AVONMOUTH HOUSE, 6 AVONMOUTH STREET, LONDON SE1 6NX

TRIBE AVONMOUTH HOUSE LTD

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

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1. INTRODUCTION

Preface

1.1 Ardent Consulting Engineers (ACE) has been commissioned by Tribe Avonmouth House Ltd to undertake a Flood Risk Assessment (FRA) and preliminary foul and surface water drainage strategy, for a proposed development at Avonmouth House, 6 Avonmouth Street, Elephant and Castle (hereafter referred to as the "Site") within the London Borough of Southwark (LBS).

1.2 The FRA has been prepared to accompany a planning application to LBS as both planning and lead local flood authority.

1.3 This FRA has been written with specific reference to the requirements of the National Planning Framework (NPPF – July 2021) and the Planning Practice Guidance (March 2014).

1.4 During the preparation of this FRA, consultation with Thames Water (TW) and the Environment Agency (EA) was undertaken.

Proposed Development Summary

1.5 The scheme proposals comprise the redevelopment of the Site to provide 233 student bedspaces and 1,733m^2 of commercial floorspace.

2. BASELINE PARAMETERS

Existing Site

2.1. The development Site is located at 6 Avonmouth Street, Elephant and Castle, London, SE1 6NX, within the London Borough of Southwark. The Site is centred on National Grid Reference 179387mN, 532136mE. A Site location plan is shown in **Figure 2-1** below.

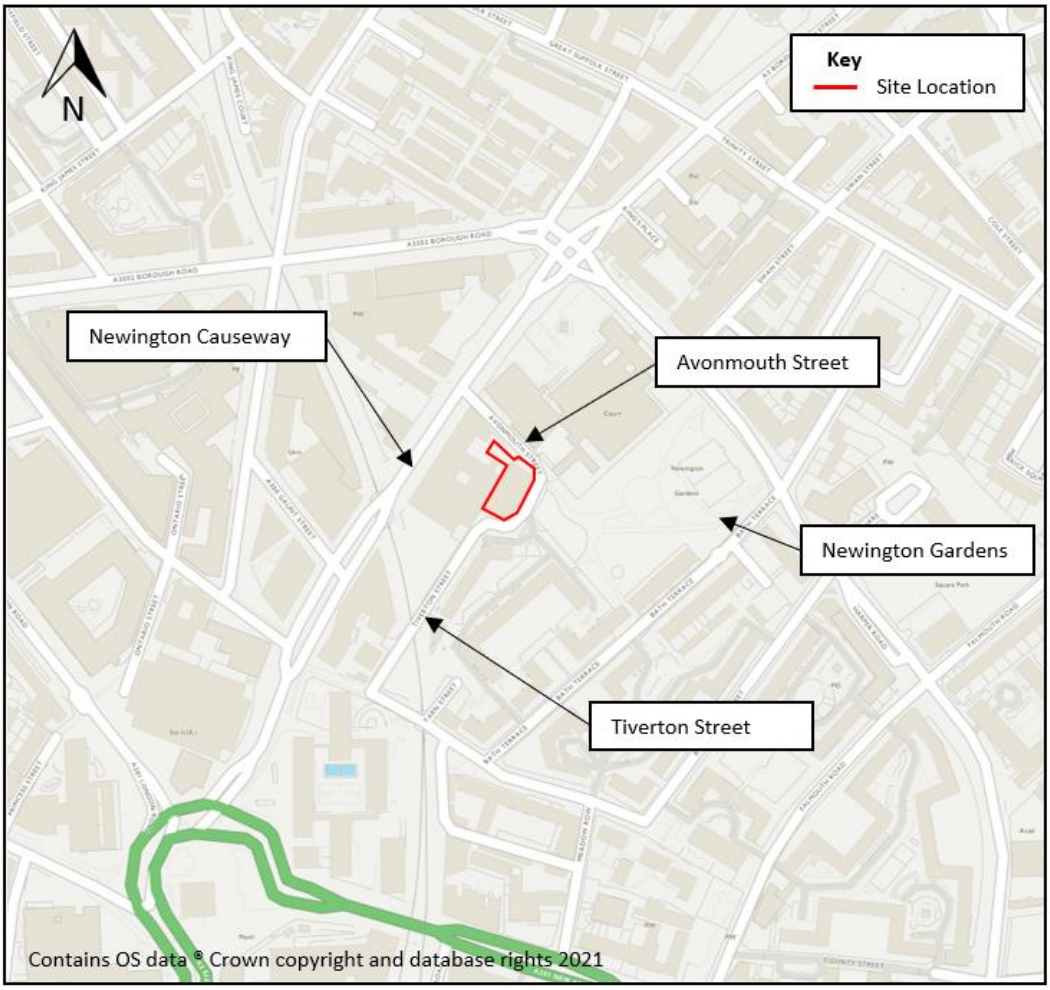


Figure 2-1: Site Location Plan (Openstreetmap.co.uk)

2.2. The Site is currently occupied by a two-storey office building. It is located east of Newington Causeway and is bound by Avonmouth Street and Tiverton Street. The Site is located approximately 1.2km south of the River Thames as shown on **Figure 2-1**. The Site is currently 100% impermeable.

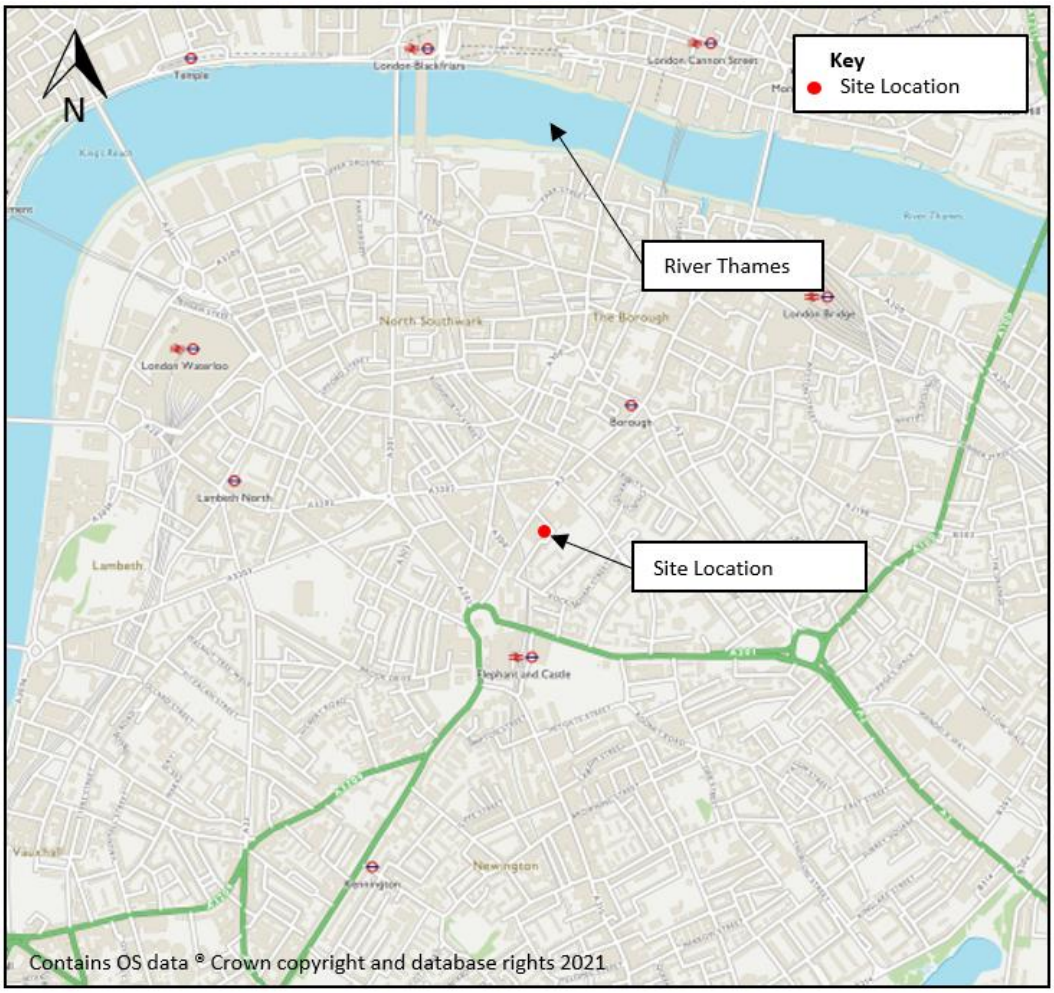


Figure 2-2: Site Location Plan (Openstreetmap.co.uk)

Development Proposals

2.3. The scheme proposals comprise the demolition of the existing 2 storey office building to allow the construction of a tiered 16-storey mixed use building with 233 student accommodation bedspaces. The basement, ground and first floors will be used as health, educational and employment space.

2.4. There are also plans for a new 'pocket park' in front of the building at the end of Tiverton Street and communal gardens on the rooftop terrace (170sqm) on the 7-storey element of the Site.

2.5. The proposed site layout plans can be found at **Appendix A**, and an extract of the ground floor plan in **Figure 2-3** below.

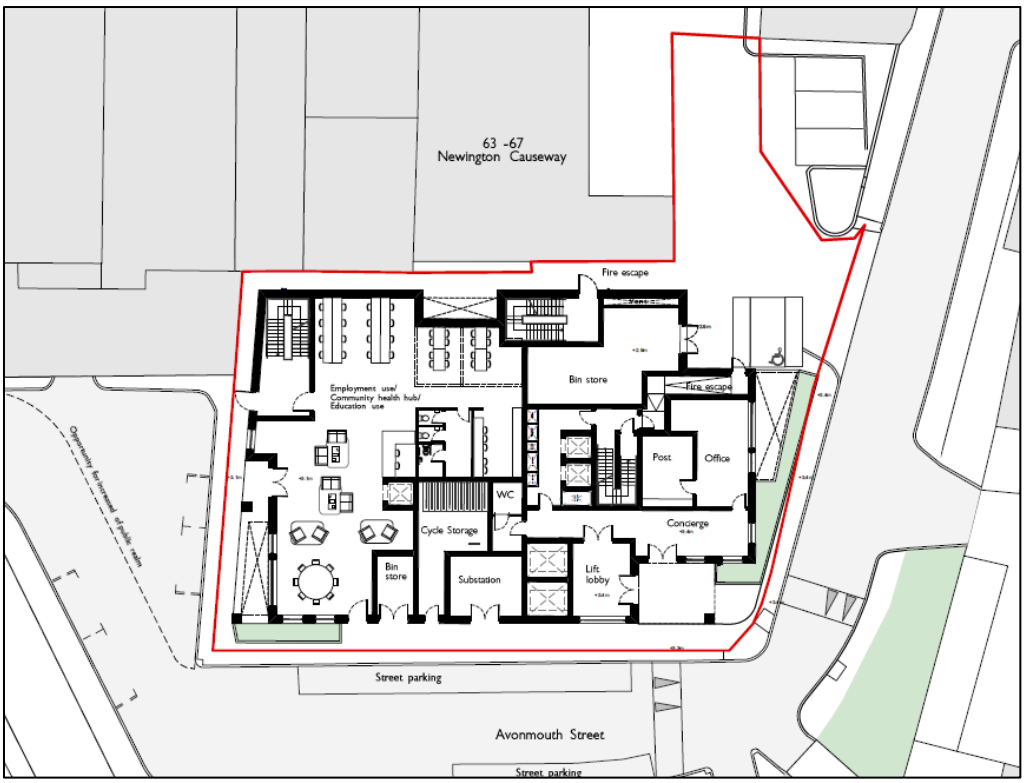


Figure 2-3 Proposed Development (Ground Floor)

2.6. The development is classified as having an overall 'More Vulnerable' land use within the NPPF.

Topography

2.7. A topographical survey was carried out by LRM Survey Services Ltd. in May 2021 and is included in **Appendix B**.

2.8. Avonmouth Street north of the Site has the highest elevations at around 3.3mAOD. The road slopes gently south-east to 2.8m AOD where it meets Tiverton Street. The lowest point is in the car park where Site levels are 2.6mAOD.

Hydrology

2.9. The nearest watercourse is the tidal River Thames located approximately 1.2km north-east of the Site. There are no other main rivers in the borough, with other drainage networks historically being incorporated into the sewer network.

Ground conditions

2.10. Using data from the British Geological Survey (BGS) as displayed in **Figures 2-4 and 2-5** below, the Site is shown to be underlain by the London Clay Formation (Clay and Silt) bedrock, overlain by Kempton Park Gravel Member (Sand and Gravel) superficial deposits.

2.11. Borehole records (TQ37NW2048) show underneath the top layers of concrete and fill (bricks, concrete and rubble) there is medium dense sandy gravel and below this firm and stiff clay with no record of groundwater being hit. The Site is also underlain by made ground. See **Appendix C** for borehole records.

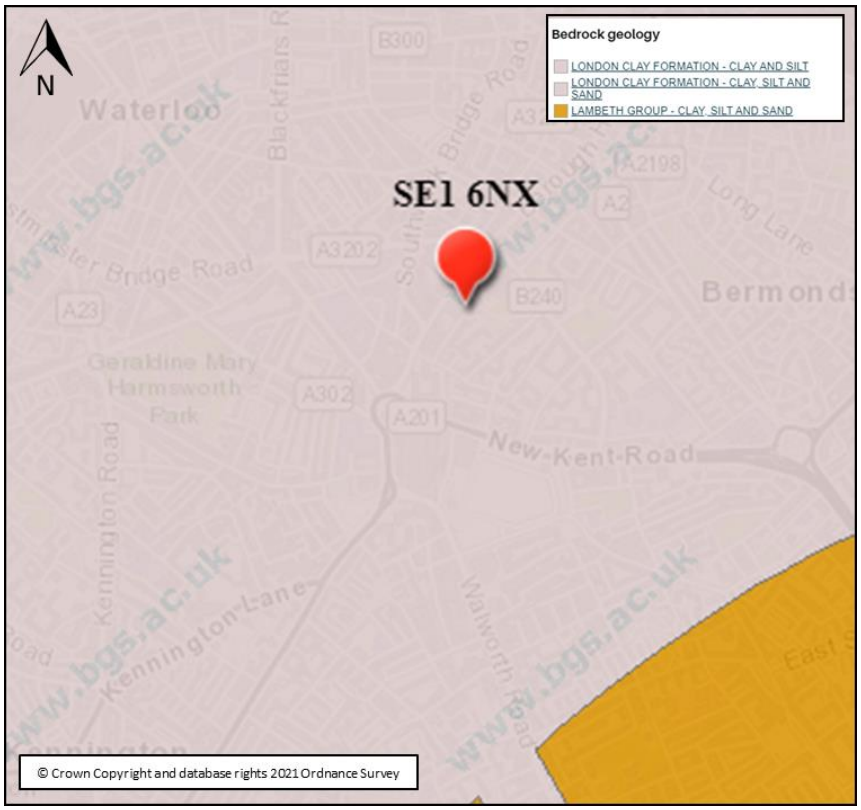


Figure 2-4: BGS Geology Maps (Bedrock Geology)

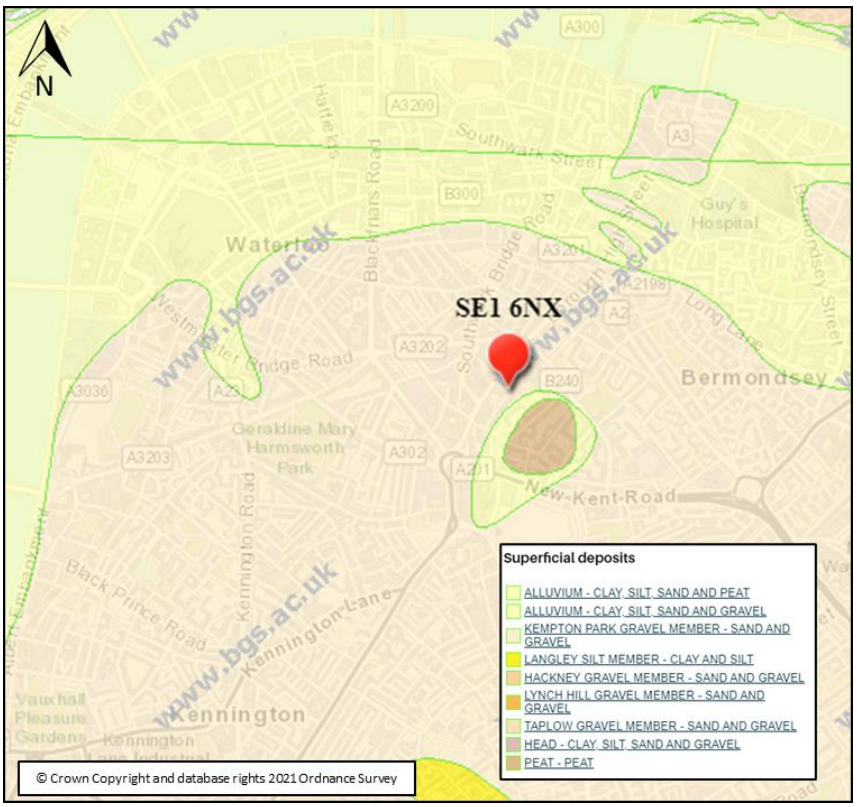


Figure 2-5: BGS Geology Maps (Superficial Geology)

2.12. The Department for the Environment, Food and Rural Affairs (Defra) mapping indicates the Site is not located within a Source Protection Zone.

Existing Sewer Infrastructure

2.13. An extract of Thames Water sewer records is provided in **Figure 2-6** below. A full copy of the plan is included in **Appendix D**.

2.14. The plan shows combined sewers run along Avonmouth Street and Newington causeway, surrounding the property, with foul water drainage directly from the Site. It is proposed to drain both the foul and surface water to the existing combined network.

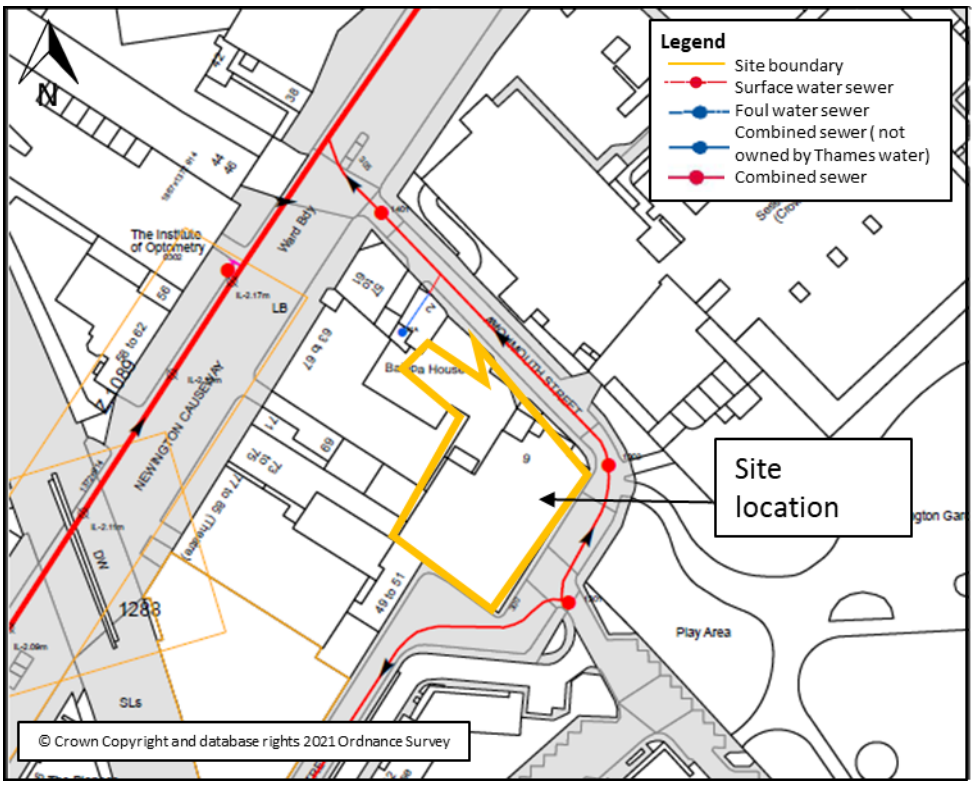


Figure 2-6: Extract of Thames Water Sewer Records

3. POLICY CONTEXT

National Planning Policy Framework

3.1. The National Planning Policy Framework (NPPF) was updated in July 2021; paragraphs 159 to 169 inclusive, establish the Planning Policy relating to flood risk management. The Technical Guide to the NPPF was superseded by the Planning Practice Guidance (PPG) in March 2014.

3.2. The main focus of the policy is to direct development towards areas of the lowest practicable flood risk and to ensure that all development is safe, without increasing flood risk elsewhere. The main considerations are:

a) applying the sequential test and then, if necessary, the exception test as set out below;

b) safeguarding land from development that is required, or likely to be required, for current or future flood management;

c) using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques); and

d) where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

Flood and Water Management Act (2010)

3.3. The Flood and Water Management Act places a duty on all flood risk management authorities to co-operate with each other. The act also provides lead local flood authorities and the Environment Agency with a power to request information required in connection with their flood risk management functions.

Sustainable Drainage Systems - Non-statutory technical standards for sustainable drainage systems March 2015

3.4. The Non-statutory technical standards for sustainable drainage systems were published in March 2015. This document sets out non-statutory technical standards for sustainable drainage systems. They should be used in conjunction with the Planning Practice Guidance. In addition, the Best Practice Guidance for the Non statutory technical standards was published in July 2015 by the Local Authority SuDS Officer Organisation (LASOO).

3.5. The Local Planning Authority (LPA) may set local requirements for planning permission that have the effect of more stringent requirements than these non-statutory technical standards.

3.6. In addition, SuDS should be designed in accordance with CIRIA 753 "The SuDS Manual", which represents current best practice.

The London Plan & Supplementary Planning Guidance (March 2021)

3.7. London Plan Policy SI 12 'Flood risk management' outlines the mayor's approach to flood risk management stating that '*Current and expected flood risk from all sources (as defined in paragraph 9.2.12) across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers and infrastructure providers.*'

3.8. London Plan Policy SI 'Sustainable drainage' outlines the mayor's approach to sustainable drainage, stating that:

- '*Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy: 1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation) 2) rainwater infiltration to ground at or close to source 3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens) 4)*

rainwater discharge direct to a watercourse (unless not appropriate) 5) controlled rainwater discharge to a surface water sewer or drain 6) controlled rainwater discharge to a combined sewer.

- *Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.*
- *Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.*

Thames Estuary 2100 Plan

3.9. The Thames Estuary 2100 Plan (TE2100) was published by the EA in November 2012 and last updated February 2021. It sets out recommendations for flood risk management for London and the Thames estuary as flood risk increases over time. Action Zone 2, the largest developed area within the Thames Estuary in Central London (Wandsworth to Deptford & London City), is where the Site resides. The recommended policy for the area is to take further action to reduce flood risk beyond that required to keep pace with climate change.

London Borough of Southwark Preliminary Flood Risk Assessment

3.10. A Preliminary Flood Risk Assessment (PFRA) was completed by URS/Scott Wilson for the London Borough of Southwark in June 2011.

3.11. A Preliminary Flood Risk Assessment (PFRA) is a high-level screening exercise to identify areas of significant flood risk (from pluvial, ordinary watercourse, groundwater and sewers) within a given study area. The PFRA involves collecting information on past (historic) and future (potential) floods, assembling the information into a PFRA report with supplemental Annexes, and identifying Flood Risk Areas.

3.12. The primary driver behind the PFRA is the Flood Risk Regulations 2009, which came into law on the 10th December 2009 and seek to transpose the EC Floods Directive (Directive 2007/60/EC on the assessment and management of flood risks) into domestic law in England and Wales and to implement its provisions.

3.13. The purpose of the PFRA report under the Regulations is to provide the evidence for identifying areas susceptible to surface water flood risk. The report will also provide a useful reference point for all local flood risk management and inform local flood risk strategies.

London Borough of Southwark Strategic Flood Risk Assessment

3.14. A Strategic Flood Risk Assessment (SFRA) was completed by AECOM on behalf of the London Borough of Southwark in January 2017.

3.15. The greatest risk to property and life for flooding within LBS is from tidal activity in the River Thames. However, the Borough is currently protected from combined tidal and fluvial flooding by the River Thames Tidal Defences (TTD) up to the 1 in 1000 year event.

3.16. The primary objective of the SFRA is to inform the revision of flooding policies, including the allocation of land for future development, within the emerging Local Plan. The SFRA can also enable the London Borough of Southwark to:

- Determine the variations in risk from all sources of flooding across the Borough;
- Prepare broad policies for the management of flood risk;
- Steer development towards areas of lowest flood risk, through application of the Sequential Test and where necessary the Exception Test;
- Assist the decision making process on flood risk issues;
- Consider opportunities to reduce flood risk to existing communities and developments through better management of surface water, provision for conveyance and of storage for flood water;

- Identify the level of detail required for site-specific Flood Risk Assessments; and
- Determine the acceptability of flood risk in relation to emergency planning capability.

3.17. The SFRA suggests the following measures to be used in development areas behind flood defences in order to promote good practice and encourage sustainable development:

- Redevelopment must ensure that sites within areas of residual flood risk are designed to be flood compatible and/or flood resilient and maximise the use of open spaces within these developments to make space for water during times of flooding. It states that opportunities should be sought to identify a safe route for any exceedance flow of floodwaters and a suitable storage or discharge location to avoid any risk to people; and
- Identify opportunities to create space for water and flooding through appropriate location, layout and design of development, in order to accommodate climate change and assist in managing future flood risk. This can be achieved by restoring floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for storage.

3.18. The SFRA suggests the following possible risk reduction measures for consideration:

- Single storey residential development should not be considered in high flood risk areas as they offer no opportunity for safe refuge.
- No residential dwellings would be permitted at basement level.
- Residual flood risk should be managed through emergency planning, site design and protection measures. The key residual flood risks within Southwark are overtopping or breach from the River Thames.
- Where development within flood risk areas is necessary due to wider sustainability/regeneration objectives, flood resistance

and resilience practices should be followed in the construction and operation of the buildings to minimise the impact of flooding.

- All residential floor levels should be situated a minimum of 300mm above the Maximum Likely Water Level, anticipated through a breach of the River Thames defences. Potential access and egress routes should also be considered and recommendations for appropriate actions for future occupants in the event of a breach occurring.
- Flood risk from all sources should be considered when identifying the perceived level of flood risk affecting the Site.
- Opportunities should be taken to identify sites where developer contributions could be used to fund future flood risk management schemes, improvements to surface water drainage systems or flood defences in adjacent areas. However, it should be noted that developer installed defences should not wholly justify development in locations with inappropriate levels of flood risk; and
- If greenfield runoff rates cannot be achieved due to site constraints, contribution to off-site solutions to reduce surface water flooding in the local areas could be taken into consideration.

London Borough of Southwark Surface Water Management Plan

3.19. A Surface Water Management Plan (SWMP) was carried out by URS Scott Wilson & Capita Symonds on behalf of the London Borough of Southwark and completed in August 2011.

3.20. In the context of SWMPs, surface water flooding incorporates flooding from sewers, drains, groundwater, and runoff from land, small watercourses (often referred to as ordinary watercourses) and ditches occurring as a result of heavy rainfall. These sources may operate independently or through a more complex interaction of several sources.

3.21. As part of this assessment, Local Flood Risk Zones (LFRZs) were identified where flooding affects houses, businesses and/or infrastructure. Those areas identified to be at more significant risk were delineated into 5 Critical Drainage Areas (CDAs) representing one or several LFRZs as well as the contributing catchment area and features that influence the predicted flood extent (refer to **Figure 3-1** below). The Site is not located in a critical drainage area.

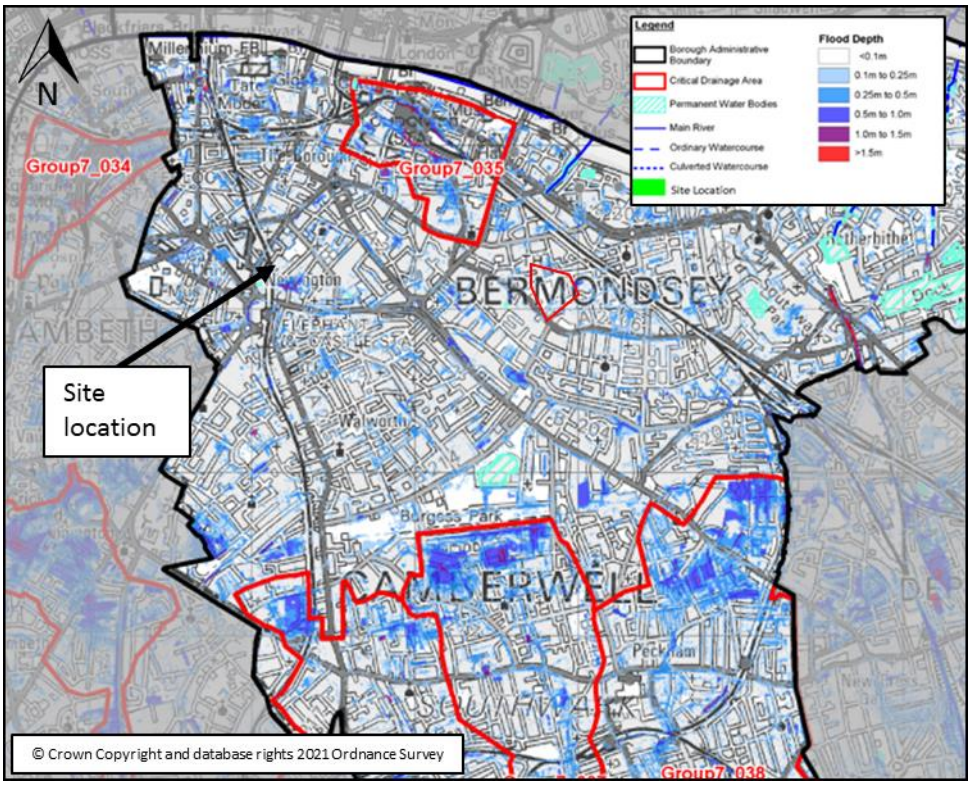


Figure 3-1: SWMP Surface Water Depth 1 in 100 + Climate Change – Critical Drainage Areas (Figure D-13)

London Borough of Southwark Local Flood Risk Management Strategy

3.22. A Flood Risk Management Strategy (FRMS) was carried out by the London Borough of Southwark and completed in August 2015. It was produced as a requirement of the Flood Risk Regulations 2009 and by the Flood and Water Management Act 2010, to help understand and manage flood risk within the Borough.

3.23. As the Lead Local Flood Authority (LLFA), Southwark Council has provided the Strategy which formalises the longer-term flood risk management priorities lead and co-ordinates local flood risk management in Southwark; namely the flood risk arising from surface water runoff, groundwater and small watercourses and ditches.

Sequential Test

3.24. The aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test. The sequential approach should be used in areas known to be at risk now or in the future from any form of flooding.

3.25. Table 2 (Flood risk vulnerability classification) of the Planning Practice Guidance (PPG) classes the residential use as More Vulnerable. As the entire Site is shown to be within Flood Zone 3 of the Environment Agency mapping, it may have been a requirement for the Sequential Test to be undertaken in consultation with the Local Planning Authority.

Exception Test

3.26. Table 3 (refer to **Figure 3-2** below) of the PPG indicates that the Exception Test is required to be undertaken for "More Vulnerable" uses in Flood Zone 3a.

Flood risk vulnerability classification (see table 2)		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood zone (see table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	×	Exception Test required	✓
	Zone 3b functional floodplain	Exception Test required	✓	×	×	×

Key: ✓ Development is appropriate.
× Development should not be permitted.

Figure 3-2: Extract of NPPF Table 3 Flood Risk Vulnerability

3.27. For the Exception Test to be passed:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; 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.

3.28. This Flood Risk Assessment forms the second part of the Exception Test and aims to 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.

4. SOURCES OF FLOODING

4.1. The NPPF requires flood risk from the following sources to be assessed, each of which are assessed separately below:

- Fluvial sources (river flooding);
- Tidal sources (flooding from the sea);
- Groundwater sources;
- Pluvial sources (flooding resulting from overland flows);
- Sewer Flooding;
- Artificial sources, canals, reservoirs etc.; and,
- It also requires the risk from increases in surface water discharge to be assessed (surface water management).

Tidal Flooding

4.2. The London Borough of Southwark is bordered to the north by the River Thames, which runs from west to east, and constitutes the northern boundary of the Borough for approximately 7 kilometres.

4.3. An extract from the indicative online Flood Zone Map is provided below in **Figure 4-1**. According to the Flood Map for Planning, the Site is located wholly in Fluvial/Tidal Flood Zone 3 associated with the River Thames.

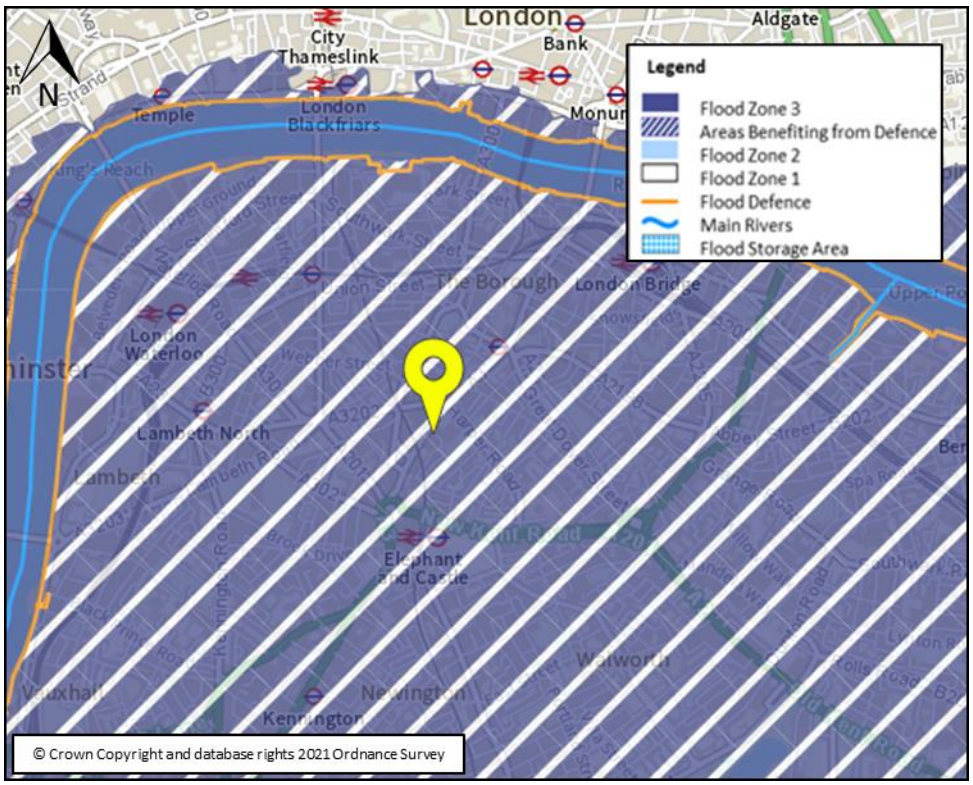


Figure 4-1: EA Flood Zone Map

4.4. **Figure 4-1** shows that the Site is located in a defended Flood Zone 3, protected by the Thames Barrier and Thames tidal walls. The defences are all raised, man-made and privately owned. It is the riparian owners' responsibility to ensure they are maintained to a crest level of 5.23 m AOD (the Statutory Flood Defence Level in this reach of the Thames). The Environment Agency inspects them twice a year to ensure that they remain fit for purpose.

4.5. LBS is protected from combined tidal and fluvial flooding by the River Thames Tidal Defences (TTD), up to the 1 in 1000-year event, therefore the risk of flooding is seen to be residual, and the Site is at low risk of tidal flooding.

Residual Tidal Flood Risk

4.6. Whilst the Site is defended against flooding from the River Thames, there remains a residual risk of failure of these defences and therefore, it is essential that planning decisions are taken with due consideration to the scale (and variability) of this risk.

4.7. Environment Agency Mapping has confirmed that the Site falls within the extents of their Thames Tidal Upriver Breach Inundation Modelling 2017 and therefore the Site would be at risk of flooding as a result of a breach of the flood defences as illustrated in **Figure 4-2**. Modelling shows that the Maximum Likely Water Level (MLWL) in this location in the event of a breach would be 3.4m AOD.

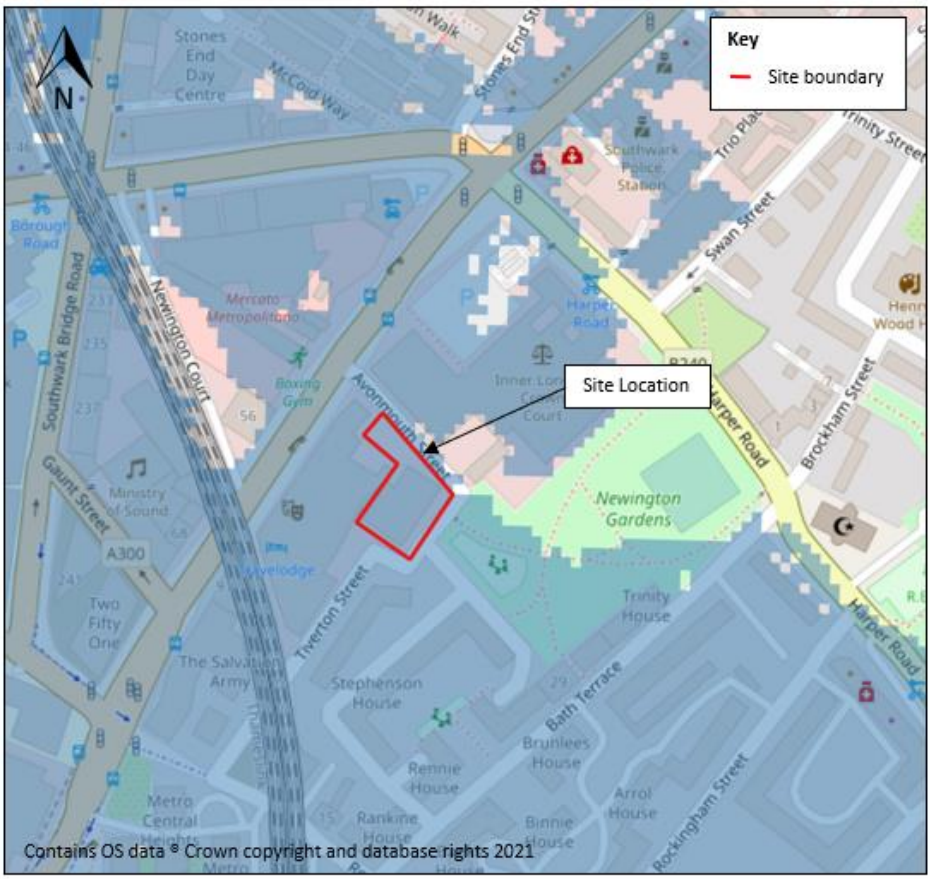


Figure 4-2: EA Modelling Flood Outlines

4.8. Sleeping accommodation should be set 300mm above the MLWL breach level. As the Site is only at risk during a breach, there is no need to limit the built footprint. Therefore, sleeping accommodation should be set at a minimum level of 3.70m AOD (3.4m AOD + 300mm). Residential use starts on the second floor so overall risk is low.

4.9. As the Site is located within the breach flood extents, there would be constraints on Finished Floor Levels. However, it should be noted that

'more vulnerable' uses are located on the second-floor level and above, with only 'less vulnerable' uses being located at ground, first floor, and basement level.

4.10. Based on the above, the Site is considered to be at high risk from the residual risk associated to a breach of the Thames Tidal Defences.

Fluvial Flooding

4.11. The River Thames, which is tidally dominated, is the only main watercourse or river within the vicinity of the Site.

4.12. The Thames Estuary Plan (2021) states fluvial flooding from the Thames is unlikely to be a problem for this policy unit where the Site resides because fluvial flood levels would not overtop the defences.

4.13. Therefore, the Site is assessed as having a low risk of fluvial flooding.

Groundwater Flooding

4.14. Map A5 of the SFRA 'Areas at Risk of Flooding from Groundwater' indicates that the Site has potential for groundwater flooding to occur at the surface. Refer to **Figure 4-3** below.

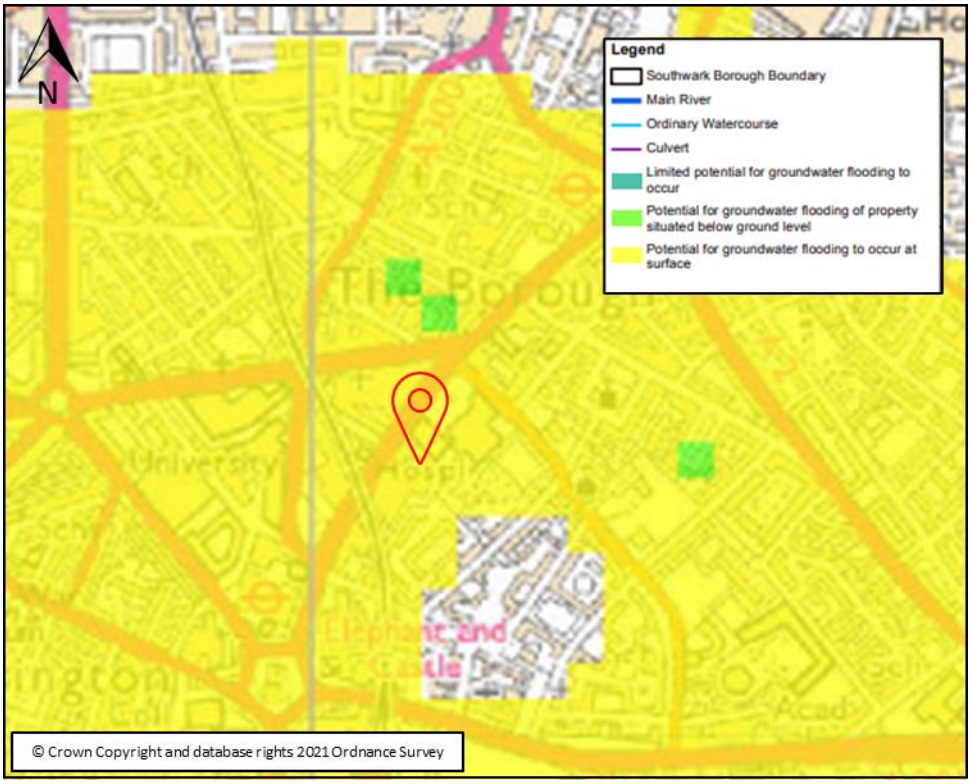


Figure 4-3: EA Flood Map for Ground Water

4.15. Referring to **Figure 4-3** you can see the superficial deposits at the Site are permeable (sand and gravel) and those connecting it to the Thames estuary floodplain are also permeable (sand, gravel and clay). The site is considered to be at medium risk of groundwater flooding.

Pluvial Flooding

4.16. The EA's Flood Map for Surface Water indicates that the Site is generally at 'Very Low' risk of surface water flooding. The car park in the centre north of the Site is 'Low Risk' as well as south of the Site where it meets Tiverton Street. Newington causeway has areas near the Site of 'Medium' and 'High' risk (between 1-3.3%), refer to **Figure 4-4** below.

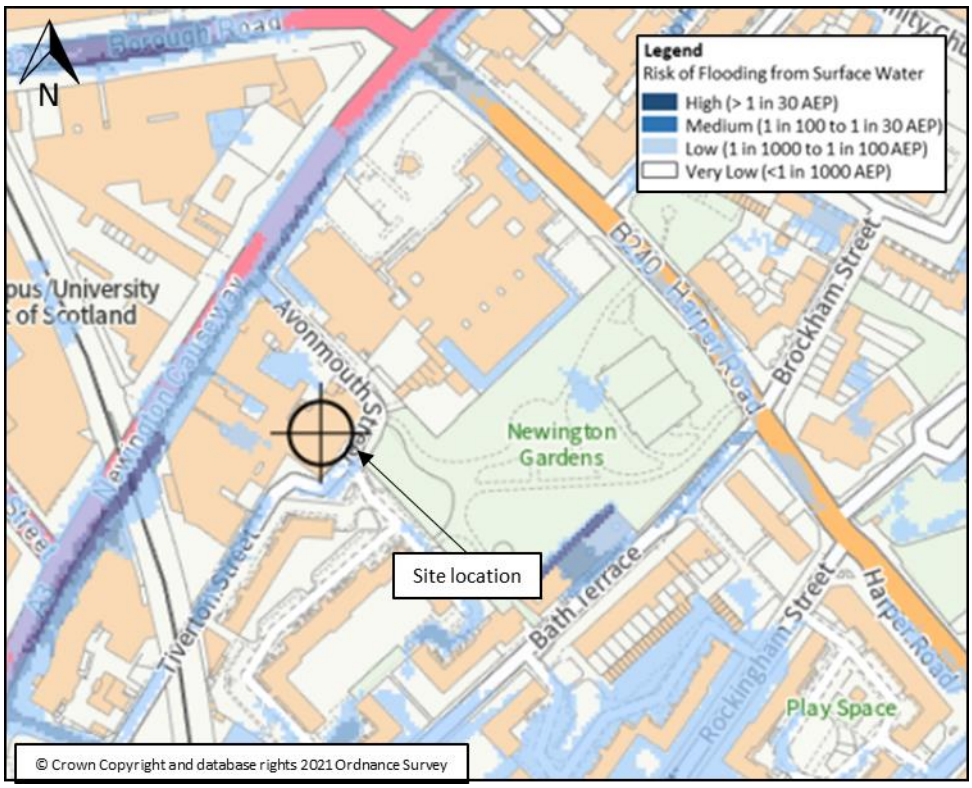


Figure 4-4: EA Flood Map for Surface Water

4.17. The LBS as part of its SFRA has ensured all new developments incorporate SuDS into their designs to help reduce run off in the borough. The Site does not fall into a Critical Drainage Areas as outlined in the SFRA.

4.18. Based on the EA surface water flood risk map: water depth in a medium risk scenario, the maximum predicted depth of flooding along Newington Causeway to the west of the Site is below 300mm for a 1 in 100 year event. The flood extents are contained within the central portion of the road as shown on **Figure 4-5** below.

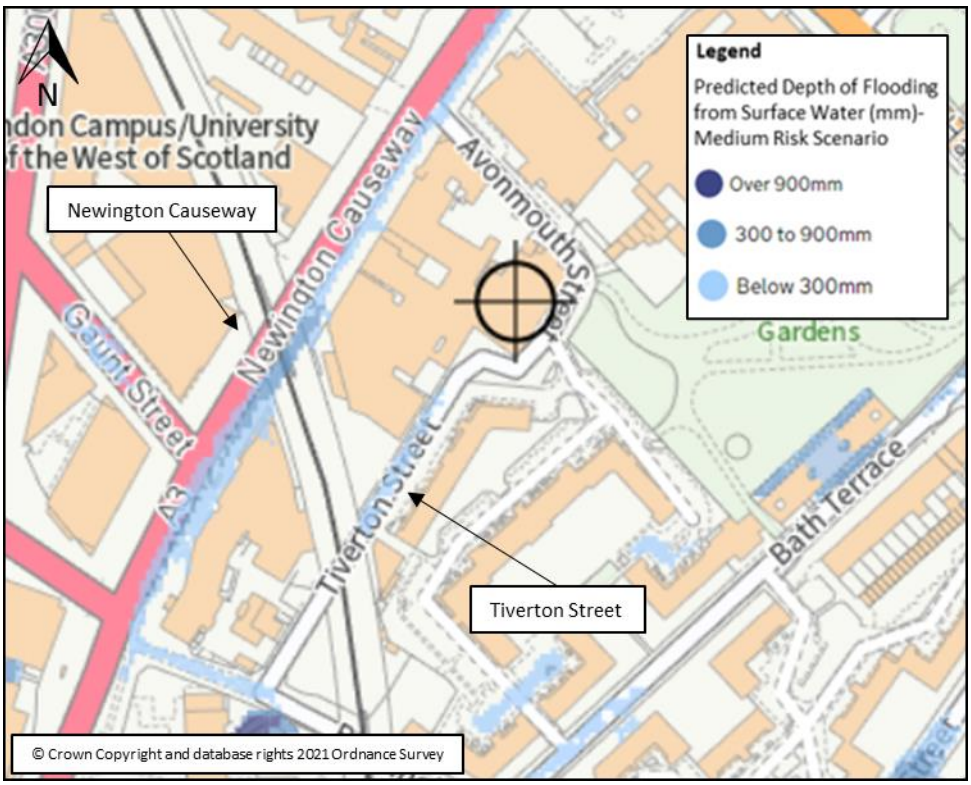


Figure 4-5: EA Flood Map for Surface Water: Predicted flood depths for the medium risk scenario (1 in 100 year event)

4.19. The risk of pluvial flooding to the Site is assessed as very low. The development of the Site will bring improvements to the surrounding area through the implementation of a surface water drainage strategy, as described in **Section 5** of this report.

Sewer Flooding

4.20. According to Map A2 'Flooding History' of the SFRA, which includes records of historical flooding based on DG5 Records, there has been no properties flooded by overloaded sewers around the Site.

4.21. The proposed drainage strategy as described in **Section 6** of this report, has been designed to accommodate rainfall volumes up to the 1 in 100 year plus 40% climate change and will therefore provide an improvement upon the current scenario.

Artificial Sources

4.22. The Environment Agency's flood maps from reservoirs indicate that the Site is not within an area at risk of flooding from reservoirs, canals or other artificial water bodies.

4.23. The risk to the Site from reservoir flooding is therefore considered to be very low.

5. FLOOD RISK MANAGEMENT

5.1. This site-specific flood risk assessment aims to 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.

Finished Floor Levels

5.2. The Site is located in Tidal Flood Zone 3, an 'Area Benefitting from Defences', due to the presence of defence assets on the River Thames. Therefore, there is a residual risk of flooding at the Site in the event these defences are breached or overtopped.

5.3. As the Site is in an area of tidal residual flood risk, it would be necessary to ensure all 'More Vulnerable' uses are located 300mm above the breach level (including consideration of climate change) in line with the Southwark SFRA.

5.4. Environment Agency Tidal Inundation Mapping shows that the breach Maximum Likely Water Level (MLWL) in this location is 3.4m AOD. All sleeping accommodation would therefore be required to be placed at or above 3.7m AOD.

5.5. The site proposals show that living accommodation is situated on the second floor and above, with commercial uses in the basement, ground and first floors. As such, the 'more vulnerable' uses of the building are located above the tidal breach level.

5.6. The development proposals also include basements. According to the SFRA, basement access threshold levels should be raised above the 1 in 100 year flood level with climate change, and all basements must include provision of internal staircases to upper floors.

Safe Access and Egress

5.7. Safe access and egress are required to enable the evacuation of people from the development and provide the emergency services with access to the development during times of flood.

5.8. Safe refuge is available for residents at higher levels above the breach flood level. Access to the upper floors from the basement and commercial area, which are above the tidal breach level, is provided which will act as safe refuge during an extreme flood event. However, the instructions of the Emergency Services on the day of an event are to be followed.

Flood Response Plan (FRP)

5.9. In the event of a breach, it is important to ensure that warning systems are in place and responsibility is assigned to be able to quickly deal with a flood event. The flood response plan outlines the flood warnings, responsibilities and safe access and egress routes from the Site. However, the advice of the emergency services should be taken on the day. Refer to **Appendix E** for the Flood Response Plan.

Flood Resistance and Resilience

5.10. It is recommended that any development proposed below the Maximum Likely Water Level should incorporate flood resistance and/or resilience construction methods to minimise the potential damage that could be caused by flooding.

5.11. Buildings will be designed with resilient materials, with the ability to withstand hydro-static and hydro-dynamic forces on any proposed supports. All electrical, service and ventilation entry points should be located as high as reasonably practicable.

5.12. In areas at risk of frequent or prolonged flooding, the following flood resilience measures should be implemented:

- Use materials with either, good drying and cleaning properties, or sacrificial materials that can easily be replaced post-flood;
- Design for water to drain away after flooding;
- Design access to all spaces to permit drying and cleaning;
- Raise the level of electrical wiring, appliances and utility metres as high as reasonably practicable;

- Coat walls with internal cement based renders; apply tanking on the inside of all internal walls;
- Ground supported floors with concrete slabs coated with impermeable membrane; and
- Use plastic water resistant internal doors.

5.13. The following flood resistance measures could be implemented where appropriate/ feasible up to a flood depth of 600mm:

- Using materials and construction with low permeability;
- Flood doors and gates with waterproof seals.

6. FOUL AND SURFACE WATER DRAINAGE STRATEGY

6.1. The London Borough of Southwark Sustainable Drainage Proforma has been included in **Appendix F**.

6.2. DEFRA's Non-statutory technical guidance for Sustainable Drainage Systems and CIRIA Guidance C753 "The SuDS Manual" have been used to determine the appropriate SuDS Strategy, which considers the spatial and environmental constraints of the Site.

6.3. Under the NPPF an allowance of 40% for the effects of climate change will achieve the policy requirements for the proposed development.

Proposed Sustainable Drainage Systems (SuDS)

6.4. Based on the Policy SI 13 (B) of the London Plan, surface water runoff should be disposed of according to the following hierarchy:

1. Store rainwater for later use (for example rainwater harvesting, blue roofs for irrigation);
2. Use infiltration techniques, such as porous surfaces in non-clay areas;
3. Rainwater attenuation in green infrastructure features for gradual release;
4. Discharge rainwater direct to a watercourse;
5. Controlled discharge to a surface water sewer/drain; and
6. Controlled discharge to the combined sewer.

6.5. As discussed in **Section 2**, BGS data indicates that the Site bedrock deposits consist of the London Clay Formation (Clay and Silt) and superficial deposits the Kempton Park Gravel Member (Sand and Gravel). Borehole records show the site to have concrete, brick and rubble on top of Sand, Gravel and sandy gravel.

6.6. Although the ground conditions may allow for infiltration, the use of infiltration systems for the disposal of surface water on the Site has been discarded due to the underlying ground conditions (clay) and risk of mobilising pollutants (present in the Made Ground) into the underlying aquifer from the site and the potential for groundwater flooding to occur in the vicinity of the site.

6.7. There are no watercourses in the vicinity of the Site. It is therefore proposed to discharge surface water runoff into the combined sewer along Avonmouth Street.

6.8. The constraints and opportunities for the use of SuDS techniques are appraised using the Management Train approach outlined in CIRIA C753 'The SuDS Manual' in **Table 6-1** below.

Table 6-1: Existing and Proposed Areas

Type:	**Infiltration Devices** (Source Control)
Constraints:	Limited space for infiltration systems (and provision of 5m buffer from buildings) due to narrow site surrounded by buildings. Unsuitable geology. The Site is underlain by layers of clay stratum. The Site is also a brownfield site (commercial use) and therefore the use of infiltration techniques would carry the risk of mobilising pollutants into the soil.
Opportunities:	Limited due to ground conditions and site layout
Type:	**Lined Permeable Paving** (Source Control)
Constraints:	It is not possible to provide infiltrating permeable paving/permavoid due to site characteristics (as per infiltration devices above).
Opportunities:	Permeable paving wrapped in geo-membrane could be used to provide surface water attenuation and a stage of treatment before discharging into the drainage system.
Type:	**Rainwater Harvesting** (Source Control)
Constraints:	The benefits of rainwater harvesting on a specific design storm event cannot be quantified, due to the seasonal availability of storage within the structure.
Opportunities:	Opportunities in amenity areas to provide harvesting features such as rain gardens, raised planters and water butts exist. However, it is difficult to quantify contribution, and therefore not included within calculations as part of this surface water management strategy
Type:	**Swales, etc.** (Permeable Conveyance)
Constraints:	In order to provide practicable attenuation benefits 1:3 side-slope swales tend to require a significant land requirement.
Opportunities:	None due to spatial constraints.
Type:	**Tree Pits/Rain gardens**
Constraints:	Subject to Landscape Architect's design.
Opportunities:	There may be opportunities to use landscaped space to incorporate tree pits.
Type:	**Green Roofs**
Constraints:	Subject to Architect's design.
Opportunities:	Compatible with type of development: Green Roofs are proposed as part of the development.
Type:	**Attenuation Tanks** (end of pipe treatment)
Constraints:	None
Opportunities:	Should additional attenuation be required this could be achieved by use of oversized sewers or geo-cellular storage attenuation.

6.9. After consideration of the CIRIA C753 SuDS Management Train approach, the most viable SuDS options for this site is a solution

combining green roofs, permeable paving and geocellular storage. Refer to Drawing **No. 2102760-001** in **Appendix G** for the proposed surface water drainage strategy.

Existing and Proposed Surface Water Discharge Rates

Existing development

6.10. The planning red line boundary area equates to 0.116 ha and comprises entirely of impermeable surfaces with the exclusion of some small, planted areas that have not been considered in this assessment.

6.11. The topographical survey shows a number of gullies and inspection chambers serving the northern portion of the Site; the outfall of this system is currently unknown and should be investigated on site. Based on site levels, surface water runoff from this plot would currently fall towards southwest corner of the Site and most likely enter the public combined sewer along Avonmouth Street.

6.12. Existing runoff rates from the site were determined using the Wallingford Procedure Rational Method for an assumed critical 5-minute storm. Equivalent peak Greenfield Runoff rates for the site were also calculated and are presented in **Table 6-2** below. Full calculations can be found in **Appendix H**.

Table 6-2: Existing and Greenfield Discharge rates

Return Period Event	Brownfield (l/s)	Greenfield (l/s)
Q_1	16.38	0.4
Q_{30}	36.45	1.0
Q_{100}	46.40	1.4
Q_{bar}	-	0.4

6.13. In line with the Policy 69 of the New Southwark Plan, discharge rates from new developments should be restricted to greenfield rates or as close as practically possible. The London Plan also states that "development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible."

6.14. However, greenfield runoff rates for the site (shown in **Table 6-2** above) are too low to be practically achieved and would introduce a risk of flooding due to potential for blockages in the flow control device. It is therefore proposed to limit discharge to 2 l/s to mitigate the risk of blockages.

6.15. A pre-planning application has been submitted to Thames Water and confirmation has been received that the existing sewerage network has sufficient capacity to accommodate the proposed surface water discharge from the proposed development. This is included in **Appendix I.**

Proposed development

6.16. The development proposes to include circa 205m^2 green roofs at roof level which will provide inception storage, increasing the time taken for run-off to enter the drainage system.

6.17. Surface water runoff from the roof would be reduced by a maximum of 20% as a result of the green roofs and amenities. This is in accord with the GRO Green Roof Code (GRO, 2011) and the Guidance for the Planning, Execution and Upkeep of Green roof Site (FFL, 2002). Therefore 20% of the green roof, amenity gardens and grassed areas will be considered permeable, equal to 41m^2. This has not been included in the preliminary calculations however comparisons between the existing and proposed hardstanding areas including and excluding green roofs are shown in **Table 6-3** and

6.19. Table 6-4 below.

Table 6-3: Existing and proposed hardstanding areas

Existing hardstanding (ha)	Proposed hardstanding (ha) (excluding green roofs)	% reduction
0.116	0.116	0%

Table 6-4: Existing and proposed hardstanding areas

Existing hardstanding (ha)	Proposed hardstanding (ha) (including green roofs)	% reduction
0.116	0.112	4%

6.20. It is proposed for the site to discharge via an outfall with a restriction of 2l/s per outfall for all events up to and including the 1 in 100 year, allowing for a 40% increase in rainfall intensity to account for climate change. This is due to greenfield runoff rates for the site (shown in **Table 6-2** above) being too low to be practically achieved, potentially introducing a risk of flooding as a result of potential blockages in the flow control device. The total rate of discharge from the Site will therefore be 2l/s. The proposed restriction will result in an 88% to 96% peak flow reduction in comparison with the existing situation.

6.21. In order to achieve the proposed discharge rate of 2l/s per outfall, it is proposed that a total storage volume of approximately 68m³ will be provided within the proposed geocellular storage. **Table 6-5** below demonstrates the significant reduction in surface water discharge rates from the proposed development.

Table 6-5: Existing and Proposed Surface Water Runoff Rates

	Return Period			
	1 in 1 year Discharge Rate	1 in 30 Year Discharge Rate	1 in 100 year Discharge Rate	1 in 100 year + 40% Discharge Rate
Pre Development (l/s)	16.38	36.45	46.40	-
Calculated Greenfield runoff (l/s)	0.4	1.0	1.4	-
Proposed post Development (l/s)	2.0	2.0	2.0	2.0
% Reduction from pre development	88%	95%	96%	-

6.22. An additional 15m^3 storage will also be available within the 0.3m layer of permeable paving and within the green roofs, although this has not been accounted for in the preliminary calculations.

6.23. MicroDrainage modelling results show there is no flooding on the Site for the 1 in 100 year including 40% climate change rainfall event. MicroDrainage modelling results are included in **Appendix J**.

6.24. It is therefore proposed that a combination of green roofs and amenities, lined permeable paving (15m^3) and a geo-cellular attenuation tank (68m^3) will provide sufficient storage volume for the 1 in 100-year storm event including a 40% allowance for climate change. Refer to **Appendix J** for proposed Surface Water calculations.

6.25. Invert and cover levels should be confirmed on-site and the location of and outfall of the existing system should be explored with a CCTV drainage survey at the detailed design stage.

Surface Water Quality

6.26. The recommended stage of treatment in terms of water quality would be provided through the aforementioned green roofs and permeable paving. In line with the SuDS Manual C753, Tables 26.2 and 26.3, the pollution hazard and mitigation indices associated with residential roofs are mitigated by the provision of SuDS features.

6.27. Please refer to **Appendix K** for copies of Tables 26.2 and 26.3, the pollution hazard and mitigation indices.

Long Term Storage

6.28. There will be a reduction of impermeable area as a result providing green amenity spaces and green roofs within the development, and as such the runoff volume generated by the developed area will be reduced. Therefore, there is no requirement for Long Term Storage.

Future Maintenance

6.29. A management company will be appointed to maintain communal areas, landscaping and shared SuDS throughout the development.

6.30. All maintenance will be in accord with the best practices and the CIRIA Manual C753. Please refer to **Appendix K** for an overview of the maintenance tasks required.

Proposed Foul Water Drainage Strategy

6.31. The existing site is currently occupied by a two-storey office building of circa 670m^2 in footprint. Based on the Thames Water Foul Flow Rates Criteria, it is estimated that the existing peak Foul Flow discharged from the site, equates to 0.384l/s. Refer to the Existing Foul Loading Calculations provided in **Appendix L**.

6.32. Based on Thames Water's foul flow loadings, the peak foul flow rate for the proposed development is calculated to be 2.803 l/s.

6.33. It is proposed that foul flows from the development will discharge into Thames Water combined sewers along Avonmouth Street. Refer to the preliminary drainage strategy drawing no. 2102760-001 provided in **Appendix G**.

6.34. The cumulative peak flow rate for the overall post-developed site (combined foul and surface water flows) is therefore 4.670 l/s (2.670 l/s + 2.00 l/s). Considering the existing site peak combined runoff rate is 47.80 l/s (46.40 l/s + 1.4 l/s), the proposals will result in a reduction of combined flows of 90% from the pre-development scenario for the 1 in 100-year event.

6.35. A pre-planning application has been submitted to Thames Water and confirmation has been received that the existing sewerage network has sufficient capacity to accommodate the proposed foul discharge from the proposed development. This is included in **Appendix I.**

7. SUMMARY AND CONCLUSIONS

7.1. Ardent Consulting Engineers has been commissioned by Tribe Avonmouth House Ltd to undertake a Flood Risk Assessment and preliminary foul and surface water drainage strategy, for a proposed development at Avonmouth House, 6 Avonmouth Street, Elephant and Castle within the London Borough of Southwark.

7.2. This FRA considers the current policy relating to flood risk, including the National Planning Policy Framework, the London Plan and the Strategic Flood Risk Assessment for Southwark.

7.3. As the entire Site is shown to be within Flood Zone 3 (defended) of the Environment Agency mapping, and the development is classified as more vulnerable, the development is subject to the sequential and exception tests. This flood risk assessment has demonstrated that the development will be safe for its lifetime taking account of the vulnerability of its users, and would not increase flood risk elsewhere.

7.4. The site defended by the Thames Barrier but is located within the modelled extents of a breach in the defences. The Site has been assessed as having a medium risk of groundwater flooding. Flooding from all other sources is assessed as being very low/low.

7.5. Flood risk management measures have been recommended to ensure that, in line with the NPFF, the site will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere. These include the following:

- Residential accommodation will be located at least 300mm above the MLWL breach level (3.4m AOD+300mm = 3.7mAOD);
- Access to areas above the tidal breach level (3.5m AOD) should be provided as emergency refuge; and
- Flood resistant/resilient construction methods should be implemented.

7.6. The surface water drainage strategy will reduce flood risk by restricting surface water flows in accordance with the London Plan and the London Borough of Southwark requirements. A sustainable urban

drainage system has been designed to incorporate green roofs, permeable paving and a geocellular attenuation tank. Storm water attenuation is provided for all storms up to and including the 1 in 100-year critical event (including a 40% allowance for climate change). The proposed development results in significant betterment over the pre development scenario in terms of a reduction of surface water runoff.

7.7. Foul water would be discharged to the existing Thames Water combined sewer in Avonmouth Street. The proposals will result in an overall reduction in the combined surface and foul water peak flows from the Site.

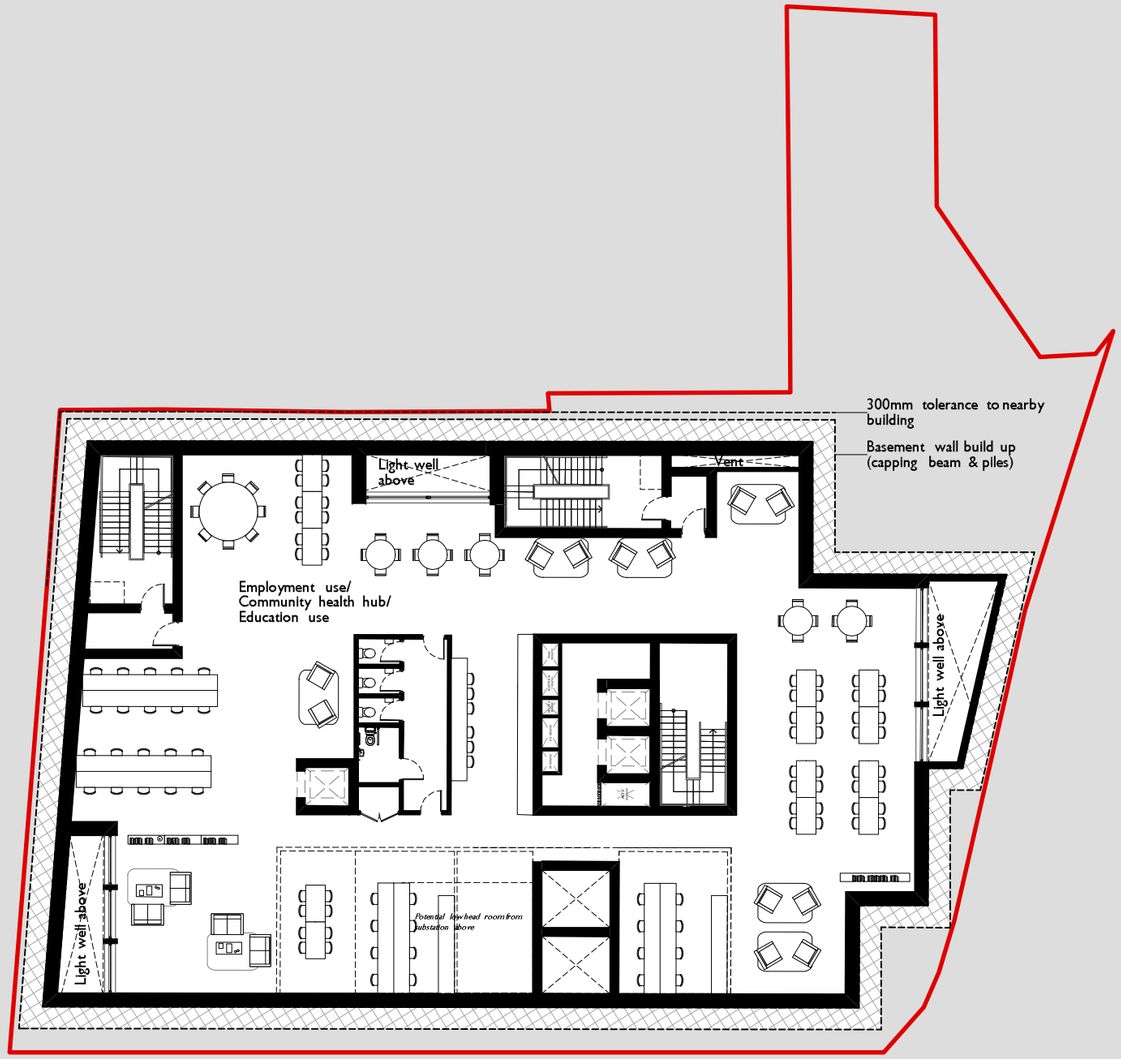
7.8. A pre-planning application has been submitted to Thames Water and confirmation has been received that the existing sewerage network has sufficient capacity to accommodate the proposed surface and foul water discharge from the proposed development

7.9. A management company will be appointed to maintain communal spaces and SuDS throughout the life of development. All maintenance will be in accordance with the best practices and the CIRIA Manual C753.

7.10. In conclusion, this FRA demonstrates that the proposals are consistent with the aims of the NPPF and the Planning Practice Guidance to the NPPF along with the aims of the Strategy Flood Risk Assessment (including the broader strategic planning requirements of Southwark Council). The Site will not be at significant risk of flooding or increase the flood risk to others.

Appendix A

Proposed Layouts



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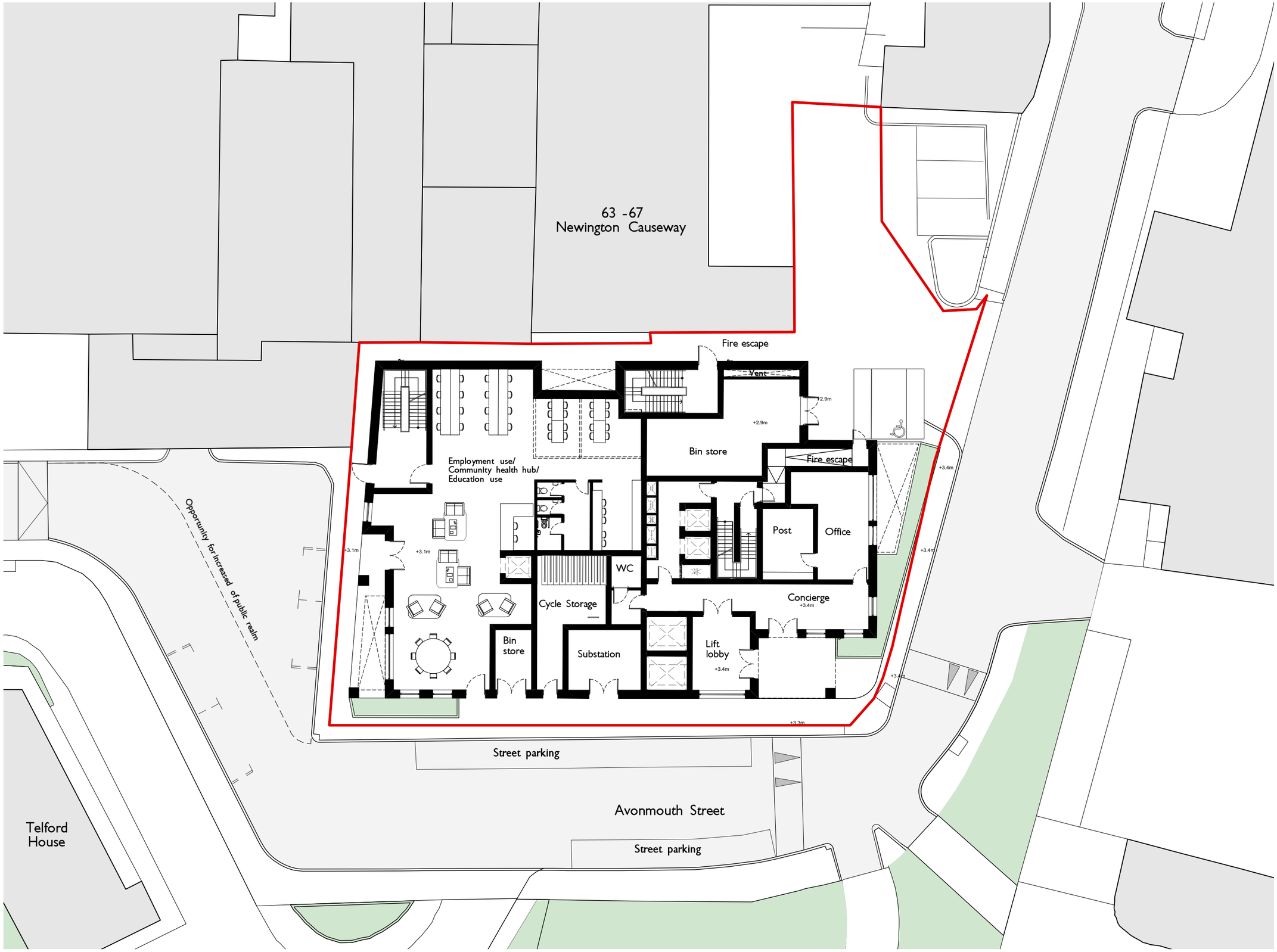
PROJECT
Avonmouth House

PROJECT CODE: 21235
CLIENT: Tribe Student Housing

DRAWING TITLE: Basement Plan
STATUS: Draft

SCALE: 1:250
SHEET: A3
DATE OF FIRST ISSUE: 04.06.21

DRAWING NUMBER: 21235-STCH-XX-B1-DR-A-0100
REVISION: F



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DRAWING TITLE: Ground Floor
STATUS: Draft

SCALE: 1:250
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DATE OF FIRST ISSUE: 04.06.21

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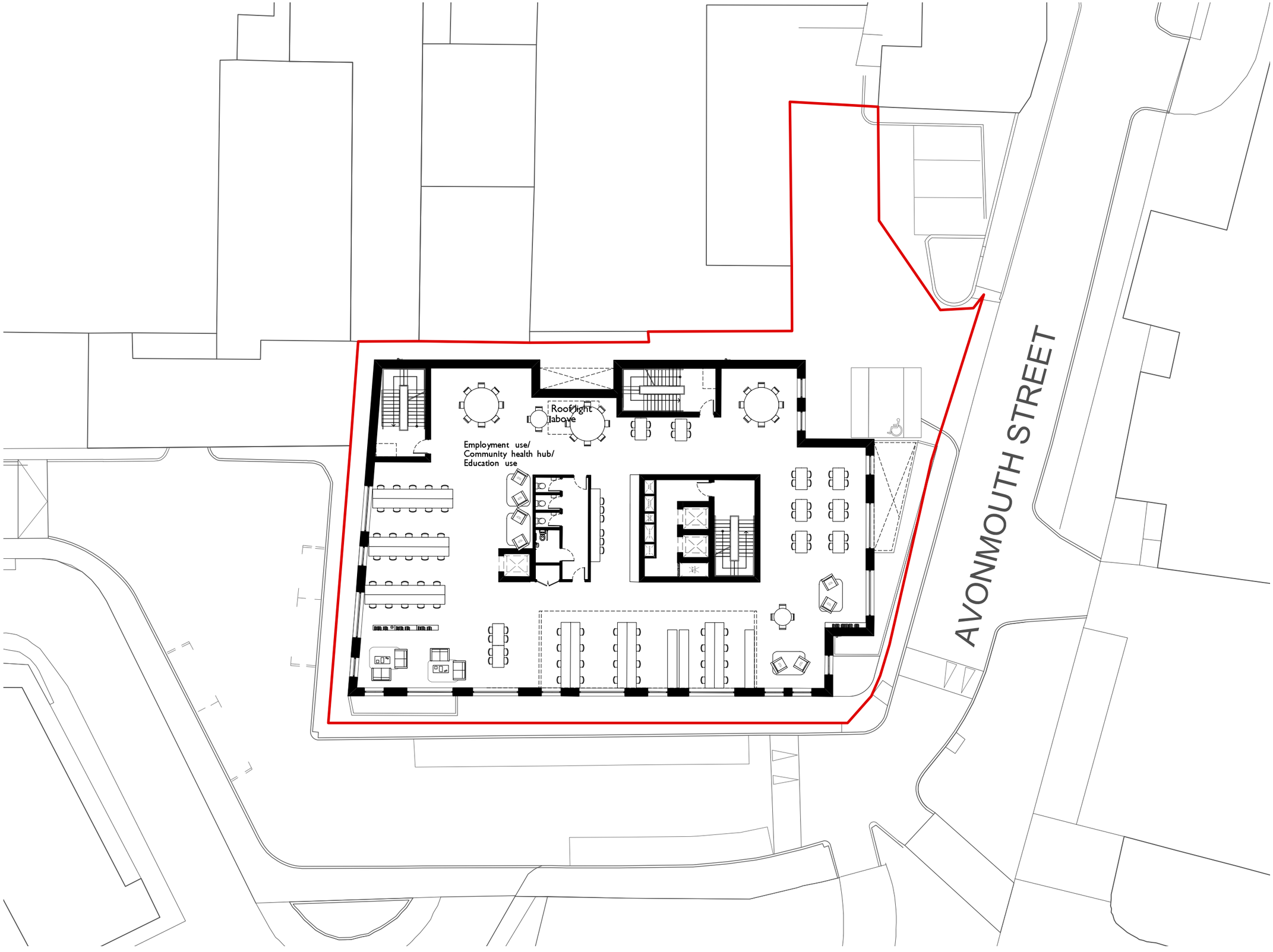

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DRAWING TITLE: Level 01
STATUS: Draft

SCALE: 1:250
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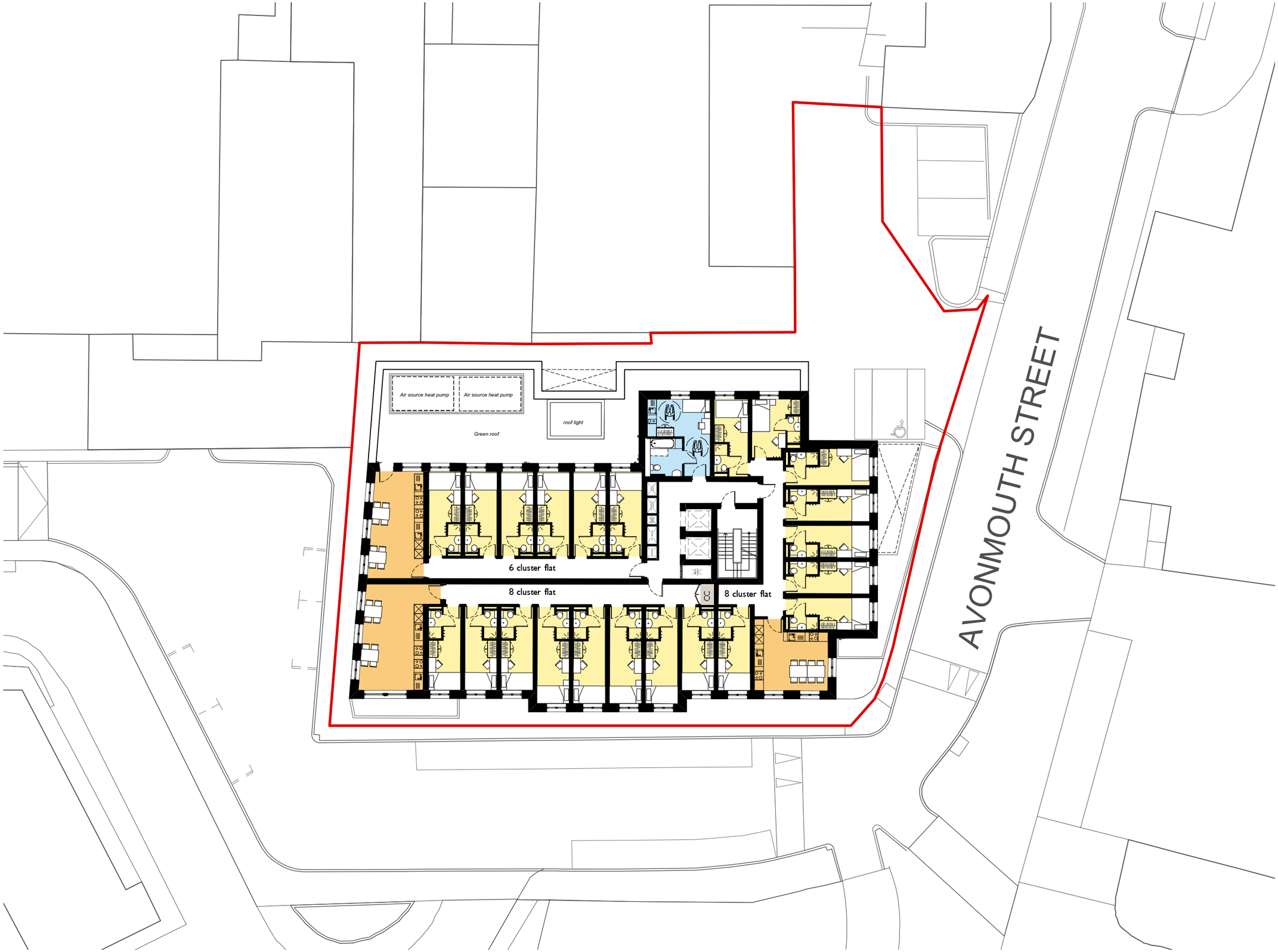

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DRAWING TITLE: Level 02
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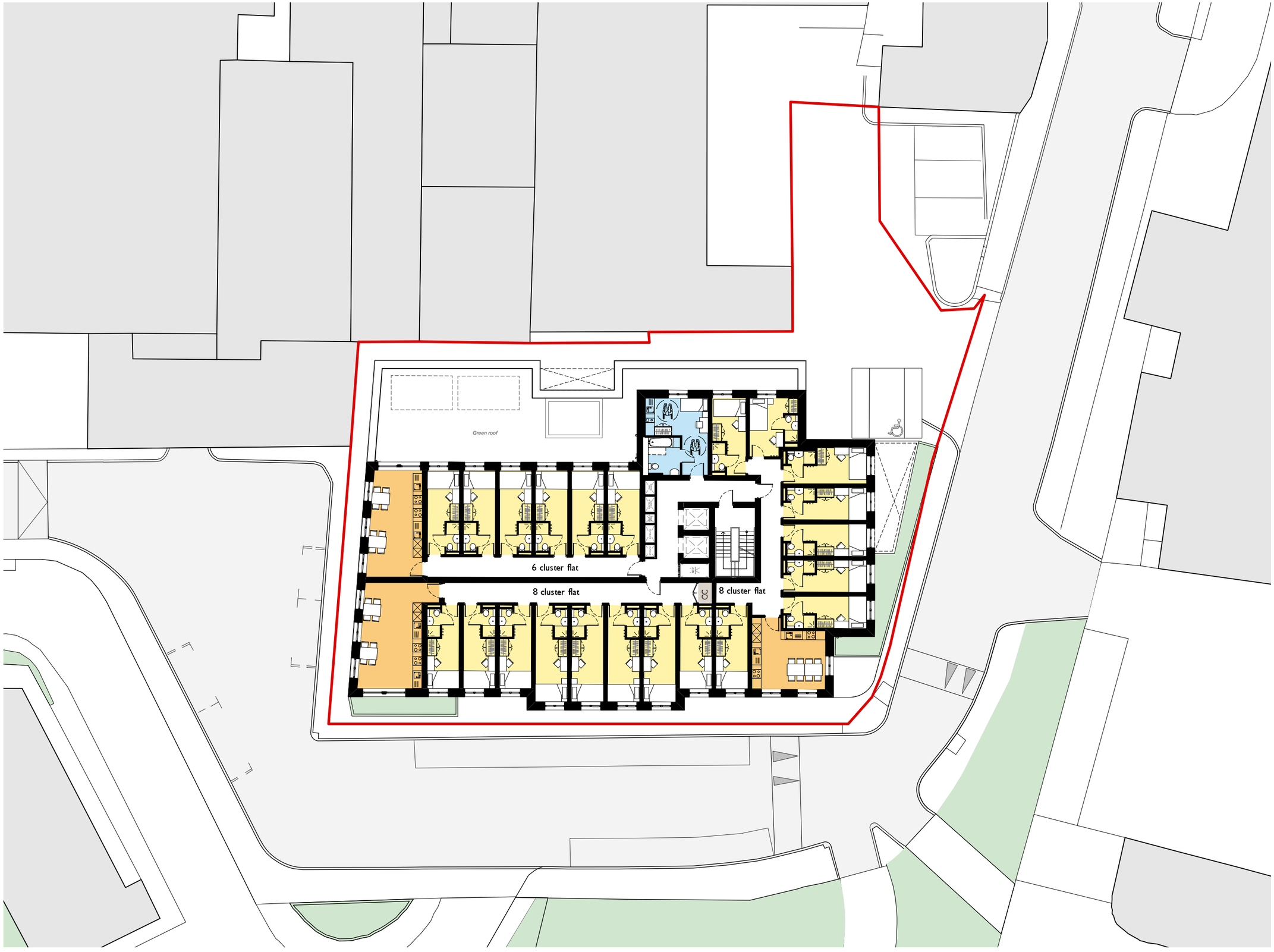

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CLIENT: Tribe Student Housing

DRAWING TITLE: Levels 03-06
STATUS: Draft

SCALE: 1:250
SHEET: A3
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DRAWING TITLE: Levels 07
STATUS: Draft

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DATE OF FIRST ISSUE: 04.06.21

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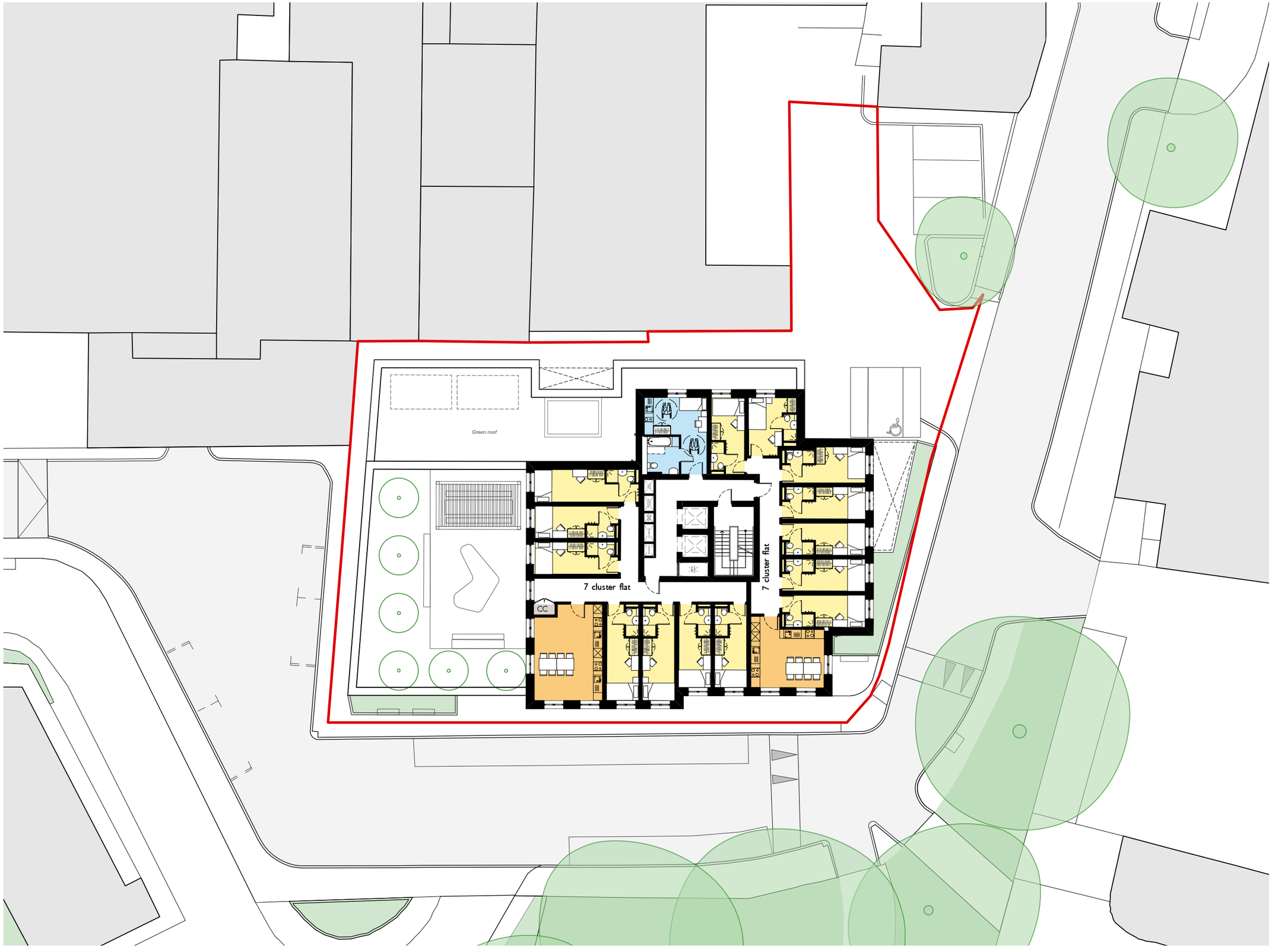

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CLIENT
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DRAWING TITLE
Levels 08-13

STATUS
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SCALE
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DATE OF FIRST ISSUE
04.06.21

DRAWING NUMBER
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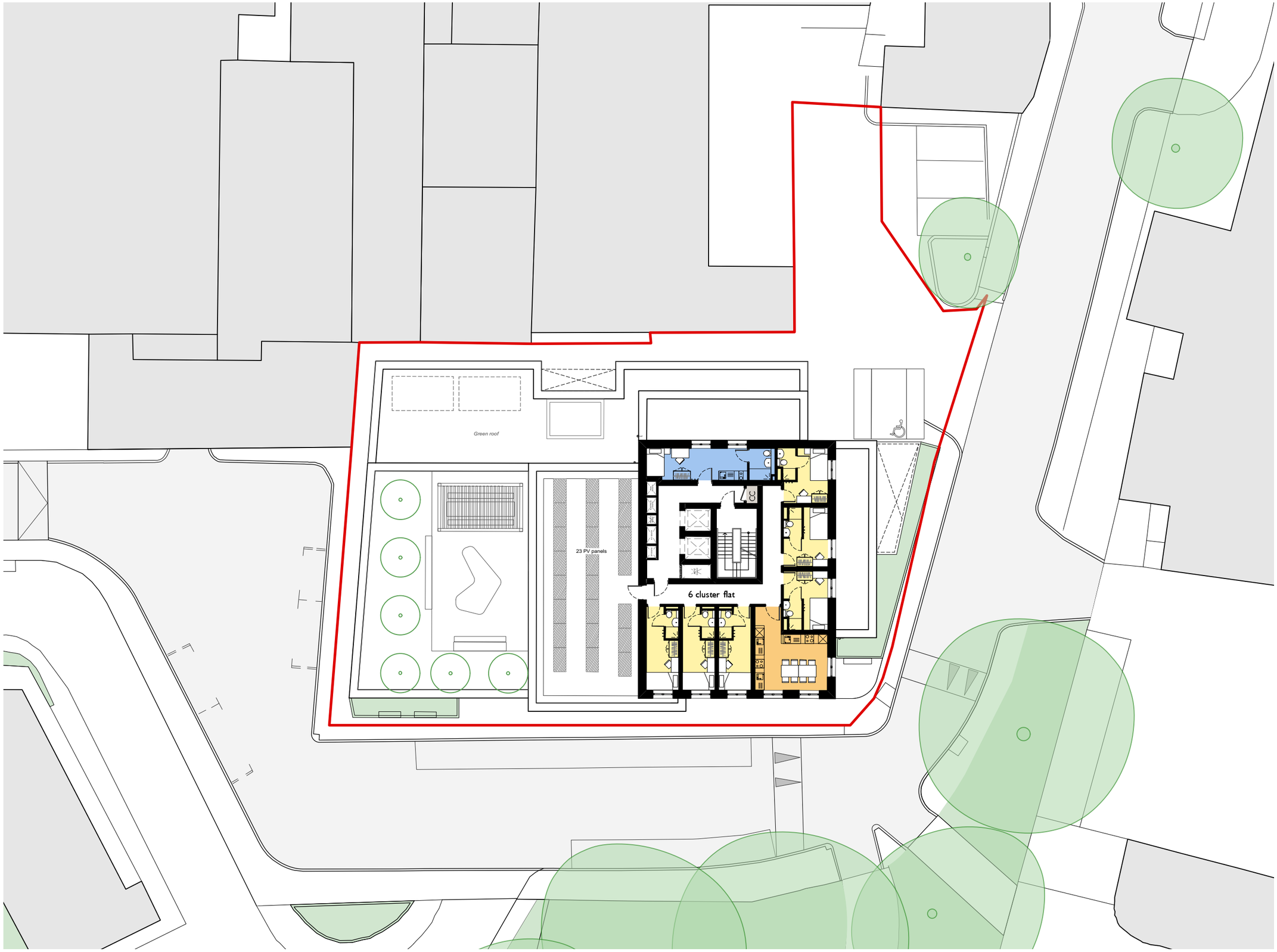

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PROJECT CODE: 21235
CLIENT: Tribe Student Housing

DRAWING TITLE: Level 14-15
STATUS: Draft

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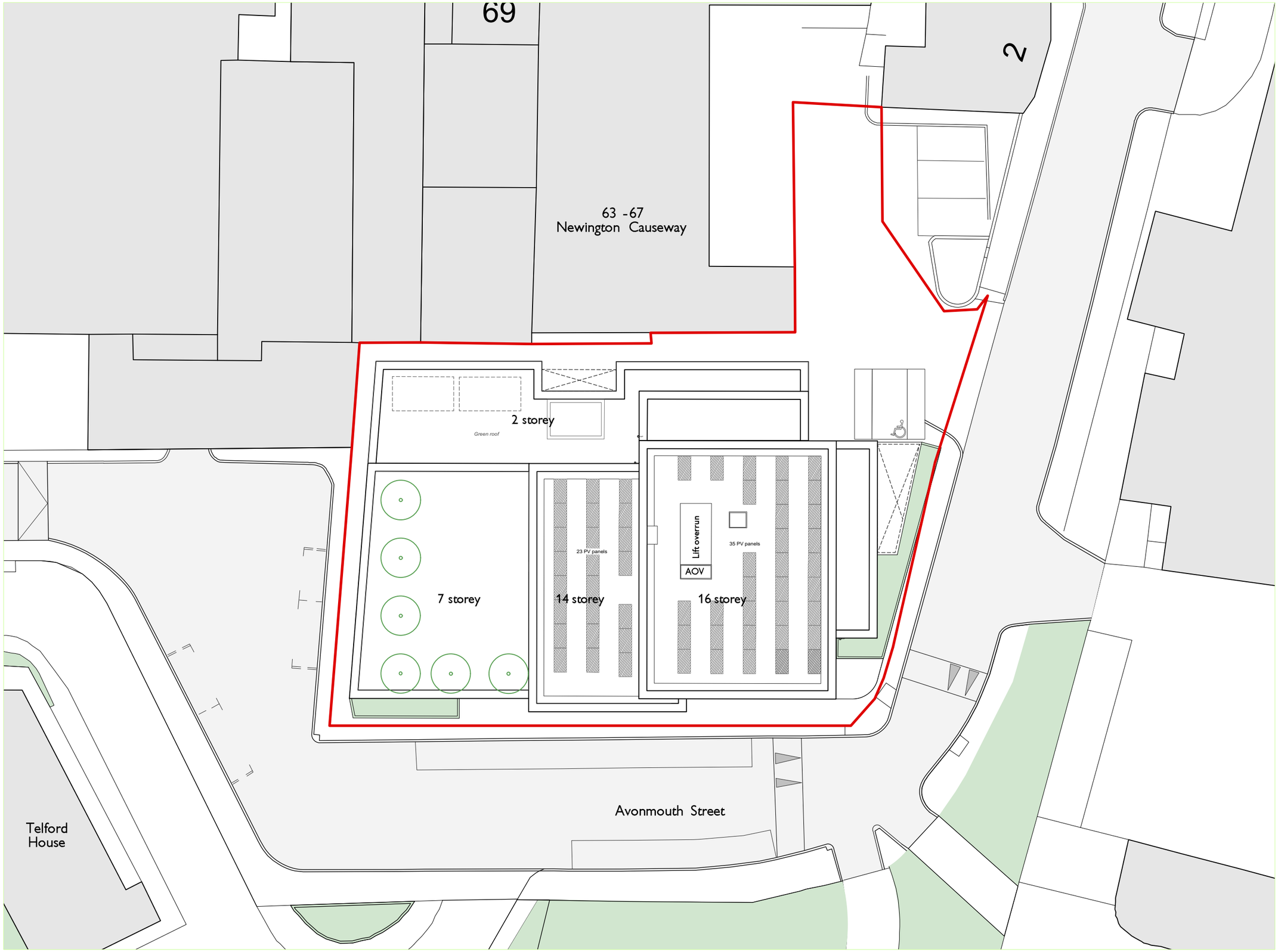

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PROJECT CODE
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CLIENT
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DRAWING TITLE
Roof

STATUS
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SCALE
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DRAWING NUMBER
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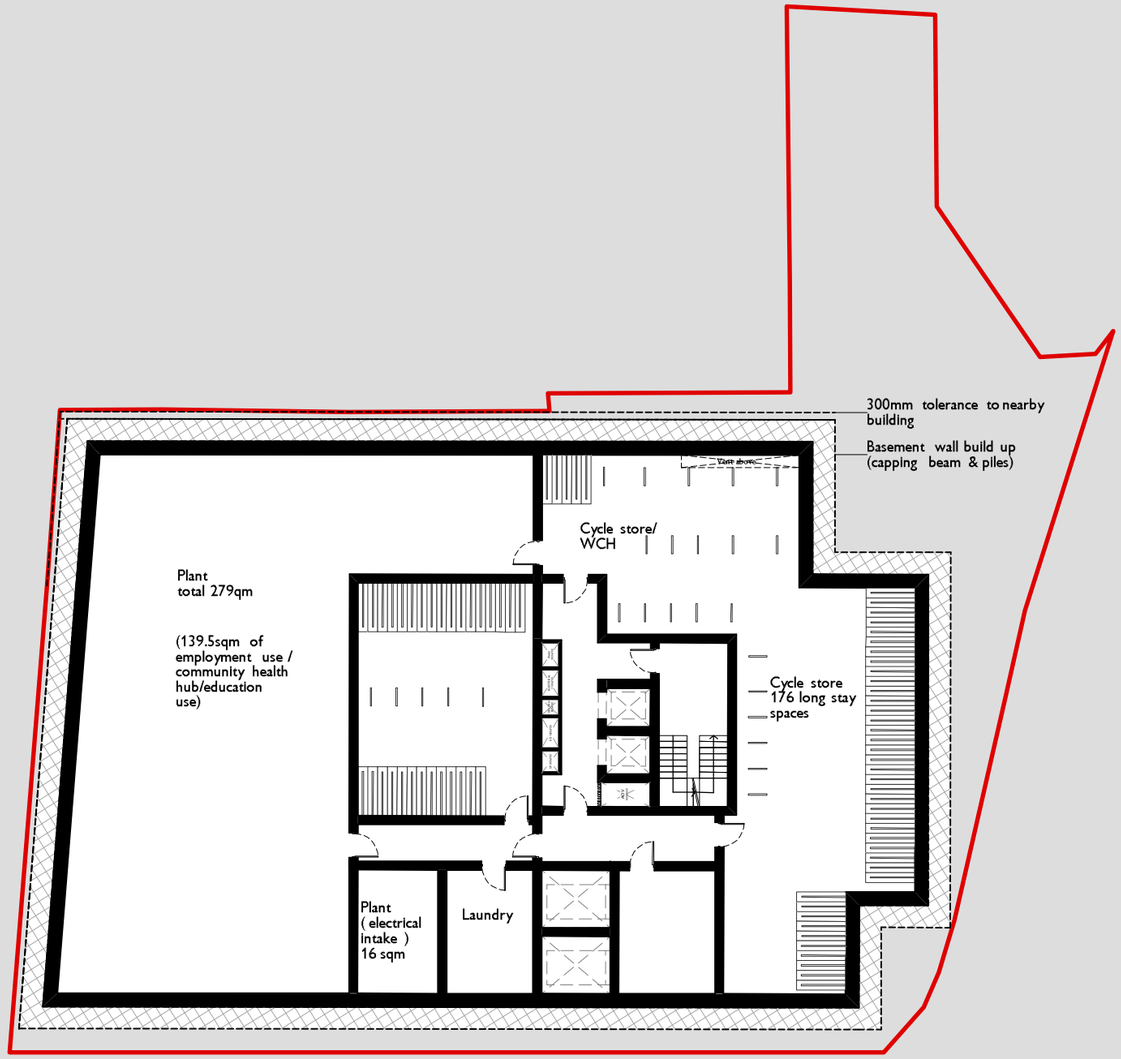
REVISION
F



0 5 10 15 M

Do not scale from this drawing. This drawing is based on dimensional survey information provided by others. The architect cannot accept resposibility for the accuracy of this survey information. All dimensions are shown in metric.

DRAWING NOTES

CC	Cleaner's Cupboard
CP	Condenser Pipwork
KE	Kitchen Extract

ISSUE	REASON FOR ISSUE	DATE
A	Design updates after pre app.	19/08/2021
B	Design coordination updates	06/09/2021
C	Annotation updates	16/09/2021
D	Annotation updates	19/10/2021

KEY PLAN

stitch.
Suite 6, Fusion House, 28 Rochester Place
London NW1 9DF
www.stitcharchitects.co.uk
+44 (0)20 3617 8725

PROJECT
Avonmouth House

PROJECT CODE: 21235
CLIENT: Tribe Student Housing

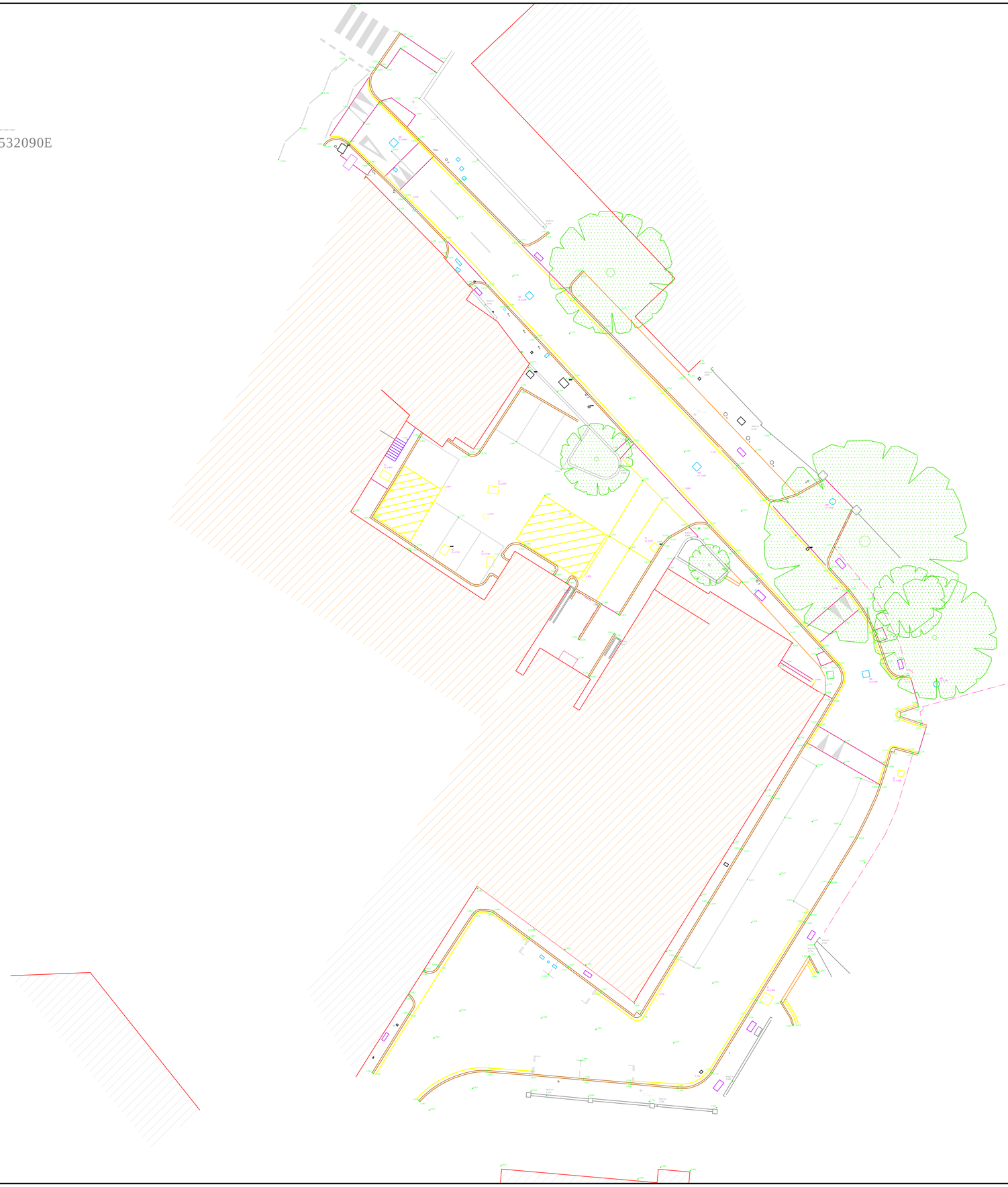
DRAWING TITLE: Basement 2 Plan
STATUS: Draft

SCALE: 1:250
SHEET: A3
DATE OF FIRST ISSUE: 13.08.21

DRAWING NUMBER: 21235-STCH-XX-B2-DR-A-0109
REVISION: D

Appendix B

Topographical Survey



Drawing not to be scaled. Dimensions indicated must be checked on site before manufacture by contractor, any discrepancy should be reported immediately.

N

ABBREVIATIONS

B	Bollard
BT	British Telecom Cover
CATV	Cable Communications Cover
CC	Coal Chute
Colt	Colt Communications
E	Electricity
FH	Fire Hydrant
G	Gully
GV	Gas Valve
IC	Inspection Cover
LP	Lamp Post
M	Mercury Communications
MH	Manhole
P	Post
RE	Roding Eye
RS	Road Sign
RWP	Rain Water Pipe
SP	Soil Pipe
SVP	Soil Vent Pipe
T	Tree
TP	Telegraph Pole
U	Unidentified
UTL	Unable To Lift
WV	Water Valve
WM	Water Meter
Bm.Lvl.	Beam Level
Cl.Lvl.	Ceiling Level
Flr.Lvl.	Floor Level
Hd.Lvl.	Head Level
Lvl.	Spot level
Spr'g Lvl.	Springing Level
W.Lvl	Wall level

Rev.	Date	Description

Architect
Aitch Group
Ironwood Works, Suite 4
19 Willow Street
London
EC2A 4BH

Site Address
Avonmouth House
London
SE1 6NX

7F Suttons Lane, Hornchurch, RM12 6RD
M: 07793 741997 T: 01708 606854
Web: www.lrm-surveyservices.co.uk
E-mail: enquiries@lrm-surveyservices.co.uk

Title
Topographical Survey

Date	Scale	Surveyed	Drawn
04-05-21	1:200	LRM	LRM

Drawing No. 21/AG/882/01

Rev

Appendix C

Borehole Logs

Asset location search

Property Searches

Ardent Consulting Engineers
52-56 52-56

LONDON
EC3M 5JE

Search address supplied

Etc Venues
6
Avonmouth Street
London
SE1 6NX

Your reference 2102760

Our reference ALS/ALS Standard/2021_4464940

Search date 9 July 2021

Knowledge of features below the surface is essential for every development

The benefits of this knowledge not only include ensuring due diligence and avoiding risk, but also being able to ascertain the feasibility of any development.

Did you know that Thames Water Property Searches can also provide a variety of utility searches including a more comprehensive view of utility providers' assets (across up to 35-45 different providers), as well as more focused searches relating to specific major utility companies such as National Grid (gas and electric).

Contact us to find out more.

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

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

0800 009 4540

Asset location search

Property Searches

Search address supplied: Etc Venues, 6, Avonmouth Street, London, SE1 6NX

Dear Sir / Madam

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

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

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

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

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

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

Contact Us

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

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

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

Asset location search

Thames Water Property Searches

Waste Water Services

Please provide a copy extract from the public sewer map.

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

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

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

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

For your guidance:

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

Clean Water Services

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

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

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

For your guidance:

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

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

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

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

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

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

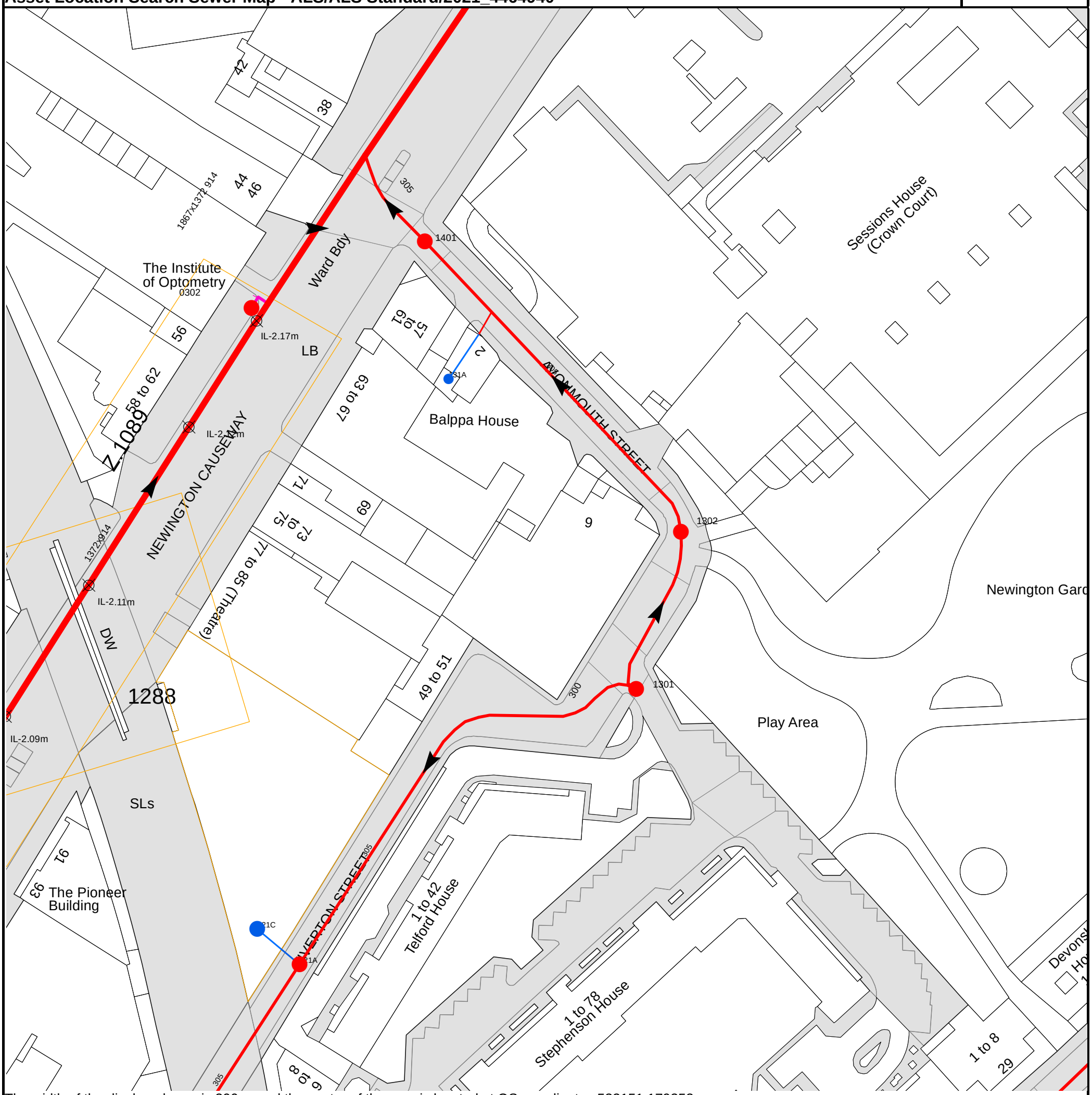
Clean Water queries

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

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

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

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4464940



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 532151,179353

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

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
021C	3	.42
121A	3	-.78
1301	2.81	.21
1302	3.14	-.46
0302	3.19	n/a
1401	2.91	-.96
131A	n/a	n/a

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

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

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

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

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

Control Valve

Drop Pipe

Ancillary

Weir

End Items

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

Outfall

Undefined End

Inlet

Other Symbols

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

Public/Private Pumping Station

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

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

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

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.

2) All measurements on the plans are metric.

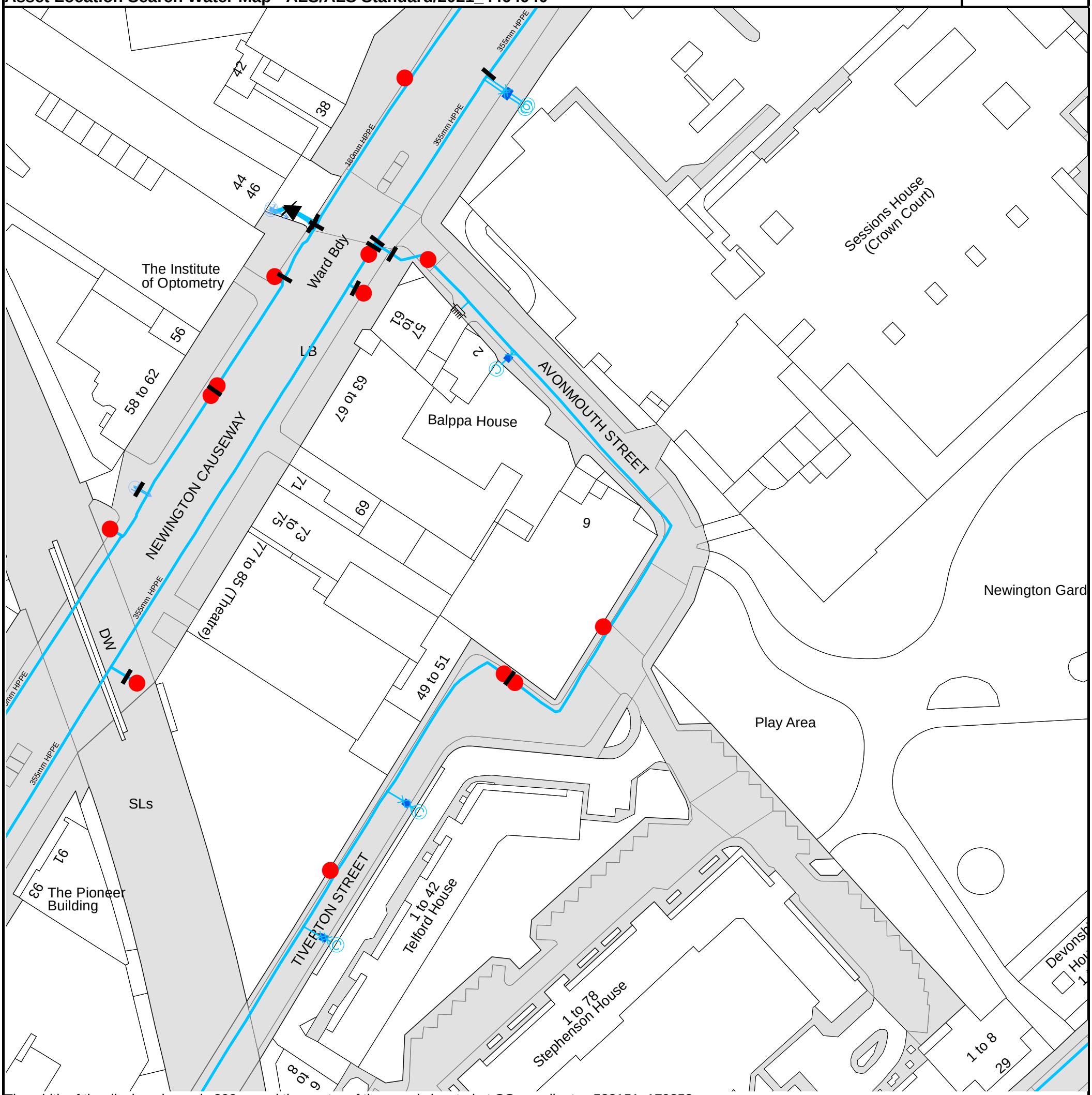
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

5) 'na' or '0' on a manhole level indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0800 009 4540.

Asset Location Search Water Map - ALS/ALS Standard/2021_4464940



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 532151, 179353.

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

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

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

16"

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

3" SUPPLY

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

3" FIRE

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

3" METERED

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

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

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

Valves

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

Hydrants

- Single Hydrant

Meters

- Meter

End Items

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

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

Operational Sites

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

Other Symbols

- Data Logger

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

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

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

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

Terms and Conditions

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

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

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

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0800 009 4540** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

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

Appendix D

Thames Water Asset Location Plans

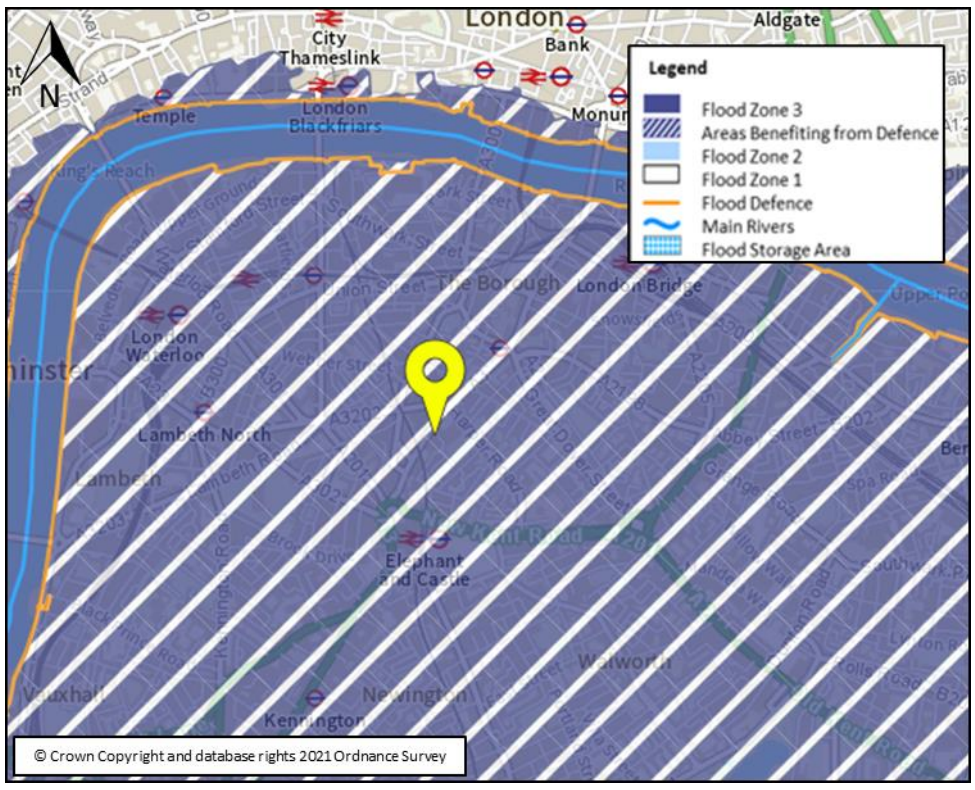
FLOOD RESPONSE PLAN

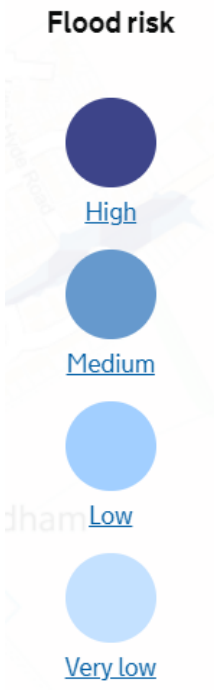
AVONMOUTH HOUSE, LONDON

ARDENT CONSULTING ENGINEERS

SEPTEMBER 2021

ENVIRONMENT AGENCY FLOOD ZONES



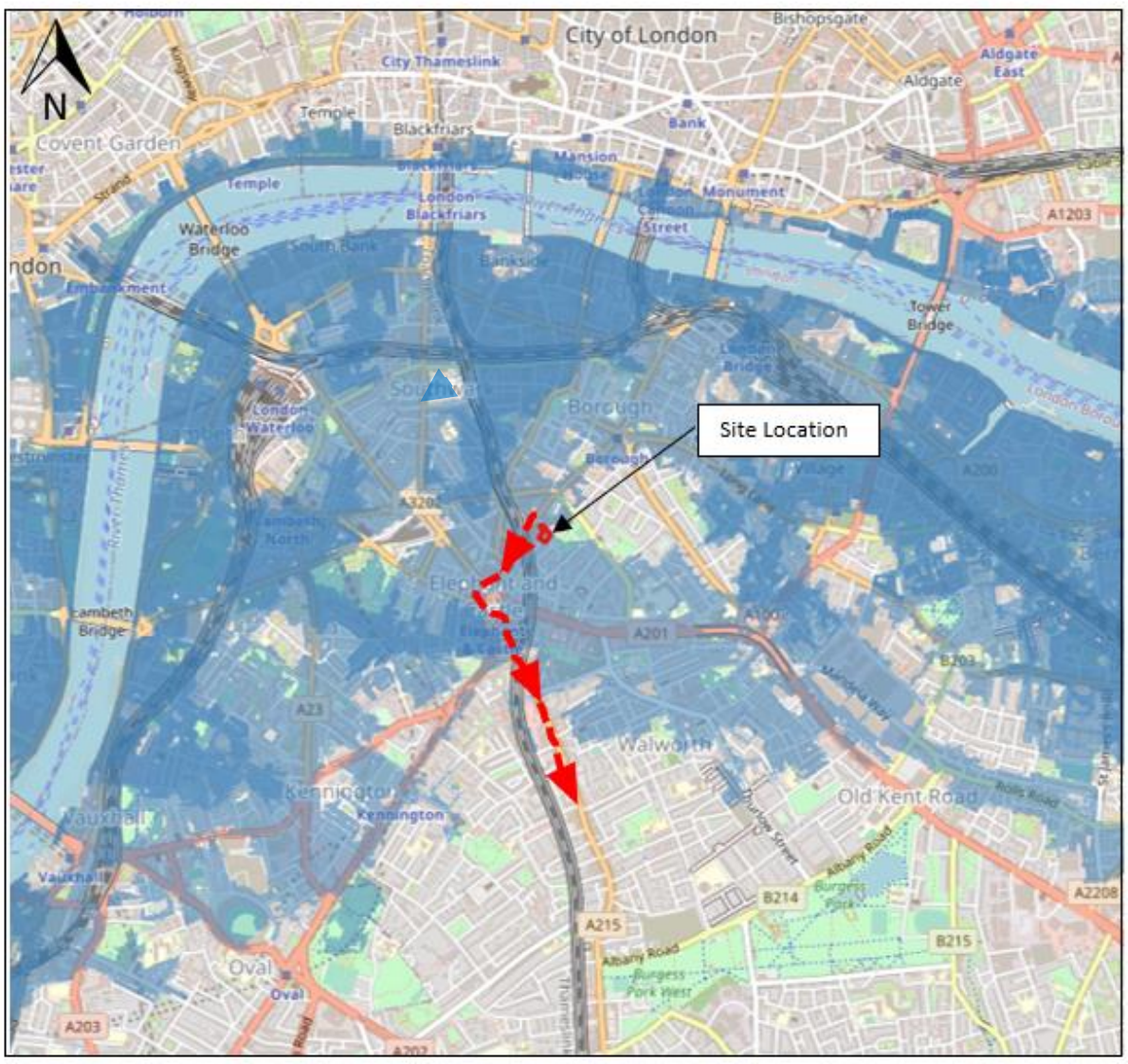


The site is located in Flood Zone 3 and is therefore considered at high risk of flooding. The site is however located within an area benefitting from defences and as such the risk is residual.

The flood mapping detailing the flood risk areas were obtained from the Environment Agency, and the information contained in this notice will be reviewed annually by the developments managing agent.

SAFE ACCESS AND EGRESS ROUTES

The below diagrams outline safe access and egress routes in the event of flooding. The site is at risk of flooding in a breach of defences and as such pedestrian/vehicular access may not be possible. Residents should seek refuge on higher floors in this instance. Safe dry access and egress may be afforded if time permits and if advised by the emergency services – residents should aim to head Along the A215 situated outside of tidal breach extents. An offsite refuge will be confirmed by emergency services during an event of a flood or breach. Details Environment Agency Flood Warnings and Emergency contact details are provided overleaf.



ENVIRONMENT AGENCY FLOOD WARNING CODES

The Environment Agency operates three levels of flood warnings as summarised below:

FLOOD ALERT

Flooding is possible.
Be prepared.

FLOOD WARNING

Flooding is expected.
Act Now.

SEVERE FLOOD WARNING

Severe flooding. Danger to life.
Action Needed.

FLOOD RESPONSE PLAN

NUNS WALK, CHURCH ROAD, GREAT YELDHAM

ARDENT CONSULTING ENGINEERS

MARCH 2021

EMERGENCY CONTACT NUMBERS:

Agency	Number
Environment Agency Flood Warnings Direct	0345 988 1188
Southwark County Council out of hours emergency	020 7525 5000
UK Power Networks (power cut)	0800 028 0247
Thames Water (loss of water supply)	0800 714 614
NHS 111 Services	111

Await further information and listen in to local radio and tv stations

IF THERE IS A DANGER TO LIFE ALWAYS DIAL 999 OR 112 AND ASK FOR THE APPROPRIATE EMERGENCY SERVICE.

EMERGENCY KIT

This is a useful bag that is packed with essentials in case you need to evacuate the premise. It should be stored somewhere you can easily get to. Handy things to keep in your grab bag include:

- A list of useful telephone numbers (local authority, insurance company, family and friends, Corgi registered gas engineer and trained electrician).
- Mobile phone charger.
- Spare home and car keys.
- Toiletries, sanitary supplies.
- First-aid kit.
- Any essential medication, or details of your prescription.
- A wind-up or battery-operated radio with spare batteries.
- Torch with spare batteries.
- Cash and credit cards.
- Spare clothes and blankets.
- Sensible flat shoes.
- Bottled water.
- A stock of non-perishable snack items.
- Essential items for babies or pets.

If asked by the emergency services to leave your premise, please do so as quickly and calmly as possible. If you have time, turn off electricity, gas, and water supplies, unplug appliances, and lock all windows and doors. Take your grab bag with you.

An offsite refuge will be confirmed by emergency Services during an event

Occupants should listen to the advice and guidance from the emergency services at the time of an incident.

Appendix E

Flood Response Plan

Southwark Council

GREATERLONDONAUTHORITY

LoDEG

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	AVONMOUTH HOUSE,
Address & post code	AVONMOUTH HOUSE, 6 AVONMOUTH STREET, LONDON SE1 6NX
OS Grid ref. (Easting, Northing)	E 532136 N 179387
LPA reference (if applicable)	-
Brief description of proposed work	The scheme proposals comprise the redevelopment of the Site to provide circa 200 student bedspaces and 1,300sqm of commercial floorspace.
Total site Area	1160 m^2
Total existing impervious area	1160 m^2
Total proposed impervious area	1160 m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
Existing drainage connection type and location	Existing connections into TW combined sewer to be investigated
Designer Name	Faye Hammer
Designer Position	Engineer
Designer Company	Ardent Consulting Engineering

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Kempton Park Gravel Member (Sand and Gravel)
Bedrock geology classification	London Clay Formation (Clay and Silt)
Site infiltration rate	NA m/s
Depth to groundwater level	NA m below ground level
Is infiltration feasible?	No

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	N
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	N	N
7 discharge rainwater to the combined sewer.	Y	Y

2c. Proposed Discharge Details

Proposed discharge location	Avonmouth Road
Has the owner/regulator of the discharge location been consulted?	Yes, awaiting response to capacity check

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^3)*	*Proposed discharge rate (l/s)*
Qbar	0.4			
1 in 1	0.4	16.38		2
1 in 30	1	36.45		2
1 in 100	2	46.49	68	2
1 in 100 + CC				2
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Hydrobrake/ Orifice Flow Control		

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements		0	
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	1160		68
Total	**1160**	**0**	**68**

4. Supporting Information

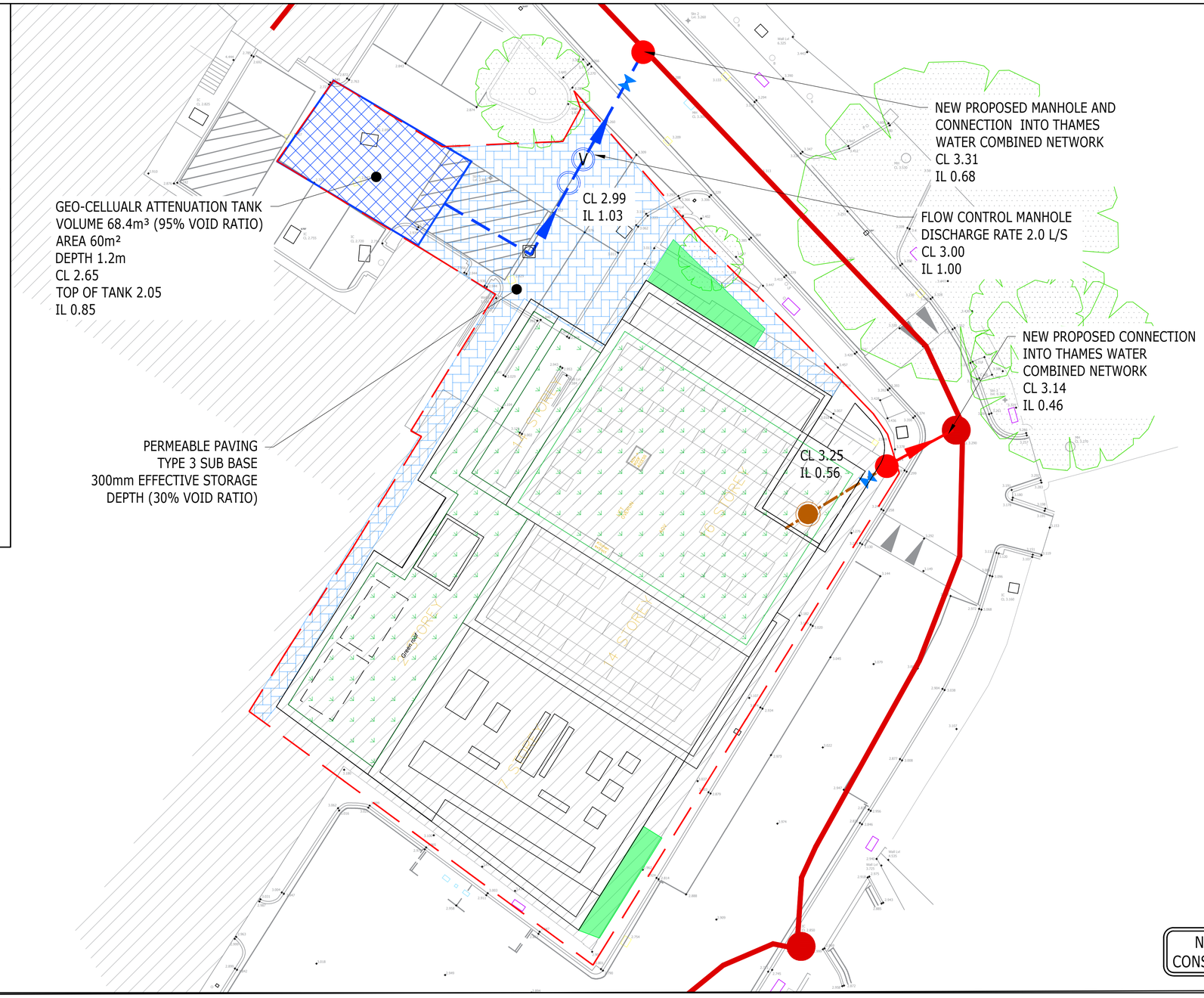
4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Paragraph 2.12-2.14 and 6.4-6.6
Drainage hierarchy (2b)	Paragraph 6.8-6.9
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Paragraph 6.16-6.23, App F, App J
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Paragraph 6.16-6.23, App J
Proposed SuDS measures & specifications (3b)	Paragraph 6.16-6.23, App F
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix A
Detailed drainage design drawings, including exceedance flow routes	Appendix F
Detailed landscaping plans	-
Maintenance strategy	Appendix K
Demonstration of how the proposed SuDS measures improve:	
a) water quality of the runoff?	Appendix K
b) biodiversity?	
c) amenity?	

Appendix F

Southwark County Council SUDS proforma

LEGEND:

- INDICATIVE SITE BOUNDARY
- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER MANHOLE
- CATCHPIT MANHOLE
- VORTEX FLOW CONTROL
- PROPOSED PERMEABLE PAVING (30% VOID RATIO)
- PROPOSED GEOCELLULAR STORATE (95% VOID RATIO)
- PROPOSED GREEN ROOF
- GRASSED AREA
- NON-RETURN VALVE
- PROPOSED COMBINED SEWER
- PROPOSED COMBINED MANHOLE
- THAMES WATER COMBINED SEWER
- PROPOSED FOUL SEWER
- PROPOSED FOUL MANHOLE



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9. THE DRAINAGE STRATEGY IS INDICATIVE ONLY, TO DEMONSTRATE DESIGN INTENT AND ATTENUATION STORAGE REQUIREMENTS.
10. INDICATIVE DRAINAGE STRATEGY SUBJECT TO THAMES WATER AND LB SOUTHWARK (LEAD LOCAL FLOOD AUTHORITY) APPROVAL.

PERMEABLE PAVING NOTES

11. LIGHT DUTY: SHOULD ONLY BE USED FOR SINGULAR OR DOUBLE DRIVES SERVING 1 OR 2 PLOTS - *NOT* SUITABLE FOR AREAS WHICH WILL BE SUBJECT TO CONSTRUCTION TRAFFIC OR POTENTIAL LOADING FROM HEAVY GOODS VEHICLES inc. DELIVERY, PANTECHNICON, REFUSE COLLECTION AND FIRE RESCUE VEHICLES
12. THE FORMATION OF THE PERMEABLE PAVING SUB-BASE MUST NOT EXCEED A GRADIENT OF 1/40.
13. FOR STEEPER GRADIENTS, USE MAXIMUM GRADIENT OF 1/40 FOR FORMATION, APPLYING VERTICAL STEPS AS NECESSARY, BUT ENSURING MINIMUM SUB-BASE THICKNESS IS ALWAYS ACHIEVED.
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15. ALL MATERIAL SPECIFICATION AND WORKMANSHIP OF PERMEABLE PAVING CONSTRUCTION TO BE STRICTLY IN ACCORDANCE WITH RECOMMENDATIONS BY MARSHALLS.

Rev	Description	Drn	Chk	App	Date
-	DRAFT	FH	CC	BC	09.09.21

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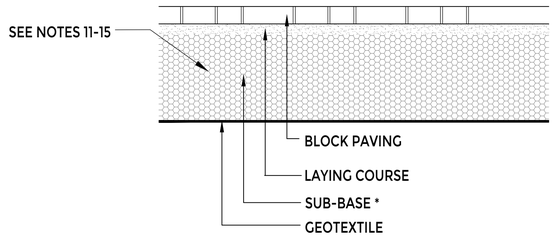
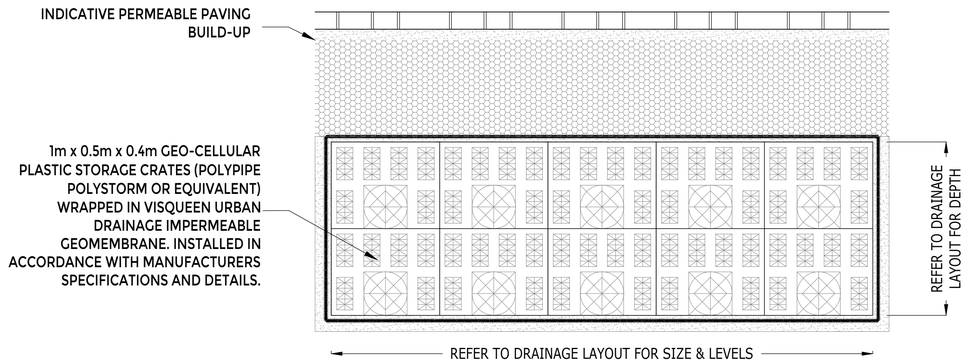


CONSTRUCTION SPECIFICATION FOR LIGHTER DUTY PERMEABLE BLOCK PAVED AREAS
SCALE 1:20



CELLULAR ATTENUATION TANK CONSTRUCTION DETAILS
(1:20)

ARDENT CONSULTING ENGINEERS
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Client: TRIBE STUDENT HOUSING

Project Title: AVONMOUTH HOUSE, 6 AVONMOUTH STREET

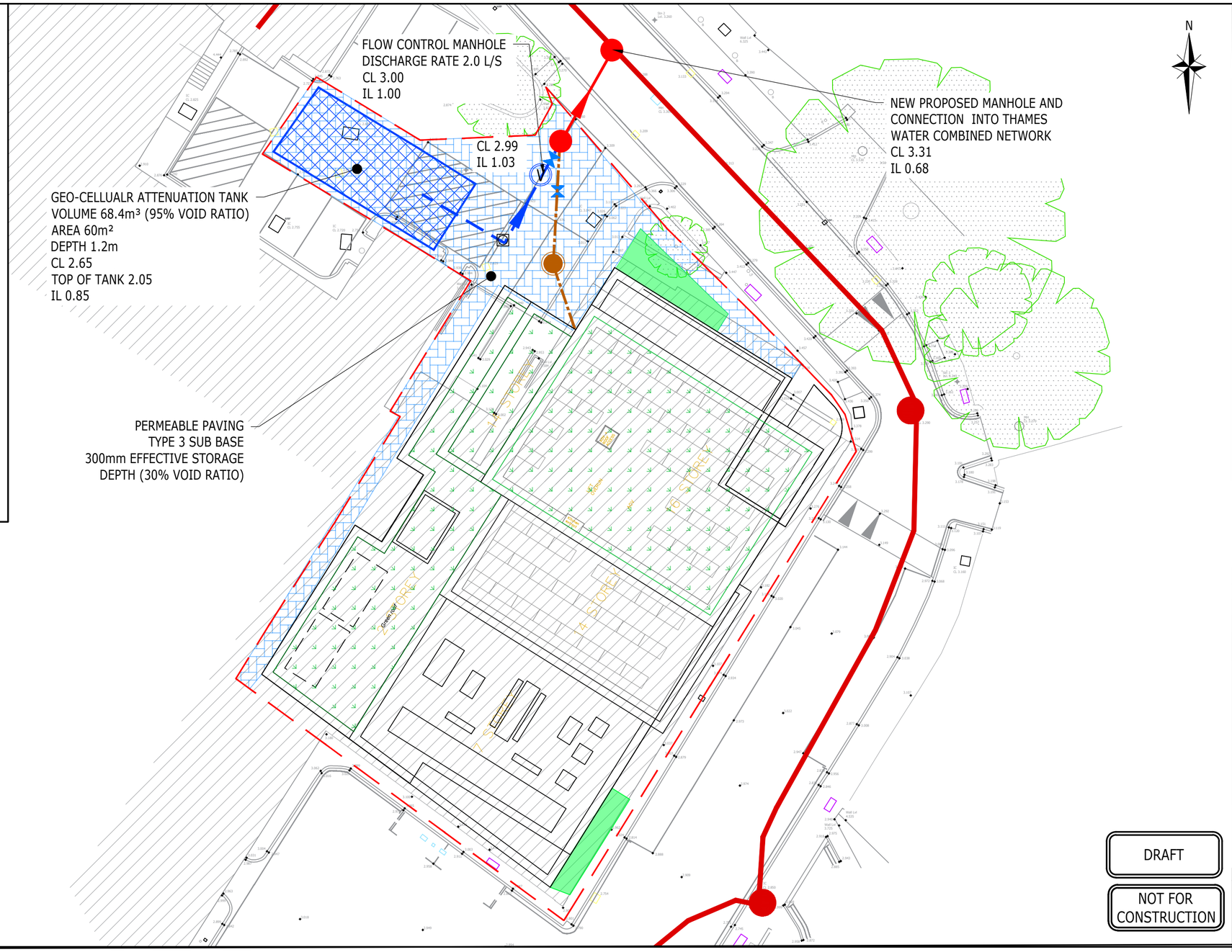
Drawing Title: FOUL AND SURFACE WATER DRAINAGE STRATEGY

A2 Scale	Date	Designed by
1:250	SEPT 2021	FH
Drawn by	Checked by	Approved by
FH	CC	BC

Drawing Number: 2102760/001 Rev -

LEGEND:

- INDICATIVE SITE BOUNDARY
- PROPOSED SURFACE WATER SEWER
- PROPOSED SURFACE WATER MANHOLE
- CATCHPIT MANHOLE
- VORTEX FLOW CONTROL
- PROPOSED PERMEABLE PAVING (30% VOID RATIO)
- PROPOSED GEOCELLULAR STORATE (95% VOID RATIO)
- PROPOSED GREEN ROOF
- GRASSED AREA
- NON-RETURN VALVE
- PROPOSED COMBINED SEWER
- PROPOSED COMBINED MANHOLE
- THAMES WATER COMBINED SEWER
- PROPOSED FOUL SEWER
- PROPOSED FOUL MANHOLE



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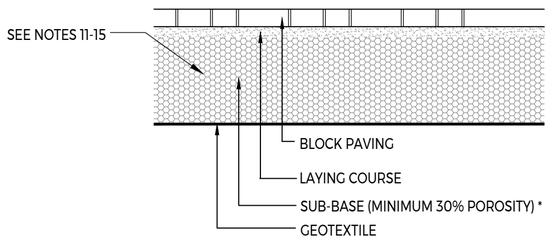

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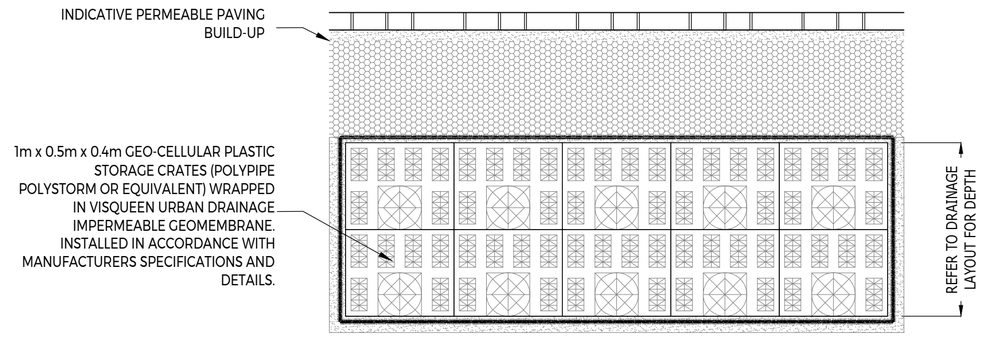

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ARDENT | CONSULTING ENGINEERS

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Client

TRIBE STUDENT HOUSING

Project Title:

AVONMOUTH HOUSE, 6 AVONMOUTH STREET

Drawing Title:

FOUL AND SURFACE WATER DRAINAGE STRATEGY

A2 Scale	Date	Designed by
1:250	SEPT 2021	FH
Drawn by	**Checked by**	**Approved by**
FH	CC	BC

Drawing Number: 2102760-001 Rev -

File Location: y:\ardent projects\2102760 - avonmouth hse, 6 avonmouth st, london\technical\acad\drawings\2102760-001 foul and surface water drainage strategy.dwg

Appendix G

Proposed Drainage Strategy

PRELIMINARY DRAINAGE CALCULATIONS

16/07/2021

ARDENT
CONSULTING ENGINEERS

EXISTING SURFACE WATER

Existing site information:

Site Boundary Area	1160	m2
Developable Area	0.116	ha
Impermeable Area	0.1160	ha

Modified Rational Method Equation: $Q_n = 2.78\ CiA$

where:

C *Runoff Coeffic* = 1 (in this case 1 as using impermeable area)

i_n *Rainfall Intensity for n return period (mm/hr)*

A *Impermeable Area (Ha)*

Q_n *Runoff for n return period (l/s)*

Rainfall Intensity:

The rainfall intensities for various return periods were extracted from Table 1(a) of the Transport and Road Research Laboratory Report - Estimated rainfall for drainage calculations in the United Kingdom (TRRL Report LR 595) by C. P. Young. For the 5 min duration.

i_1	50.8	mm/hr
i_{30}	113.02	mm/hr
i_{100}	143.9	mm/hr

Existing Surface Water Runoff:

Therefore:

			C		i_n		A		Q_n	
Q_1	2.78	x	1	x	50.8	x	0.116	=	**16.38**	**l/s**
Q_{30}	2.78	x	1	x	113.0	x	0.116	=	**36.45**	**l/s**
Q_{100}	2.78	x	1	x	143.9	x	0.116	=	**46.40**	**l/s**

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	SAAR (mm)	600	Urban	0.000
Area (ha)	0.116	Soil	0.450	Region Number	Region 6

Results l/s

QBAR Rural	0.4
QBAR Urban	0.4
Q1 year	0.4
Q1 year	0.4
Q30 years	1.0
Q100 years	1.4

Appendix H

Existing Foul and Surface Water Discharge Rates

Miss Faye Hammer
Ardent Consulting Engineers
Third Floor, The Hallmark Building
52-56 Leadenhall Street
London
EC3M 5JE

Wastewater pre-planning
Our ref DS6086369

15 August 2021

Pre-planning enquiry: Capacity confirmation (Rev. A)

Site Address: Avonmouth House, 6 Avonmouth Street, Southwark, London, SE1 6NX

Dear Miss Hammer,

Thank you for providing information on your development for the proposed 233no. max capacity student accommodation and 1,300m² commercial premises. We have based our assessment on the information you provided to us and have copied below for clarity:-

Proposed foul and storm flows to discharge via gravity into manhole ref. 131A. Surface water runoff restricted to 2.0l/s.

From the information you have provided, we can confirm that the existing sewerage network does have sufficient capacity to accommodate the proposed **foul and surface water** discharge from the proposed development. This confirmation for capacity is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of 3 years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you have any questions, please do not hesitate to contact me.

Yours sincerely

Rahim Khan
Thames Water – Development Engineer
rahim.khan@thameswater.co.uk

Appendix I

Thames Water Capacity Check

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

Half Drain Time : 517 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	0.491	0.366	0.0	0.0	0.0	27.9	O K
30 min Summer	0.598	0.473	0.0	0.0	0.0	35.9	O K
60 min Summer	0.696	0.571	0.0	0.5	0.5	43.4	O K
120 min Summer	0.784	0.659	0.0	0.8	0.8	50.1	O K
180 min Summer	0.826	0.701	0.0	0.9	0.9	53.3	O K
240 min Summer	0.848	0.723	0.0	0.9	0.9	55.0	O K
360 min Summer	0.867	0.742	0.0	0.9	0.9	56.4	O K
480 min Summer	0.873	0.748	0.0	1.0	1.0	56.9	O K
600 min Summer	0.879	0.754	0.0	1.0	1.0	57.3	O K
720 min Summer	0.884	0.759	0.0	1.0	1.0	57.7	O K
960 min Summer	0.890	0.765	0.0	1.0	1.0	58.2	O K
1440 min Summer	0.891	0.766	0.0	1.0	1.0	58.2	O K
15 min Winter	0.535	0.410	0.0	0.0	0.0	31.2	O K
30 min Winter	0.652	0.527	0.0	0.4	0.4	40.0	O K
60 min Winter	0.762	0.637	0.0	0.7	0.7	48.4	O K
120 min Winter	0.861	0.736	0.0	0.9	0.9	56.0	O K
180 min Winter	0.909	0.784	0.0	1.0	1.0	59.6	O K
240 min Winter	1.293	1.168	0.0	1.5	1.5	61.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	145.634	0.0	0.0	27
30 min Summer	93.894	0.0	0.0	42
60 min Summer	57.587	0.0	7.8	70
120 min Summer	34.141	0.0	16.0	128
180 min Summer	24.837	0.0	20.8	186
240 min Summer	19.716	0.0	24.1	244
360 min Summer	14.179	0.0	28.8	360
480 min Summer	11.227	0.0	32.4	416
600 min Summer	9.362	0.0	35.3	474
720 min Summer	8.067	0.0	37.8	532
960 min Summer	6.374	0.0	41.7	662
1440 min Summer	4.567	0.0	47.5	930
15 min Winter	145.634	0.0	0.0	27
30 min Winter	93.894	0.0	3.9	41
60 min Winter	57.587	0.0	13.1	68
120 min Winter	34.141	0.0	22.3	126
180 min Winter	24.837	0.0	27.6	182
240 min Winter	19.716	0.0	31.3	234

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
360 min Winter	1.416	1.291	0.0	1.7	1.7	61.3	O K
480 min Winter	1.682	1.557	0.0	1.9	1.9	61.6	O K
600 min Winter	1.772	1.647	0.0	2.0	2.0	61.7	O K
720 min Winter	1.763	1.638	0.0	2.0	2.0	61.7	O K
960 min Winter	1.627	1.502	0.0	1.9	1.9	61.5	O K
1440 min Winter	1.292	1.167	0.0	1.5	1.5	61.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
360 min Winter	14.179	0.0	36.6	290
480 min Winter	11.227	0.0	40.7	356
600 min Winter	9.362	0.0	43.9	426
720 min Winter	8.067	0.0	46.6	498
960 min Winter	6.374	0.0	51.1	640
1440 min Winter	4.567	0.0	57.5	930

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.300	Shortest Storm (mins)	15
Ratio R	0.444	Longest Storm (mins)	1440
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.102

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.034	4	8	0.034	8	12	0.034

Model Details

Storage is Online Cover Level (m) 2.650

Cellular Storage Structure

Invert Level (m) 0.125 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	80.0	0.0	0.801	0.0	0.0
0.800	80.0	0.0			

Orifice Outflow Control

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 0.600

Appendix J

Preliminary Proposed Drainage Calculations

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	**Very low**	**0.2**	**0.2**	**0.05**
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

Table 1: Pollution hazard indices for different land use classifications

(land use in bold applicable for the development).

	Mitigation indices		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	0.5	0.6	0.6
Bio retention system (green roof)	**0.8**	**0.8**	**0.8**
Permeable pavement	**0.7**	**0.6**	**0.7**
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 2: Indicative SuDS mitigation indices for discharges to surface waters

(bold text is applicable to this development).

For surface water discharge from Residential Parking Areas and Low Traffic Roads <300 traffic movements/day			
	Required mitigation indices		
Source	**TSS**	**Metals**	**Hydrocarbons**
Very low	**0.2**	**0.2**	**0.05**
Type of SuDS component provided			
Permeable pavement	0.7	0.6	0.7
Bio retention system (green roof)	0.8	0.8	0.8
Total	**1.50**	**1.40**	**1.50**
Check	**+1.30**	**+1.20**	**+1.45**

Table 3: SuDS mitigation indices provided

Appendix K

SUDS Treatment Table Indices and SUDS Management Schedule

1.0 INTRODUCTION

1.1 The development at Avonmouth House, 6 Avonmouth Street includes a number of Sustainable Drainage Systems (SuDS) as part of the surface water drainage system including green roofs, permeable paving and geocellular tanks. This Technical Note sets out an outline management plan for the aforementioned SuDS components.

1.2 The proposed SuDS components in addition to addressing climate change will bring a number of benefits in terms of water quality, environmental, and social amenity.

1.3 The maintenance of all SuDS components will be in accord with the best practices and CIRIA document C753 "The SuDS Manual". Typical maintenance activities for the proposed SuDS components have been reproduced from Table 32.1 of "The SuDS Manual" in **Table 1** below. A private management company will be set up to maintain the surface water drainage network, including on-site SuDS. .

Table 1: Typical SuDS Maintenance Activities

Operation and maintenance activity	SuDS component		
	Geo-cellular Tank	Permeable paving	Green roof
Regular maintenance			
Inspection	■	■	■
Litter and debris removal	□	■	■
Grass cutting			■
Weed and invasive plant control		□	■
Shrub management		□	
Shoreline vegetation			
Aquatic vegetation management			
Occasional maintenance			
Sediment management	■	■	
Vegetation replacement			■
Vacuum sweeping and brushing		■	
Remedial maintenance			
Structure rehabilitation / repair	□	□	□
■ will be required □ may be required			

2.0 SuDS MANAGEMENT PLAN

2.1 This plan is intended to cover all on-site drainage structures. The Site Management Team should oversee and implement the SuDS Management Plan and designate a qualified person who will be responsible for the proper operation and maintenance of the surface water drainage structures.

Water Quality Management

2.2 In line with Tables 26.2 and 26.3 of the CIRIA C753 The SuDS Manual, it can be seen that the proposed greenroofs and permeable paving would provide sufficient treatment for the surface water runoff from the Site.

2.3 The surface drainage network would also be designed to protect and enhance the quality of surface water runoff through the removal of sediment and pollutants. Catchpit manholes and silt trapped gullies will reduce the amount of pollutants entering the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular sweeping and litter removal, prohibitions on the use of pesticides, and maintenance of bin areas.

Maintenance Program

2.4 The Site Management Team will conduct the SuDS Management Plan set forth in this document. The Site Management will ensure that inspections and record keeping are timely and accurate. Inspection & Maintenance Log Forms should include the date and physical conditions of the structures, depth of sediment in structures, evidence of overtopping or debris blockage and maintenance required of each structure. Records of maintenance will be kept on file on-site and copies of Inspection & Maintenance Log sheets indicating all work and inspections will be available to the Council upon request. A model Maintenance log in appended for reference.

2.5 Regular maintenance should include:

- Inspect channel and gully inlet grates and remove any debris every 6 months or as determined to be reasonable based on experience with the installed

systems to ensure that the gullies are working in their intended fashion and that they are free of debris;

- Inspect gully sumps and bottom of drain manholes quarterly; if depth of sediment in sumps exceeds 50% capacity, sediment must be removed. Excessive sediment shall be removed and properly disposed by a licensed drainage cleaning company.

- All litter shall be picked up and removed from the parking areas, external bin store, wetland areas, green roofs, and soft landscaping.

- Inspect all green roofs. Replant bare areas or areas with sparse growth.

- Inspect external bin stores for spillage and scattered litter must be performed on a regular basis to prevent the spread of pollutants into the surface water drainage network.

- Green roofs will require regular inspection and maintenance on a weekly or fortnightly basis, especially during the establishment stage (first 12 – 15 months). Maintenance during the establishment stage should be made the responsibility of the green roof provider, to ensure healthy growth and satisfactory establishment. Regular inspections of the green roof area should also include the soil substrate for the presence of erosion and drainage inlets to ensure run-off can discharge unrestricted.

- The inlets, outlet and vents and overflows of SuDS components should be checked annually and after large storms to ensure that they are in good condition and operating as designed. Regular maintenance includes inspection and identification of any areas that are not operating correctly monthly for the first 3 months and then every 6 months after.

Winter Maintenance Program

2.6 Ensure that drainage structures are not blocked by ice, snow, debris or rubbish during winter months.

Operation and Maintenance requirements

2.7 Recommendations for the operation and maintenance including typical frequencies are included in **Tables 2, 3** and **4** below.

Table 2: SuDS Operation and Maintenance Requirements- Green Roofs

SUDS Element	**Green Roofs**	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular Maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	6 monthly and annually, or as required
	During establishment (i.e. year one) replace dead plants	Monthly
	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
Remedial Work	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required.
	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources or erosion damage should be identified and controlled	As required.

Monitoring	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.

Table 3: SuDS Operation and Maintenance Requirements- Permeable paving

SUDS Element	**Permeable Paving**	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular Maintenance	Brushing and vacuuming	Once a year or as required
Occasional Maintenance	Stabilise and mow contributing adjacent area	As required
	Removal of weed or management using glyphospate applied directly into weeds by an applicator rather than spraying	As required
Remedial Work	Remediate any landscaping which has been raised to within 50mm of the level of the paving	As required.
	Remedial work to any depressions, rutting and cracked or broken	As required.

	blocks considered detrimental to structural performance or a hazard to users.	
Monitoring	Rehabilitation of surface or upper structure by remedial sweeping	Every 10 to 15 years, or as required
	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	3 monthly, 48hrs after large storms in first 6 months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 4: SuDS Operation and Maintenance Requirements- Attenuation tank

SUDS Element	**Attenuation Tank**	
Maintenance Period	**Maintenance Task**	**Frequency**
Maintenance Work	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 risk to performance)	Monthly
	Remove sediment from pre-treatment structures and/or internal forebays.	Annually, or as required
Remedial Work	Repair/rehabilitate inlets, outlets, overflows and vents	As required.

Monitoring	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.

Suds Management Plan- Appendix A

Drainage Operation and Maintenance Log

Site Maintenance Supervisor:_____ Date:_____

☐ Routine ☐ Response to rainfall event _ in ☐ Other:_____

BMP	Frequency	Date Performed	Comments
Gullies and Manholes	Monthly Inspections		
	Maintenance Quarterly and as necessary		
Pavement Areas (parking, driveways, service areas)	Quarterly Sweeping		
	Rubbish & Litter Removal as Necessary		
Green Roofs	Annual inspection		
Green Roofs Geocellular attenuation (permavoid)	Bi-annual maintenance as necessary		
	Inspect and identify areas not operating property every 3 months (for the first 3 months) and every 6 months after		
Geocellular attenuation (permavoid)	Full bi-annual inspection		

Appendix J

Foul Water Calculations

PRELIMINARY DRAINAGE CALCULATIONS

15/09/2021

EXISTING FOUL WATER

ARDENT
CONSULTING ENGINEERS

Unit Type	Existing Area/Units		Hours (hrs)	Foul Water Flow Rate l/day			Peak Factor	Peaked Loading l/s			Loading (l/s)
office	670	sqm	24	750	per	sqm	6.6	0.0572917	per	property	0.384

TOTAL EXISTING FOUL LOADING = **0.384**

PROPOSED FOUL WATER

Unit Type	Proposed Area/Units		Hours (hrs)	Foul Water Flow Rate l/day			Peak Factor	Peaked Loading l/s			Loading (l/s)
General Housing p	233	units	24	150	per	person	6.6	0.0114583	per	person	2.670

TOTAL PROPOSED FOUL LOADING = **2.670**

STORAGE REQUIREMENTS IF DOWNSTREAM CAPACITY ISSUES (RESIDENTIAL)

Storage Requirements	160	l/s/unit	*Appendix C - Code for Adoption*
Maximum Allowable Rate	4.0	l/s	*Restricted by D/S Capacity*
Excess Number of Units	-116	-	*No. of units that there is no downstream capacity*
Storage Provision	-18.6	m^3	