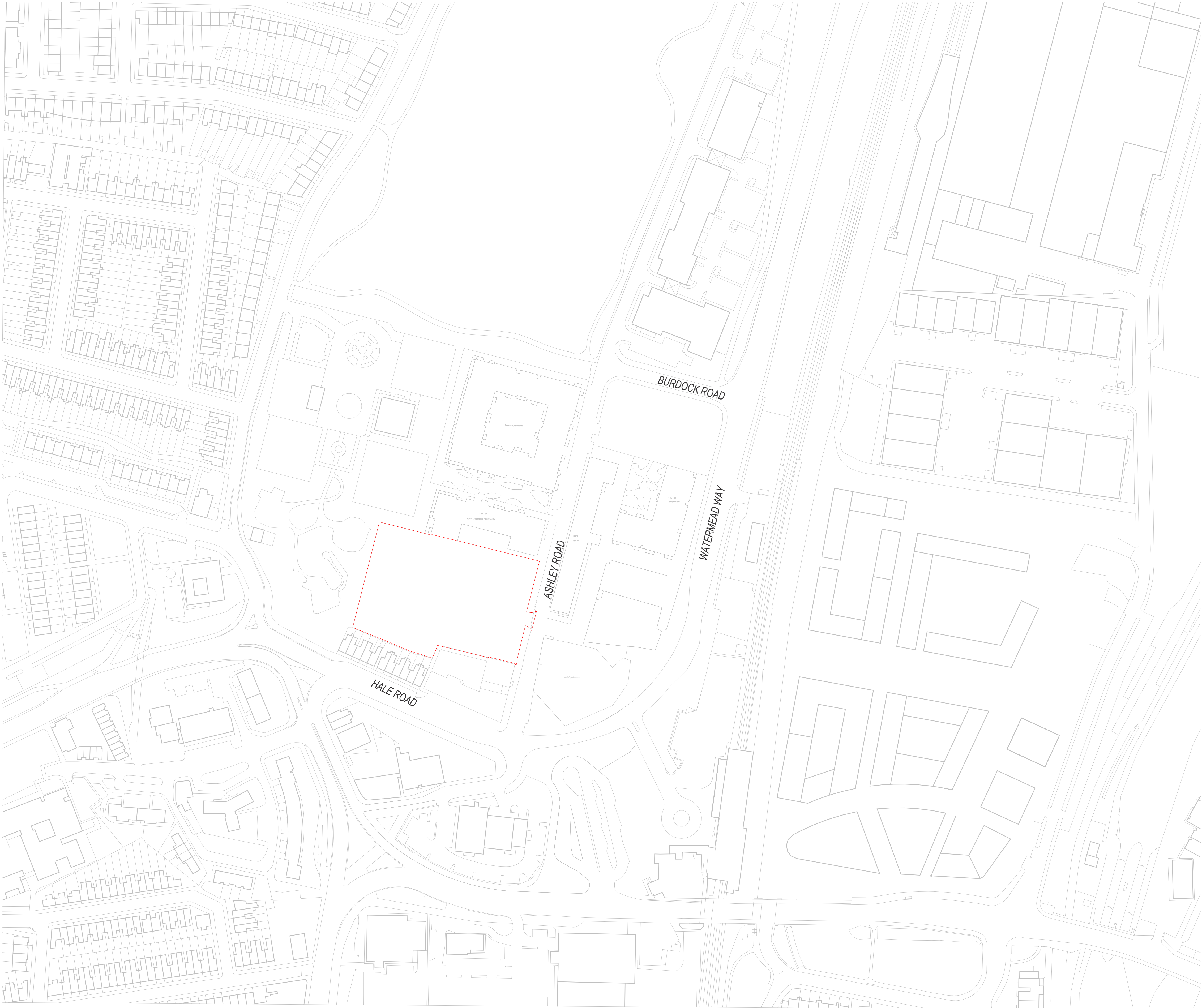
AHCF-DLA-ZZ-XX-DR-A- 20000

DOCUMENT PURPOSE

PLANNING

REVISION

**P01**



**ASHLEY HOUSE SITE - SITE LOCATION PLAN**

1 : 1250



## Appendix B – Site Geology



whitby wood

LEVEL 1, FRIARS YARD  
160 BLACKFRIARS ROAD  
LONDON SE1 8EZ  
UNITED KINGDOM

## BGS GEOLOGY MAPS

### ASHLEY PARK

P452287

10/06/2026

#### Legend

-  Site Boundary
-  London Clay Formation - Clay, Silt and Sand
-  Enfield Silt Member - Clay and Silt

1:10,000

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Contains OS data © Crown copyright and database right (2019)

Superficial Deposits

Bedrock Geology

## Appendix C – Flood Maps

## RISK OF FLOODING FROM RIVERS AND SEAS EXTENT

**ASHLEY PARK**

**P452287**

**10/06/2026**

### Legend

- Site Boundary
- High Risk
- Medium Risk
- Low Risk
- Very Low Risk
- / Spatial Flood Defences
- / Statutory Main River

1:5,000

**PRESENT DAY SCENARIO**

**CLIMATE CHANGE SCENARIO**

**RISK OF FLOODING FROM  
RIVERS AND SEAS  
FLOOD DEPTHS  
(CLIMATE CHANGE)**

**ASHLEY PARK**

**P452287**

**24/06/2026**

**Legend**

-  Site Boundary
-  High Risk
-  Medium Risk
-  Low Risk
-  Very Low Risk
-  Spatial Flood Defences
-  Statutory Main River

1:1,500



## RISK OF FLOODING FROM SURFACE WATER EXTENT

ASHLEY PARK

P452287

10/06/2026

### Legend

- Site Boundary
- High Risk
- Medium Risk
- Low Risk

1:2,500

**PRESENT DAY SCENARIO**

**CLIMATE CHANGE SCENARIO**



whitby wood

LEVEL 1, FRIARS YARD  
160 BLACKFRIARS ROAD  
LONDON SE1 8EZ  
UNITED KINGDOM

## SOURCE PROTECTION ZONES MAP

**ASHLEY PARK**

**P452287**

**24/06/2026**

### Legend

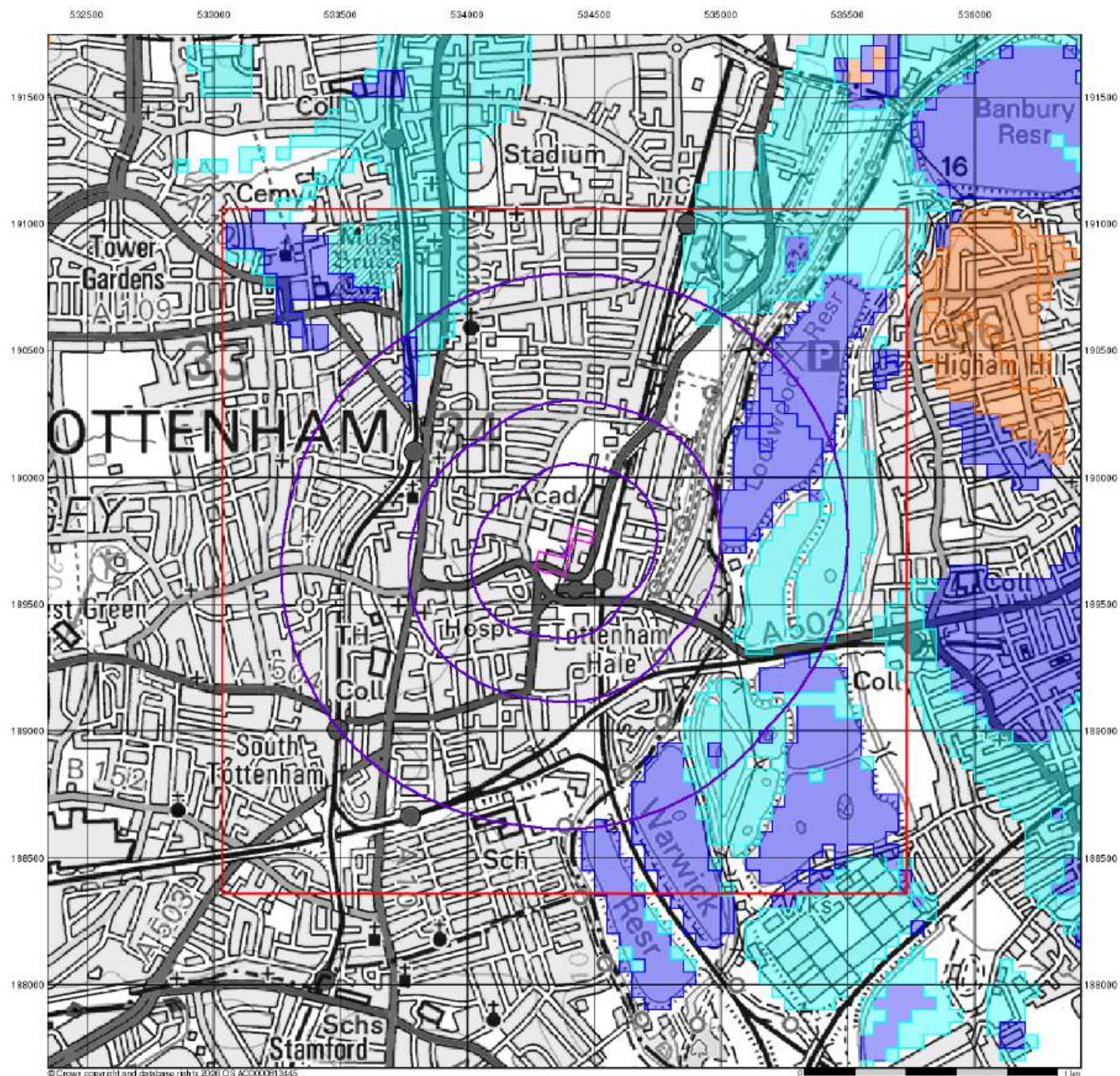
 Site Boundary

-  Zone I - Inner Protection Zone
-  1c
-  Zone II - Outer Protection Zone
-  2c
-  Zone III - Total Catchment
-  3c
-  Zone of Special Interest

1:20,000

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Survey materials © UKRI [2019].  
Contains OS data © Crown  
copyright and database right  
(2019)

## Appendix D – Envirocheck Mapping



# Envirocheck<sup>®</sup>

LANDMARK INFORMATION GROUP<sup>®</sup>

## BGS Flood GFS Data

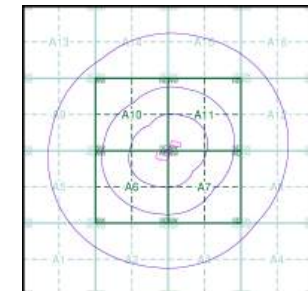
### General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice

### Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

## Site Sensitivity Context Map - Slice A



## Order Details

Order Number: 404335009\_1\_1  
 Customer Ref: P452287  
 National Grid Reference: 534380, 189710  
 Slice: A  
 Site Area (Ha): 1.35  
 Search Buffer (m): 1000

## Site Details

Car Park, Lee Valley Technopark, Ashley Road, London, N17 9LN

**Landmark<sup>®</sup>**  
 LANDMARK INFORMATION GROUP

Tel: 0844 844 9952  
 Fax: 0844 844 9951  
 Web: [www.envirocheck.co.uk](http://www.envirocheck.co.uk)

## Appendix E – Greenfield/Existing Run-Off Rates

GREENFIELD RUNOFF RATE

Pre-development discharge

Site Makeup

Greenfield

Greenfield Method

FEH

Positively Drained Area (ha)

0.715

SAAR (mm)

617

Host

6

BFIHost

0.567

Region

6

QBar/QMed conversion factor

1.136

Betterment (%)

0

Calc

QMed (l/s)

1.2

QBar (l/s)

1.3

| Return Period (years) | Growth Factor | Q (l/s) |
|-----------------------|---------------|---------|
| 2                     | 0.88          | 1.2     |
| 30                    | 2.40          | 3.2     |
| 100                   | 3.19          | 4.3     |

99% BETTERMENT RUNOFF RATE

Pre-development discharge

Site Makeup

Brownfield

Brownfield Method

MRM

Contributing Area (ha)

0.715

PIMP (%)

100

CV

1.000

Time of Concentration (mins)

5.00

Betterment (%)

99

Calc

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 2                     | 1.8     |
| 30                    | 3.3     |
| 100                   | 4.2     |

2 l/s STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

2.000

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

797

to

915

BROWNFIELD RUNOFF RATE

Pre-development discharge

Site Makeup

Brownfield

Brownfield Method

MRM

Contributing Area (ha)

0.715

PIMP (%)

100

CV

1.000

Time of Concentration (mins)

5.00

Betterment (%)

0

Calc

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 2                     | 181.5   |
| 30                    | 334.2   |
| 100                   | 423.6   |

QBAR STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

1.300

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

841

to

1011

50% BETTERMENT STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

211.800

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

134

to

265

50% BETTERMENT RUNOFF RATE

Pre-development discharge

Site Makeup

Brownfield

Brownfield Method

MRM

Contributing Area (ha)

0.715

PIMP (%)

100

CV

1.000

Time of Concentration (mins)

5.00

Betterment (%)

50

Calc

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 2                     | 90.8    |
| 30                    | 167.1   |
| 100                   | 211.8   |

GREENFIELD STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

1.200

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

850

to

1028

BROWNFIELD STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

423.600

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

63

to

187

ASHLEY PARK

PRELIMINARY

ATTENUATION CALCULATIONS

GENERAL NOTES:

whitby wood

|                |                            |          |      |          |  |
|----------------|----------------------------|----------|------|----------|--|
| Project Title: | ASHLEY PARK                |          |      |          |  |
| Project No:    | P452287                    |          |      |          |  |
| Sketch No:     | P452287-WW-XX-XX-SK-C-1001 |          |      |          |  |
| Title:         | ATTENUATION CALCULATIONS   |          |      |          |  |
| Scale:         | Rev:                       | Date:    | Eng: | Checked: |  |
| NTS            | P02                        | 19/08/26 | MS   | SM       |  |

**END OF REPORT**

whitby wood



# whitby wood

## **ASHLEY PARK, TOTTENHAM HALE**

### DRAINAGE STRATEGY REPORT

ACHF-WW-ZZ-XX-TR-C-00003

Status: S0 - Initial status

P452287

Revision: P02

Client: Re:shape T Ltd

Date: 19/08/2026

REVISION HISTORY

| REVISION | DATE       | DESCRIPTION OF CHANGE | PREPARED BY: | REVIEWED BY: | APPROVED BY: |
|----------|------------|-----------------------|--------------|--------------|--------------|
| P01      | 24/07/2026 | Draft Planning Issue  | MS           | SM           | SM           |
| P02      | 19/08/2026 | Updated to Comments   | MS           | SM           | SM           |

PREPARED BY:



Matthew Sproat

Graduate Engineer – Civils

REVIEWED BY:



Sam Martin

Associate – Civils

APPROVED BY:



Sam Martin

Associate – Civils

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Appendix B – Thames Water Asset Location Map

Appendix C - Geology

Appendix D – Greenfield / Existing Run-off Rates

Appendix E – Proposed Drainage Strategy

Appendix F – SuDS Proforma

Appendix G – Causeway Flow + Model Results

## DISCLAIMER

Whitby Wood Limited (WW) is appointed by Re:shape T Ltd to provide Structural, Civil and Geotechnical consultancy services for the development of Ashley Park.

This report has been produced for the exclusive use of Re:shape T Ltd for the purposes set out herein only and it should not be used in whole or in part by any third parties without the express permission of WW in writing. WW neither owes nor accepts any duty to any third party whether in contract, tort or otherwise and shall not be liable for any loss, damage or expense of whatsoever nature which is caused by their reliance on the information contained in this report.

# 1 INTRODUCTION

Whitby Wood have been commissioned for the design of the below ground foul and surface water drainage systems for the development at former Ashley House site, Tottenham Hale, London, hereby referred to as 'The Site'. This report has been undertaken to ascertain the constraint of flooding in order to redevelop The Site and allow the introduction of Sustainable Drainage Systems (SuDS) to act as the key aspect of flood mitigation. This is a supporting document to The Flood Risk Assessment (FRA).

## 1.1 SOURCES OF INFORMATION

A review of the relevant information from a range of sources has been undertaken and includes the following:

- Whitby Wood, Flood Risk Assessment (2026);
- The London Borough of Haringey, Strategic Flood Risk Assessment (SFRA) (2022);
- The London Borough of Haringey, Local Flood Risk Management Strategy and 5-year Delivery Plan, 2025-2030 (2025);
- Greater London Authority, London Plan (2021);
- BS EN12056-2:2000, Gravity drainage systems inside buildings (2010);
- CIRIA, The SuDS Manual (2016);
- Building Regulations Part H;
- BS EN 752:2017, Drainage & Sewer Systems Outside Buildings;
- Design and Construction Guidance (DCG) – Sewerage Sector Guidance (for adopted connections);
- Ministry of Housing Communities & Local Government, National Planning Policy Framework (NPPF) (2026);
- British Geology Survey [Accessed June 2026].

## 1.2 SITE LOCATION AND DESCRIPTION

The Site, Ashley Park, is located within the London borough of Haringey, N17 9LZ. The Site is approximately 0.715 ha and is centred at 534332 Easting and 189663 Northing. A Site location plan has been included within Figure 1 and **Appendix A**.

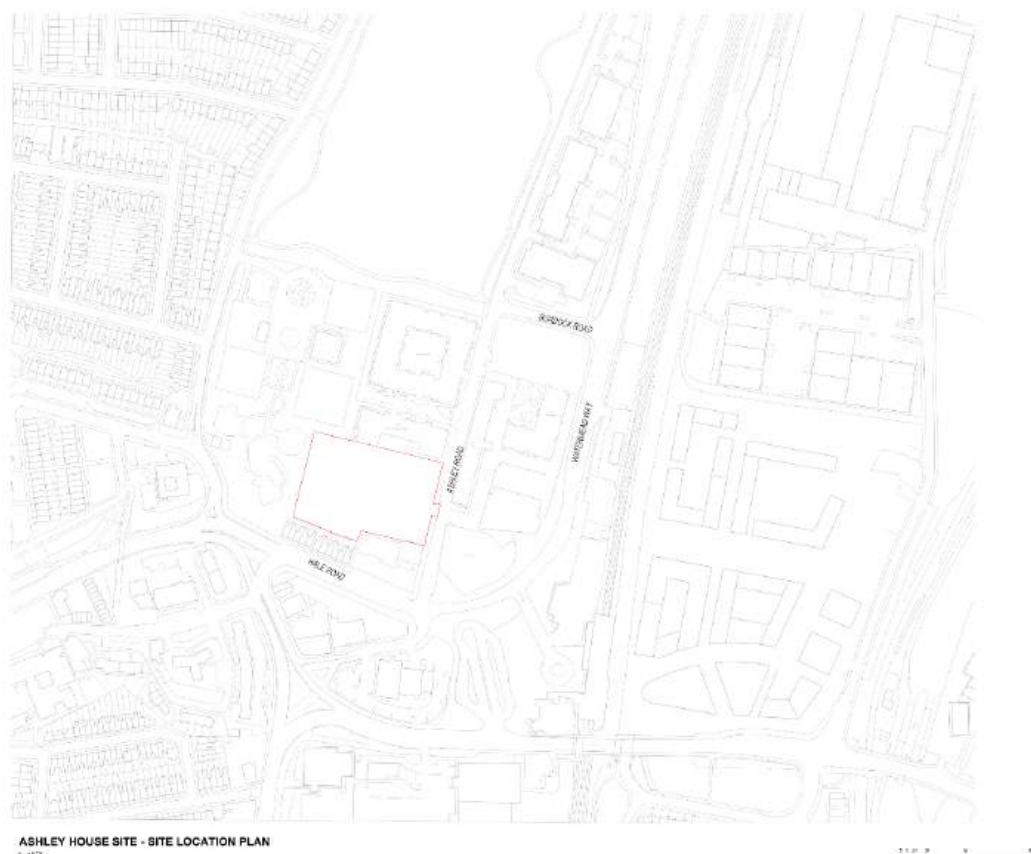


Figure 1 - Site location map

### 1.3 EXISTING DRAINAGE

Thames Water sewer records show that there are public combined, foul and surface water sewers surrounding The Site. To the east of The Site on Ashley Road, there is a 1380mm diameter combined trunk sewer running north. Alongside this, there is a separate 229mm diameter foul water sewer and a 229mm diameter surface water sewer. These two 229mm sewers on east of Ashley Road both run southbound. To the southeast of The Site, there are two further 229mm foul and surface water sewers, running parallel to The Site boundary which connect to sewers on Hale Road. The asset search can be found in **Appendix B**.

A CCTV investigation to confirm other routes and connectivity in the area is recommended. It is clear from the asset search that manholes 3601 and 3602 could be potential points of connection for The Site's foul and surface water outfall respectively.

### 1.4 GEOLOGY

Information published by the British Geological Survey indicates that the bedrock geology of The Site consists of London Clay Formation - Clay, silt and sand, a sedimentary bedrock formed between 56 and 47.8 million years ago during the Palaeogene period. A superficial deposit is also present, in the form of Enfield Silt Member - Clay and silt, a sedimentary superficial deposit formed between 116 thousand years ago and the present during the Quaternary period. A geological map showing this can be found in **Appendix C**.

### 1.5 PROPOSED DEVELOPMENT

Full planning permission for a phased mixed -use development comprising: (i) enabling works and operations; (ii) residential development (Use Class C3) including affordable housing; (iii) shared living accommodation (Sui Generis), (iv) commercial and community floorspace (Use Classes E and F2); and (v) site-wide and/or phase-specific access, servicing, public realm, blue-badge parking, cycle parking, open space, hard and soft landscaping, utilities, plant and all other associated works.

For the purposes of this Flood Risk Assessment, the positively drained area will be taken as the full 0.715 ha.

## 2 DRAINAGE DESIGN POLICIES

The following design guidance will need to be adhered to for the proposed foul and surface water drainage system that will serve The Site.

- Building Regulations Part H;
- National Planning Policy Framework (NPPF) (2026);
- Design and Construction Guidance (DCG) – Sewerage Sector Guidance (for adopted connections);
- BS EN 752:2017, Drainage & Sewer Systems Outside Buildings; and
- BS EN 12056-1:2000, Gravity Drainage Inside Buildings.

### 2.1 OVERALL SITE DRAINAGE REQUIREMENTS:

There are a range of requirements which the proposed drainage system is expected to meet. These have been set out by various guidance documents and stakeholders. The main requirements from each guidance document or stakeholder have been set out in the table below.

Table 1 – Requirements for The Proposed Drainage System

| Sources/Stakeholders                                       | Requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| National standards for sustainable drainage systems (SuDS) | <ul style="list-style-type: none"> <li>• Where runoff from the development is to an above ground surface water body that can accommodate uncontrolled surface water discharges without any associated environmental impact, then the peak flow control and volume control standards may not need to apply, subject to written approval by the relevant risk management authority.</li> <li>• The first 5mm of rainfall for the majority of rainfall events should not result in runoff from The Site to surface waters or piped drainage systems.</li> <li>• When discharging to an above ground surface water body, sewer or other piped drainage system, the surface water runoff rate for the 1 in 2-year event shall be controlled to ensure development runoff from an event of this magnitude has no negative impact, and the 1 in 100-year event shall be controlled to ensure the runoff from the development does not increase flood risk elsewhere.</li> <li>• Any flooding from the surface water drainage system for events up to the 1 in 100-year event shall be managed within the development.</li> <li>• The risks (both on and off the development) associated with flooding from the surface water drainage system for exceedance events greater than the 1 in 100-year event shall be appropriately managed.</li> <li>• The peak allowable discharge rate from the development to surface waters or sewers for the 1 in 2-year event shall be limited to the equivalent 1 in 2-year greenfield runoff rate, or 3 l/s/ha, whichever is the greater.</li> <li>• Where the volume of runoff discharged from the development to surface waters or sewers for the 1 in 100-year, 6-hour rainfall event is greater than the volume of greenfield runoff for the same rainfall event, the peak allowable discharge rate from the development for the 1 in 100-year event shall be limited to the 1 in 2-year greenfield runoff rate or 3l/s/ha, whichever is the greater.</li> <li>• Where the volume of runoff discharged from the development to surface waters or sewers for the 1 in 100-year, 6-hour rainfall event is less than or equivalent to the volume of greenfield runoff for the same event, the peak allowable discharge rate from the development for the 1 in 100-year event shall be limited to the 1 in 100-year greenfield runoff rate or 3l/s/ha, whichever is the greater.</li> <li>• For previously developed sites a 'relaxation factor' shall be applied to the target 1 in 2-year and 1 in 100-year greenfield runoff rates where evidence is provided that demonstrates why greenfield runoff or 3l/s/ha rates cannot be achieved and this is agreed with the approving body. This relaxation factor shall be no greater than 5 times the greenfield runoff rate.</li> </ul> |

|                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Design and Construction Guidance – Sewerage Sector Guidance Appendix C (2021)</b> | <ul style="list-style-type: none"> <li>Where a component is designed to convey or store flows in excess of the 1 in 30-year return period event, the designer should demonstrate that the upstream system (including any inlets such as gullies or pervious paving) has the capacity to allow the flows to reach the component.</li> <li>Where an overland flow route is used, it should not be designed to operate more frequently than in a 1 in 30-year return period design rainfall event.</li> <li>Design foul water peak flow rates should be 4000L per dwelling per day.</li> </ul>                                                                                                                                                                                                 |
| <b>Building Regulations Approved Document H</b>                                      | <ul style="list-style-type: none"> <li>Surface water shall discharge to one of the following listed in order of priority:</li> <li>An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,</li> <li>A watercourse; or where that is not reasonably practicable,</li> <li>A sewer.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Sewerage Undertaker (Thames Water)</b>                                            | <ul style="list-style-type: none"> <li>A pre-development application is required to check the public sewer has capacity for the proposed discharge rates. At the time of writing a Thames Water pre-planning application has not been submitted.</li> <li>A section 106 application to connect to the public sewer will need to be submitted for any new connections to the public sewer.</li> <li>If the network is to be adopted, then a S104 application will need to be made in this instance.</li> <li>If any existing sewers require diverting, then an application to Thames Water to divert a public sewer under section 185 will need to be made.</li> <li>A section 116 application for the removal of public sewers will be required for any abandoned public sewers.</li> </ul> |
| <b>London Borough of Haringey (LLFA)</b>                                             | <ul style="list-style-type: none"> <li>Acting as the LLFA, any guidelines and policies outlined in the local Surface Water Management Plan or Local Plan should be adhered to.</li> <li>Where possible the proposed discharge rates should be discussed and approved with the LLFA as early as possible.</li> <li>The LLFA has not yet been contacted and commented on an appropriate discharge rate.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                            |

## 2.2 PLANNING POLICY REQUIREMENTS

The NPPF (National Planning Policy Framework) specifies 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. Opportunities to reduce the flood risk to The Site itself and elsewhere, taking climate change into account, should be investigated. The drainage proposals within this strategy have been prepared to meet planning policy requirements.

## 2.3 LONDON PLAN

In addition to the requirements of the NPPF, the London Plan also sets out the principles for all London based developments with respect to Flood Risk and SuDS. These should be followed where the local plan policies set out in Section 2.4 below do not supersede.

In particular, the following policies will apply:

- Policy SI 5 Water Infrastructure;
- Policy SI 12 Flood Risk Management; and
- Policy SI 13 Sustainable Drainage.

This list is not exhaustive, and other policies may be applicable.

## 2.4 HARINGEY LOCAL PLAN

Within the London Borough of Haringey Local Plan are relevant sections that are associated with Flood Risk and Drainage.

### 2.4.1 Policy DM24 : Managing and Reducing Flood Risk

A. The Council will ensure that all proposals for new development avoid and reduce the risk of flooding to future occupants and do not increase the risk of flooding.

B. All proposals for new development within Flood Zone 2 and 3a will be required to provide sufficient evidence for the Council to assess whether the requirements of the Sequential Test and Exception Test, where required, have been satisfied. Proposals must be informed by a site-specific Flood Risk Assessment (FRA) taking account of all potential sources of flooding and should:

- a. Demonstrate the application of a sequential approach for the development of individual sites to ensure that the most vulnerable land uses are located in areas of The Site that are at lowest risk of flooding;
- b. Preserve overland flood and flow routes and ensure there is no net loss of flood storage. Adequate flood storage and compensation should be provided on site, or if this is not possible, provided off site where circumstances allow;
- c. Where appropriate, set out the mitigation measures that will be incorporated on site to manage residual flood risk including:
  - i. Finished floor levels set no lower than 300mm above the 1 in 100 chance in any given year, including an allowance for climate change, flood level; and
  - ii. Ensure safe access and egress for future users of the development or an appropriate emergency evacuation plan.
- d. Contribute to naturalising watercourses where opportunities arise.

C. All proposals for new development will be required to:

- a. Manage and reduce surface water run-off; and
- b. Manage water and wastewater discharges.

D. With the exception of water compatible uses and essential infrastructure, development in areas designated in Haringey's Strategic Flood Risk Assessment as being within Flood Zone 3b will not be permitted.

### 3 SURFACE WATER MANAGEMENT

#### 3.1 GREENFIELD RUNOFF RATES AND VOLUME

Greenfield runoff rates have been calculated using FEH methodology which can be found in **Appendix D**. The table below shows the greenfield runoff rates for the development and factored to provide a runoff rate per hectare. For the purposes of this DSR, the positively drained area (0.715 ha) has been used. The existing discharge rates have been calculated using the Modified Rational Method as presented in Equation 1, as recommended in Table 24.1 of the CIRIA SuDS manual. The percentage of impermeable area (PIMP) has been taken as 100%, as only the developed areas of The Site have been considered in the calculation. A time concentration of 5 minutes was assumed. A runoff coefficient of 1 has been used as only impermeable areas have been included in the calculation.

$$Q = 2.78 C_v C_r i A_i \quad (1)$$

Where;

$C_v$  is the volumetric runoff coefficient;

$C_r$  is the dimensionless routing coefficient, with a value of 1.3 used;

$i$  is the rainfall intensity; and

$A_i$  is the impermeable area.

Table 2 – Greenfield Runoff and Existing Discharge Rates

| Return Period | Greenfield runoff rates                  |                      | Existing Discharge Rates (l/s) |
|---------------|------------------------------------------|----------------------|--------------------------------|
|               | Positively Drained Area [0.715 ha] (l/s) | Per hectare (l/s/ha) |                                |
| QBAR          | 1.3                                      | 1.82                 | -                              |
| 2-year        | 1.2                                      | 1.68                 | 181.5                          |
| 30-year       | 3.2                                      | 4.48                 | 334.2                          |
| 100-year      | 4.2                                      | 5.87                 | 423.6                          |

#### 3.2 PROPOSED DISCHARGE RATES AND VOLUMES

The drainage strategy for the site is to maintain low water levels in the attenuation system under normal conditions, ensuring maximum storage capacity is available during severe storm events. The outfall will feature a flow control device limiting discharge to 1.3 l/s, discharging surface water at the highest rate possible without increasing flood risk downstream. The Site will attenuate all storm events up to and including the 1 in 100 year + 40% climate change event, providing approximately 927.8 m<sup>3</sup> of attenuation through the use of blue/green roofs, permeable paving and an attenuation tank, as discussed further in Section 4. The hydraulic modelling confirms the proposed system is adequate, as shown in **Appendix F**.

A pre-planning enquiry is to be submitted to Thames Water to ascertain whether their sewers will have sufficient capacity and a decision is awaited.

### 3.3 DELIVERING A SUDS SCHEME

The philosophy of SuDS is about maximising the benefits and minimising the negative impacts of surface water runoff from developed areas. The ‘four pillars’ of SuDS design as described by the SuDS Manual are;

- Water Quantity;
- Water Quality;
- Amenity; and
- Biodiversity.

SuDS deliver high quality drainage while supporting areas to cope better with severe rainfall both now and in the future. SuDS can improve the quality of life in developments by making them more vibrant, visually attractive, sustainable and more resilient to change, by improving urban air quality, regulating building temperatures, reducing noise and delivering recreation and education opportunities.

SuDS design should maximise the use of the available space by delivering efficient drainage together with other functions to help meet the objectives of The Site. The SuDS design should, as much as possible, be based around the following;

- Using surface water runoff as a resource;
- Managing rainwater close to where it falls;
- Managing runoff on the surface;
- Allowing rainfall to soak into the ground;
- Promoting evapotranspiration;
- Slowing and storing runoff to mimic natural runoff characteristics;
- Reducing contamination of runoff through pollution prevention and controlling the runoff at source; and
- Treating runoff to reduce the risk of urban contaminants causing environmental pollution.

Any proposed development on The Site has the potential to maximise SuDS and conform to SuDS best practice. Ultimately a well designed and constructed SuDS scheme will provide a robust and reliable surface water drainage network, whilst providing increased amenity and biodiversity.

#### 3.3.1 SuDS Component Performance

The effectiveness of SuDS components in improving development surface water run-off quality is summarised in the table below. Combinations of treatments can be used to reduce potential pollutants from reaching the receiving course.

Table 3 – SuDS Treatment train

| SuDS Component       | Interception | Peak flow control: Low | Peak flow control: High | Volume reduction | Volume control | Gross sediments | Fine sediments | Hydrocarbons/PAHs | Metals | Nutrients |
|----------------------|--------------|------------------------|-------------------------|------------------|----------------|-----------------|----------------|-------------------|--------|-----------|
| Rainwater Harvesting | Y            | Y                      | S                       | Y                | N              | N               | N              | N                 | N      | N         |
| Pervious Pavement    | Y            | Y                      | Y                       | Y                | Y              | Y               | Y              | Y                 | Y      | Varies    |
| Filter Strips        | Y            | N                      | N                       | N                | N              | Y               | N              | Y                 | Y      | Varies    |
| Swales               | Y            | Y                      | S                       | Y(*)             | N              | Y               | Y(+)           | Y                 | Y      | Y(-)      |

|                                      |   |   |   |       |   |       |       |         |       |        |
|--------------------------------------|---|---|---|-------|---|-------|-------|---------|-------|--------|
| <b>Trenches</b>                      | Y | Y | S | Y (*) | N | N     | N     | Y       | Y     | Y (-)  |
| <b>Detention Basins</b>              | Y | Y | Y | N     | Y | Y     | Y (+) | Y       | Y     | Varies |
| <b>Ponds</b>                         | N | Y | Y | N     | Y | N (~) | Y     | Limited | Y     | Varies |
| <b>Wetlands</b>                      | N | Y | S | N     | Y | N (~) | Y     | Limited | Y     | Y      |
| <b>Green Roofs</b>                   | Y | Y | N | N     | N | N     | N     | Y       | N     | N      |
| <b>Bioretention Systems</b>          | Y | Y | S | Y (*) | N | N (~) | Y     | Y       | Y     | Y      |
| <b>Proprietary Treatment Systems</b> | N | N | N | N     | N | Y     | Y     | Y (!)   | Y (!) | Y (!)  |
| <b>Subsurface Storage</b>            | N | Y | Y | N     | Y | N (~) | N     | N       | N     | N      |
| <b>Subsurface Conveyance Pipes</b>   | N | N | N | N     | Y | N (~) | N     | N       | N     | N      |

#### Notes:

- S: Not normally with standard designs, but possible where space is available and designs mitigate impact of high flow rates.
- Y (\*): Where infiltration is facilitated by the design.
- N (~): Gross sediment retention is possible but not recommended due to negative maintenance and performance implications.
- Y (+): Where designs minimise the risk of fine sediment mobilisation during larger events.
- Y (!): Where designs specifically promote the trapping and breakdown of soils and PAH based constituents.
- Y ("): Where subsurface soil structure facilitates the trapping and breakdown of oils and PAH based constituents.

### 3.3.2 Hydraulic Design Criteria

The below outlines the best practice criteria for hydraulic control required for interception, runoff rate control and volume control.

- Interception

To fulfil the requirements for Interception, there should normally be no runoff from The Site for an initial depth of rainfall, usually 5mm. This is usually achieved through the use of infiltration, evapotranspiration, or rainwater harvesting. Introducing soft landscaping to brownfield sites will also help achieve this.

- Flow and Volume Control

Discharge rates for all storm events should be restricted to current greenfield run-off rates or as close as is reasonably practicable.

- Attenuation and hydraulic controls will be used to manage flow rates.

Rainwater harvesting, or the use of Long-Term Storage can be used to achieve runoff volume control. Across The Site, 927.8 m<sup>3</sup> of attenuation will be provided which will provide a method to store surface water. This attenuation volume has been designed to accommodate all storm events up to and including the 1 in 100 year + 40% climate change event.

- Water Quality Design Criteria

Current best practice takes a risk-based approach to managing discharges of surface runoff to the receiving environment. The following text provides guidance on the extent of water quality management likely to be appropriate for The Site.

- Hazard Classification

Runoff from clean roof surfaces (i.e. not metal roofs, roofs close to polluted atmospheric discharges, or roofs close to populations of flocking birds) is classified as Low in terms of hazard status.

Runoff from roads, parking and other areas of residential, commercial and industrial sites (that are not contaminated with waste, high levels of hydrocarbons, or other chemicals) is classified as Medium in terms of hazard status.

- Treatment requirements for disposal to surface water systems

As The Site is brownfield, roof runoff will require at least 1 treatment stage prior to discharge. Runoff from other parts of this site such as roads, parking and other areas will require ideally 2 treatment stages prior to discharge.

## 4 DRAINAGE DESIGN PROPOSALS

### 4.1 SURFACE WATER

The design of a surface water drainage system to serve the Proposed Development considers both water treatment and on-site attenuation in accordance with CIRIA C753. The SuDS components proposed aim to emulate the natural drainage system of The Site through attenuation of flows and imitating natural percolation where possible. This has the added benefit of alleviating water quality issues associated with urban drainage runoff.

The current proposal for the surface water drainage strategy for The Site includes the introduction of blue/green roofs, permeable paving and an attenuation tank. The inclusion of these sustainable drainage systems will provide a method of capturing water at its source and will aid in slowing down surface water run-off whilst simultaneously treating surface water at both roof and ground level. The Proposed Development will also incorporate soft landscaping to increase amenity, biodiversity, and water interception treatment.

The Proposed Development will be constructed in two phases, north and south. Two pumps will be provided, each discharging surface water at a rate of 0.65 l/s to a demarcation chamber, which connects to Thames Water manhole 3601, designated as a surface water sewer on Ashley Road.

The proposed attenuation for The Site has been calculated to be approximately 927.8 m<sup>3</sup>, split between the proposed permeable paving, attenuation tank and blue/green roofs, as shown in **Appendix E**. A hydraulic model of the proposed system has been developed using Causeway Flow+, with results indicating no pluvial flooding of the Proposed Development up to and including the 1 in 100 year event + 40% climate change allowance, as presented in Appendix F.

#### 4.1.1 Drainage Hierarchy

The drainage hierarchy should be considered for any new development. The following list details these requirements and which elements can be achieved for this site. Where possible elements as high up the hierarchy have been selected:

- Rainwater use a resource (for example rainwater harvesting, green roofs for irrigation);
  - This is the current strategy with the incorporation of green roofs.
- Rainwater infiltration to ground at or close to source;
  - Infiltration will not be feasible as there needs to be a minimum easement of 5m from the structure to ensure infiltrating water doesn't interact with the building's foundations.
- Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
  - This is the current strategy with the incorporation of green roofs.
- Attenuate rainwater by storing in tanks or sealed water features for gradual release;
  - This is the current strategy with the use of attenuation tanks and permeable paving.
- Discharge rainwater direct to a watercourse;
  - Discharging directly to a watercourse is not feasible as this would require having to by-pass third party land to perform the connection.
- Discharge rainwater to a surface water sewer/drain;
  - The outfall from The Site will be discharged to manhole 10 which is designated as a surface water sewer.
- Discharge rainwater to the combined water sewers.
  - Not necessary as appropriate surface water sewer is available.

#### 4.1.2 Water Cycle

The water cycle strategy puts emphasis on four key areas of interest:

- Consumption;
- Quality;
- Re-use; and
- Re-cycle.

Rainwater will be heavily treated through its discharge process by passing through the green roofs. Planting on the

green roof will remove sediments and pollutants from the runoff. Water treatment will also be offered via the incorporation of soft landscaping at the podium level of the development.

#### 4.1.3 Pollution Mitigation

Wherever possible, when discharging runoff from The Site to surface waters, SuDS should be designed to intercept runoff for most rainfall events up to approximately 5 mm in depth in allowance for treatment for pollutants.

This approach has been taken to minimise the impact of the Proposed Development on the environment. Techniques that control pollution close to the source, offer a suitable means of treatment for run-off from low-risk areas such as roofs and non-operational areas as currently proposed.

The tables below have been extracted from the CIRIA SuDS Manual 26.14 and 26.15 to be used to provide a basis and show adequate protection of the environment. The land use within the development is predominantly categorised as medium or below for the pollution hazard levels. The proposed SuDS measures have also been highlighted in Table 5.

The proposed SuDS features on site, predominately green blue roofs, should ensure The Site achieves sufficient treatment for total suspended solids.

Table 4 - Pollution Hazard Indices for Different Land Use Classifications

| Land use                                                                                                                                                                               | Impermeability                                                                                                                | Total suspended solids                                                                                        | Hydrocarbons                                                                                              | Metals                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Roofs <ul style="list-style-type: none"> <li>Industrial/ commercial</li> <li>Residential</li> </ul>                                                                                    | <ul style="list-style-type: none"> <li>1.0</li> <li>0.9</li> </ul>                                                            | <ul style="list-style-type: none"> <li>0.3</li> <li>0.4-0.5</li> </ul>                                        | <ul style="list-style-type: none"> <li>0.2</li> <li>0.1</li> </ul>                                        | <ul style="list-style-type: none"> <li>0.4-0.8</li> <li>0.2-0.5</li> </ul>                                |
| Highways <ul style="list-style-type: none"> <li>Motorways</li> <li>Major arterial highways</li> <li>Urban distributor roads</li> <li>Residential streets</li> <li>Pavements</li> </ul> | <ul style="list-style-type: none"> <li>0.8-0.9</li> <li>0.7-0.8</li> <li>0.6-0.7</li> <li>0.4-0.6</li> <li>0.5-0.6</li> </ul> | <ul style="list-style-type: none"> <li>0.9</li> <li>0.8</li> <li>0.7-0.8</li> <li>0.4</li> <li>0.4</li> </ul> | <ul style="list-style-type: none"> <li>0.9</li> <li>0.8</li> <li>0.8</li> <li>0.6</li> <li>0.3</li> </ul> | <ul style="list-style-type: none"> <li>0.8</li> <li>0.8</li> <li>0.7</li> <li>0.6</li> <li>0.3</li> </ul> |
| Car parks/ hardstanding <ul style="list-style-type: none"> <li>Industrial/ commercial</li> <li>Driveways (residential)</li> </ul>                                                      | <ul style="list-style-type: none"> <li>0.6-0.8</li> <li>0.5</li> </ul>                                                        | <ul style="list-style-type: none"> <li>0.6-0.7</li> <li>0.5</li> </ul>                                        | <ul style="list-style-type: none"> <li>0.7</li> <li>0.4</li> </ul>                                        | <ul style="list-style-type: none"> <li>0.4-0.5</li> <li>0.3</li> </ul>                                    |
| Open areas <ul style="list-style-type: none"> <li>Gardens (all types)</li> <li>Parks/ golf courses</li> <li>Grassed areas (including verges, all types)</li> </ul>                     | <ul style="list-style-type: none"> <li>0.1</li> <li>0.2</li> <li>0.1</li> </ul>                                               | <ul style="list-style-type: none"> <li>0.3</li> <li>0.2-0.3</li> <li>0.2-0.3</li> </ul>                       | <ul style="list-style-type: none"> <li>0</li> <li>0</li> <li>0.05</li> </ul>                              | <ul style="list-style-type: none"> <li>0.01</li> <li>0.02</li> <li>0.05</li> </ul>                        |

Table 5 - SuDS Mitigation Indices for Discharges to Surface Waters

| SuDS Type      | Mitigation Indices           |              |                   |              |
|----------------|------------------------------|--------------|-------------------|--------------|
|                | Total suspended solids (TTS) | Hydrocarbons | Organic Pollution | Heavy Metals |
| Filter drains  | 0.6                          | 0.8          | 0.7               | 0.7          |
| Porous asphalt | 0.7                          | 0.9          | 0.9               | 0.9          |

|                                    |         |      |      |         |
|------------------------------------|---------|------|------|---------|
| Porous paving                      | 0.2     | 0.3  | 0.2  | 0.3     |
| Sedimentation tank                 | 0.95    | 0.95 | 0.95 | 0.95    |
| Green roof                         | 0.8–0.9 | 0.9  | 0.5  | 0.7–0.9 |
| Filter strip                       | 0.9     | 0.8  | 0.8  | 0.7     |
| Swales                             | 0.7     | 0.6  | 0.4  | 0.4     |
| Soakaways                          | 0.3     | 0.6  | 0.5  | 0.5     |
| Infiltration trench                | 0.3     | 0.6  | 0.5  | 0.5     |
| Infiltration basin                 | 0.05    | 0.05 | 0.01 | 0.05    |
| Retention pond                     | 0.6     | 0.5  | 0.6  | 0.5     |
| Detention basin                    | 0.7     | 0.7  | 0.8  | 0.6     |
| Extended detention basins          | 0.4     | 0.4  | 0.4  | 0.4     |
| Lagoons                            | 0.9     | 0.9  | 0.9  | 0.8     |
| Constructed wetlands – subsurface  | 0.2     | 0.1  | 0.1  | 0.1     |
| Constructed wetlands – surface     | 0.4     | 0.2  | 0.2  | 0.2     |
| Conventional gully & pipe drainage | 1.0     | 1.0  | 1.0  | 1.0     |

#### 4.1.4 Overland Flow Path

An overland flow path drawing must be produced to ensure that flows are safely managed during extreme rainfall events. This drawing will identify above-ground flood pathways that may form when the capacity of the drainage system is exceeded or when runoff rates surpass inlet capacities. The levels strategy on site is to ensure that surface flows are directed away from the building, linked effectively across The Site, and integrated with SuDS components where appropriate.

## 4.2 FOUL WATER

Foul wastewater is to increase from the existing development due to the introduction of a large number of residential units and new commercial areas at ground floor level. Foul water design flow rates have been estimated using a peak allowance of 4,000 litres per dwelling per day (0.05 l/s per dwelling), giving an estimated peak foul flow of approximately 4.35 l/s for the 87 residential (Class C3) units and 26.1 l/s for the 522 Purpose-Built Shared Living (PBSL) studios, giving a total estimated peak residential foul flow of approximately 30.45 l/s. The commercial foul water contribution is to be confirmed at the next design stage.

The proposed foul water outfall will be connected to the existing publicly owned foul sewer network under Thames Water ownership that runs alongside the eastern boundary of The Site on Ashley Road. There is the option to connect to either the combined trunk sewer running northbound or the foul water sewer which runs southbound. A pre-planning enquiry will be submitted to Thames Water to ascertain whether their sewers will have sufficient capacity.

## 4.3 INTERNAL DRAINAGE

Foul water stacks and rainwater pipes dropping below slab level internal to the building will be picked up by inspection chambers situated outside the building. Where this is not possible, due to site constraints and building foundations, inspection chambers may need to be positioned internally. In this instance, the chambers will be double sealed and situated within areas that are publicly accessible to ensure the system can be inspected or accessed at all times. Any internal chambers will be positioned at the next design stage once a set of frozen MEP drawings are available.

## 5 ADOPTION AND MAINTENANCE

It is assumed that drainage on site will not be adopted by Thames Water. However, where applicable, drainage will be designed to adoptable standards set out by Guidance, and Construction Guidance; Sewerage Sector Guidance Appendix C.

### 5.1 TYPICAL SUDS MAINTENANCE SCHEDULE

The CIRIA SuDS manual has been reviewed and the operation and maintenance guidance for different surface water systems has been extracted and is provided in the following tables. These requirements should be considered as a minimum level of maintenance and the maintenance contractor should establish if more regular or intensive maintenance is required to ensure continued operation of the drainage system, any alterations to the regularity of the maintenance tasks should be recorded in the operation and maintenance manual.

#### 5.1.1 Blue & Green Roofs

A blue roof is a roof design that is explicitly intended to store water. This storage can be designed as attenuation storage (with water released in a controlled manner), as storage for use such as irrigation (potentially of adjacent green roof areas), cooling water (for use in reducing the temperature of the roof on hot days, or for internal cooling plant) or non-potable use within the building, and/or for recreational opportunities. Blue roofs can include open water surfaces, storage within or beneath a porous medium or modular surface, or below a raised decking surface or impermeable cover. A green roof is a roof design with a layer of living vegetation or planting to provide a range of benefits such as improving thermal performance, visual benefit, and ecological value. It is possible to combine a blue and green roof by having a layer of storage sat beneath the vegetation which maximises benefits. The table below has been extracted from table 12.5 - operation and maintenance requirements for green roofs from the SuDS Manual.

Table 6 - Maintenance Requirements for Green / Blue Roofs

| Maintenance Schedule       | Required Action                                                                                                                                                                                                 | Typical Frequency                                    |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| <b>Regular Inspections</b> | 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                     |
| <b>Regular Maintenance</b> | 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 dead plant as required                                                                                                                                            | Monthly (but usually responsibility of manufacturer) |
|                            | Post establishment, replace dead plants as required (where >5% 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 grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate                                                                    | Six monthly or as required                           |

|                         |                                                                                                                                                                                            |             |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| <b>Remedial Actions</b> | If erosion channels are evident, these should be established with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled | As required |
|                         | If drain inlets has settled, cracked, or moved, investigate and repair as appropriate                                                                                                      | As required |

### 5.1.2 Attenuation Tanks

Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The table below is extracted from table 21.3 of the SuDS manual and provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive, and some actions may not always be required.

Table 7 – Maintenance Requirements for Attenuation Storage Tanks

| Maintenance Schedule       | Required Action                                                                                                                                                                                               | Typical Frequency                    |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|
| <b>Regular Maintenance</b> | Inspect and identify any areas that are not operating correctly. If required, take remedial action.                                                                                                           | Monthly for 3 months, then annually. |
|                            | Remove debris from the catchment surface (where it may cause risks to performance).                                                                                                                           | Monthly                              |
|                            | For systems where rainfall infiltrates into the tank from above, check surface water or filter for blockage by sediment, algae, or other matter; remove and replace surface infiltration medium as necessary. | Annually                             |
|                            | Remove sediment from pre-treatment structures and/ internal forebays.                                                                                                                                         | Annually, or as required.            |
| <b>Remedial Actions</b>    | Repair/rehabilitate inlets, outlet, overflows and vents.                                                                                                                                                      | As required.                         |
| <b>Monitoring</b>          | Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.                                                                                   | Annually.                            |
|                            | Survey inside of tank for sediment build-up and remove if necessary.                                                                                                                                          | Every 5 years or as required.        |

### 5.1.4. Permeable Paving

Permeable paving can be in the form of either porous paving which allows water to filter through the block itself or paving blocks with gaps between that allow water to filter between blocks. The latter is preferred in this instance. Water can then be stored in the sub-base and either allowed to infiltrate into the ground if possible or collected by a perforated pipe and drained into the system. To preserve the infiltration capacity of pervious paving, regular inspection is important for the effective operation of pervious pavements. Table 1 has been extracted from table 20.15 of the CIRIA C753 SuDS manual.

Table 8 – Maintenance Requirements for Permeable Paving

| Maintenance Schedule       | Required Action                                                     | Typical Frequency                                                                                          |
|----------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Regular Maintenance</b> | Brushing and vacuuming (standard cosmetic sweep over whole surface) | Once a year, after autumn leaf fall, or Reduced frequency as required, based on site-specific observations |

|                               |                                                                                                                                                                                     |                                                                                                                                                                                                              |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               |                                                                                                                                                                                     | of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is likely to collect the most sediment |
| <b>Occasional Maintenance</b> | Stabilise and mow contributing adjacent areas                                                                                                                                       | As required                                                                                                                                                                                                  |
|                               | Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying                                                               | As required – once per year on less frequently used pavements                                                                                                                                                |
| <b>Remedial Actions</b>       | Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the paving                                                          | As required                                                                                                                                                                                                  |
|                               | Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users and replace lost jointing material | As required                                                                                                                                                                                                  |
|                               | Rehabilitation of surface and upper substructure by remedial sweeping                                                                                                               | Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)                                                                                                     |
| <b>Monitoring</b>             | 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                                                                                                                                                                                                     |

### 5.1.3 Pipework

In addition to the above pipework should usually be jetted and cleaned as and when blockages appear to have occurred. Pipes should be checked for build-up of debris and other waste that could cause blockages or damage to the pipework. Occasional maintenance should be carried out annually or as required.

### 5.1.4 Flow Controls

Maintenance for the blue roof flow control system should be in alignment to manufacturers recommendations. It is recommended that a service and maintenance contract is taken out with the provider.

### 5.1.5 Timetable

Maintenance should be carried out and timetabled from the date of installation. Each SuDS feature and component has a recommended and typical frequency for inspection which should be adhered to as close as practically possible. Where not adopted, the landowner or private management company are responsible for its implementation.

The final adoption and maintenance arrangements for the surface water drainage system will be confirmed in due course and will be subject to a planning condition requiring submission and approval of maintenance details prior to occupation.

## 6 RISKS AND UNCERTAINTIES

The following outlines the current uncertainties and associated risks for aspects related to drainage for this development.

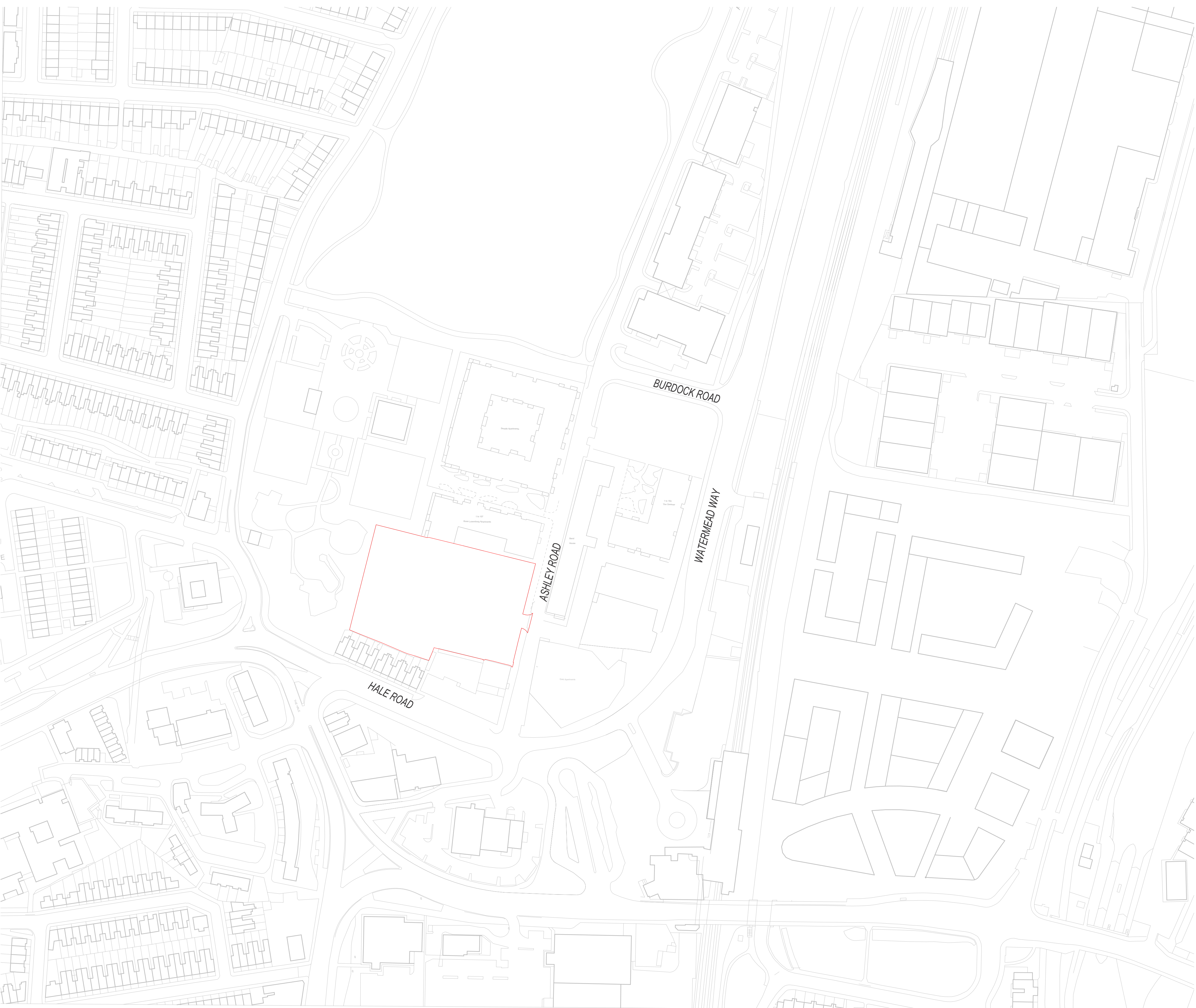
- **MEP coordination** – The proposed drainage layout is subject to change upon receipt of a proposed above ground drainage plan from the appointed MEP engineer. Any amendments made to the above ground drainage design is likely to cause subsequent changes to the below ground drainage design.
- **Thames Water Pre-planning Enquiry** – To ensure that there is sufficient capacity within the Thames water network a pre-planning enquiry will have to confirm that the sewer systems have sufficient capacity.

## 7 CONCLUSION

The main conclusions from this drainage strategy report are detailed below:

- The Site is located within Flood Zone 2 and a Flood Risk Assessment has been prepared as a supporting document to this report;
- Blue/green roofs, permeable paving and an attenuation tank have been introduced to the scheme to attenuate surface water and provide water quality and amenity enhancements;
- Ultimately, surface water will discharge to the surface water sewer at manhole 3602 and foul water will discharge to the foul water or combined Thames Water sewer on Ashley Road, with the exact connection points to be confirmed;
- The proposed attenuation for the Proposed Development has been calculated to be approximately 927.8 m<sup>3</sup>, confirmed by hydraulic modelling in Appendix G;
- The estimated peak foul flow is 4.35 l/s for the 87 C3 units and 26.1 l/s for the 522 PBSL studios (30.45 l/s total). The commercial foul water contribution is to be confirmed at the next design stage;
- A pre-planning enquiry is to be submitted to Thames Water to confirm sufficient capacity within the network and a decision is awaited;
- An overland flow path has been shown on proposed drainage strategy drawings in Appendix E is to be produced to ensure that flows are safely managed during extreme rainfall events;
- Typical maintenance for the drainage network has been identified in Section 5;
- SuDS Proforma is shown in Appendix F; and
- The proposed SuDS scheme responds to the relevant policy requirements and appropriately addresses the drainage needs of the development.

## Appendix A – Site Location Map

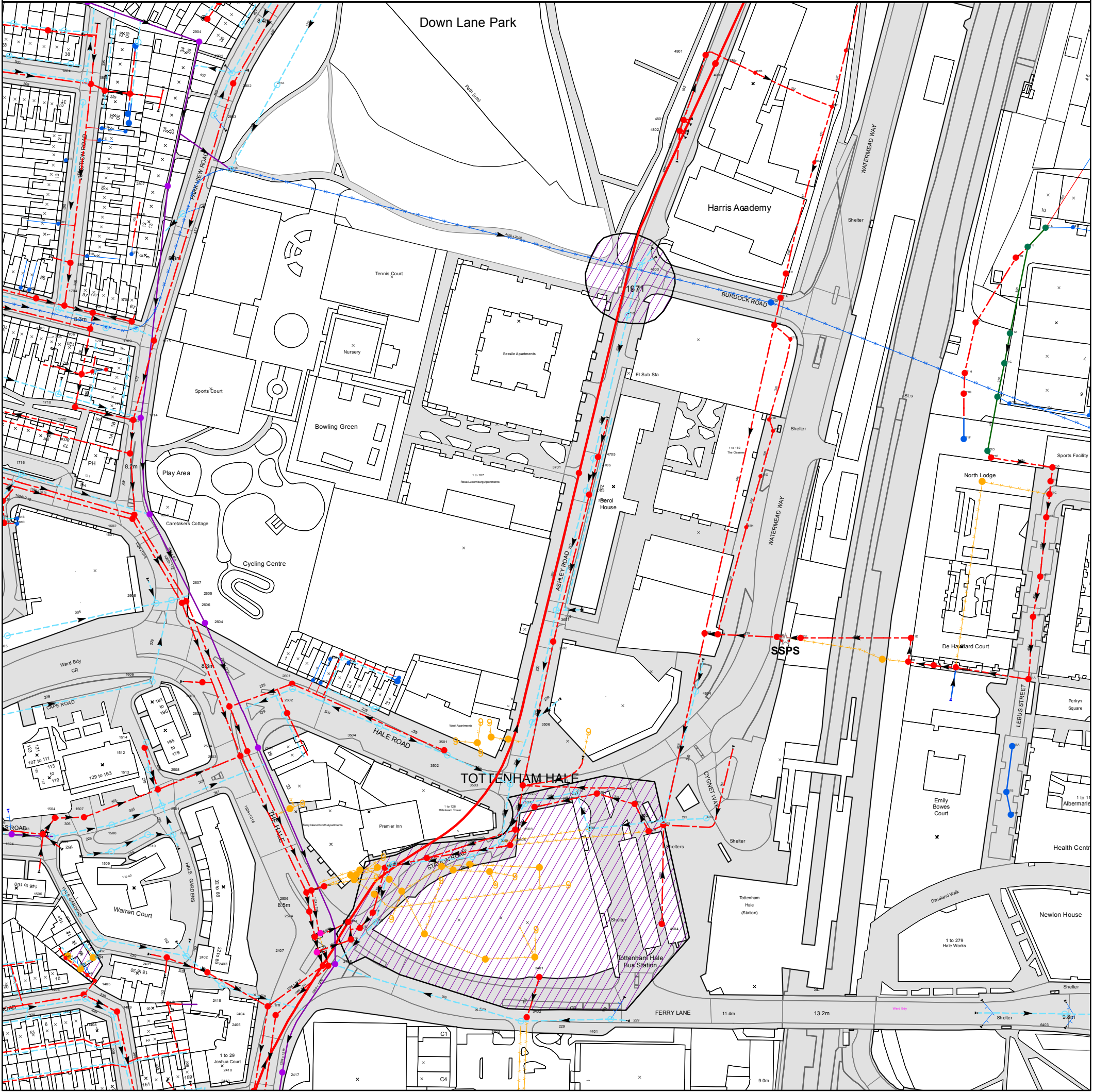


ASHLEY HOUSE SITE - SITE LOCATION PLAN

1 : 1250



## Appendix B – Thames Water Asset Location Map



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 before any works are undertaken. Crown copyright Reserved

**Scale:** 1:1788  
**Width:** 500m  
**Printed By:** BArumuga  
**Print Date:** 04/06/2026  
**Map Centre:** 534379,189680  
**Grid Reference:** TQ3489NW

**Comments:**

ALS/ALS Standard/2026\_5339503

NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

| REFERENCE | COVER LEVEL | INVERT LEVEL |
|-----------|-------------|--------------|
| 2417      | 8           | 6.25         |
| 2418      | 8.14        | 6.92         |
| 2405      | 7.82        | 5.22         |
| 2406      | 8.06        | 5.23         |
| 2407      | 8.03        | 5.12         |
| 241D      |             |              |
| 3403      | 8.65        | 7.04         |
| 1709      | 8.34        | 6.98         |
| 3505      | 8.28        | 5.92         |
| 18TS      |             |              |
| 1603      | 8.15        | 6.55         |
| 1715      | 8.23        | 6.39         |
| 1707      | 8.28        | 5.71         |
| 26XS      |             |              |
| 26YQ      |             |              |
| 1605      | 8.46        | 7.44         |
| 4401      | 9.17        | 7.66         |
| 29WW      |             |              |
| 3701      | 8.67        | -0.23        |
| 18TT      |             |              |
| 1601      | 8.1         | 5.32         |
| 2505      | 8.2         | 6.47         |
| 1514      | 8.41        | 7.56         |
| 3502      | 8.22        | 7.36         |
| 19RX      |             |              |
| 1503      | 8.76        | 6.36         |
| 1404      | 8.26        | 7.24         |
| 4501      | 8.48        | 7.45         |
| 4504      |             |              |
| 4903      | 8.35        | -1.22        |
| 4802      | 8.52        | 7.88         |
| 3602      | 8.5         | 6.91         |
| 2501      | 8.32        | 7.41         |
| 18TW      |             |              |
| 1712      |             |              |
| 1405      | 99.45       | 98.43        |
| 2603      | 8.27        | 5.44         |
| 4901      | 8.46        | 7.52         |
| 1714      | 8.14        | 6.55         |
| 2806      | 8.22        | 7.27         |
| 2802      | 8.29        | 6            |
| 2504      | 8.16        | 5.42         |
| 2904      | 9.03        | 6.9          |
| 1703      | 8.44        | 7.07         |
| 4604      | 8.31        | 7.66         |
| 2602      | 8.34        | 7.02         |
| 2506      | 8.24        | 5.23         |
| 1509      | 8.38        | 7.72         |
| 1803      | 8.95        | 7.18         |
| 4502      | 8.94        | 7.84         |
| 36YX      |             |              |
| 1408      | 8.16        | 7            |
| 1406      | 8.28        | 6.64         |
| 1409      | 8.17        | 6.6          |
| 1407      | 8.26        | 7.05         |
| 3508      | 8.22        | 6.34         |
| 2402      | 7.8         | 7.03         |
| 4706      | 8.6         | 7.95         |
| 1720      |             |              |
| 3512      | 7.97        | 6.98         |
| 1801      | 8.5         | 6.37         |
| 2403      | 8.22        | 6.64         |
| 2524      |             |              |
| 1713      | 8.13        | 5.69         |
| 3510      | 8.04        | 5.72         |
| 1706      | 8.2         | 5.86         |
| 1804      | 8.92        | 7.54         |
| 171A      |             |              |
| 681J      |             |              |
| 571C      |             |              |
| 571J      |             |              |
| 581B      |             |              |
| 661B      |             |              |
| 661D      |             |              |
| 181A      |             |              |
| 1705      | 8.3         | 5.87         |
| 571B      |             |              |
| 561B      |             |              |
| 561D      |             |              |
| 571E      |             |              |
| 671B      |             |              |

| REFERENCE | COVER LEVEL | INVERT LEVEL |
|-----------|-------------|--------------|
| 2513      | 8.14        | 0.1          |
| 2523      | 7.73        | 4.91         |
| 2404      | 7.76        | 5.12         |
| 2408      | 8.08        | 6.29         |
| 251A      |             |              |
| 171D      |             |              |
| 19VT      |             |              |
| 3503      | 8.19        | 7.2          |
| 1602      | 8.11        | 5.42         |
| 2502      | 8.15        | 7.52         |
| 1606      | 8.18        | 7.17         |
| 2604      | 8.17        | 6.45         |
| 4803      | 8.67        | 8.01         |
| 26YS      |             |              |
| 3401      |             |              |
| 3509      | 8.21        | 6.98         |
| 2503      | 8.22        | 5.32         |
| 1802      | 8.79        | 7.7          |
| 1719      | 8.14        | 5.66         |
| 1708      | 8.34        | 6.98         |
| 2607      | 8.21        | 7.01         |
| 1512      | 8.43        | 6.58         |
| 1510      | 8.26        | 7.58         |
| 1506      | 8.6         | 7.33         |
| 1704      | 8.4         | 5.98         |
| 19WX      |             |              |
| 4902      | 8.35        | -1.22        |
| 1513      | 8.37        | 7.7          |
| 4503      | 8.7         | 6.31         |
| 3506      | 8.4         | 7.45         |
| 4801      | 8.52        | 7.82         |
| 6403      | 9.41        |              |
| 2401      | 7.87        | 6.81         |
| 18TQ      |             |              |
| 1504      | 8.68        | 6.34         |
| 3402      | 8.73        | 7.06         |
| 3501      | 8.23        | 6.98         |
| 19VR      |             |              |
| 2606      | 8.28        | 5.46         |
| 2801      | 8.32        | 7.08         |
| 2508      | 8.31        | 6.15         |
| 3702      | 8.77        | 7.82         |
| 1710      |             |              |
| 1716      | 8.23        | 6.88         |
| 2601      | 8.32        | 6.38         |
| 36ZP      |             |              |
| 19WP      |             |              |
| 1508      | 8.48        | 7.55         |
| 3703      | 8.69        | 7.17         |
| 1524      |             |              |
| 19VW      |             |              |
| 19RY      |             |              |
| 1507      | 8.59        | 6.27         |
| 2609      | 8.26        | 6.11         |
| 2807      | 9.03        | 6.67         |
| 3513      | 8.23        | 7.08         |
| 2605      | 8.28        | 5.43         |
| 4705      | 8.61        | 7.24         |
| 2608      | 8.12        | 7.05         |
| 3504      | 8.31        | 7.46         |
| 19WV      |             |              |
| 29XY      |             |              |
| 1505      | 8.72        | 7.7          |
| 3507      | 8.22        | 6.46         |
| 2803      | 8.29        | 7.54         |
| 3601      | 8.64        | 7.55         |
| 461B      |             |              |
| 571D      |             |              |
| 571A      |             |              |
| 171B      |             |              |
| 241B      |             |              |
| 671M      |             |              |
| 661C      |             |              |
| 5601      |             |              |
| 1702      | 8.35        | 6.07         |
| 281A      |             |              |
| 561A      |             |              |
| 661A      |             |              |
| 181E      |             |              |
| 671A      |             |              |
| 671C      |             |              |

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 before any works are undertaken. Crown copyright Reserved

ALS/ALS Standard/2026\_5339503

NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

| REFERENCE | COVER LEVEL | INVERT LEVEL |
|-----------|-------------|--------------|
| 181B      |             |              |
| 181D      |             |              |
| 4702      |             |              |
| 5801      | 8.55        | 6.57         |
| 481C      |             |              |
| 36ZR      |             |              |
| 2507      | 8.23        | 5.38         |
| 591A      |             |              |
| 461F      |             |              |
| 571I      |             |              |
| 571G      |             |              |
| 261B      |             |              |
| 681I      |             |              |
| 471A      |             |              |
| 471C      |             |              |
| 451A      | 108.95      | 108.096      |
| 161C      | 8.01        | 5.96         |
| 161D      | 8.32        | 6            |
| 181I      |             |              |
| 551B      |             |              |
| 261D      |             |              |
| 351P      |             |              |
| 251E      |             |              |
| 351S      |             |              |
| 451F      |             |              |
| 351U      |             |              |
| 251D      | 8.35        | 5.48         |
| 471F      |             |              |
| 461H      |             |              |
| 141L      | 99.58       | 98.46        |
| 141E      | 99.69       | 98.55        |
| 141K      | 99.52       | 98.43        |
| 451H      |             |              |

| REFERENCE | COVER LEVEL | INVERT LEVEL |
|-----------|-------------|--------------|
| 181C      |             |              |
| 171E      |             |              |
| 281B      | 8.56        | 5.66         |
| 481A      |             |              |
| 261A      |             |              |
| 26XP      |             |              |
| 241C      | 8.33        | 3.42         |
| 481B      |             |              |
| 571H      |             |              |
| 571F      |             |              |
| 171F      |             |              |
| 681A      |             |              |
| 4603      | 8.32        | 6.3          |
| 471B      |             |              |
| 261C      |             |              |
| 161B      | 8.34        | 7.45         |
| 171G      | 8           | 5.86         |
| 181H      |             |              |
| 551A      |             |              |
| 551C      |             |              |
| 471D      |             |              |
| 251F      |             |              |
| 351Q      |             |              |
| 351T      |             |              |
| 451G      |             |              |
| 351R      |             |              |
| 461G      |             |              |
| 471G      |             |              |
| 471E      |             |              |
| 141J      |             |              |
| 141H      |             |              |
| 141I      |             |              |



# Asset Location Search - Sewer Key

## Public Sewer Types (Operated and maintained by Thames Water)

|                                                                                   |                                                                                                                                                   |
|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <b>Foul Sewer:</b> A sewer designed to convey waste water from domestic and industrial sources to a treatment works.                              |
|  | <b>Surface Water Sewer:</b> A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses. |
|  | <b>Combined Sewer:</b> A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.   |
|  | <b>Storm Sewer</b>                                                                                                                                |
|  | <b>Sludge Sewer</b>                                                                                                                               |
|  | <b>Foul Trunk Sewer</b>                                                                                                                           |
|  | <b>Surface Trunk Sewer</b>                                                                                                                        |
|  | <b>Combined Trunk Sewer</b>                                                                                                                       |
|  | <b>Foul Rising Main</b>                                                                                                                           |
|  | <b>Surface Water Rising Main</b>                                                                                                                  |
|  | <b>Combined Rising Main</b>                                                                                                                       |
|  | <b>Vacuum</b>                                                                                                                                     |
|  | <b>Thames Water Proposed</b>                                                                                                                      |
|  | <b>Vent Pipe</b>                                                                                                                                  |
|  | <b>Gallery</b>                                                                                                                                    |

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

|                                                                                     |                                                              |                                                                                     |                                                                |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------|
|  | <b>Sewer</b>                                                 |  | <b>Culverted Watercourse</b>                                   |
|  | <b>Proposed</b>                                              |  | <b>Decommissioned Sewer</b>                                    |
|  | <b>Content of this drainage network is currently unknown</b> |  | <b>Ownership of this drainage network is currently unknown</b> |

### 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.

## 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.

|                                                                                   |                  |                                                                                     |              |
|-----------------------------------------------------------------------------------|------------------|-------------------------------------------------------------------------------------|--------------|
|  | <b>Air Valve</b> |  | <b>Meter</b> |
|  | <b>Dam Chase</b> |  | <b>Vent</b>  |
|  | <b>Fitting</b>   |                                                                                     |              |

## Operational Controls

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

|                                                                                   |                      |                                                                                     |                  |
|-----------------------------------------------------------------------------------|----------------------|-------------------------------------------------------------------------------------|------------------|
|  | <b>Ancillary</b>     |  | <b>Drop Pipe</b> |
|  | <b>Control Valve</b> |  | <b>Weir</b>      |

## 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.

|                                                                                     |                      |                                                                                       |                |
|-------------------------------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------------|----------------|
|  | <b>Inlet</b>         |  | <b>Outfall</b> |
|  | <b>Undefined End</b> |                                                                                       |                |

## Other Symbols

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

|                                                                                     |                                           |                                                                                     |                                         |
|-------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------------------------------------------------------------|-----------------------------------------|
|  | <b>Change of Characteristic Indicator</b> |  | <b>Public / Private Pumping Station</b> |
|  | <b>Invert Level</b>                       |  | <b>Summit</b>                           |

## Areas

Lines denoting areas of underground surveys, etc.

|                                                                                     |                         |
|-------------------------------------------------------------------------------------|-------------------------|
|  | <b>Agreement</b>        |
|  | <b>Chamber</b>          |
|  | <b>Operational Site</b> |

## Ducts or Crossings

|                                                                                       |                       |                                                                        |
|---------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------|
|    | <b>Casement</b>       | Ducts may contain high voltage cables. Please check with Thames Water. |
|  | <b>Conduit Bridge</b> |                                                                        |
|  | <b>Subway</b>         |                                                                        |
|  | <b>Tunnel</b>         |                                                                        |

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.

## Appendix C - Geology



whitby wood

LEVEL 1, FRIARS YARD  
160 BLACKFRIARS ROAD  
LONDON SE1 8EZ  
UNITED KINGDOM

## BGS GEOLOGY MAPS

### ASHLEY PARK

P452287

10/06/2026

#### Legend

-  Site Boundary
-  London Clay Formation - Clay, Silt and Sand
-  Enfield Silt Member - Clay and Silt

1:10,000

Contains British Geological Survey materials © UKRI [2019].  
Contains OS data © Crown copyright and database right (2019)

Superficial Deposits

Bedrock Geology

## Appendix D – Greenfield / Existing Run-off Rates

GREENFIELD RUNOFF RATE

Pre-development discharge

Site Makeup

Greenfield

Greenfield Method

FEH

Positively Drained Area (ha)

0.715

SAAR (mm)

617

Host

6

BFIHost

0.567

Region

6

QBar/QMed conversion factor

1.136

Betterment (%)

0

Calc

QMed (l/s)

1.2

QBar (l/s)

1.3

| Return Period (years) | Growth Factor | Q (l/s) |
|-----------------------|---------------|---------|
| 2                     | 0.88          | 1.2     |
| 30                    | 2.40          | 3.2     |
| 100                   | 3.19          | 4.3     |

99% BETTERMENT RUNOFF RATE

Pre-development discharge

Site Makeup

Brownfield

Brownfield Method

MRM

Contributing Area (ha)

0.715

PIMP (%)

100

CV

1.000

Time of Concentration (mins)

5.00

Betterment (%)

99

Calc

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 2                     | 1.8     |
| 30                    | 3.3     |
| 100                   | 4.2     |

2 l/s STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

2.000

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

797

to

915

BROWNFIELD RUNOFF RATE

Pre-development discharge

Site Makeup

Brownfield

Brownfield Method

MRM

Contributing Area (ha)

0.715

PIMP (%)

100

CV

1.000

Time of Concentration (mins)

5.00

Betterment (%)

0

Calc

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 2                     | 181.5   |
| 30                    | 334.2   |
| 100                   | 423.6   |

QBAR STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

1.300

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

841

to

1011

50% BETTERMENT STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

211.800

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

134

to

265

50% BETTERMENT RUNOFF RATE

Pre-development discharge

Site Makeup

Brownfield

Brownfield Method

MRM

Contributing Area (ha)

0.715

PIMP (%)

100

CV

1.000

Time of Concentration (mins)

5.00

Betterment (%)

50

Calc

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 2                     | 90.8    |
| 30                    | 167.1   |
| 100                   | 211.8   |

GREENFIELD STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

1.200

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

850

to

1028

BROWNFIELD STORAGE CALCULATION

Storage Estimate

Return Period (years)

100

Climate Change (%)

40

Impermeable Area (ha)

0.715

Peak Discharge (l/s)

423.600

Infiltration Coefficient (m/hr)  
(leave blank if no infiltration)

Required Storage (m³)

Calc

from

63

to

187

ASHLEY PARK

PRELIMINARY

ATTENUATION CALCULATIONS

GENERAL NOTES:

whitby wood

|                |                            |          |      |          |  |
|----------------|----------------------------|----------|------|----------|--|
| Project Title: | ASHLEY PARK                |          |      |          |  |
| Project No:    | P452287                    |          |      |          |  |
| Sketch No:     | P452287-WW-XX-XX-SK-C-1001 |          |      |          |  |
| Title:         | ATTENUATION CALCULATIONS   |          |      |          |  |
| Scale:         | Rev:                       | Date:    | Eng: | Checked: |  |
| NTS            | P02                        | 19/08/26 | MS   | SM       |  |

## Appendix E – Proposed Drainage Strategy

**CONSTRUCTION**  
THIS DRAWING SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

**MAINTENANCE/CLEANING/OPERATION.**  
MAINTENANCE OF SUDS FEATURES AND THE DRAINAGE SYSTEM SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE CIRIA SUDS MANUAL AND MANUFACTURERS SPECIFICATIONS

DECOMMISSIONING/DEMOLITION.  
REFER TO DRAWING FOR EXTENT OF EXISTING SITE DRAINAGE TO BE ABANDONED/REMOVED

## NOTES

1. DO NOT SCALE FROM THIS DRAWING. ONLY FIGURED DIMENSIONS ARE TO BE USED.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM UNLESS NOTED OTHERWISE.
4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERING DRAWINGS AND SPECIFICATIONS.
5. ALL FOUL AND SURFACE WATER PIPENWORK TO BE LAID AT MINIMUM GRADIENTS OF 1:40 AND 1:100 RESPECTIVELY UNLESS NOTED OTHERWISE.
6. ALL PIPEWORK TO BE 100mm DIAMETER UNLESS NOTED OTHERWISE.
7. ROCKER PIPES TO BE INSTALLED AT CONNECTION POINTS TO STRUCTURES TO ALLOW FOR MOVEMENT CAUSED BY SETTLEMENT.
8. ALL DRAWINGS DESIGNED TO ADOPTEE STANDARDS WHERE POSSIBLE, AND BUILDING REGULATIONS PART H.
9. INVERT LEVEL REFERS TO THE INTERNAL BASE OF THE CHAMBER, INCLUDING SUMP DEPTH WHERE APPLICABLE.

## KEY

- 
- RED LINE BOUNDARY
- NORTH PHASE BOUNDARY
- SOUTH PHASE BOUNDARY
- EXISTING SURFACE WATER SEWER
- PROPOSED SURFACE WATER SEWER
- PROPOSED PERFORATED PIPE
- PROPOSED RISING MAIN PIPE
- ATTENUATION TANK
- RAIN GARDEN / PERMEABLE PAVING
- SURFACE WATER MANHOLE / PUMP / EXISTING MANHOLE
- EXCEEDANCE FLOW PATHS

|    |   |                        |     |   |                    |
|----|---|------------------------|-----|---|--------------------|
| AC | - | ACCESS FITTING/CHAMBER | IC  | - | INSPECTION CHAMBER |
| CL | - | COVER LEVEL            | IL  | - | INVERT LEVEL       |
| CW | - | COMBINED WATER         | MH  | - | MANHOLE            |
| CP | - | CATCHPIT               | SW  | - | SURFACE WATER      |
| EX | - | EXISTING               | SL  | - | SOFFIT LEVEL       |
| FW | - | FOUL WATER             | TBC | - | TO BE CONFIRMED    |

|     |                     |     |     |     |            |
|-----|---------------------|-----|-----|-----|------------|
| P02 | UPDATED TO COMMENTS | MS  | SM  | SM  | 19/08/2026 |
| P01 | DRAFT ISSUE         | MS  | SM  | SM  | 23/06/2026 |
| REV | DESCRIPTION         | DRN | CHK | APP | DATE       |

whitby wood

LEVEL 1, FRIARS YARD, 160 BLACKFRIARS ROAD  
LONDON SE1 8EZ, UNITED KINGDOM  
+44 (0)20 7442 2216

|        |
|--------|
| CLIENT |
|--------|

RE:SHAPE

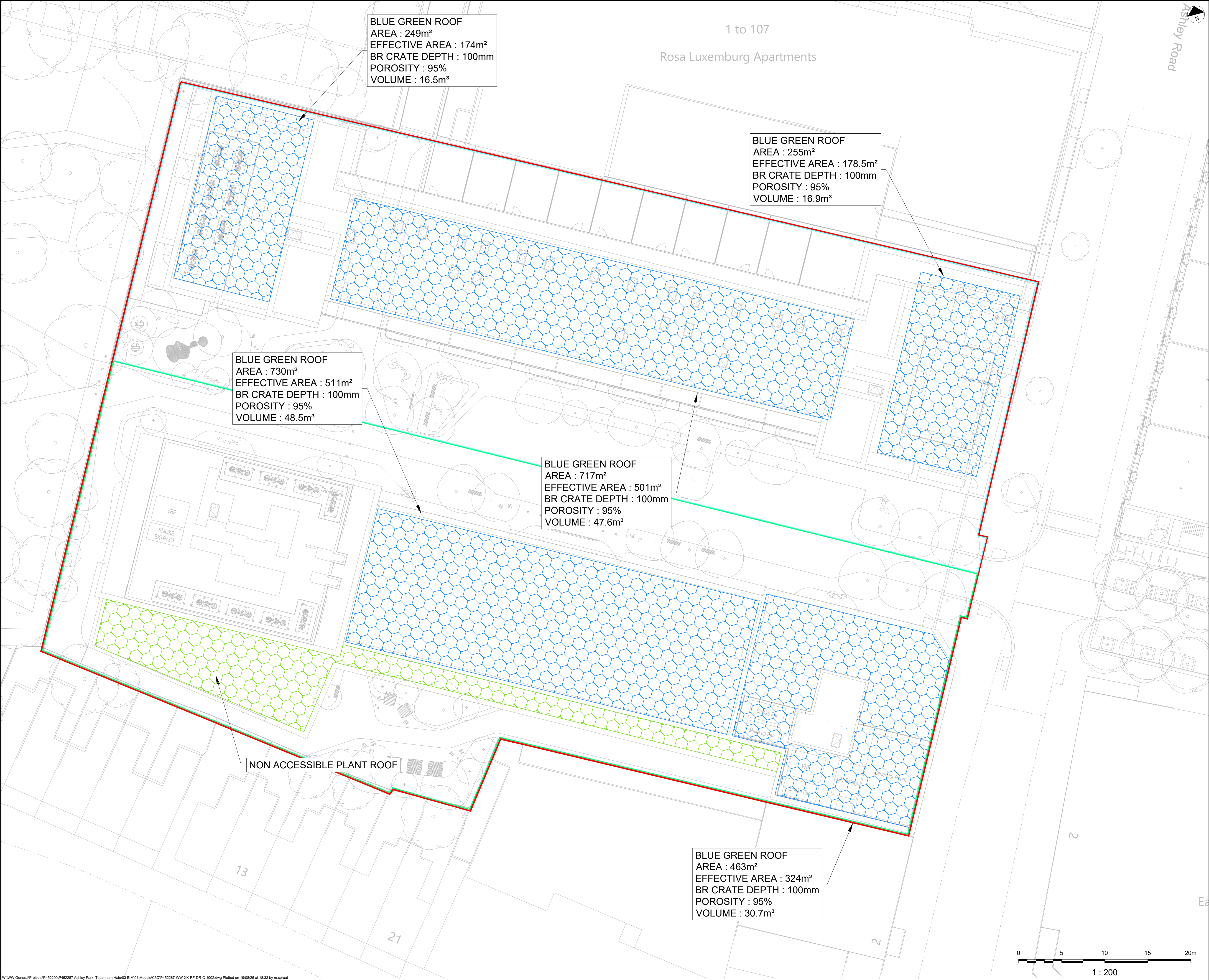
|                |
|----------------|
| PROJECT        |
| ASHLEY ROAD    |
| TOTTENHAM HALE |

PRELIMINARY

|               |
|---------------|
| DRAWING TITLE |
|---------------|

### PROPOSED DRAINAGE LAYOUT

|                                              |                      |                |               |                 |
|----------------------------------------------|----------------------|----------------|---------------|-----------------|
| DATE<br>19/08/2026                           | SCALES @ A1<br>1:200 | DRAWN BY<br>MS | CHECKED<br>SM | APPROVED<br>SM  |
| DRAWING NUMBER<br>P452287-WW-XX-00-DR-C-1001 |                      |                |               | REVISION<br>P02 |



HEALTH AND SAFETY INFORMATION

CONSTRUCTION  
THIS DRAWING SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

MAINTENANCE/CLEANING/OPERATION  
MAINTENANCE OF SUDS FEATURES AND THE DRAINAGE SYSTEM SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE CIRA SUDS MANUAL AND MANUFACTURERS SPECIFICATIONS

DECOMMISSIONING/DEMOLITION  
REFER TO DRAWING FOR EXTENT OF EXISTING SITE DRAINAGE TO BE ABANDONED/REMOVED

NOTES

1. DO NOT SCALE FROM THIS DRAWING. ONLY FIGURED DIMENSIONS ARE TO BE USED.

2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

3. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM UNLESS NOTED OTHERWISE.

4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.

5. ALL FOIL AND SURFACE WATER PIPEWORK TO BE LAID AT MINIMUM GRADIENTS OF 1:40 AND 1:100 RESPECTIVELY UNLESS NOTED OTHERWISE.

6. ALL PIPEWORK TO BE 100mm DIAMETER UNLESS NOTED OTHERWISE.

7. ROCKER PIPES TO BE INSTALLED AT CONNECTION POINTS TO STRUCTURES TO ALLOW FOR MOVEMENT CAUSED BY SETTLEMENT.

8. ALL DRAINAGE IS DESIGNED TO ADOPTABLE STANDARDS WHERE POSSIBLE, AND BUILDING REGULATIONS PART H.

9. INVERT LEVEL REFERS TO THE INTERNAL BASE OF THE CHAMBER, INCLUDING SUMP DEPTH WHERE APPLICABLE.

10. BLUE ROOF DESIGN IS SUBJECT TO BLUE ROOF MANUFACTURER DETAILS AND CALCULATIONS.

KEY

RED LINE BOUNDARY

NORTH PHASE BOUNDARY

SOUTH PHASE BOUNDARY

BLUE / GREEN ROOF

|     |                     |     |     |     |            |
|-----|---------------------|-----|-----|-----|------------|
| P02 | PLANNING SUBMISSION | MS  | SM  | SM  | 19/08/2026 |
| P01 | DRAFT ISSUE         | MS  | SM  | SM  | 23/06/2026 |
| REV | DESCRIPTION         | DRN | CHK | APP | DATE       |

whitby wood

whitbywood.com

LEVEL 1, FRIARS YARD, 160 BLACKFRIARS ROAD  
LONDON SE1 8EZ, UNITED KINGDOM  
+44 (0)20 7442 2216

CLIENT

RE:SHAPE

PROJECT

ASHLEY ROAD  
TOTTENHAM HALE

PRELIMINARY

DRAWING TITLE

PROPOSED ROOF DRAINAGE LAYOUT

|                |                          |             |       |          |    |         |    |          |          |     |
|----------------|--------------------------|-------------|-------|----------|----|---------|----|----------|----------|-----|
| DATE           | 19/08/2026               | SCALES @ A1 | 1:200 | DRAWN BY | MS | CHECKED | SM | APPROVED | SM       |     |
| DRAWING NUMBER | ACHF-WW-ZZ-RF-DR-C-52001 |             |       |          |    |         |    |          | REVISION | P02 |

W:\WW General\Projects\P452200\P452287 Ashley Park, Tottenham Hale\03 BIM\01 Models\IC3D\P452287-WW-ZZ-RF-DR-C-1002.dwg Plotted on 19/08/26 at 16:33 by m.sproat

## Appendix F – SuDS Proforma

|                           |                                                                                                 |                                                                                                                                                                                                                                                                                                  |
|---------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Project & Site Details | Project / Site Name (including sub-catchment / stage / phase where appropriate)                 | Ashley Park, Tottenham Hale                                                                                                                                                                                                                                                                      |
|                           | Address & post code                                                                             | Former Ashley House Site, Ashley Park, Tottenham Hale, London, N17 9LZ                                                                                                                                                                                                                           |
|                           | OS Grid ref. (Easting, Northing)                                                                | E 534332<br>N 189663                                                                                                                                                                                                                                                                             |
|                           | LPA reference (if applicable)                                                                   | London Borough of Haringey                                                                                                                                                                                                                                                                       |
|                           | Brief description of proposed work                                                              | Mixed use development comprising residential accommodation (Class C3) and shared living accommodation (Sui Generis) alongside commercial/community floorspace (Class E/F2) and public realm, blue-badge and cycle parking, open space, hard and soft landscaping and all other associated works. |
|                           | Total site Area                                                                                 | 7154 m <sup>2</sup>                                                                                                                                                                                                                                                                              |
|                           | Total existing impervious area                                                                  | 7154 m <sup>2</sup>                                                                                                                                                                                                                                                                              |
|                           | Total proposed impervious area                                                                  | 7154 m <sup>2</sup>                                                                                                                                                                                                                                                                              |
|                           | Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)? | Low – Haringey SFRA (2022)                                                                                                                                                                                                                                                                       |
|                           | Existing drainage connection type and location                                                  | Foul, Surface and Combined                                                                                                                                                                                                                                                                       |
|                           | Designer Name                                                                                   | Matthew Sproat                                                                                                                                                                                                                                                                                   |
|                           | Designer Position                                                                               | Graduate Engineer – Civils                                                                                                                                                                                                                                                                       |
| Designer Company          | Whitby Wood Limited                                                                             |                                                                                                                                                                                                                                                                                                  |

|                                                                   |                                                                                        |                                             |                |
|-------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------|----------------|
| 2. Proposed Discharge Arrangements                                | 2a. Infiltration Feasibility                                                           |                                             |                |
|                                                                   | Superficial geology classification                                                     | Enfield Silt Member – Clay and silt         |                |
|                                                                   | Bedrock geology classification                                                         | London Clay Formation – Clay, silt and sand |                |
|                                                                   | Site infiltration rate                                                                 | / m/s                                       |                |
|                                                                   | Depth to groundwater level                                                             | / m below ground level                      |                |
|                                                                   | Is infiltration feasible?                                                              | No                                          |                |
|                                                                   | 2b. Drainage Hierarchy                                                                 |                                             |                |
|                                                                   |                                                                                        | Feasible (Y/N)                              | Proposed (Y/N) |
|                                                                   | 1 store rainwater for later use                                                        | Y                                           | Y              |
|                                                                   | 2 use infiltration techniques, such as porous surfaces in non-clay areas               | N                                           | N              |
|                                                                   | 3 attenuate rainwater in ponds or open water features for gradual release              | N                                           | N              |
|                                                                   | 4 attenuate rainwater by storing in tanks or sealed water features for gradual release | Y                                           | Y              |
|                                                                   | 5 discharge rainwater direct to a watercourse                                          | N                                           | N              |
|                                                                   | 6 discharge rainwater to a surface water sewer/drain                                   | Y                                           | Y              |
|                                                                   | 7 discharge rainwater to the combined sewer.                                           | Y                                           | N              |
| 2c. Proposed Discharge Details                                    |                                                                                        |                                             |                |
| Proposed discharge location                                       | SW sewer on Ashley Road                                                                |                                             |                |
| Has the owner/regulator of the discharge location been consulted? | TW pre-planning enquiry to be submitted                                                |                                             |                |

| 3. Drainage Strategy | 3a. Discharge Rates & Required Storage |                                   |                               |                                                |
|----------------------|----------------------------------------|-----------------------------------|-------------------------------|------------------------------------------------|
|                      |                                        | Greenfield (GF) runoff rate (l/s) | Existing discharge rate (l/s) | Required storage for GF rate (m <sup>3</sup> ) |
|                      | Qbar                                   | 1.3                               |                               |                                                |
|                      | 1 in 1                                 | 1.2                               | 181.5                         |                                                |
|                      | 1 in 30                                | 3.2                               | 334.2                         | 1.3                                            |
|                      | 1 in 100                               | 4.3                               | 423.6                         | 1.3                                            |
|                      | 1 in 100 + CC                          |                                   |                               | 927.8                                          |
|                      | Climate change allowance used          |                                   | 40%                           |                                                |
|                      | 3b. Principal Method of Flow Control   |                                   |                               |                                                |
|                      | 3c. Proposed SuDS Measures             |                                   |                               |                                                |
|                      |                                        | Catchment area (m <sup>2</sup> )  | Plan area (m <sup>2</sup> )   | Storage vol. (m <sup>3</sup> )                 |
|                      | Rainwater harvesting                   | 0                                 |                               | 0                                              |
|                      | Infiltration systems                   | 0                                 |                               | 0                                              |
|                      | Green roofs                            | 0                                 | 0                             | 0                                              |
|                      | Blue roofs                             | 2414                              | 2,414                         | 160.2                                          |
|                      | Filter strips                          | 0                                 | 0                             | 0                                              |
|                      | Filter drains                          | 0                                 | 0                             | 0                                              |
|                      | Bioretention / tree pits               | 0                                 | 0                             | 0                                              |
|                      | Pervious pavements                     | 2137                              | 2,072                         | 373                                            |
|                      | Swales                                 | 0                                 | 0                             | 0                                              |
|                      | Basins/ponds                           | 0                                 | 0                             | 0                                              |
|                      | Attenuation tanks                      | 2589                              |                               | 554.8                                          |
|                      | <b>Total</b>                           | <b>7140</b>                       | <b>4486</b>                   | <b>1088</b>                                    |

| 4. Supporting Information | 4a. Discharge & Drainage Strategy                                                                                     | Page/section of drainage report |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------|---------------------------------|
|                           | Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results         | Section 4.1                     |
|                           | Drainage hierarchy (2b)                                                                                               | Section 4.1.1                   |
|                           | Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location | Appendix B                      |
|                           | Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations                                       | Appendix D&F/Section3           |
|                           | Proposed SuDS measures & specifications (3b)                                                                          | 4.1/Appendix E                  |
|                           | 4b. Other Supporting Details                                                                                          | Page/section of drainage report |
|                           | Detailed Development Layout                                                                                           | Appendix E                      |
|                           | Detailed drainage design drawings, including exceedance flow routes                                                   | Appendix E&F                    |
|                           | Detailed landscaping plans                                                                                            | Appendix E                      |
|                           | Maintenance strategy                                                                                                  | Section 5                       |
|                           | Demonstration of how the proposed SuDS measures improve:                                                              |                                 |
|                           | a) water quality of the runoff?                                                                                       | Section 4.1.3                   |
|                           | b) biodiversity?                                                                                                      | Section 4.1                     |
|                           | c) amenity?                                                                                                           | Section 4.1                     |

## Appendix G – Causeway Flow + Model Results

WW

Whitby Wood Limited

File: Ashley Park.pfd

Network: Storm Network

Tom Tosetti

19/08/2026

Page 1

Design Settings

Rainfall Methodology

FEH-22

Return Period (years)

100

Additional Flow (%)

40

CV

1.000

Time of Entry (mins)

5.00

Maximum Time of Concentration (mins)

30.00

Maximum Rainfall (mm/hr)

50.0

Minimum Velocity (m/s)

1.00

Connection Type

Level Soffits

Minimum Backdrop Height (m)

0.200

Preferred Cover Depth (m)

1.200

Include Intermediate Ground

✓

Enforce best practice design rules

x

Pipeline Schedule

| Link    | Length<br>(m) | Slope<br>(1:X) | Dia<br>(mm) | Link<br>Type | US CL<br>(m) | US IL<br>(m) | US Depth<br>(m) | DS CL<br>(m) | DS IL<br>(m) | DS Depth<br>(m) |
|---------|---------------|----------------|-------------|--------------|--------------|--------------|-----------------|--------------|--------------|-----------------|
| 1.001   | 9.299         | 59.2           | 100         | Circular     | 8.640        | 6.966        | 1.574           | 8.640        | 6.809        | 1.731           |
| 1.002   | 31.837        | 100.7          | 150         | Circular     | 8.640        | 6.759        | 1.731           | 8.640        | 6.443        | 2.047           |
| 1.003   | 30.266        | 100.9          | 150         | Circular     | 8.640        | 6.443        | 2.047           | 8.640        | 6.143        | 2.347           |
| 4.000   | 21.605        | 54.0           | 100         | Circular     | 8.640        | 8.000        | 0.540           | 8.640        | 7.600        | 0.940           |
| 3.000   | 51.158        | 56.2           | 100         | Circular     | 8.640        | 7.340        | 1.200           | 8.640        | 6.430        | 2.110           |
| 3.001   | 21.121        | 704.0          | 225         | Circular     | 8.640        | 6.430        | 1.985           | 8.640        | 6.400        | 2.015           |
| 4.001   | 25.647        | 21.4           | 150         | Circular     | 8.640        | 7.600        | 0.890           | 8.640        | 6.400        | 2.090           |
| 3.002   | 15.345        | 76.7           | 225         | Circular     | 8.640        | 6.400        | 2.015           | 8.640        | 6.200        | 2.215           |
| 1.006   | 19.361        | 420.9          | 375         | Circular     | 8.640        | 6.200        | 2.065           | 8.640        | 6.154        | 2.111           |
| 1.007   | 33.184        | -18.0          | 375         | Circular     | 8.640        | 6.154        | 2.111           | 8.640        | 8.000        | 0.265           |
| 1.007_1 | 21.995        | 27.5           | 375         | Circular     | 8.640        | 8.000        | 0.265           | 8.640        | 7.200        | 1.065           |
| 1.004   | 38.548        | 169.8          | 225         | Circular     | 8.640        | 6.312        | 2.103           | 8.640        | 6.085        | 2.330           |
| 5.000   | 19.818        | 0.9            | 100         | Circular     | 30.000       | 29.500       | 0.400           | 8.640        | 7.600        | 0.940           |
| 6.000   | 17.376        | 0.8            | 100         | Circular     | 30.000       | 29.500       | 0.400           | 8.640        | 7.340        | 1.200           |
| 7.000   | 37.880        | 1.7            | 100         | Circular     | 30.000       | 29.500       | 0.400           | 8.640        | 7.340        | 1.200           |
| 2.000   | 14.389        | 0.6            | 100         | Circular     | 30.000       | 29.500       | 0.400           | 8.640        | 7.340        | 1.200           |
| 1.005   | 19.947        | 12.9           | 225         | Circular     | 8.640        | 7.340        | 1.075           | 8.640        | 5.798        | 2.617           |
| 1.006_1 | 33.660        | -15.3          | 375         | Circular     | 8.640        | 5.798        | 2.467           | 8.640        | 8.000        | 0.265           |
| 1.000   | 37.719        | 59.5           | 100         | Circular     | 8.640        | 7.600        | 0.940           | 8.640        | 6.966        | 1.574           |

| Link    | US<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type | DS<br>Node | Node<br>Type |
|---------|------------|-------------|--------------|------------|------------|--------------|
| 1.001   | SW 02      |             | Junction     |            | SW 03      | Junction     |
| 1.002   | SW 03      |             | Junction     |            | SW 04      | Junction     |
| 1.003   | SW 04      |             | Junction     |            | SW 05      | Junction     |
| 4.000   | SW 07      |             | Junction     |            | SW 08      | Junction     |
| 3.000   | SW 11      |             | Junction     |            | SW 10      | Junction     |
| 3.001   | SW 10      |             | Junction     |            | SW 09      | Junction     |
| 4.001   | SW 08      |             | Junction     |            | SW 09      | Junction     |
| 3.002   | SW 09      |             | Junction     |            | SW 12      | Junction     |
| 1.006   | SW 12      |             | Junction     |            | TANK N     | Junction     |
| 1.007   | TANK N     |             | Junction     |            | SW 13      | Junction     |
| 1.007_1 | SW 13      |             | Junction     |            | TW 3601    | Junction     |
| 1.004   | SW 05      |             | Junction     |            | SW 06      | Junction     |
| 5.000   | BLUEROOF 1 |             | Junction     |            | SW 08      | Junction     |
| 6.000   | BLUEROOF 2 |             | Junction     |            | SW 12      | Junction     |
| 7.000   | BLUEROOF 3 |             | Junction     |            | TANK N     | Junction     |
| 2.000   | BLUEROOF 4 |             | Junction     |            | SW 06      | Junction     |
| 1.005   | SW 06      |             | Junction     |            | TANK S     | Junction     |
| 1.006_1 | TANK S     |             | Junction     |            | SW 13      | Junction     |
| 1.000   | SW 01      | 1200        | Manhole      | Adoptable  | SW 02      | Junction     |

Manhole Schedule

| Node  | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections | Link  | IL<br>(m) | Dia<br>(mm) |     |
|-------|----------------|-----------------|-----------|--------------|-------------|-------------|-------|-----------|-------------|-----|
| SW 02 | 534307.174     | 189633.808      | 8.640     | 1.674        |             | 1           | 1.000 | 6.966     | 100         |     |
|       |                |                 |           |              |             |             | 0     | 1.001     | 6.966       | 100 |

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Manhole Schedule

| Node       | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections                                                                                 | Link             | IL<br>(m)      | Dia<br>(mm) |
|------------|----------------|-----------------|-----------|--------------|-------------|---------------------------------------------------------------------------------------------|------------------|----------------|-------------|
| SW 03      | 534300.281     | 189627.567      | 8.640     | 1.881        |             |  1        | 1.001            | 6.809          | 100         |
| SW 04      | 534271.436     | 189641.041      | 8.640     | 2.197        |             |  1        | 1.002            | 6.759          | 150         |
| SW 08      | 534280.636     | 189680.772      | 8.640     | 1.040        |             |  1<br>2   | 1.003<br>5.000   | 6.443<br>7.600 | 150<br>100  |
| SW 07      | 534285.754     | 189701.762      | 8.640     | 0.640        |             |  0        | 4.001            | 7.600          | 150         |
| SW 11      | 534360.592     | 189684.167      | 8.640     | 1.300        |             |  0        | 4.000            | 8.000          | 100         |
| SW 10      | 534310.810     | 189695.954      | 8.640     | 2.210        |             |  1        | 3.000            | 7.340          | 100         |
| SW 09      | 534305.726     | 189675.454      | 8.640     | 2.240        |             |  1<br>2  | 3.001<br>4.001   | 6.430<br>6.400 | 225<br>150  |
| SW 12      | 534320.258     | 189670.524      | 8.640     | 2.440        |             |  1<br>2 | 3.002<br>6.000   | 6.400<br>7.340 | 225<br>100  |
| TANK N     | 534338.689     | 189664.595      | 8.640     | 2.486        |             |  1<br>2 | 1.006<br>7.000   | 6.200<br>7.340 | 375<br>100  |
| SW 13      | 534368.700     | 189650.435      | 8.640     | 0.640        |             |  1<br>2 | 1.007<br>1.006_1 | 6.154<br>8.000 | 375<br>375  |
| TW 3601    | 534390.676     | 189651.350      | 8.640     | 1.440        |             |  1      | 1.007_1          | 8.000          | 375         |
| BLUEROOF 1 | 534296.843     | 189692.178      | 30.000    | 0.500        |             |  0      | 5.000            | 29.500         | 100         |
| BLUEROOF 2 | 534331.964     | 189683.365      | 30.000    | 0.500        |             |  0      | 6.000            | 29.500         | 100         |
| BLUEROOF 3 | 534375.487     | 189673.585      | 30.000    | 0.500        |             |  0      | 7.000            | 29.500         | 100         |
| BLUEROOF 4 | 534316.131     | 189647.348      | 30.000    | 0.500        |             |  0      | 2.000            | 29.500         | 100         |
| SW 05      | 534278.750     | 189670.410      | 8.640     | 2.497        |             |  1      | 1.003            | 6.143          | 150         |
|            |                |                 |           |              |             |  1      | 1.004            | 6.312          | 225         |

Manhole Schedule

| Node   | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | Link    | IL (m) | Dia (mm) |
|--------|-------------|--------------|--------|-----------|----------|-------------|---------|--------|----------|
| SW 06  | 534316.309  | 189661.736   | 8.640  | 2.555     |          | 1           | 2.000   | 7.340  | 100      |
|        |             |              |        |           |          | 2           | 1.004   | 6.085  | 225      |
|        |             |              |        |           |          | 0           | 1.005   | 7.340  | 225      |
| TANK S | 534335.694  | 189657.036   | 8.640  | 2.842     |          | 1           | 1.005   | 5.798  | 225      |
|        |             |              |        |           |          | 0           | 1.006_1 | 5.798  | 375      |
| SW 01  | 534343.897  | 189625.196   | 8.640  | 1.040     | 1200     | 0           | 1.000   | 7.600  | 100      |

Simulation Settings

|                      |          |                            |     |                        |     |
|----------------------|----------|----------------------------|-----|------------------------|-----|
| Rainfall Methodology | FEH-22   | Skip Steady State          | x   | 2 year (l/s)           | 0.0 |
| Rainfall Events      | Singular | Drain Down Time (mins)     | 240 | 30 year (l/s)          | 0.0 |
| Summer CV            | 1.000    | Additional Storage (m³/ha) | 0.0 | 100 year (l/s)         | 0.0 |
| Winter CV            | 1.000    | Starting Level (m)         |     | Check Discharge Volume | x   |
| Analysis Speed       | Normal   | Check Discharge Rate(s)    | ✓   |                        |     |

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                    | 0                     | 0                     |
| 30                    | 35                    | 0                     | 0                     |                       |                       |                       |                       |

Pre-development Discharge Rate

|                              |            |                        |      |                  |   |
|------------------------------|------------|------------------------|------|------------------|---|
| Site Makeup                  | Greenfield | SPR                    | 0.10 | Betterment (%)   | 0 |
| Greenfield Method            | IH124      | Region                 | 1    | QBar             |   |
| Positively Drained Area (ha) |            | Growth Factor 2 year   | 0.90 | Q 2 year (l/s)   |   |
| SAAR (mm)                    |            | Growth Factor 30 year  | 1.95 | Q 30 year (l/s)  |   |
| Soil Index                   | 1          | Growth Factor 100 year | 2.48 | Q 100 year (l/s) |   |

Node BLUEROOF 1 Online Head/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 29.500

| Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) |
|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|
| 0.010    | 1.000      | 0.030    | 1.300      | 0.050    | 1.500      | 0.070    | 1.700      | 0.090    | 1.800      | 0.110    | 1.900      | 0.130    | 2.100      | 0.150    | 2.200      |
| 0.020    | 1.200      | 0.040    | 1.400      | 0.060    | 1.600      | 0.080    | 1.700      | 0.100    | 1.900      | 0.120    | 2.000      | 0.140    | 2.200      |          |            |

Node BLUEROOF 2 Online Head/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 29.500

| Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) | Head (m) | Flow (l/s) |
|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|
| 0.010    | 1.000      | 0.030    | 1.300      | 0.050    | 1.500      | 0.070    | 1.700      | 0.090    | 1.800      | 0.110    | 1.900      | 0.130    | 2.100      | 0.150    | 2.200      |
| 0.020    | 1.200      | 0.040    | 1.400      | 0.060    | 1.600      | 0.080    | 1.700      | 0.100    | 1.900      | 0.120    | 2.000      | 0.140    | 2.200      |          |            |

Node BLUEROOF 3 Online Head/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 29.500



Node SW 07 Carpark Storage Structure

|                             |         |                           |       |               |       |
|-----------------------------|---------|---------------------------|-------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 8.000 | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |       | Depth (m)     | 0.600 |
| Safety Factor               | 2.0     | Width (m)                 | 9.490 | Inf Depth (m) |       |
| Porosity                    | 0.30    | Length (m)                | 9.490 |               |       |

Node SW 10 Carpark Storage Structure

|                             |         |                           |        |               |       |
|-----------------------------|---------|---------------------------|--------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 7.800  | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |        | Depth (m)     |       |
| Safety Factor               | 2.0     | Width (m)                 | 11.400 | Inf Depth (m) | 0.600 |
| Porosity                    | 0.30    | Length (m)                | 11.400 |               |       |

Node SW 09 Carpark Storage Structure

|                             |         |                           |        |               |       |
|-----------------------------|---------|---------------------------|--------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 7.800  | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |        | Depth (m)     | 0.600 |
| Safety Factor               | 2.0     | Width (m)                 | 10.950 | Inf Depth (m) |       |
| Porosity                    | 0.30    | Length (m)                | 10.950 |               |       |

Node SW 12 Carpark Storage Structure

|                             |         |                           |        |               |       |
|-----------------------------|---------|---------------------------|--------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 7.800  | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |        | Depth (m)     | 0.600 |
| Safety Factor               | 2.0     | Width (m)                 | 15.000 | Inf Depth (m) |       |
| Porosity                    | 0.30    | Length (m)                | 15.000 |               |       |

Node BLUEROOF 1 Depth/Area Storage Structure

|                             |                        |                            |           |                           |                            |
|-----------------------------|------------------------|----------------------------|-----------|---------------------------|----------------------------|
| Base Inf Coefficient (m/hr) | 0.00000                | Safety Factor              | 2.0       | Invert Level (m)          | 29.500                     |
| Side Inf Coefficient (m/hr) | 0.00000                | Porosity                   | 0.95      | Time to half empty (mins) | 92                         |
| Depth (m)                   | Area (m <sup>2</sup> ) | Inf Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> )    | Inf Area (m <sup>2</sup> ) |
| 0.000                       | 390.0                  | 0.0                        | 0.150     | 390.0                     | 0.0                        |

Node BLUEROOF 2 Depth/Area Storage Structure

|                             |                        |                            |           |                           |                            |
|-----------------------------|------------------------|----------------------------|-----------|---------------------------|----------------------------|
| Base Inf Coefficient (m/hr) | 0.00000                | Safety Factor              | 2.0       | Invert Level (m)          | 29.500                     |
| Side Inf Coefficient (m/hr) | 0.00000                | Porosity                   | 0.95      | Time to half empty (mins) | 192                        |
| Depth (m)                   | Area (m <sup>2</sup> ) | Inf Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> )    | Inf Area (m <sup>2</sup> ) |
| 0.000                       | 840.0                  | 0.0                        | 0.150     | 840.0                     | 0.0                        |

Node BLUEROOF 3 Depth/Area Storage Structure

|                             |                        |                            |           |                           |                            |
|-----------------------------|------------------------|----------------------------|-----------|---------------------------|----------------------------|
| Base Inf Coefficient (m/hr) | 0.00000                | Safety Factor              | 2.0       | Invert Level (m)          | 29.500                     |
| Side Inf Coefficient (m/hr) | 0.00000                | Porosity                   | 0.95      | Time to half empty (mins) | 128                        |
| Depth (m)                   | Area (m <sup>2</sup> ) | Inf Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> )    | Inf Area (m <sup>2</sup> ) |
| 0.000                       | 300.0                  | 0.0                        | 0.150     | 300.0                     | 0.0                        |

Node BLUEROOF 4 Depth/Area Storage Structure

|                             |                        |                            |           |                           |                            |
|-----------------------------|------------------------|----------------------------|-----------|---------------------------|----------------------------|
| Base Inf Coefficient (m/hr) | 0.00000                | Safety Factor              | 2.0       | Invert Level (m)          | 29.500                     |
| Side Inf Coefficient (m/hr) | 0.00000                | Porosity                   | 0.95      | Time to half empty (mins) |                            |
| Depth (m)                   | Area (m <sup>2</sup> ) | Inf Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> )    | Inf Area (m <sup>2</sup> ) |
| 0.000                       | 1540.0                 | 0.0                        | 0.150     | 1540.0                    | 0.0                        |

Node SW 05 Carpark Storage Structure

|                             |         |                           |        |               |       |
|-----------------------------|---------|---------------------------|--------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 7.800  | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |        | Depth (m)     | 0.600 |
| Safety Factor               | 2.0     | Width (m)                 | 10.000 | Inf Depth (m) |       |
| Porosity                    | 0.30    | Length (m)                | 10.000 |               |       |

Node SW 06 Carpark Storage Structure

|                             |         |                           |        |               |       |
|-----------------------------|---------|---------------------------|--------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 6.085  | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |        | Depth (m)     | 0.600 |
| Safety Factor               | 2.0     | Width (m)                 | 19.750 | Inf Depth (m) |       |
| Porosity                    | 0.30    | Length (m)                | 19.750 |               |       |

Node TANK S Depth/Area Storage Structure

|                             |                        |                            |           |                           |                            |
|-----------------------------|------------------------|----------------------------|-----------|---------------------------|----------------------------|
| Base Inf Coefficient (m/hr) | 0.00000                | Safety Factor              | 2.0       | Invert Level (m)          | 5.798                      |
| Side Inf Coefficient (m/hr) | 0.00000                | Porosity                   | 0.95      | Time to half empty (mins) |                            |
| Depth (m)                   | Area (m <sup>2</sup> ) | Inf Area (m <sup>2</sup> ) | Depth (m) | Area (m <sup>2</sup> )    | Inf Area (m <sup>2</sup> ) |
| 0.000                       | 190.0                  | 0.0                        | 1.600     | 190.0                     | 0.0                        |
|                             |                        |                            | 1.601     | 0.0                       | 0.0                        |

Node TANK N Carpark Storage Structure

|                             |         |                           |        |               |       |
|-----------------------------|---------|---------------------------|--------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 7.800  | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |        | Depth (m)     | 0.600 |
| Safety Factor               | 2.0     | Width (m)                 | 10.000 | Inf Depth (m) |       |
| Porosity                    | 0.30    | Length (m)                | 10.000 |               |       |

Node SW 01 Carpark Storage Structure

|                             |         |                           |       |               |       |
|-----------------------------|---------|---------------------------|-------|---------------|-------|
| Base Inf Coefficient (m/hr) | 0.00000 | Invert Level (m)          | 7.800 | Slope (1:X)   | 200.0 |
| Side Inf Coefficient (m/hr) | 0.00000 | Time to half empty (mins) |       | Depth (m)     | 0.600 |
| Safety Factor               | 2.0     | Width (m)                 | 3.000 | Inf Depth (m) |       |
| Porosity                    | 0.30    | Length (m)                | 3.000 |               |       |

Results for 2 year Critical Storm Duration. Lowest mass balance: 94.05%

| Node Event                     | US Node    | Peak (mins) | Level (m) | Depth (m)     | Inflow (l/s)   | Node Vol (m³) | Flood (m³)    | Status             |
|--------------------------------|------------|-------------|-----------|---------------|----------------|---------------|---------------|--------------------|
| 1440 minute winter             | SW 02      | 1050        | 7.358     | 0.392         | 0.2            | 0.0000        | 0.0000        | SURCHARGED         |
| 1440 minute winter             | SW 03      | 1050        | 7.358     | 0.599         | 0.6            | 0.0000        | 0.0000        | SURCHARGED         |
| 2880 minute summer             | SW 04      | 1740        | 7.357     | 0.914         | 0.4            | 0.0000        | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 08      | 11          | 7.632     | 0.032         | 3.8            | 0.0000        | 0.0000        | OK                 |
| 15 minute summer               | SW 07      | 12          | 8.020     | 0.020         | 0.9            | 0.1149        | 0.0000        | OK                 |
| 15 minute summer               | SW 11      | 10          | 7.386     | 0.046         | 3.6            | 0.0000        | 0.0000        | OK                 |
| 10080 minute summer            | SW 10      | 6600        | 6.767     | 0.337         | 0.2            | 0.0000        | 0.0000        | SURCHARGED         |
| 10080 minute summer            | SW 09      | 6600        | 6.767     | 0.367         | 0.6            | 0.0000        | 0.0000        | SURCHARGED         |
| 10080 minute summer            | SW 12      | 6600        | 6.767     | 0.567         | 1.0            | 0.0000        | 0.0000        | SURCHARGED         |
| 10080 minute summer            | TANK N     | 6600        | 6.767     | 0.613         | 1.3            | 107.7017      | 0.0000        | SURCHARGED         |
| 10080 minute summer            | SW 13      | 6840        | 8.009     | 0.009         | 0.3            | 0.0000        | 0.0000        | OK                 |
| 10080 minute summer            | TW 3601    | 6840        | 7.209     | 0.009         | 0.3            | 0.0000        | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 1 | 120         | 29.514    | 0.014         | 3.4            | 5.2467        | 0.0000        | OK                 |
| 240 minute summer              | BLUEROOF 2 | 168         | 29.517    | 0.017         | 5.8            | 13.8556       | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 3 | 116         | 29.519    | 0.019         | 3.6            | 5.2901        | 0.0000        | OK                 |
| 360 minute summer              | BLUEROOF 4 | 288         | 29.528    | 0.028         | 10.6           | 41.4605       | 0.0000        | OK                 |
| 2880 minute summer             | SW 05      | 1740        | 7.357     | 1.214         | 0.5            | 0.0000        | 0.0000        | SURCHARGED         |
| 2880 minute summer             | SW 06      | 1740        | 7.357     | 1.272         | 1.9            | 64.4824       | 0.0000        | OK                 |
| 10080 minute winter            | TANK S     | 7680        | 6.263     | 0.465         | 0.9            | 83.8980       | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 01      | 10          | 7.641     | 0.041         | 2.7            | 0.0460        | 0.0000        | OK                 |
| Link Event<br>(Upstream Depth) | US Node    | Link        | DS Node   | Outflow (l/s) | Velocity (m/s) | Flow/Cap      | Link Vol (m³) | Discharge Vol (m³) |
| 1440 minute winter             | SW 02      | 1.001       | SW 03     | 0.2           | 0.427          | 0.025         | 0.0728        |                    |
| 1440 minute winter             | SW 03      | 1.002       | SW 04     | 0.5           | 0.414          | 0.028         | 0.5605        |                    |
| 2880 minute summer             | SW 04      | 1.003       | SW 05     | 0.4           | 0.036          | 0.023         | 0.5328        |                    |
| 15 minute summer               | SW 08      | 4.001       | SW 09     | 3.8           | 0.719          | 0.098         | 0.1449        |                    |
| 15 minute summer               | SW 07      | 4.000       | SW 08     | 0.7           | 0.474          | 0.087         | 0.0345        |                    |
| 15 minute summer               | SW 11      | 3.000       | SW 10     | 3.5           | 0.648          | 0.433         | 0.2721        |                    |
| 10080 minute summer            | SW 10      | 3.001       | SW 09     | 0.2           | 0.161          | 0.010         | 0.8400        |                    |
| 10080 minute summer            | SW 09      | 3.002       | SW 12     | 0.6           | 0.165          | 0.010         | 0.6103        |                    |
| 10080 minute summer            | SW 12      | 1.006       | TANK N    | 1.0           | 0.217          | 0.010         | 2.1355        |                    |
| 10080 minute summer            | TANK N     | Pump        | SW 13     | 0.2           |                |               |               |                    |
| 10080 minute summer            | SW 13      | 1.007_1     | TW 3601   | 0.3           | 0.546          | 0.001         | 0.0137        | 88.6               |
| 180 minute summer              | BLUEROOF 1 | Head/Flow   | SW 08     | 1.1           |                |               |               |                    |
| 240 minute summer              | BLUEROOF 2 | Head/Flow   | SW 12     | 1.1           |                |               |               |                    |
| 180 minute summer              | BLUEROOF 3 | Head/Flow   | TANK N    | 1.2           |                |               |               |                    |
| 360 minute summer              | BLUEROOF 4 | Head/Flow   | SW 06     | 1.3           |                |               |               |                    |
| 2880 minute summer             | SW 05      | 1.004       | SW 06     | 0.4           | 0.020          | 0.011         | 1.5331        |                    |
| 2880 minute summer             | SW 06      | 1.005       | TANK S    | 1.7           | 0.353          | 0.012         | 0.4048        |                    |
| 10080 minute winter            | TANK S     | 1.006_1     | SW 13     | 0.2           | -0.028         | 0.001         | 1.8664        |                    |
| 15 minute summer               | SW 01      | 1.000       | SW 02     | 2.7           | 0.916          | 0.340         | 0.1106        |                    |

Results for 30 year Critical Storm Duration. Lowest mass balance: 94.05%

| Node Event                     | US Node    | Peak (mins) | Level (m) | Depth (m)     | Inflow (l/s)   | Node Vol (m³) | Flood (m³)    | Status             |
|--------------------------------|------------|-------------|-----------|---------------|----------------|---------------|---------------|--------------------|
| 15 minute summer               | SW 02      | 12          | 7.414     | 0.448         | 7.4            | 0.0000        | 0.0000        | SURCHARGED         |
| 960 minute summer              | SW 03      | 525         | 7.386     | 0.627         | 1.9            | 0.0000        | 0.0000        | SURCHARGED         |
| 960 minute summer              | SW 04      | 525         | 7.381     | 0.938         | 2.6            | 0.0000        | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 08      | 11          | 7.654     | 0.054         | 10.7           | 0.0000        | 0.0000        | OK                 |
| 15 minute summer               | SW 07      | 12          | 8.034     | 0.034         | 2.7            | 0.3406        | 0.0000        | OK                 |
| 15 minute summer               | SW 11      | 12          | 7.766     | 0.426         | 10.7           | 0.0000        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 10      | 7200        | 7.349     | 0.919         | 0.2            | 0.0000        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 09      | 7200        | 7.349     | 0.949         | 0.6            | 0.0000        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 12      | 7200        | 7.349     | 1.149         | 1.1            | 0.0000        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | TANK N     | 7200        | 7.349     | 1.195         | 1.4            | 209.9346      | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 13      | 7440        | 8.013     | 0.013         | 0.8            | 0.0000        | 0.0000        | OK                 |
| 10080 minute winter            | TW 3601    | 7440        | 7.212     | 0.012         | 0.8            | 0.0000        | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 1 | 132         | 29.542    | 0.042         | 8.3            | 15.4305       | 0.0000        | OK                 |
| 240 minute winter              | BLUEROOF 2 | 224         | 29.547    | 0.047         | 9.1            | 37.8771       | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 3 | 132         | 29.557    | 0.057         | 8.9            | 16.1802       | 0.0000        | OK                 |
| 360 minute winter              | BLUEROOF 4 | 352         | 29.574    | 0.074         | 15.6           | 107.9136      | 0.0000        | OK                 |
| 960 minute summer              | SW 05      | 525         | 7.373     | 1.230         | 3.1            | 0.0000        | 0.0000        | SURCHARGED         |
| 960 minute summer              | SW 06      | 525         | 7.372     | 1.287         | 6.3            | 64.4824       | 0.0000        | OK                 |
| 10080 minute winter            | TANK S     | 7440        | 6.928     | 1.130         | 1.8            | 203.9495      | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 01      | 12          | 7.808     | 0.208         | 8.1            | 0.2406        | 0.0000        | SURCHARGED         |
| Link Event<br>(Upstream Depth) | US Node    | Link        | DS Node   | Outflow (l/s) | Velocity (m/s) | Flow/Cap      | Link Vol (m³) | Discharge Vol (m³) |
| 15 minute summer               | SW 02      | 1.001       | SW 03     | 8.5           | 1.084          | 1.077         | 0.0728        |                    |
| 960 minute summer              | SW 03      | 1.002       | SW 04     | 2.0           | 0.532          | 0.116         | 0.5605        |                    |
| 960 minute summer              | SW 04      | 1.003       | SW 05     | 2.7           | 0.154          | 0.153         | 0.5328        |                    |
| 15 minute summer               | SW 08      | 4.001       | SW 09     | 10.8          | 0.919          | 0.278         | 0.2877        |                    |
| 15 minute summer               | SW 07      | 4.000       | SW 08     | 2.1           | 0.708          | 0.255         | 0.0717        |                    |
| 15 minute summer               | SW 11      | 3.000       | SW 10     | 8.9           | 1.134          | 1.098         | 0.4003        |                    |
| 10080 minute winter            | SW 10      | 3.001       | SW 09     | 0.2           | 0.130          | 0.010         | 0.8400        |                    |
| 10080 minute winter            | SW 09      | 3.002       | SW 12     | 0.6           | 0.055          | 0.010         | 0.6103        |                    |
| 10080 minute winter            | SW 12      | 1.006       | TANK N    | 1.1           | 0.217          | 0.011         | 2.1355        |                    |
| 10080 minute winter            | TANK N     | Pump        | SW 13     | 0.4           |                |               |               |                    |
| 10080 minute winter            | SW 13      | 1.007_1     | TW 3601   | 0.8           | 0.699          | 0.002         | 0.0237        | 219.2              |
| 180 minute summer              | BLUEROOF 1 | Head/Flow   | SW 08     | 1.4           |                |               |               |                    |
| 240 minute winter              | BLUEROOF 2 | Head/Flow   | SW 12     | 1.5           |                |               |               |                    |
| 180 minute summer              | BLUEROOF 3 | Head/Flow   | TANK N    | 1.6           |                |               |               |                    |
| 360 minute winter              | BLUEROOF 4 | Head/Flow   | SW 06     | 1.7           |                |               |               |                    |
| 960 minute summer              | SW 05      | 1.004       | SW 06     | 3.2           | 0.138          | 0.081         | 1.5331        |                    |
| 960 minute summer              | SW 06      | 1.005       | TANK S    | 6.2           | 0.738          | 0.043         | 0.4181        |                    |
| 10080 minute winter            | TANK S     | 1.006_1     | SW 13     | 0.4           | -0.038         | 0.004         | 1.8747        |                    |
| 15 minute summer               | SW 01      | 1.000       | SW 02     | 7.4           | 1.146          | 0.936         | 0.2951        |                    |

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 94.05%

| Node Event                     | US Node    | Peak (mins) | Level (m) | Depth (m)     | Inflow (l/s)   | Node Vol (m³) | Flood (m³)    | Status             |
|--------------------------------|------------|-------------|-----------|---------------|----------------|---------------|---------------|--------------------|
| 8640 minute winter             | SW 02      | 6540        | 7.839     | 0.873         | 0.2            | 0.2034        | 0.0000        | SURCHARGED         |
| 8640 minute winter             | SW 03      | 6540        | 7.839     | 1.080         | 0.7            | 0.7260        | 0.0000        | SURCHARGED         |
| 8640 minute winter             | SW 04      | 6540        | 7.839     | 1.396         | 0.8            | 0.6601        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 08      | 7140        | 7.896     | 0.296         | 0.4            | 2.4583        | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 07      | 12          | 8.040     | 0.040         | 3.6            | 0.4546        | 0.0000        | OK                 |
| 15 minute summer               | SW 11      | 12          | 8.384     | 1.044         | 14.4           | 0.0000        | 0.0000        | FLOOD RISK         |
| 10080 minute winter            | SW 10      | 7140        | 7.896     | 1.466         | 0.2            | 2.6260        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 09      | 7140        | 7.896     | 1.496         | 0.7            | 2.4586        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 12      | 7140        | 7.896     | 1.696         | 1.4            | 3.9356        | 0.0000        | SURCHARGED         |
| 10080 minute winter            | TANK N     | 7140        | 7.896     | 1.742         | 1.9            | 283.4126      | 0.0000        | SURCHARGED         |
| 10080 minute winter            | SW 13      | 7260        | 8.016     | 0.016         | 1.2            | 0.0000        | 0.0000        | OK                 |
| 10080 minute winter            | TW 3601    | 7260        | 7.216     | 0.016         | 1.2            | 0.0000        | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 1 | 140         | 29.560    | 0.060         | 11.2           | 22.0939       | 0.0000        | OK                 |
| 240 minute winter              | BLUEROOF 2 | 232         | 29.568    | 0.068         | 12.3           | 54.0527       | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 3 | 140         | 29.582    | 0.082         | 12.0           | 23.3745       | 0.0000        | OK                 |
| 360 minute winter              | BLUEROOF 4 | 352         | 29.603    | 0.103         | 21.0           | 151.2760      | 0.0000        | SURCHARGED         |
| 8640 minute winter             | SW 05      | 6540        | 7.839     | 1.696         | 0.8            | 0.4692        | 0.0000        | SURCHARGED         |
| 8640 minute winter             | SW 06      | 6540        | 7.839     | 1.754         | 2.0            | 64.4824       | 0.0000        | SURCHARGED         |
| 8640 minute winter             | TANK S     | 6540        | 7.839     | 2.041         | 2.2            | 288.8903      | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 01      | 13          | 8.054     | 0.454         | 10.9           | 1.1796        | 0.0000        | SURCHARGED         |
| Link Event<br>(Upstream Depth) | US Node    | Link        | DS Node   | Outflow (l/s) | Velocity (m/s) | Flow/Cap      | Link Vol (m³) | Discharge Vol (m³) |
| 8640 minute winter             | SW 02      | 1.001       | SW 03     | -0.2          | 0.346          | -0.025        | 0.0728        |                    |
| 8640 minute winter             | SW 03      | 1.002       | SW 04     | -0.5          | 0.271          | -0.027        | 0.5605        |                    |
| 8640 minute winter             | SW 04      | 1.003       | SW 05     | -0.7          | -0.039         | -0.039        | 0.5328        |                    |
| 10080 minute winter            | SW 08      | 4.001       | SW 09     | 0.4           | 0.396          | 0.010         | 0.4515        |                    |
| 15 minute summer               | SW 07      | 4.000       | SW 08     | 2.8           | 0.784          | 0.334         | 0.0861        |                    |
| 15 minute summer               | SW 11      | 3.000       | SW 10     | 10.8          | 1.386          | 1.341         | 0.4003        |                    |
| 10080 minute winter            | SW 10      | 3.001       | SW 09     | 0.2           | 0.094          | 0.010         | 0.8400        |                    |
| 10080 minute winter            | SW 09      | 3.002       | SW 12     | 0.7           | 0.168          | 0.011         | 0.6103        |                    |
| 10080 minute winter            | SW 12      | 1.006       | TANK N    | 1.4           | 0.217          | 0.014         | 2.1355        |                    |
| 10080 minute winter            | TANK N     | Pump        | SW 13     | 0.5           |                |               |               |                    |
| 10080 minute winter            | SW 13      | 1.007_1     | TW 3601   | 1.2           | 0.805          | 0.003         | 0.0334        | 333.5              |
| 180 minute summer              | BLUEROOF 1 | Head/Flow   | SW 08     | 1.6           |                |               |               |                    |
| 240 minute winter              | BLUEROOF 2 | Head/Flow   | SW 12     | 1.7           |                |               |               |                    |
| 180 minute summer              | BLUEROOF 3 | Head/Flow   | TANK N    | 1.7           |                |               |               |                    |
| 360 minute winter              | BLUEROOF 4 | Head/Flow   | SW 06     | 1.9           |                |               |               |                    |
| 8640 minute winter             | SW 05      | 1.004       | SW 06     | -0.8          | -0.021         | -0.021        | 1.5331        |                    |
| 8640 minute winter             | SW 06      | 1.005       | TANK S    | 2.0           | 0.417          | 0.014         | 0.7933        |                    |
| 8640 minute winter             | TANK S     | 1.006_1     | SW 13     | 0.7           | -0.038         | 0.006         | 1.8818        |                    |
| 15 minute summer               | SW 01      | 1.000       | SW 02     | 7.5           | 1.162          | 0.952         | 0.2951        |                    |

Results for 100 year Critical Storm Duration. Lowest mass balance: 94.05%

| Node Event                     | US Node    | Peak (mins) | Level (m) | Depth (m)     | Inflow (l/s)   | Node Vol (m³) | Flood (m³)    | Status             |
|--------------------------------|------------|-------------|-----------|---------------|----------------|---------------|---------------|--------------------|
| 15 minute summer               | SW 02      | 12          | 7.723     | 0.757         | 7.2            | 0.0000        | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 03      | 12          | 7.665     | 0.906         | 21.0           | 0.0000        | 0.0000        | SURCHARGED         |
| 360 minute summer              | SW 04      | 208         | 7.417     | 0.974         | 8.1            | 0.0000        | 0.0000        | SURCHARGED         |
| 2160 minute winter             | SW 08      | 2160        | 7.845     | 0.245         | 1.3            | 0.6732        | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 07      | 12          | 8.039     | 0.039         | 3.5            | 0.4400        | 0.0000        | OK                 |
| 15 minute summer               | SW 11      | 12          | 8.295     | 0.955         | 13.9           | 0.0000        | 0.0000        | SURCHARGED         |
| 2160 minute winter             | SW 10      | 2160        | 7.845     | 1.415         | 0.7            | 0.7032        | 0.0000        | SURCHARGED         |
| 2160 minute winter             | SW 09      | 2160        | 7.845     | 1.445         | 2.4            | 0.6730        | 0.0000        | SURCHARGED         |
| 2160 minute winter             | SW 12      | 2160        | 7.845     | 1.645         | 4.0            | 0.9263        | 0.0000        | SURCHARGED         |
| 2160 minute winter             | TANK N     | 2160        | 7.845     | 1.691         | 5.5            | 281.9056      | 0.0000        | SURCHARGED         |
| 4320 minute winter             | SW 13      | 4200        | 8.014     | 0.014         | 1.0            | 0.0000        | 0.0000        | OK                 |
| 4320 minute winter             | TW 3601    | 4200        | 7.214     | 0.014         | 1.0            | 0.0000        | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 1 | 140         | 29.558    | 0.058         | 10.9           | 21.4440       | 0.0000        | OK                 |
| 240 minute winter              | BLUEROOF 2 | 232         | 29.566    | 0.066         | 12.0           | 52.7576       | 0.0000        | OK                 |
| 180 minute summer              | BLUEROOF 3 | 140         | 29.579    | 0.079         | 11.7           | 22.6344       | 0.0000        | OK                 |
| 480 minute winter              | BLUEROOF 4 | 464         | 29.602    | 0.102         | 16.4           | 149.8366      | 0.0000        | SURCHARGED         |
| 360 minute summer              | SW 05      | 208         | 7.389     | 1.246         | 9.6            | 0.0000        | 0.0000        | SURCHARGED         |
| 360 minute summer              | SW 06      | 208         | 7.383     | 1.298         | 17.0           | 64.4824       | 0.0000        | OK                 |
| 4320 minute winter             | TANK S     | 4320        | 7.266     | 1.468         | 2.9            | 264.9547      | 0.0000        | SURCHARGED         |
| 15 minute summer               | SW 01      | 13          | 8.017     | 0.417         | 10.5           | 1.0362        | 0.0000        | SURCHARGED         |
| Link Event<br>(Upstream Depth) | US Node    | Link        | DS Node   | Outflow (l/s) | Velocity (m/s) | Flow/Cap      | Link Vol (m³) | Discharge Vol (m³) |
| 15 minute summer               | SW 02      | 1.001       | SW 03     | 9.6           | 1.231          | 1.223         | 0.0728        |                    |
| 15 minute summer               | SW 03      | 1.002       | SW 04     | 19.3          | 1.098          | 1.093         | 0.5605        |                    |
| 360 minute summer              | SW 04      | 1.003       | SW 05     | 7.8           | 0.441          | 0.439         | 0.5328        |                    |
| 2160 minute winter             | SW 08      | 4.001       | SW 09     | 1.3           | 0.451          | 0.033         | 0.4515        |                    |
| 15 minute summer               | SW 07      | 4.000       | SW 08     | 2.7           | 0.776          | 0.324         | 0.0845        |                    |
| 15 minute summer               | SW 11      | 3.000       | SW 10     | 10.6          | 1.353          | 1.309         | 0.4003        |                    |
| 2160 minute winter             | SW 10      | 3.001       | SW 09     | 0.6           | 0.179          | 0.033         | 0.8400        |                    |
| 2160 minute winter             | SW 09      | 3.002       | SW 12     | 2.4           | 0.317          | 0.040         | 0.6103        |                    |
| 2160 minute winter             | SW 12      | 1.006       | TANK N    | 3.9           | 0.316          | 0.041         | 2.1355        |                    |
| 2160 minute winter             | TANK N     | Pump        | SW 13     | 0.5           |                |               |               |                    |
| 4320 minute winter             | SW 13      | 1.007_1     | TW 3601   | 1.0           | 0.753          | 0.003         | 0.0283        | 116.8              |
| 180 minute summer              | BLUEROOF 1 | Head/Flow   | SW 08     | 1.6           |                |               |               |                    |
| 240 minute winter              | BLUEROOF 2 | Head/Flow   | SW 12     | 1.7           |                |               |               |                    |
| 180 minute summer              | BLUEROOF 3 | Head/Flow   | TANK N    | 1.7           |                |               |               |                    |
| 480 minute winter              | BLUEROOF 4 | Head/Flow   | SW 06     | 1.9           |                |               |               |                    |
| 360 minute summer              | SW 05      | 1.004       | SW 06     | 9.4           | 0.307          | 0.236         | 1.5331        |                    |
| 360 minute summer              | SW 06      | 1.005       | TANK S    | 11.6          | 0.929          | 0.080         | 0.4260        |                    |
| 4320 minute winter             | TANK S     | 1.006_1     | SW 13     | 0.5           | -0.040         | 0.005         | 1.8782        |                    |
| 15 minute summer               | SW 01      | 1.000       | SW 02     | 7.2           | 1.159          | 0.922         | 0.2951        |                    |

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 94.05%

| Node Event                     | US Node    | Peak (mins) | Level (m) | Depth (m)     | Inflow (l/s)   | Node Vol (m³) | Flood (m³)    | Status             |
|--------------------------------|------------|-------------|-----------|---------------|----------------|---------------|---------------|--------------------|
| 5760 minute winter             | SW 02      | 5640        | 8.398     | 1.432         | 0.5            | 4.3952        | 0.0000        | FLOOD RISK         |
| 5760 minute winter             | SW 03      | 5640        | 8.398     | 1.639         | 0.7            | 40.1774       | 0.0000        | FLOOD RISK         |
| 5760 minute winter             | SW 04      | 5640        | 8.398     | 1.955         | 1.2            | 33.7639       | 0.0000        | FLOOD RISK         |
| 2880 minute winter             | SW 08      | 2820        | 8.371     | 0.771         | 1.4            | 19.5517       | 0.0000        | FLOOD RISK         |
| 2880 minute winter             | SW 07      | 2820        | 8.371     | 0.371         | 0.3            | 9.3258        | 0.0000        | FLOOD RISK         |
| 15 minute summer               | SW 11      | 10          | 8.640     | 1.300         | 19.5           | 0.0000        | 0.0000        | FLOOD RISK         |
| 2880 minute winter             | SW 10      | 2820        | 8.371     | 1.941         | 0.7            | 21.1520       | 0.0000        | FLOOD RISK         |
| 2880 minute winter             | SW 09      | 2820        | 8.371     | 1.971         | 2.5            | 19.5513       | 0.0000        | FLOOD RISK         |
| 2880 minute winter             | SW 12      | 2820        | 8.371     | 2.171         | 4.1            | 36.0117       | 0.0000        | FLOOD RISK         |
| 2880 minute winter             | TANK N     | 2820        | 8.371     | 2.217         | 5.7            | 297.6689      | 0.0000        | FLOOD RISK         |
| 4320 minute winter             | SW 13      | 3240        | 8.016     | 0.016         | 1.3            | 0.0000        | 0.0000        | OK                 |
| 4320 minute winter             | TW 3601    | 3240        | 7.216     | 0.016         | 1.3            | 0.0000        | 0.0000        | OK                 |
| 240 minute summer              | BLUEROOF 1 | 184         | 29.587    | 0.087         | 12.9           | 32.1459       | 0.0000        | OK                 |
| 360 minute winter              | BLUEROOF 2 | 344         | 29.598    | 0.098         | 12.4           | 78.2144       | 0.0000        | OK                 |
| 180 minute winter              | BLUEROOF 3 | 164         | 29.619    | 0.119         | 11.2           | 33.8884       | 0.0000        | SURCHARGED         |
| 480 minute winter              | BLUEROOF 4 | 472         | 29.650    | 0.150         | 23.0           | 219.0723      | 0.0000        | SURCHARGED         |
| 5760 minute winter             | SW 05      | 5640        | 8.398     | 2.255         | 1.4            | 17.2025       | 0.0000        | FLOOD RISK         |
| 5760 minute winter             | SW 06      | 5640        | 8.398     | 2.313         | 2.8            | 64.4824       | 0.0000        | FLOOD RISK         |
| 5760 minute winter             | TANK S     | 5640        | 8.398     | 2.600         | 3.2            | 288.8903      | 0.0000        | FLOOD RISK         |
| 5760 minute winter             | SW 01      | 5640        | 8.398     | 0.798         | 0.3            | 2.4990        | 0.0000        | FLOOD RISK         |
| Link Event<br>(Upstream Depth) | US Node    | Link        | DS Node   | Outflow (l/s) | Velocity (m/s) | Flow/Cap      | Link Vol (m³) | Discharge Vol (m³) |
| 5760 minute winter             | SW 02      | 1.001       | SW 03     | -0.5          | 0.346          | -0.058        | 0.0728        |                    |
| 5760 minute winter             | SW 03      | 1.002       | SW 04     | -0.6          | 0.271          | -0.034        | 0.5605        |                    |
| 5760 minute winter             | SW 04      | 1.003       | SW 05     | -1.1          | -0.060         | -0.060        | 0.5328        |                    |
| 2880 minute winter             | SW 08      | 4.001       | SW 09     | 1.4           | 0.444          | 0.036         | 0.4515        |                    |
| 2880 minute winter             | SW 07      | 4.000       | SW 08     | -0.3          | 0.206          | -0.041        | 0.1690        |                    |
| 15 minute summer               | SW 11      | 3.000       | SW 10     | 13.3          | 1.695          | 1.641         | 0.4003        |                    |
| 2880 minute winter             | SW 10      | 3.001       | SW 09     | 0.7           | 0.161          | 0.034         | 0.8400        |                    |
| 2880 minute winter             | SW 09      | 3.002       | SW 12     | 2.5           | 0.317          | 0.041         | 0.6103        |                    |
| 2880 minute winter             | SW 12      | 1.006       | TANK N    | 4.1           | 0.319          | 0.042         | 2.1355        |                    |
| 2880 minute winter             | TANK N     | Pump        | SW 13     | 0.6           |                |               |               |                    |
| 4320 minute winter             | SW 13      | 1.007_1     | TW 3601   | 1.3           | 0.819          | 0.003         | 0.0349        | 170.5              |
| 240 minute summer              | BLUEROOF 1 | Head/Flow   | SW 08     | 1.8           |                |               |               |                    |
| 360 minute winter              | BLUEROOF 2 | Head/Flow   | SW 12     | 1.9           |                |               |               |                    |
| 180 minute winter              | BLUEROOF 3 | Head/Flow   | TANK N    | 2.0           |                |               |               |                    |
| 480 minute winter              | BLUEROOF 4 | Head/Flow   | SW 06     | 2.2           |                |               |               |                    |
| 5760 minute winter             | SW 05      | 1.004       | SW 06     | -1.3          | -0.032         | -0.032        | 1.5331        |                    |
| 5760 minute winter             | SW 06      | 1.005       | TANK S    | 2.8           | 0.307          | 0.019         | 0.7933        |                    |
| 5760 minute winter             | TANK S     | 1.006_1     | SW 13     | 0.7           | -0.016         | 0.006         | 1.8831        |                    |
| 5760 minute winter             | SW 01      | 1.000       | SW 02     | -0.2          | 0.345          | -0.027        | 0.2951        |                    |

END OF REPORT