WEBB YATES ENGINEERS

Flood Risk Assessment and SuDS Report

J3932 Twickenham Riverside

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1. INTRODUCTION

Webb Yates Engineers (WYE) is part of a design team commissioned to undertake a Flood Risk Assessment (FRA) for the development associated with Twickenham Riverside Project. The FRA is to support a planning application for the proposed development

An FRA has been required for this specific site as the proposed development partially lies within Flood Zone 3.

This study considers the issues relating to Flood Risk and drainage associated with the development proposals. The purpose of this assessment is to assess how the development proposal affects flood risk both to the site and the surrounding areas and ensure the development will be safe for its lifetime considering the vulnerability of its users. This will be in accordance with national guidance and local guidance provided by the London Borough of Richmond upon Thames (LBRuT) the Lead Local Flood Authority (LLFA) for the site.

This document has been prepared with reference to:

- National Planning Policy Framework (NPPF) March 2012
- National Planning Practice Guidance (NPPG) March 2014
- Sustainable Drainage Systems: Non-Statutory technical standards for sustainable drainage systems, March 2015.
- Assessing and Managing Flood Risk in Development Code of Practice BS8533:2011.
- Sewers for Adoption 7th Edition, October 2012.
- Environment Agency (EA) Flood Maps (https://flood-map-for-planning.service.gov.uk/).
- Defra's MAGIC Map (https://magic.defra.gov.uk/MagicMap.aspx.
- London Borough of Richmond upon Thames Strategic Flood Risk Assessment (SFRA), 2020
- The London Borough of Richmond Upon Thames (LBRuT) SuDS Guidance Document
- The LBRuT Surface Water Management Plan (SWMP).
- The LBRuT Local Flood Risk Management Strategy.
- The LBRuT Local Plan.
- The London Plan.
- The London Supplementary Planning Guidance (SPG) – Sustainable Design and Construction (www.london.gov.uk) 2014.
- London Borough of Richmond upon Thames: Guidance on Producing a Flood Emergency Plan, November 2011.
- Thames Estuary 2100 (TE2100) Plan
- Phase 1 and Phase 2 – Site Investigation Report, GeoSphere Environmental 4955,GI/GROUND/ PC,SG,JD,19-11-20/V2, 19/11/2020

2. GENERAL DESCRIPTION OF SITE

Details of the site location are included below in Table 1 supported by Figure 1 and Figure 2.

Table 1: Site location

Description	Site Location
Nearest post code	TW1 3DX
Lead Local Flood Authority	London Borough of Richmond upon Thames
Area	1.2 ha
Lat, Long	51.445646, -0.327590
Nat Grid	TQ163731 / TQ1632173177
OS X (Eastings)	516321
OS Y (Northings)	173177
Nearest watercourse	River Thames

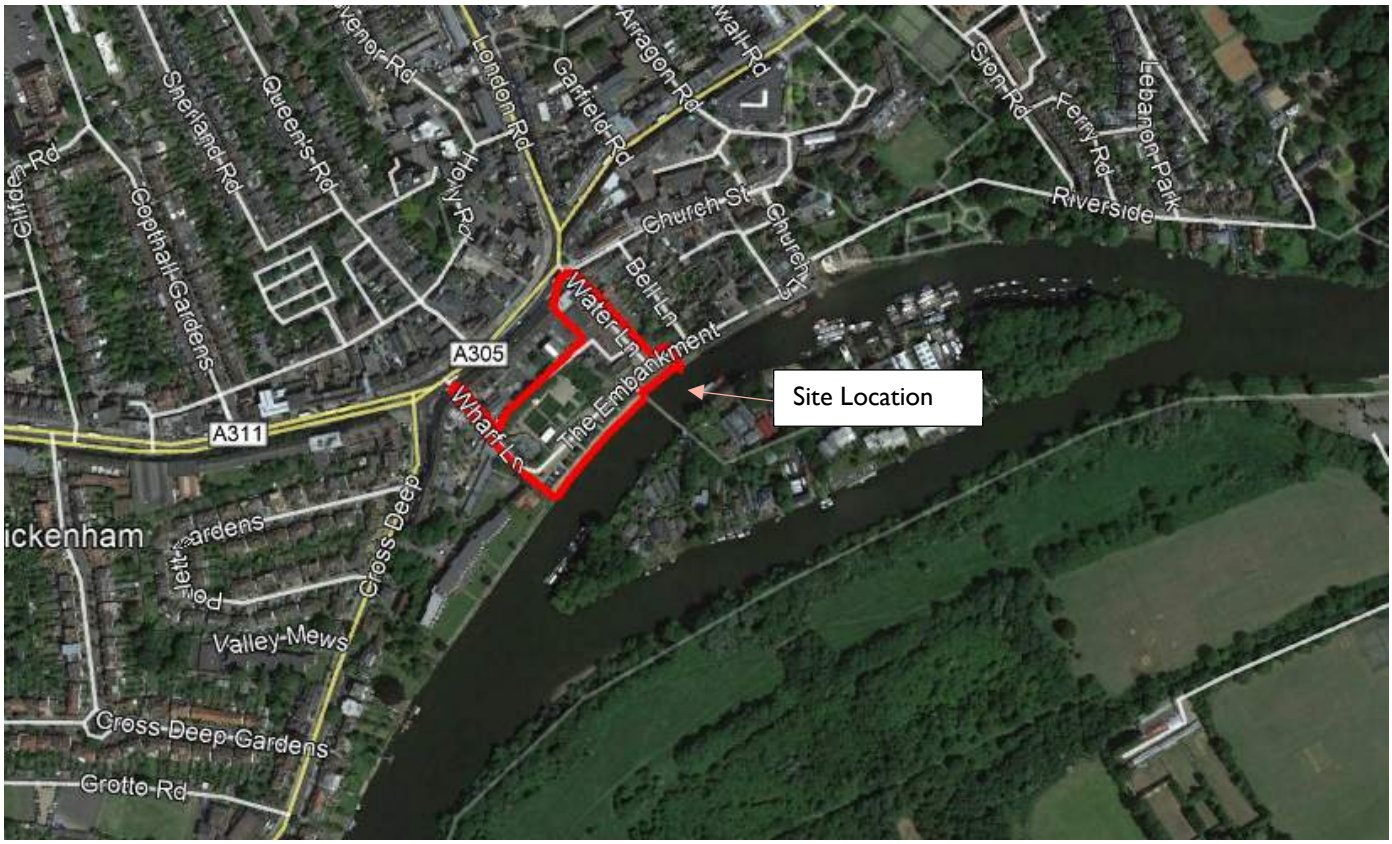


Figure 1. Site location (Satellite image)

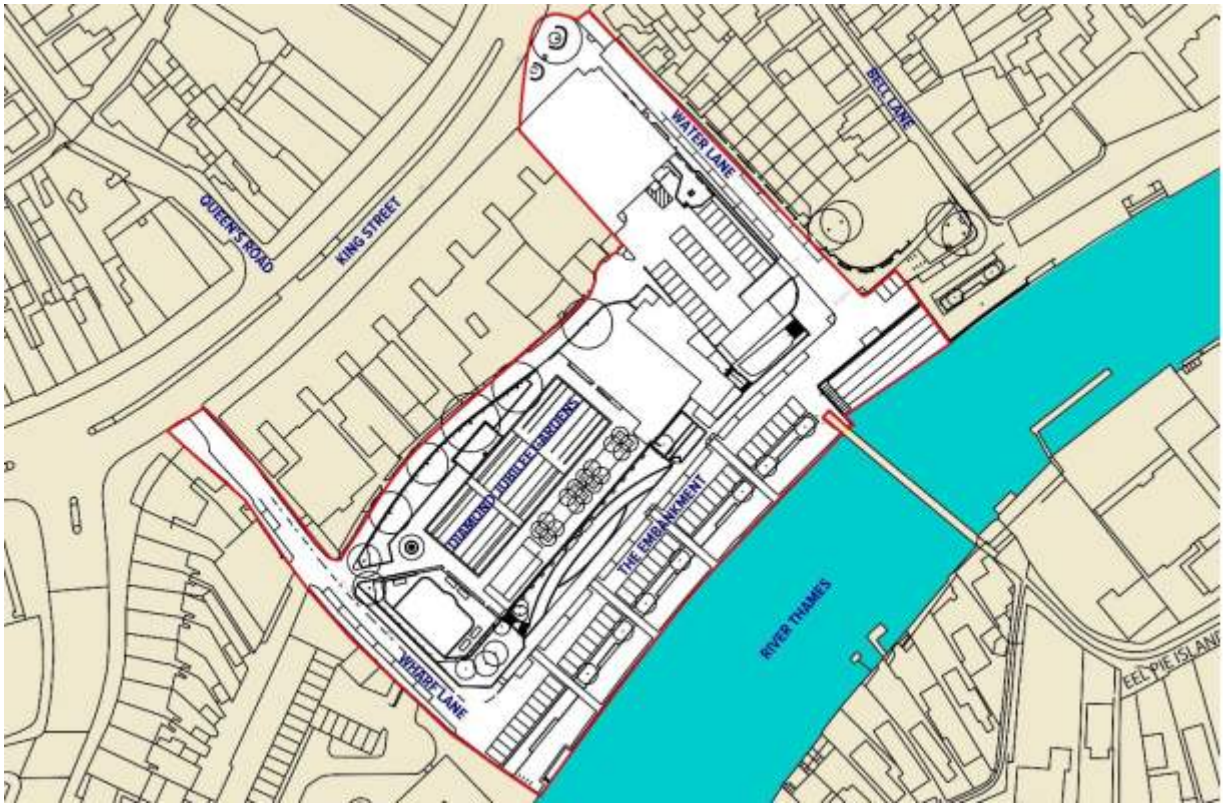


Figure 2. Site location

The site is bound by Water Lane to the north-east, retail units and Diamond Jubilee Gardens to the north-west, Wharf Lane to the south-west and The Embankment to the south-east. The total site area is approximately 1.2 ha. Currently, the southwestern portion of the site is occupied by the Diamond Jubilee Gardens. A car park is situated to the south-east of the site and commercial buildings occupy the north-east of the site. A topographical survey of the site can be found in Appendix A.

3. SITE CONTEXT

3.1. Geology

A desktop review of the geology in the area was undertaken using the British Geological Survey (BGS) maps. For more detailed geological information refer to the Phase 1 and Phase 2 – Site Investigation Report completed by Geosphere Environmental 19/11/2020, report reference: 4955,GI/GROUND/ PC,SG,JD,19-11-20/V2.

The bedrock material of the site was identified as The London Clay (refer to Figure 3). This material mainly comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand, which commonly increase towards the base and towards the top of the formation. At the base, and at some other levels, thin beds of black rounded flint gravel occurs in places. Glauconite is present in some of the sands and in some clay beds, and white mica occurs at some levels.

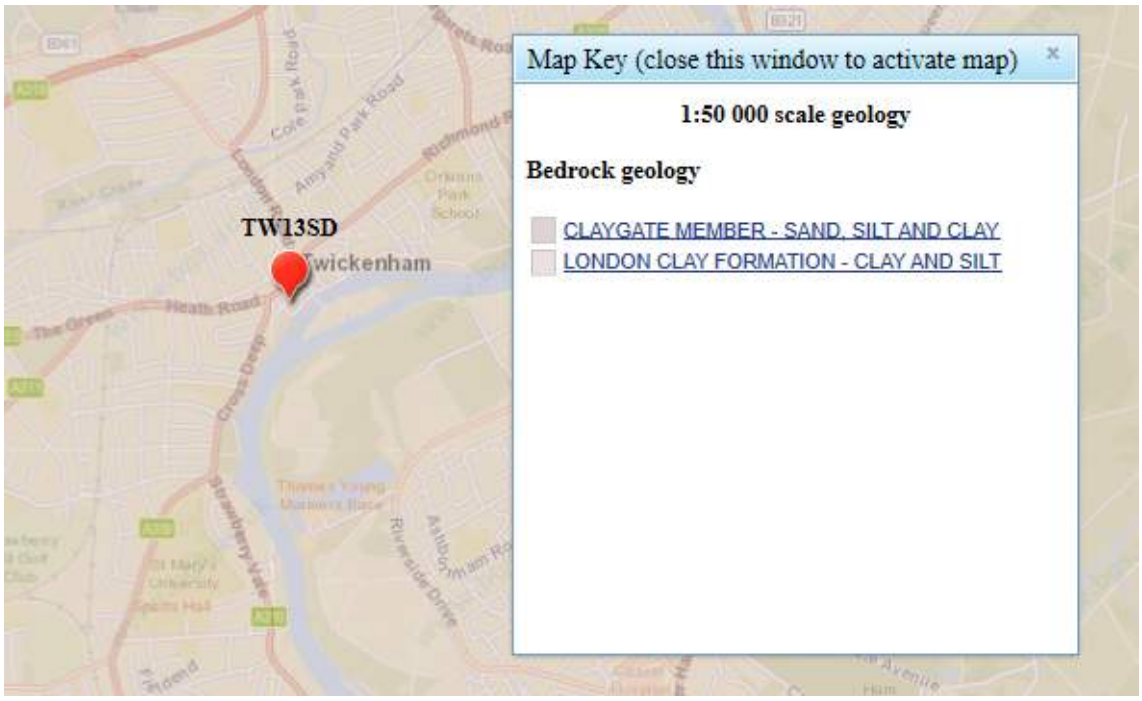


Figure 3. BGS Bedrock Material

The site superficial ground material was identified as Langley Silt Member- Clay and Silt. (refer to Figure 4).

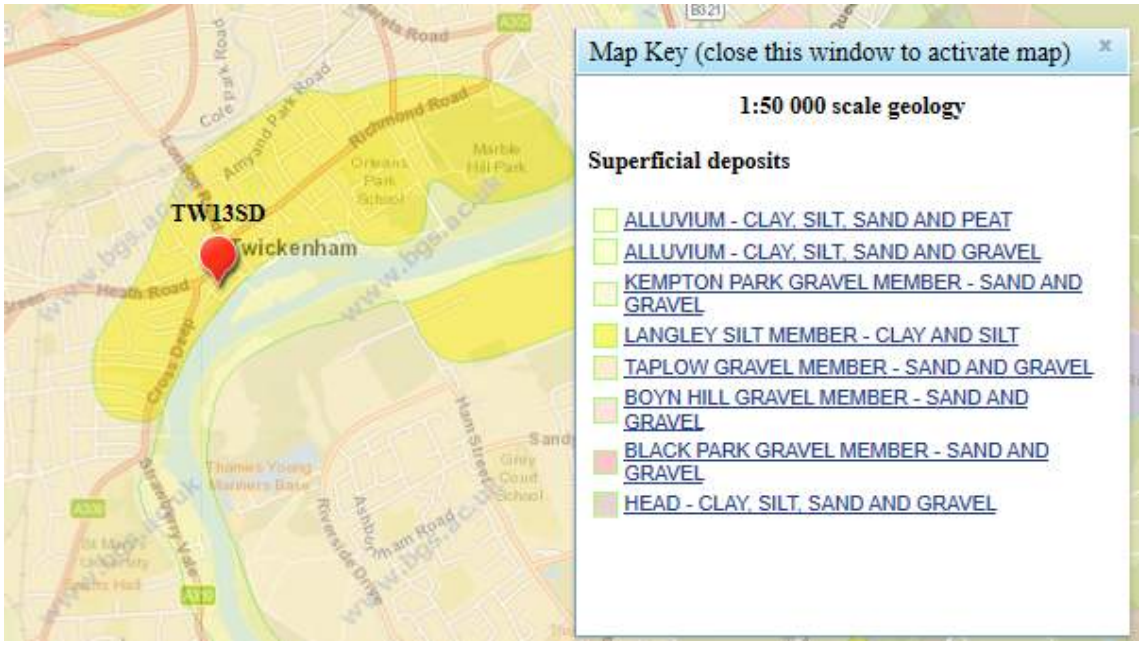


Figure 4. BGS Superficial Material

Historical boreholes, within the site boundary, were identified on the BGS website, refer to Figure 5.

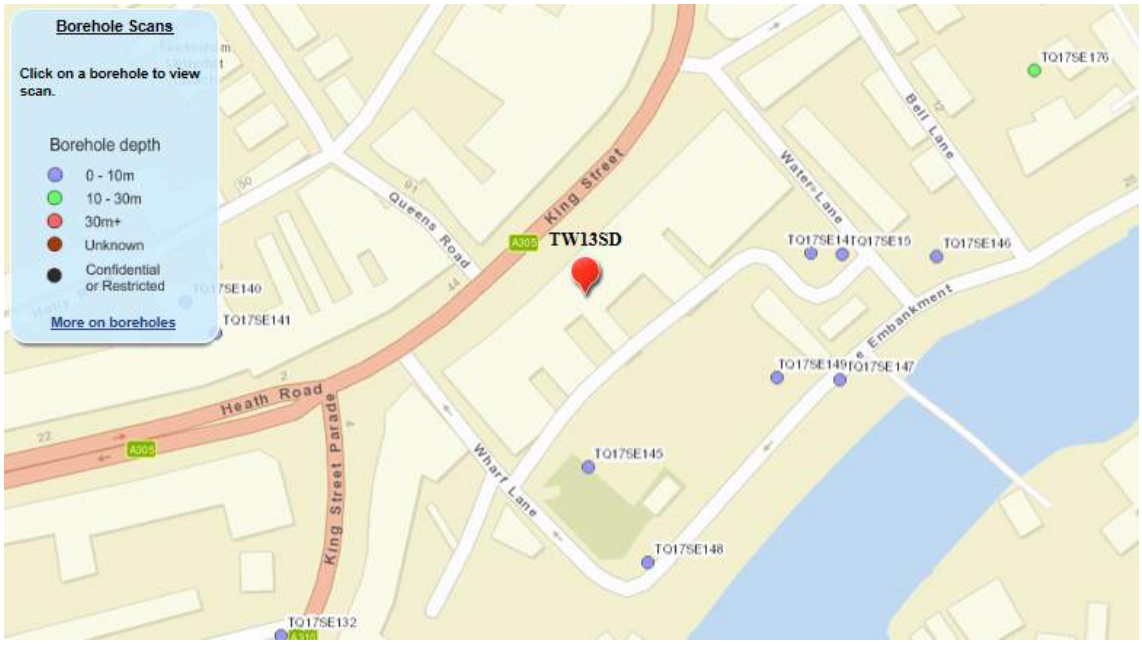


Figure 5. BGS Historical Boreholes

The results shall be subject to site specific investigation.

3.2. Existing drainage

Figure 6 shows the existing drainage infrastructure including the existing pipe network, flood defences and permeable area.

Figure 6. Existing drainage

3.2.1. Flood defences

The product 4 data for the site states the following bout the existing flood defences.

"The design standard of protection of the flood defences in this area of the Thames is 0.1% AEP; they are designed to defend London up to a 1 in 1000 year tidal flood event. The defences are all raised, man-made and privately owned. It is the riparian owners' responsibility to ensure that they are maintained to a crest level of 6.02 m mAOD (the Statutory Flood Defence Level in this reach of the Thames). We inspect them twice a year to ensure that they remain fit for purpose. The current condition grade for defences in the area is 2 (good), on a scale of 1 (very good) to 5 (very poor). There are no planned improvements in this area."

The infrastructure protected by the existing flood defence includes the Diamond Jubilee Park, Carparks and disused buildings. These protected areas are those which shall be removed or replaced as part of the proposed development. Therefore, the risk associated with changing the flood defence location is negligible to the surrounding area.

3.2.2. Existing Sewer/ Surface Water

Details of the existing sewer network was provided by Thames Water.

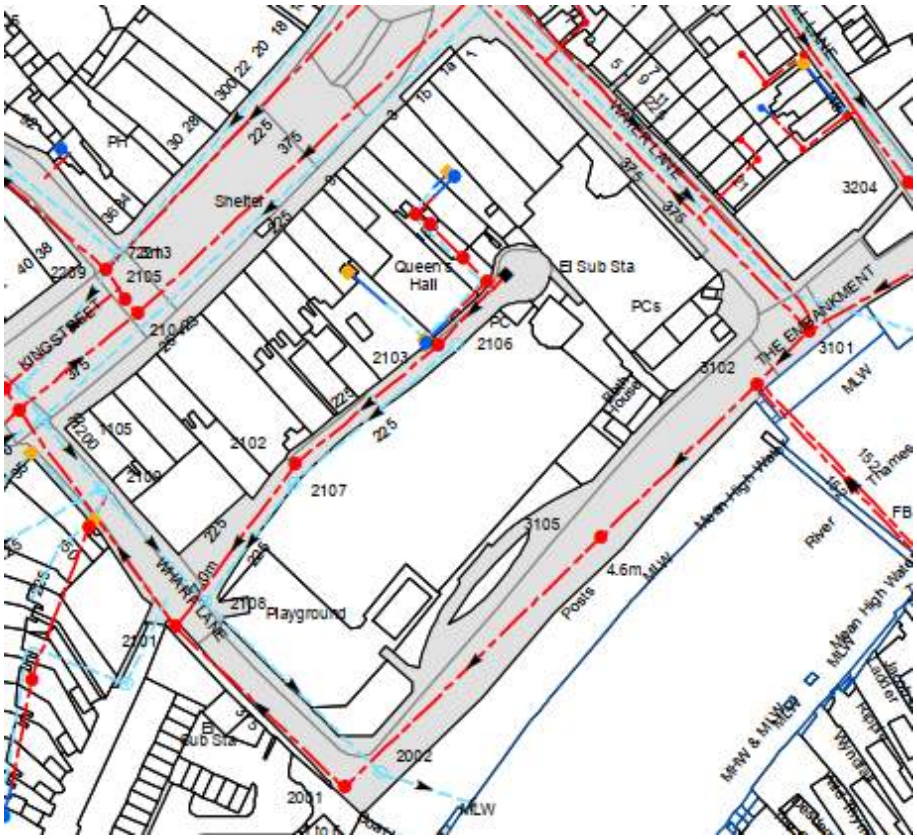


Figure 7. Extract from Thames Water Asset Search

4. PLANNING POLICY AND GUIDANCE

4.1. National Planning Policy Framework and Planning Practice Guidance

The revised National Planning Policy Framework (NPPF), published in Feb 2019, sets out the UK Government's planning policies for England, and how these are expected to be implemented. The Planning Practice Guidance (PPG) provides advice on how to account for and address the risks associated with flooding. It was first published in 2014 and is updated on a regular basis to meet the changes in the NPPF.

The NPPF aims to steer development away from areas at high risk of flooding. In order to achieve this, development types are classified according to vulnerability. The "Flood Risk and Coastal Change" chapter of the PPG details acceptable compatibility between flood zones and development types and is based on revised NPPF technical guidance (see tables below).

The NPPF states that a site-specific Flood Risk Assessment is required to identify and assess the risks of all forms of flooding to and from the development for all developments greater than 1.0 (ha) in flood zone. The Flood Zone definitions are provided in the "Flood risk and Coastal Change" chapter of the PPG, indicated below.

Table 2. Flood zone definition

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Source: Planning Practice Guidance, Flood Risk and Coastal Change

Figure 8: Government Long term flood risk assessment for locations in England map showing Flood Zones [https://flood-map-for-planning.service.gov.uk/]

In accordance with the NPPF, as the site is larger than 1.0 ha and partially situated within **Flood Zone 3**, a site-specific FRA is required.

Table 3 Site specific flood zone elevations

Flood Zone	Tidal flood level	Fluvial flood level	Critical flood level
Flood Zone 1	≥ 6.9 m	≥ 6.94 m	≥ 6.94 m
Flood zone 2	6.42 m - 6.90 m	5.69 m – 6.94 m	6.42 m - 6.94 m
Flood zone 3	≤ 6.42 m	≤ 5.69 m	≤ 6.42 m

LBRuT SFRA classifies the Flood Zone 3 area of the site as Flood zone 3b Functional Floodplain.

The "Flood Risk and Coastal Change" chapter of the PPG provides guidance on the suitable development types for each flood zone classification (see Table 4).

Table 4. Flood Risk Vulnerability and Flood Zone Compatibility

Flood risk vulnerability classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
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.*

Source: Planning Practice Guidance, Flood Risk and Coastal Change

The proposed design includes a variety of development types. The risk vulnerability classification of each development type, in accordance with "Flood Risk and Coastal Change" chapter of the PPG, is summarised in Table 5 below.

Table 5 Site specific Flood Risk Vulnerability and Flood Zone Compatibility

		Sequential test results			
Development Type	Flood risk vulnerability classification	Flood Zone 1	Flood Zone 2	Flood Zone 3a	Flood Zone 3b
Basement/Plant room	Highly Vulnerable	✓	Exception Test Required	×	×
Residential	More Vulnerable	✓	✓	Exception Test Required	×
Nursery	More Vulnerable				
Pub	More Vulnerable				
Café	Less Vulnerable	✓	✓	✓	×
Commercial/Retail	Less Vulnerable				
Workspace	Less Vulnerable				
Museum	Less Vulnerable				
Open space	Water compatible	✓	✓	✓	✓

4.1.1. Exception Test

The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. For the exception test to be passed it should be demonstrated that:

(a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and

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

As the proposed design has all of the proposed Highly Vulnerable, More Vulnerable and Less Vulnerable development located in Flood Zone 1, no exception test is required.

4.2. The London Plan (2016) and the Draft New London Plan (2017)

The London Plan (2016) is the current overall development strategy for London over the next 20-25 years. It sets up an integrated economic, environmental, transport and social framework supported by detailed regulations. Further to the 2016 version, a new draft London Plan was published for consultation in December 2017. Whilst not expected to be adopted until 2019, the draft new London Plan has been considered in this assessment as it is increasingly referred to in the planning decision process. Minor comments have been added to the Draft New London Plan in August 2018 however these are primarily re-wordings and do not change the recommended approach outlined by the London Plan 2016.

Policy 5.12 Flood risk management states:

- Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 (TE2100) and Catchment Flood Management Plans.
- Developments which are required to pass the Exceptions Test set out in the NPPF and the Technical Guidance will need to address flood resilient design and emergency planning by demonstrating that:
    - the development will remain safe and operational under flood conditions
    - a strategy of either safe evacuation and/or safely remaining in the building is followed under flood conditions
    - key services including electricity, water etc will continue to be provided under flood conditions
    - buildings are designed for quick recovery following a flood.
- Development adjacent to flood defences will be required to protect the integrity of existing flood defences and wherever possible should aim to be set back from the banks of watercourses and those defences to allow their management, maintenance and upgrading to be undertaken in a sustainable and cost effective way.

Policy 5.13. Sustainable drainage states:

The London Plan states that the development should utilise sustainable urban drainage systems (SuDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. store rainwater for later use
2. use infiltration techniques, such as porous surfaces in non-clay areas
3. attenuate rainwater in ponds or open water features for gradual release

4. attenuate rainwater by storing in tanks or sealed water features for gradual release
5. discharge rainwater direct to a watercourse
6. discharge rainwater to a surface water sewer/drain
7. discharge rainwater to the combined sewer.

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

4.3. Non-statutory Technical Standards for Sustainable Drainage Systems

The Non-Statutory Technical Standards for Sustainable Drainage Systems was published in March 2015 and is the current guidance for the design, maintenance and operation of SuDS.

The standards set out the following requirements relevant to this design:

- S1: Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards (S2 and S3 below) and volume control technical standards (S4 and S6 below) need not apply.
- S3: For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.
- S5: Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to that development.
- S6: Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk
- S7: The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.
- S8: The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event in any part of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development

- S9: The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

4.4. London Borough of Richmond upon Thames Strategic Flood Risk Assessment (SFRA), 2020

The purpose of this Level 1 Strategic Flood Risk Assessment (SFRA) is to deliver the planning and flood risk requirements as defined by the 2019 National Planning Policy Framework (NPPF). This SFRA supersedes the 2016 SFRA, enabling Richmond upon Thames to be compliant with the latest policy requirements and utilise the latest data to better assess flood risk.

4.5. London Borough of Richmond Upon Thames Local Plan

The London Borough of Richmond upon Thames (LBRT) Local Plan was adopted in July 2018. The Local Plan sets out policies and guidance for development in the borough over the next 15 years and replaces previous policies within the Core Strategy and Development Management Plan.

Policy LP21 of the Local Plan deals with Flood Risk and Sustainable Drainage. This policy states:

A. All developments should avoid, or minimise, contributing to all sources of flooding, including fluvial, tidal, surface water, groundwater and flooding from sewers, taking account of climate change and without increasing flood risk elsewhere. Development will be guided to areas of lower risk by applying the 'Sequential Test' as set out in national policy guidance, and where necessary, the 'Exception Test' will be applied. Unacceptable developments and land uses will be refused in line with national policy and guidance, the Council's Strategic Flood Risk Assessment (SFRA) and as outlined in the table below.

   In Flood Zones 2 and 3, all proposals on sites of 10 dwellings or more or 1000sqm of non-residential development or more, or on any other proposal where safe access/egress cannot be achieved, a Flood Emergency Plan must be submitted.

   Where a Flood Risk Assessment is required, on-site attenuation to alleviate fluvial and/or surface water flooding over and above the Environment Agency's floodplain compensation is required where feasible.

Zone	Land uses and developments – restrictions	Sequential Test	Exception Test	Flood Risk Assessment
3b	The functional floodplain as identified in the Council's Strategic Flood Risk Assessment will be protected by not permitting any form of development on undeveloped sites unless it: • is for Water Compatible development. • is for essential utility infrastructure which has to be located in a flood risk area and no alternative locations are available and it can be demonstrated that the development would be safe, without increasing flood risk elsewhere and where possible would reduce flood risk overall.	Required for essential utility infrastructure	Required for essential utility infrastructure	Required for all development proposals

	Redevelopment of existing developed sites will only be supported if there is no intensification of the land use and a net flood risk reduction is proposed; any restoration of the functional floodplain will be supported. Proposals for the change of use or conversion to a use with a higher vulnerability classification will not be permitted.			
3a	Land uses are restricted to Water Compatible, Less Vulnerable and More Vulnerable development. Highly Vulnerable developments will not be permitted. Self-contained residential basements and bedrooms at basement level will not be permitted.	Required for all developments unless exceptions outlined in the justification apply	Required for more vulnerable development	Required for all development proposals
2	No land use restrictions Self-contained residential basements and bedrooms at basement level will not be permitted.	Required for all developments unless exceptions outlined in the justification apply	Required for highly vulnerable development	Required for all development proposals unless for change of use from water compatible to less vulnerable
1	No land use restrictions	Not applicable	Not applicable	A Drainage Statement is required for sites all major developments. Required for all other development proposals where there is evidence of a risk from other sources of flooding, including surface water, ground water and sewer flooding.

B. Basements within flood affected areas of the borough represent a particularly high risk to life, as they may be subject to very rapid inundation. Applicants will have to demonstrate that their proposal complies with the following:

Flood Zone 3b (Functional Floodplain)	Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units will not be permitted
Flood Zone 3a (Tidal / Fluvial)	In areas of Extreme, Significant and Moderate Breach Hazard (as set out in the Council's SFRA): <u>New basements:</u> • restricted to Less Vulnerable / Water Compatible use only. • 'More Vulnerable' uses will only be considered if a site-specific Flood Risk Assessment demonstrates that the risk to life can be managed. Bedrooms at basement levels will not be permitted. • 'Highly Vulnerable' such as self-contained basements/bedrooms use will not be permitted. <u>Existing basements:</u> • No basement extensions, conversions or additions for 'Highly Vulnerable' uses. • 'More Vulnerable' uses will only be considered if a site-specific Flood Risk Assessment demonstrates that the risk to life can be managed. In areas of Low or No Breach Hazard (as set out in the Council's SFRA): • <u>New basements:</u> if the Exception Test (where applicable) is passed, basements may be permitted for residential use where they are not self-contained or used for bedrooms.

	• Existing basements: basement extensions, conversions or additions may be permitted for existing developments where they are not self-contained or used for bedrooms. If a basement, basement extension or conversion is acceptable in principle in terms of its location, it must have internal access to a higher floor and flood resistant and resilient design techniques must be adopted.
Flood Zone 2	In areas of Extreme, Significant and Moderate Breach Hazard (as set out in the Council's SFRA): • New Basements: if the Exception Test (where applicable) is passed, basements may be permitted for residential use where they are not self-contained or used for bedrooms. • Existing Basements: basement extensions, conversions or additions maybe permitted for existing developments where they are not self-contained or used for bedrooms. If a basement, basement extension or conversion is acceptable in principle in terms of its location, it must have internal access to a higher floor and flood resistant and resilient design techniques must be adopted.
Flood Zone 1	No restrictions on new or extensions to existing basements

C. The Council will require the use of Sustainable Drainage Systems (SuDS) in all development proposals. Applicants will have to demonstrate that their proposal complies with the following:

   a. A reduction in surface water discharge to greenfield run-off rates wherever feasible.

   b. Where greenfield run-off rates are not feasible, this will need to be demonstrated by the applicant, and in such instances, the minimum requirement is to achieve at least a 50% attenuation of the site's surface water runoff at peak times based on the levels existing prior to the development

D. Applicants will have to demonstrate that their proposal complies with the following:

   a. Retain the effectiveness, stability and integrity of flood defences, riverbanks and other formal and informal flood defence infrastructure.

   b. Ensure the proposal does not prevent essential maintenance and upgrading to be carried out in the future.

   c. Set back developments from riverbanks and existing flood defence infrastructure where possible (16 metres for the tidal Thames and 8 metres for other rivers).

   d. Take into account the requirements of the Thames Estuary 2100 Plan and the River Thames Scheme, and demonstrate how the current and future requirements for flood defences have been incorporated into the development.

   e. The removal of formal or informal flood defences is not acceptable unless this is part of an agreed flood risk management strategy by the Environment Agency

4.6. Thames Estuary 2100 (TE2100)

The TE2100 plan is the overarching flood management strategy for the Thames Estuary and therefore any development planning should be based on the same underlying data.

The TE2100 in-channel levels take into account operation of the Thames Barrier when considering future levels. The Thames Barrier requires regular maintenance and with additional closures the opportunity for maintenance will be reduced. When this happens, river levels – for which the Barrier would normally shut for the present-day condition – will have to be allowed through to ensure that the barrier is not shut too often. For this reason, levels upriver of the barrier will increase and the tidal walls will need to be heightened to match.

In west London there is a heavy influence from upriver flows (fluvial flows). The flood defences are built to manage tidal flood risk only. With very high fluvial flows, the river levels in west London could be above the 0.1% annual probability tidal level.

The climate change levels are assessed to determine the future tidal defence levels. For this reason, they only account for extreme tidal events and not extreme fluvial flow events.

The EA Product 4 data shows that the closest upstream node to the site is 2.2. The present-day water level at this node is 5.95 m AOD and future water level, in 2100, is 6.45 m AOD. New development should either include future defence raising or demonstrate that future raising will be feasible to a level of 6.90 m AOD.

4.7. Building Regulations Part H

The Building Regulations Requirement H3 stipulates that rainwater from roofs and paved areas is carried away from the surface to discharge to one of the following (listed in order of priority):

a) an adequate soakaway or some other adequate infiltration system,

b) a watercourse, or where that is not practicable,

c) a sewer.

5. PROPOSED DEVELOPMENT

The proposed development includes the removal of the existing buildings from the site and includes 2 proposed buildings, referred to as the Wharf Lane building and the Water Lane building.

The Water Lane development is 4 stories high and bridges over the proposed laneway access which runs along the back of the proposed development. It contains residential dwellings above ground level. Ground level shall contain a café space, retail and plant room.

The Wharf Lane building is 5 stories high with a basement. The top 4 floors of the building are proposed to be residential apartments. The ground floor contains a pub and office/retail space. The basement is proposed for WC, storage, pub kitchen and plant room.

As part of the project brief, 2600 m^3 is required to be included in the project for the Diamond Jubilee Park. This area is required to be above the 1 in 100-year rainfall event + 35% climate change as part of the project conditions. The project also includes the removal of parking form The Embankment area and alteration to the existing retaining walls and landscaping.

Refer to Appendix B for drawings of the proposed design.

6. POTENTIAL SOURCES OF FLOODING

6.1. Flooding from Sea and Rivers

6.1.1. Climate change

In accordance with the NPPF guidance, the effects of climate change should be included within the assessment of future flood risk. Peak river flow allowances show the anticipated changes to peak flow by river basin district. The table below is an extract of the NPPF peak river flow climate change allowances for the River Thames basin.

Table 6: peak river flow climate change allowances for the River Thames

River basin district	Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%

To determine which allowance category to apply, it is necessary to consider the flood zone and the flood vulnerability risk classification. From the PPG it was assessed that the following climate change allowances are appropriate:

1. highly vulnerable – use higher central and upper end allowances to assess a range of allowances – 35% - 70%
2. more vulnerable – use the higher central and upper end allowances to assess a range of allowances - 35% - 70%
3. less vulnerable – use the higher central allowances - 35%
4. water compatible – use the central allowance – 25%

The proposed Diamond Jubilee Park area is required to have a 35% climate change allowance applied as part of the project conditions.

6.1.2. Existing flood risk

Fluvial and tidal flooding occurs when the capacity of a watercourse is exceeded such that water overtops the channel. The risk of flooding from rivers or seas is classified as **High**, based on Figure 9.

The EA's modelled floodplain map shows that part of the site is within Flood Zone 3. Therefore, it is at risk of flooding from the River Thames. Land in flood zone 3 is assessed as having annual probability of fluvial flooding greater than 1% or tidal flooding greater than 0.5% and comprises of land utilise for flow and storage in times of flood.

Tidal records indicate that the monthly high tide at the nearby Richmond Lock reach up to 5.4 mAOD, indicating that the low tier of the site is likely store flood water multiple times in a single year.

In West London, there is a heavy influence from upstream (fluvial) flows. The flood defences are built to manage tidal flood risk only. With very high fluvial flows, the river levels in west London could be above the tidal defence level.

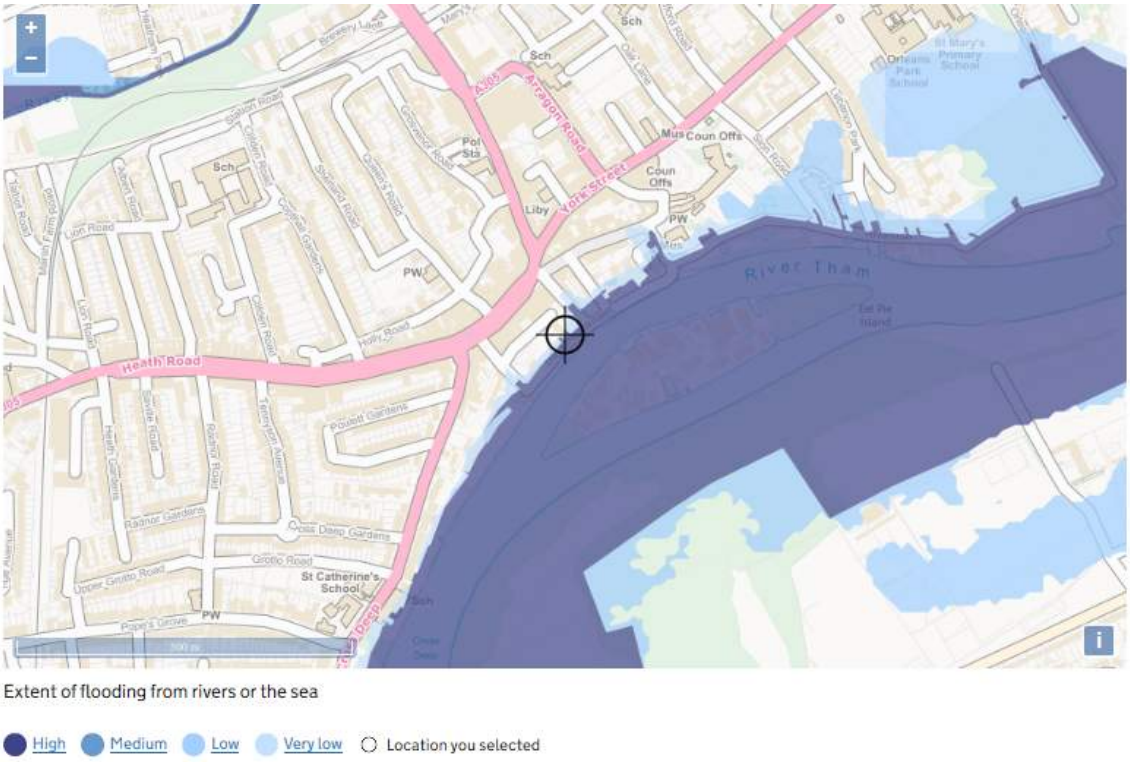


Figure 9: EA Online Flood Map from Sea and Rivers (Source: https://flood-map-for-planning.service.gov.uk).

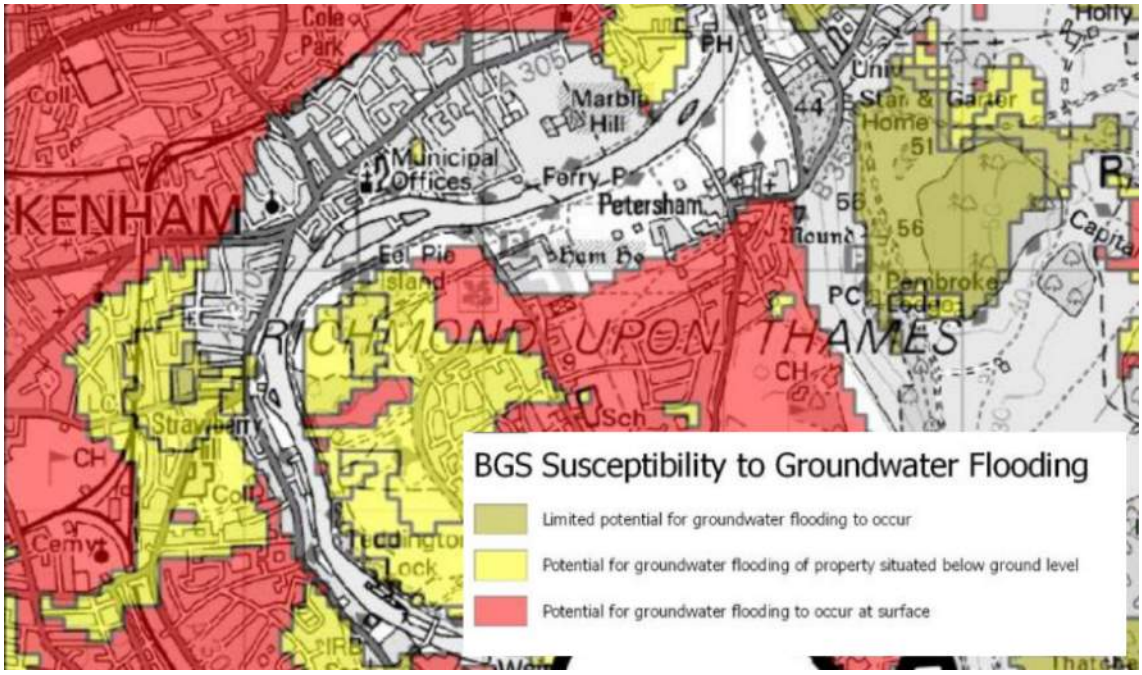
The tidal flood risk was provided by the EA with the product 4 information. The TE2100 flood level is 6.45 m and the TE2100 flood defence level is 6.90 m AOD.

Product 7 fluvial flood information was provided by the EA which identified that the maximum flood level for the site in a 1 in 100-year event + 35% allowance for climate change was 6.94 m AOD.

6.2. Flooding from groundwater

As the site is situated on impermeable strata, the site is not likely to be at risk from groundwater flooding. Furthermore, the SFRA shows that the site is not situated in an area susceptible to groundwater flooding. The risk of flooding from groundwater is considered **Negligible.**

Figure 10 BGS Susceptibility to Groundwater Flooding.



The London Borough of Richmond upon Thames SFRA suggests that a screening assessment is carried out as part of the planning application submission for all basement and cellar proposals within the throughflow and groundwater policy zones. The screening assessment should address the impacts of the proposed subsurface development on the area's subterranean characteristics, land stability, and flood risk and drainage.

Since a basement is included as part of the proposal the following points are thought to negate the need for further assessment of this risk:

1. As the site is situated on impermeable strata, the site is not likely to be at risk from groundwater flooding. Furthermore, the SFRA shows that the site is not situated in an area susceptible to groundwater flooding.
2. The preliminary site investigation results indicate that there are below ground obstructions which would prevent reliable infiltration for the area of the site located within Flood Zone 1. The site was previously used as a Lido which has since been filled with impermeable material, the specific detail of this material is unknown. The site contains existing buildings and the associated below ground foundations which may be removed as part of the proposed works. This combination of existing below ground obstructions makes the existing site unfavourable for throughflow of groundwater.
3. Any proposed basement shall be designed to be watertight and to allow for the water pressure in the surrounding ground material since the basement floor level shall be lower than the 100 + 35% CC fluvial flood event. This protects the basement from any risk associated with groundwater or through flow.

4. Any existing through flow, which managed to travel through the ground obstructions, would drain to the lower adjacent ground via weep holes in the existing flood defence walls surrounding the site. The proposed design reduces the number of retaining walls surrounding the raised land, due to the tiered landscaping on the south west corner of the site. The effect on any groundwater flow through would be beneficial as the landscaping provides an easier path for water than the existing retaining walls and weep holes.
   The areas where retaining walls are proposed to be used for flood defence would not increase the risk from the existing condition.

5. Aside from during major fluvial flood events, when the ground is saturated from flood levels above ground level, the groundwater level for the site is expected to be low as shown in Figure 10. In the rare event that groundwater flooding was to occur, this would be in the low-lying areas of flood zone 3b including The Embankment, Water Lane and Wharf Lane. The proposed basement and buildings are protected from flooding in these areas by flood defence structures.

The above points demonstrate why the proposed development, including the basement, does not increase the throughflow and groundwater related flood risk for the site or neighbouring properties.

6.3. Flooding from Sewers

The LBRuT SFRA identified zero sewer flooding incidents at the proposed site. An extract from the SFRA Sewer Flooding map is below in Figure 11. Therefore, the risk of flooding from sewer is considered **Low.**

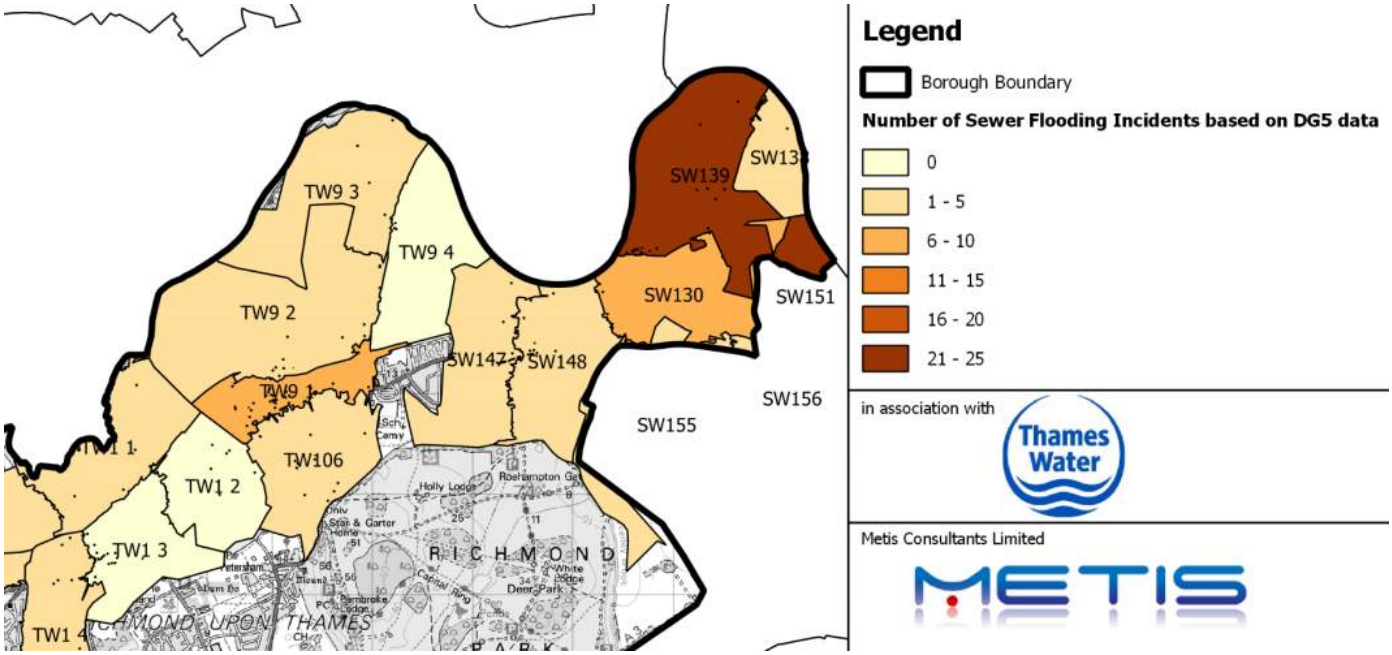


Figure 11. Sewer Flooding Incidents Map (LBRuT SFRA Extract)

6.4. Flooding from Surface Water

6.4.1. Climate change

In accordance with the NPPF guidance, the effects of climate change should be included within the assessment of future flood risk. As the site area is less than 5 km^2, the site is classified as 'small' and therefore the climate change allowances in NPPF Technical Guidance Table 2 are appropriate. This table has been included below for reference.

Table 7: Table showing climate change allowances (Extract from NPPF Technical Guidance, Table 2)

Table 2: peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Based on these values the hydraulic drainage design for the proposed drainage network has been modelled for a range of rainfall intensities up to and including ones for a 1 in 100 year event plus 40% allowance for climate change.

6.4.2. Existing flood risk

Flooding from surface water maps provided by the Environment Agency have been used to assess the effects of flooding from pluvial effects. There are four levels of risk as defined by the Environment Agency:

- High – each year, the area has a chance of flooding of greater than 1 in 30 (3.3%)
- Medium – each year, the area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%)
- Low – Each year, the area has a chance of flooding of less than 1 1000 (0.1%) and 1 in 100 (1%)
- Very low – each year, the area has a chance of flooding of less than 1 in 1000 (0.1%)

Figure 12: EA Online Surface Water Flood Map (Source: https://flood-warning-information.service.gov.uk/long-term-flood-risk/map).

Figure 12 identifies that there is a **Low** risk of flooding on Water Lane and Wharf Lane.

The proposed changes to Wharf Lane and Water Lane are not likely to change the risk of surface water flooding in these areas. Overflow and flood waters will continue to flow by gravity to the edge of The Embankment into the River Thames.

Surface water in Flood Zone 3b shall drain directly into the river. Surface water in the areas protected by the flood structures shall either infiltrate into the proposed soft landscaping, or be captured within a drainage network and attenuated prior to discharge into the existing Thames Water network which outfalls through the River Thames wall. Therefore, the risk of surface water flooding remains **Low** for Wharf Lane and Water Lane and **Very Low** for the area protected by the flood defence structures.

6.5. Flooding from Reservoirs, Canals and Other Artificial Sources

The 'Risk of flooding from reservoirs' map, produced by the Environment Agency (Figure 13) indicates that there is a **Negligible** Risk of flooding from this source at the location of the Proposed Development buildings which will be protected by the elevated topography. There is some residual risk to the areas of the site within flood zone 3b however this is not increased from the existing condition. There are no other known sources of flood risk that would pose a risk to the development site.

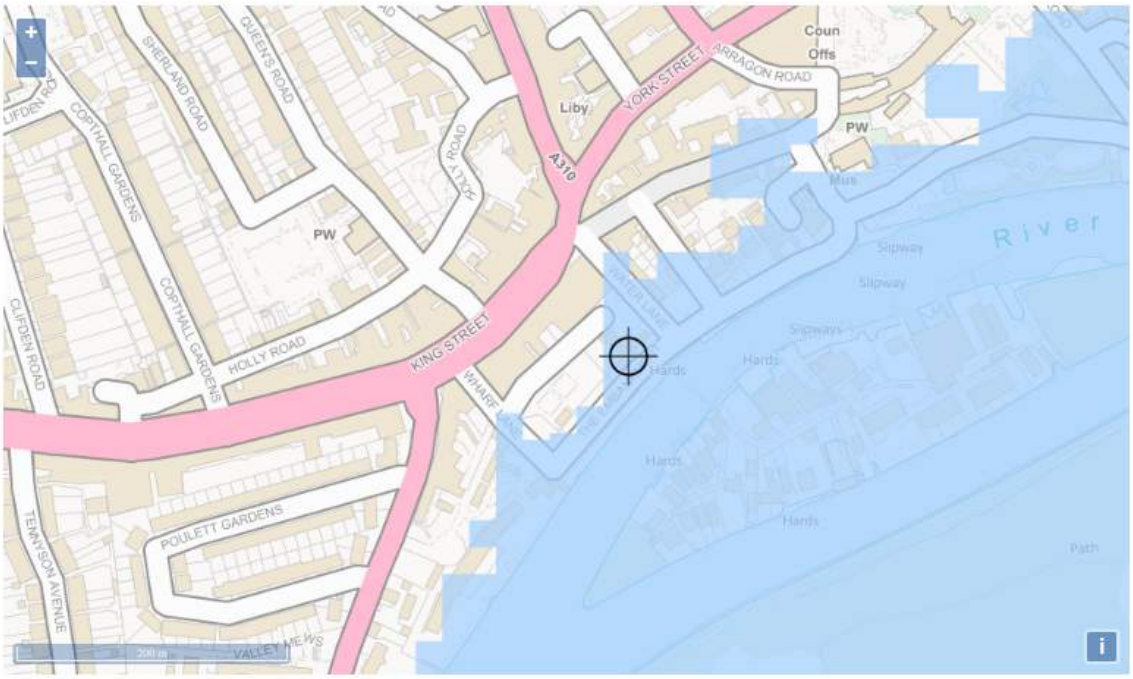


Figure 13: EA Online Flooding from Reservoirs Map (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map).

7. PRELIMINARY DRAINAGE STRATEGY

In accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems, flow from the site which can be directly drained into the River Thames shall not be subject to peak flow or volume restrictions.

To avoid changes to the river wall, surface water runoff which cannot drain by gravity directly into the River Thames is proposed to be captured and discharged into the existing Thames Water surface water network. The invert level of the Thames water pipe is lower than the daily high tides therefore the design shall provide sufficient attenuation on site to prevent flooding as a result of choking or backflow from the downstream connection.

An allowance of 40% additional rainfall shall be made for the effects of climate change in accordance with the National Planning Policy Framework (NPPF).

The proposed design shall increase the green area of the site, this will be quantified during the next stage of the design. However, due to the high tidal levels and the preliminary site investigation results, infiltration is not currently considered a viable option for surface water discharge.

7.1. Proposed Flood Defences

The proposed design shall remove the existing flood defence and provide new flood defence structures around the proposed development. The flood defence wall shall provide protection equal or greater than the TE2100 defence level of 6.90 m. Sketch J3932-C-SK-0009 located in Appendix B shows the location of the proposed flood defence line relative to the existing.

To ensure no increase in flood risk for the area, the new flood wall location and the proposed design shall be assessed to ensure there is no loss of flood storage in a level for level volume assessment. The Stage 2 Flood Storage Assessment is included in Appendix B.

7.2. Foul Water Drainage

It is proposed to keep the new above ground foul drainage runs separate from the surface water drainage and connect into the existing Thames Water foul network. During the next design stage Thames Water shall be contacted regarding the capacity of their existing foul water network to ensure this connection can be achieved. Sketch J3932-C-SK-0009 in Appendix B shows the proposed flood defence wall relative to the existing foul drainage and identified where diversions may be required.

8. FLOOD RISK MITIGATION MEASURES

The following flood risk mitigation measures shall continue to be developed as the design progresses.

8.1. Flood Emergency Plan

A Flood Emergency Plan shall be produced for the site. The plan shall be in accordance with the LBRuT document: Guidance on Producing a Flood Emergency Plan – November 2011.

8.2. Freeboard:

The proposed development ground floor level has an FFL of 7.4 m AOD which provides 0.5 m of freeboard above the TE2100 future defence level. This provides 0.46 m freeboard above the fluvial flood level for the 1 in 100 year event + 35% climate change. This is greater than the minimum freeboard of 300 mm specified by the LBRuT SFRA.

8.3. Flood Compensation

Loss of available floodplain storage due to changes to flood defence walls locations and landscaping can result in an increase in the risk of flooding elsewhere along the river and the EA will not accept an increase in flood risk off site. The flood storage volume has been assessed for the pre and post development surfaces to assess the impact on the flood storage, with a requirement that there is no net reduction in storage at any level.

The Stage 2 design showed no reduction in flood storage volumes. Refer to drawing J3932-C-DR-2000 Flood Storage Assessment (located in Appendix B) for full details. As the design develops the flood storage assessment shall be adjusted to confirm that there is no reduction in flood storage from the existing condition. The final assessment shall be in 200 mm bands as agreed with the EA as their standard practice.

8.4. Flood risk permit

A Flood Risk Activity Permit is required from the EA and all works to the flood defence line will be in accordance with the EA's flood defence guidance and specifications.

The proposed flood defence strategy has been reviewed with the EA and the overall principles were viewed positively. Key elements of the strategy are as follow:

- Maintain an adequate offset between the flood defence wall and adjacent structures to allow for access to inspect, maintain and repair.
    - Typically, 4 m offset at on the high side of the proposed structure.
    - Typically, 8 m minimum offset at the base of the retaining structure.
- Ensure that there is potential for future extension / raising of the flood defence line
- Flood defence level set to the TE2100 level

- Ensure that the flood defences are independent of any other structure.
- Flood defence shall be suitable to withstand interaction with moving flood waters including the salinity of the sea water.

9. CONCLUSION

The site is partially within Flood Zone 3b and Flood zone 1. The proposed development is "water compatible" within Flood Zone 3b and all other proposed buildings are located in Flood Zone 1 protected by the flood defence structures. This is compatible with the sequential test, NPPF guidance and the LBRuT Local Plan.

The proposed design includes the relocation of flood defence structures. In accordance with LBRuT and Environment Agency requirements the proposed flood defence structures have been designed to the TE2100 level. The design allows essential maintenance and upgrading to be carried out in the future.

The EA has been consulted regarding minimum offset from the flood defence structures and the river wall in accordance with LBRuT SFRA. This design will still require approval by the EA at a future design stage. To ensure that there is no increase in risk of flooding to the adjacent areas, a flood storage capacity check has been undertaken. The Stage 2 proposal provides the required level for level storage to prevent an increase to the site flood risk.

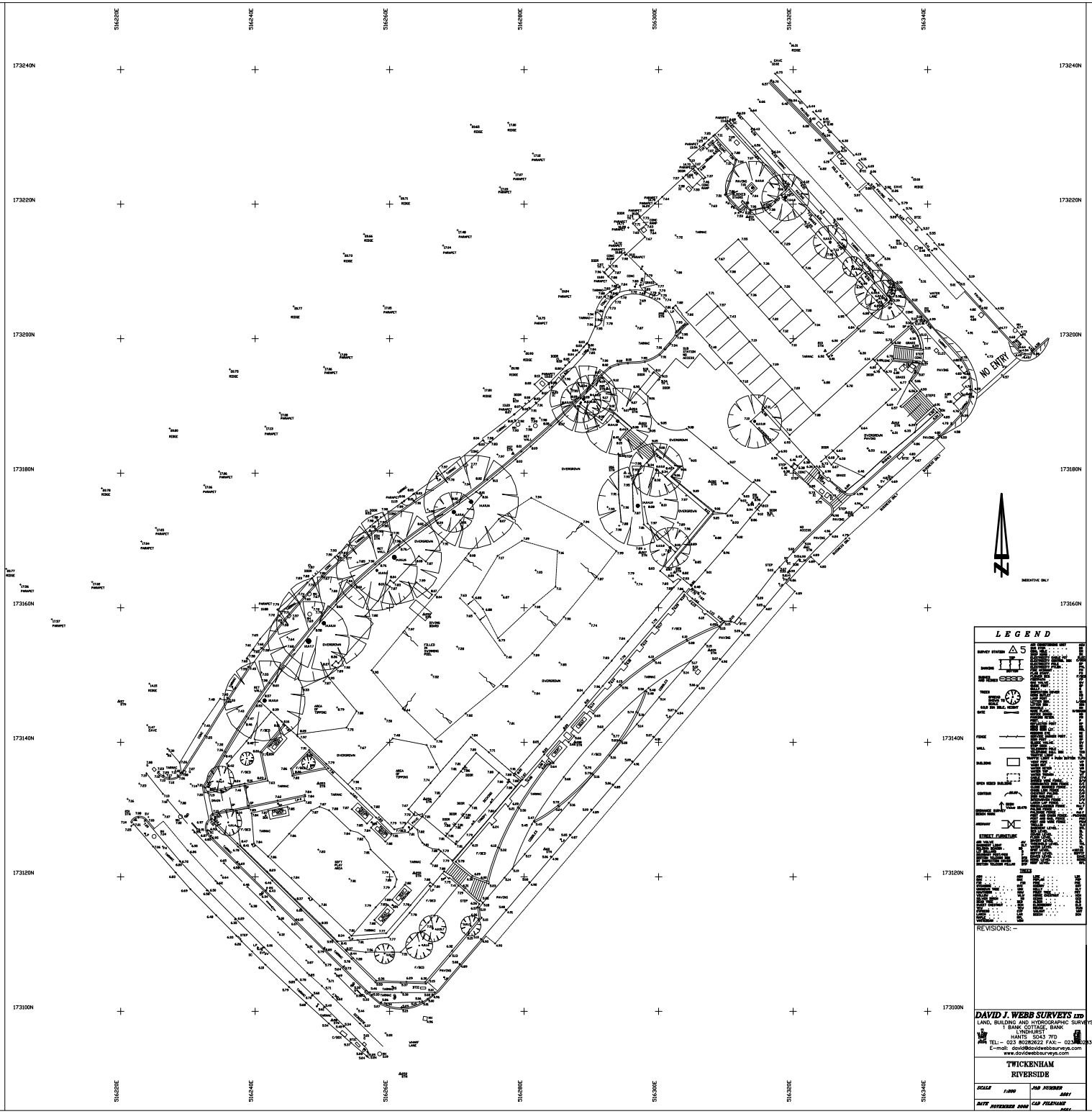
Due to the site being located adjacent to the River Thames, the surface water and SuDS strategy has been developed to suit the Non-Statutory Technical Standards for Sustainable Drainage Systems S1 requirement which identifies that:

"Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or a large estuary) the peak flow control standards (S2 and S3 below) and volume control technical standards (S4 and S6 below) need not apply."

The preliminary site investigation results indicate that there are below ground obstructions which would prevent reliable infiltration for the area of the site located within Flood Zone 1. Surface water flow rates from the site shall not be restricted however, sufficient on-site attenuation shall be provided to ensure no flooding when the outfall is submerged at high tide.

During the next design stage Thames Water shall be consulted to obtain permission for the proposed connections and build over agreements.

10. APPENDIX A TOPOGRAPHIC SURVEY



LEGEND

REVISIONS: –

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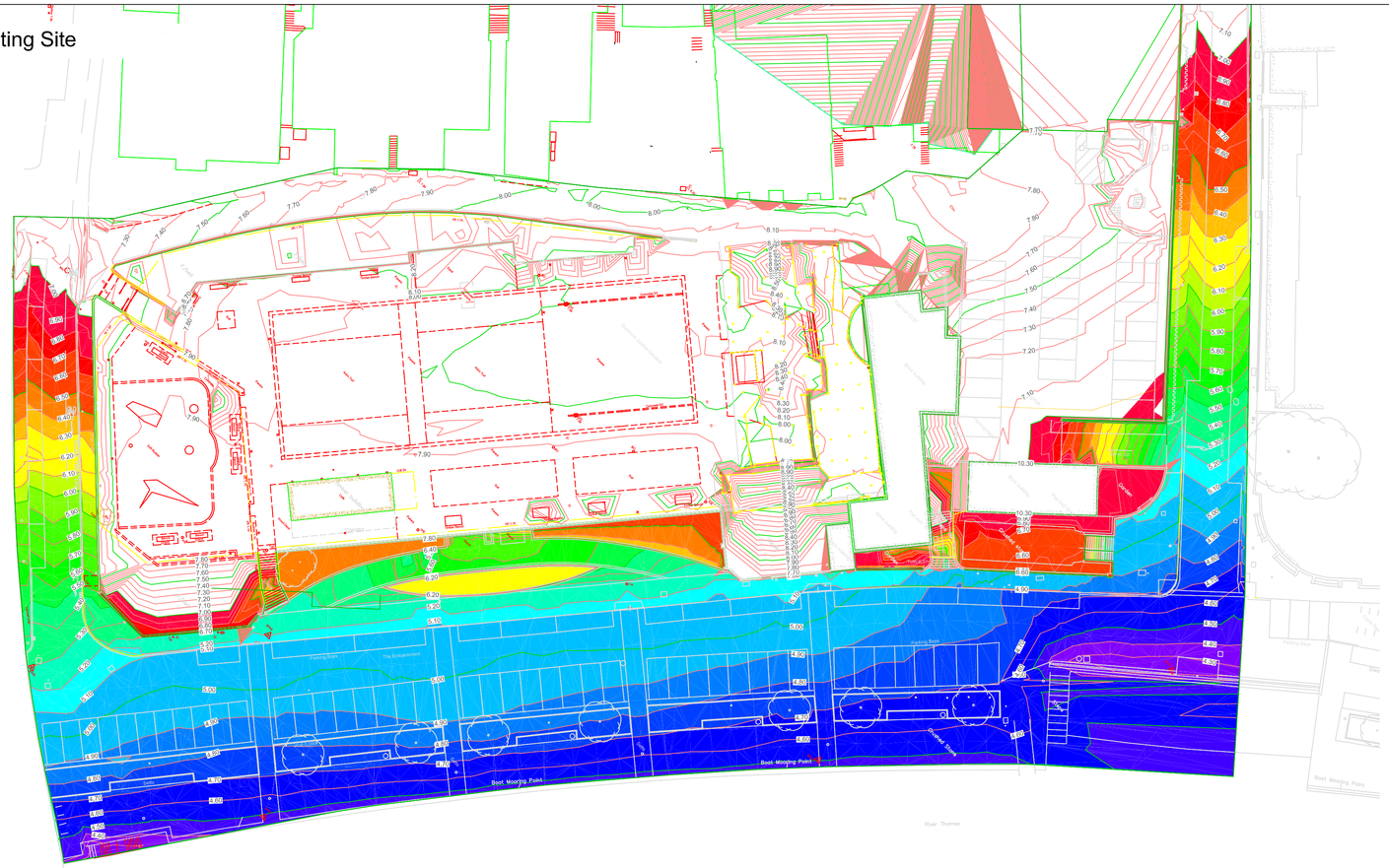
TWICKENHAM
RIVERSIDE

SCALE 1:200	JOB NUMBER 5001
DATE NOVEMBER 2008	CAD FILENAME 5001

11. APPENDIX B PROPOSED DESIGN DRAWINGS

Existing Site



Proposed Site

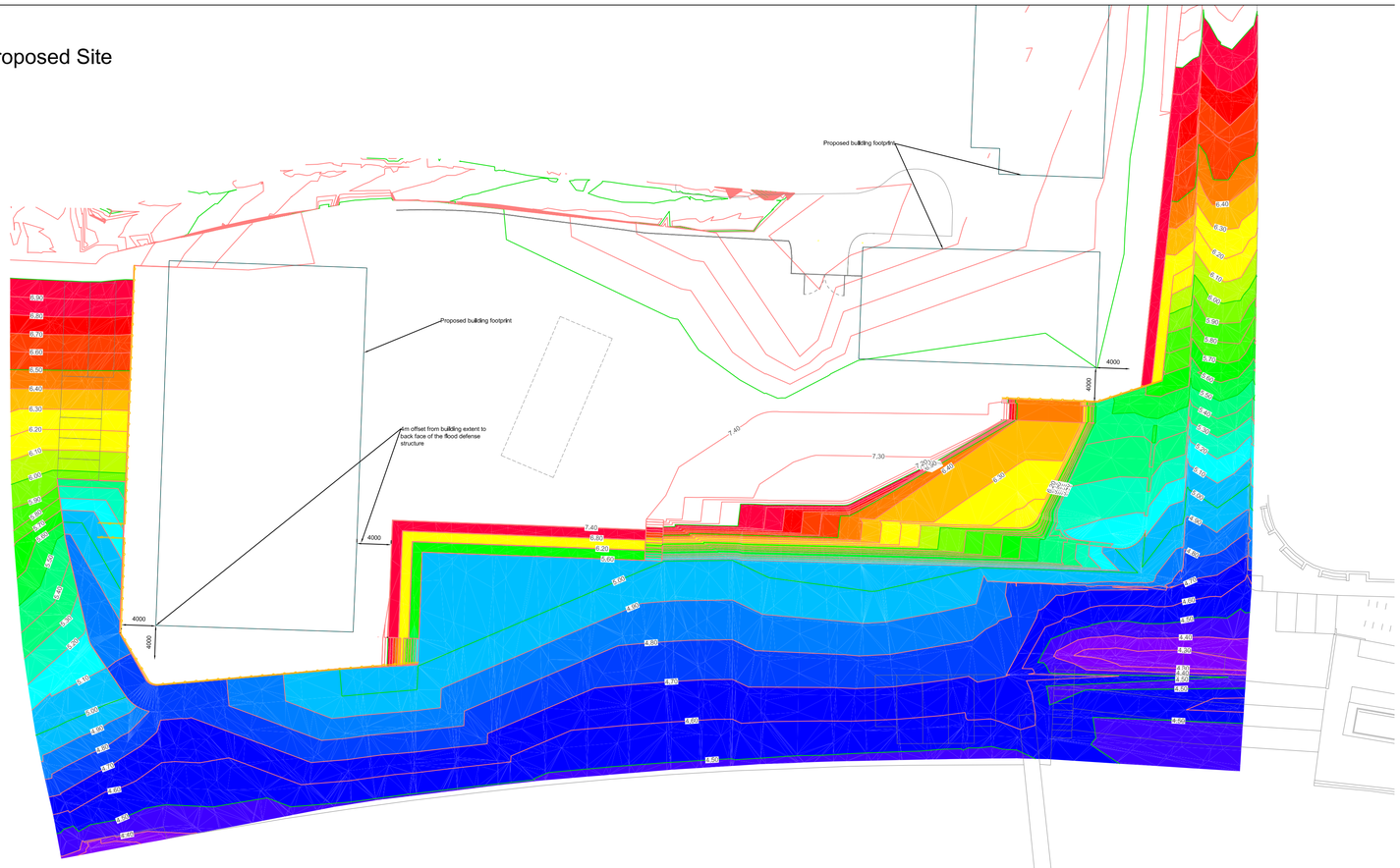


Table 1: Flood Storage Assessment

Outputs from Civil 3D Surface assessment				Additional adjustments				
Maximum Elevation (mAOD)	Minimum Elevation (mAOD)	Existing Volume (m3)	Proposed Volume (m3)	Stairs on wharf lane (m3)	Adjustment allow for assumed 300 mm wide flood defence structure (m3)	Adjusted Proposed volume (m3)	Δ (m3)	Δ (%)
7.0	6.9	498.8	520.2	-0.2	-1.4	518.6	19.7	4.0%
6.9	6.8	487.1	511.4	-0.3	-1.4	509.7	22.7	4.7%
6.8	6.7	477.9	496.5	-0.3	-1.4	494.8	17.0	3.6%
6.7	6.6	467.8	489.3	-0.3	-1.4	487.6	19.8	4.2%
6.6	6.5	455.5	482.0	-0.3	-1.4	480.3	24.8	5.4%
6.5	6.4	442.2	473.7	-0.4	-1.2	472.1	29.9	6.8%
6.4	6.3	430.1	457.3	-0.4	-1.1	455.8	25.7	6.0%
6.3	6.2	422.3	440.8	-0.4	-1.1	439.3	17.0	4.0%
6.2	6.1	413.0	424.7	-0.4	-1.1	423.2	10.2	2.5%
6.1	6.0	407.5	416.6	-0.5	-1.0	415.2	7.7	1.9%
6.0	5.9	401.7	409.0	-0.5	-1.0	407.6	5.8	1.5%
5.9	5.8	395.8	403.0	-0.5	-1.0	401.5	5.8	1.5%
5.8	5.7	390.0	397.8	-0.5	-1.0	396.3	6.3	1.6%
5.7	5.6	380.2	392.4	-1.3	-1.0	390.1	9.9	2.6%
5.6	5.5	372.3	381.1	-1.3	-0.7	379.2	6.8	1.8%
5.5	5.4	364.2	372.4	-1.3	-0.7	370.4	6.3	1.7%
5.4	5.3	355.3	361.6	-1.3	-0.7	359.7	4.3	1.2%
5.3	5.2	342.7	349.1	-1.3	-0.7	347.1	4.4	1.3%
5.2	5.1	318.3	335.7	-1.3	-0.7	333.7	15.4	4.8%
5.1	5.0	290.2	324.1	-1.3	-0.7	322.1	31.9	11.0%
5.0	4.9	235.2	269.6	-1.3	-0.3	268.1	32.8	14.0%
4.9	4.8	184.5	225.0	-1.3	-0.1	223.6	39.1	21.2%
4.8	4.7	140.9	177.4	0.0	-0.1	177.2	36.3	25.8%
4.7	4.6	101.3	127.1	0.0	-0.1	127.0	25.7	25.3%
4.6	4.5	62.2	72.7	0.0	0.0	72.7	10.5	16.9%
4.5	4.4	19.7	18.7	0.0	0.0	18.7	-1.0	-4.9%
4.4	4.3	7.2	6.8	0.0	0.0	6.8	-0.3	-4.7%
4.3	4.2	1.4	1.4	0.0	0.0	1.4	0.0	-2.1%
						Total	405.6	

Refer to Note 7.

Notes

1. Do not scale the drawing
2. All dimensions are in meters unless noted otherwise
3. Any discrepancies between structural and architectural setting out dimensions must be brought to the attention of the Architect and Engineers
4. From EA Product 4 and Product 7 data:
   - TE2100 = 6.90 m
   - 1 in 100 year + 35% Climate change = 6.94 m
5. Through discussions with EA, flood defence structure to be at least 4 m away from proposed building extent.
6. The existing surface was created using multiple site topographic surveys, small discrepancies from the actual surface levels may result from the triangulation process. An effort has been made to review the model and any remaining discrepancies are considered negligible to the accuracy and overall outcome of this assessment.
7. No area of the existing site with an elevation below 4.5mAOD is proposed to be raised as part of the proposed works. The flood storage assessment table shows a decrease in storage volume between 4.5 m AOD and 4.2 m AOD. This is a result of the surface triangles changing at the interface of the proposed and existing surface in Civil 3D.

Rev	Date	Description	Dm	App
00	07.12.20	Stage 2 submission	GB	GPD

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Project
Twickenham Riverside

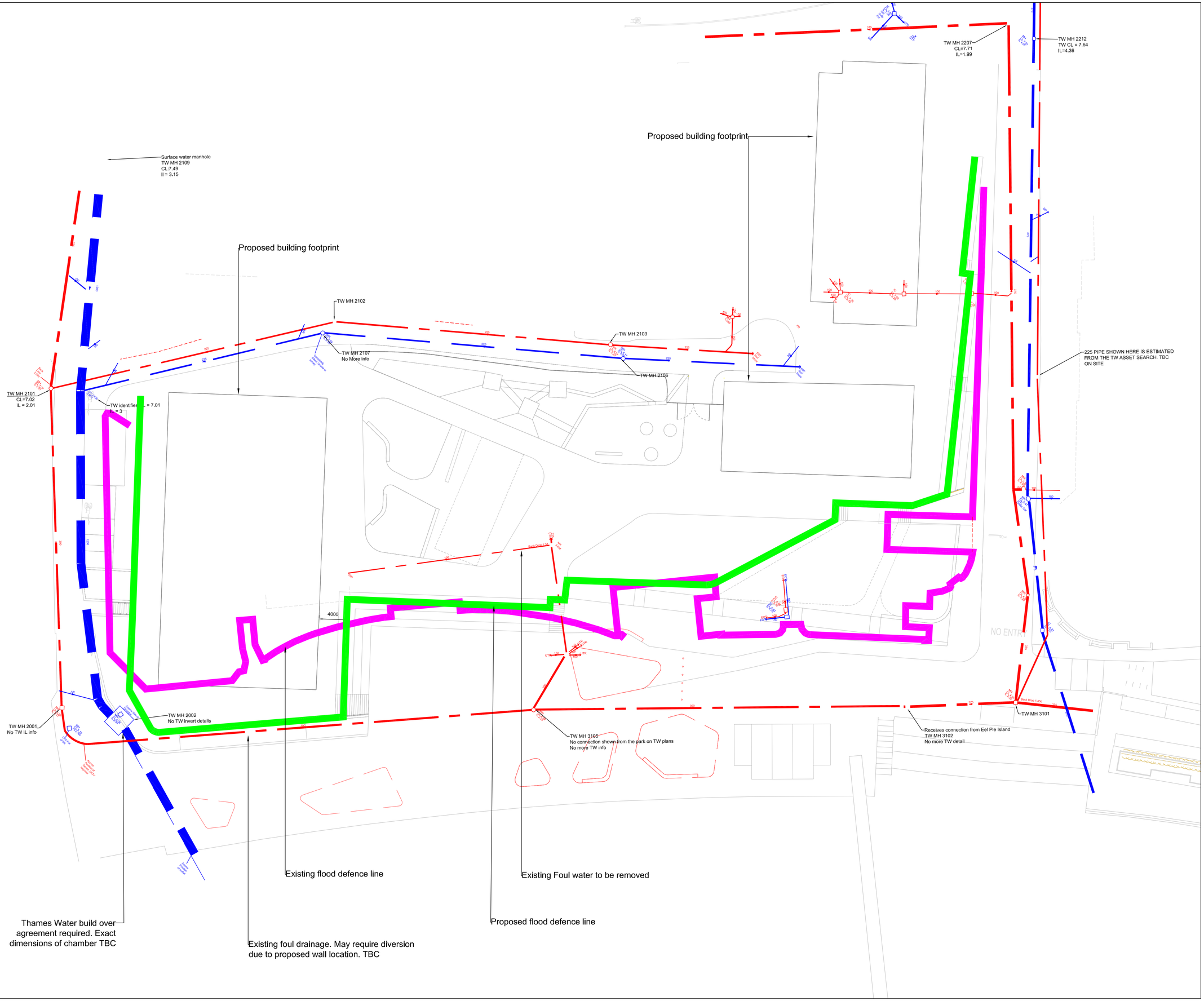
Drawing Title
Flood Storage Assessment

Drawing Status
For Information

Drawn by	Checked by	Sheet size	Scale	Rev status
GB	AM	A1	NTS	S9

Drawing Number
J3932-C-DR-2000

Revision
00



Notes

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2. Any discrepancies between structural and architectural setting out dimensions must be brought to the attention of the Architect and Engineers
3. From EA Product 4 and Product 7 data:
   - TE2100 = 6.90 m
   - 1 in 100 year + 35% Climate change = 6.94 m
4. Through discussions with EA, flood defence structure to be at least 4 m away from proposed building extent.
5. Any proposed connections or alterations to the existing below ground drainage shall require coordination with Thames Water and other utility providers.

Rev	Date	Description	Drn	App
00	07.12.20	Stage 2 submission	GB	LB

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Project
Twickenham Riverside

Drawing Title
Stage 2 Flood Defences & Existing Below Ground Drainage

Drawing Status
For Information

Drawn by	Checked by	Sheet size	Scale	Rev status
GB	LB	A1	NTS	S9

Drawing Number
J3932-C-SK-0009

Revision
00

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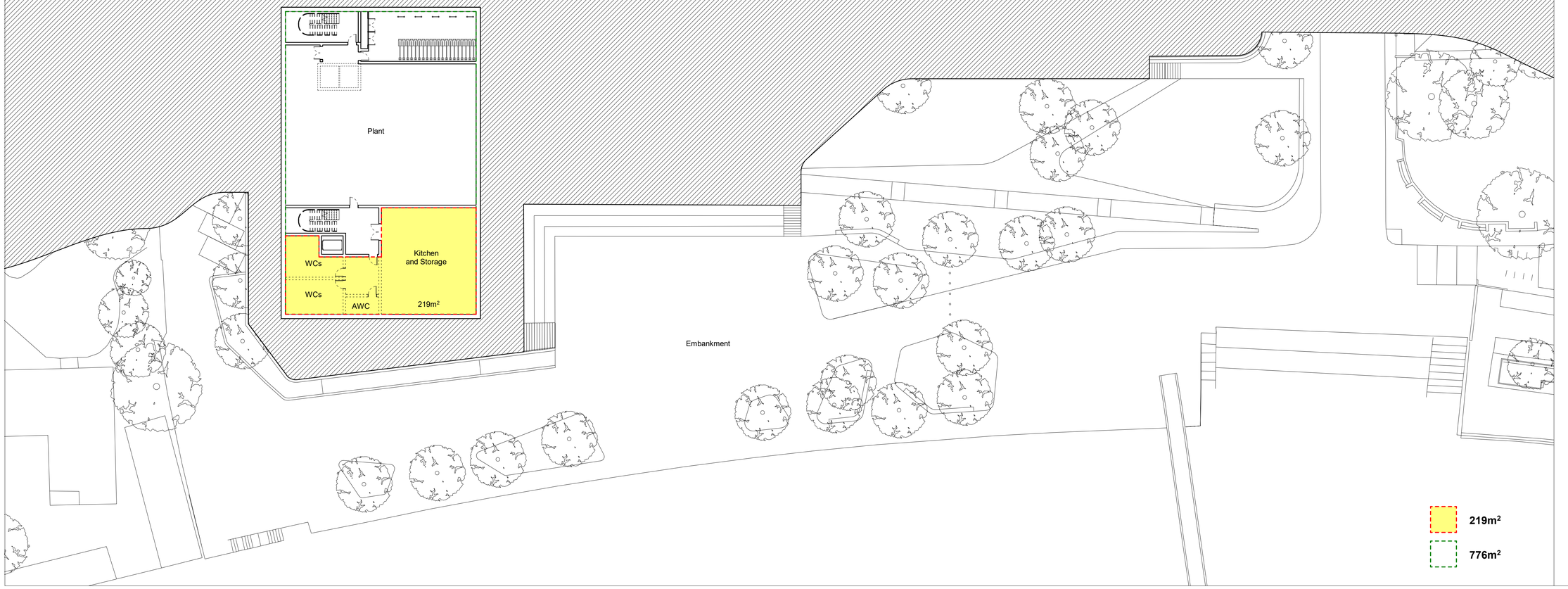
Site boundary based on mark-up provided by LBRuT as part of Twickenham Riverside Invitation to Tender document, June 2019. Requires legal verification.

Proposed buildings and landscaping based on competition scheme (August 2019) and does not take into account any design development following this. This scheme is subject to change.

Landscape design and levels subject to change following further design development.



Date	Rev.	Description	Approved By
04/11/2020	P01	M034 - Issue to Project Manager	MB

Date	Rev.	Description	Approved By

DRAFT

Scale at 1:250

0 2 5 10m

Project	Twickenham Riverside	Code	TRS	File Name	Number / Rev.
Subject	Lower Ground Floor Plan Area			TRS-HAL-A-	SK-037 P01
Architects	Hopkins Architects Limited 27 Broadley Terrace, London, NW1 6LG T: 020 7724 1751 E: mail@hopkins.co.uk			Date 11/04/20	Scale 1 : 250 at A1

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Site boundary based on mark-up provided by LBRuT as part of Twickenham Riverside Invitation to Tender document, June 2019. Requires legal verification.

Proposed buildings and landscaping based on competition scheme (August 2019) and does not take into account any design development following this. This scheme is subject to change.

Landscape design and levels subject to change following further design development.

Date	Rev.	Description	Approved By
04/11/2020	P01	M034 - Issue to Project Manager	MB

Date	Rev.	Description	Approved By

DRAFT

Scale at 1:250

0 2 5 10m

Project	Twickenham Riverside	Code	TRS	File Name	Number / Rev.
Subject	Ground Floor Plan Area			TRS-HAL-A-	SK-038 P01
Architects	Hopkins Architects Limited 27 Broadley Terrace, London, NW1 6LG T: 020 7724 1751 E: mail@hopkins.co.uk			Date 11/04/20	Scale 1 : 250 at A1

This drawing is illustrative, not based on accurate survey information and should not be used for legal purposes.

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Existing site levels based on Stanfords Portal LIDAR Height Data DTM Survey Information (13/06/2019) © Crown copyright and database rights 2019 OS Licence 100035409.

Site boundary based on mark-up provided by LBRuT as part of Twickenham Riverside Invitation to Tender document, June 2019. Requires legal verification.

Proposed buildings and landscaping based on competition scheme (August 2019) and does not take into account any design development following this. This scheme is subject to change.

Landscape design and levels subject to change following further design development.

Date	Rev.	Description	Approved By
04/11/2020	P01	M034 - Issue to Project Manager	MB

Date	Rev.	Description	Approved By

DRAFT

Scale at 1:250

0 2 5 10m

Project	Twickenham Riverside	Code TRS	File Name	Number / Rev.
Subject	First Floor Plan Area		TRS-HAL-A-	SK-039 P01
Architects	Hopkins Architects Limited 27 Broadley Terrace, London, NW1 6LG T: 020 7724 1751 E: mail@hopkins.co.uk		Date 11/04/20	Scale 1 : 250 at A1

This drawing is illustrative, not based on accurate survey information and should not be used for legal purposes.

Existing locations of buildings, roads, waterways and parkland based on Ordnance Survey data (Stanfords OS MasterMap 07/06/2019) © Crown copyright and database rights 2019 OS Licence 100035409

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Site boundary based on mark-up provided by LBRuT as part of Twickenham Riverside Invitation to Tender document, June 2019. Requires legal verification.

Proposed buildings and landscaping based on competition scheme (August 2019) and does not take into account any design development following this. This scheme is subject to change.

Landscape design and levels subject to change following further design development.

Date	Rev.	Description	Approved By
04/11/2020	P01	M034 - Issue to Project Manager	MB

Date	Rev.	Description	Approved By

DRAFT

Scale at 1:250

0 2 5 10m

Project	Twickenham Riverside	Code	TRS	File Name	Number / Rev.
Subject	Second Floor Plan Area			TRS-HAL-A-	SK-040 P01
Architects	Hopkins Architects Limited 27 Broadley Terrace, London, NW1 6LG T: 020 7724 1751 E: mail@hopkins.co.uk			Date 11/04/20	Scale 1 : 250 at A1

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Site boundary based on mark-up provided by LBRuT as part of Twickenham Riverside Invitation to Tender document, June 2019. Requires legal verification.

Proposed buildings and landscaping based on competition scheme (August 2019) and does not take into account any design development following this. This scheme is subject to change.

Landscape design and levels subject to change following further design development.

Date	Rev.	Description	Approved By
04/11/2020	P01	M034 - Issue to Project Manager	MB

Date	Rev.	Description	Approved By

DRAFT

Scale at 1:250

0 2 5 10m

Project	Twickenham Riverside	Code TRS	File Name	Number / Rev.
Subject	Third Floor Plan Area		TRS-HAL-A-	SK-041 P01
Architects	Hopkins Architects Limited 27 Broadley Terrace, London, NW1 6LG T: 020 7724 1751 E: mail@hopkins.co.uk		Date 11/04/20	Scale 1 : 250 at A1

This drawing is illustrative, not based on accurate survey information and should not be used for legal purposes.

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Site boundary based on mark-up provided by LBRuT as part of Twickenham Riverside Invitation to Tender document, June 2019. Requires legal verification.

Proposed buildings and landscaping based on competition scheme (August 2019) and does not take into account any design development following this. This scheme is subject to change.

Landscape design and levels subject to change following further design development.

Date	Rev.	Description	Approved By
04/11/2020	P01	M034 - Issue to Project Manager	MB

Date	Rev.	Description	Approved By

DRAFT

Scale at 1:250

0 2 5 10m

Project	Twickenham Riverside	Code	TRS	File Name	Number / Rev.
Subject	Fourth Floor Plan Area			TRS-HAL-A-	SK-042 P01
Architects	Hopkins Architects Limited 27 Broadley Terrace, London, NW1 6LG T: 020 7724 1751 E: mail@hopkins.co.uk			Date 11/04/20	Scale 1 : 250 at A1

12. APPENDIX C EXSITING SEWER/WATER MAPS

Asset Location Search Sewer Map - ALS/ALS Standard/2016_3373517

The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 516279,173177

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

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

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

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

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

Control Valve

Drop Pipe

Ancillary

Weir

End Items

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

Outfall

Undefined End

Inlet

Other Symbols

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

Public/Private Pumping Station

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

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

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

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

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

2) All measurements on the plans are metric.

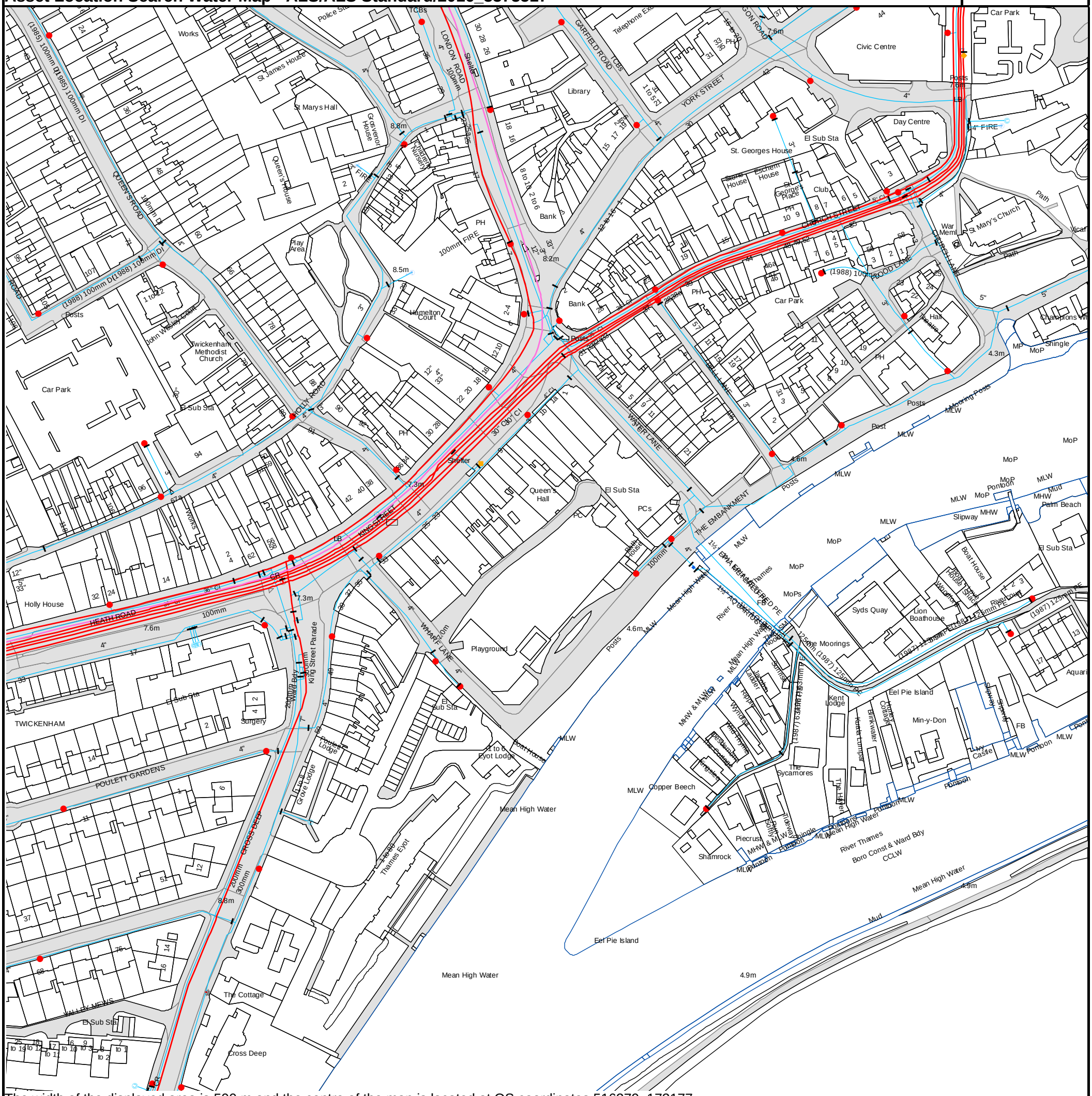
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

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

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

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Asset Location Search Water Map - ALS/ALS Standard/2016_3373517



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 516279, 173177.

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.