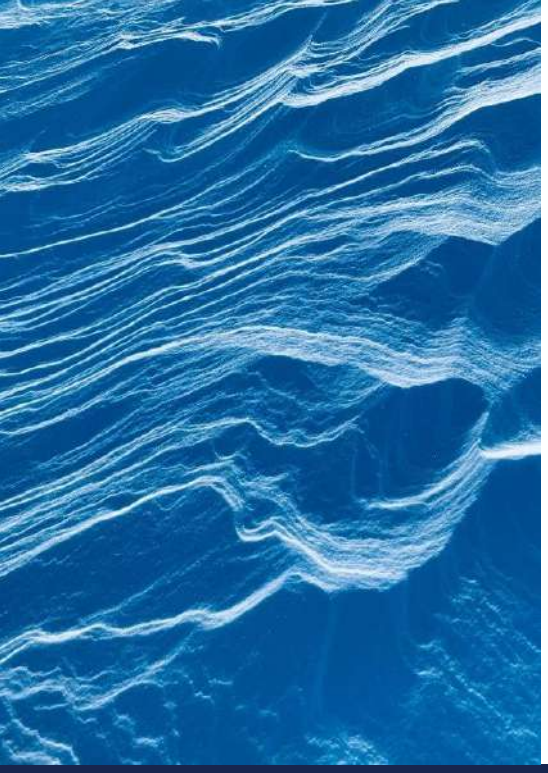

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Flood Risk Assessment and Surface Water Drainage Strategy
AEG3755_TW1_Twickenham_07

Site Address: 32 Park Road
Twickenham
TW1 2PX

UK Experts in Flood Modelling, Flood Risk Assessments, and Surface Water Drainage Strategies

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Document Issue Record

Project: Flood Risk Assessment and Surface Water Drainage Strategy

Prepared for: Uchechi Okereke & Ellie Okereke

Reference: AEG3755_TW1_Twickenham_07

Site Location: 32 Park Road, Twickenham, TW1 2PX

Issue	Date	Author	Check	Auth.	Comments
1	24/01/2024	Oliver Manston	JA	OH	First issue
1.01	04/12/2024	Oliver Manston		OH	Revisions throughout in line with the latest scheme proposed for the site.

Please Note:

Table of Contents

Summary

Development Description	Existing	Proposed
Development Type	A Residential Dwelling	Construction of a two storey rear extension to the existing dwelling
EA Vulnerability Classification	More Vulnerable	More Vulnerable
Ground Levels	Existing ground levels vary between 5.51m AOD and 6.00m AOD across the site based on EA LiDAR data	FFLs to be set no lower than those of the existing dwelling
Level of Sleeping Accommodation	First Floor Level	First Floor Level
Surface Water Drainage	N/A[1]	See Section 6
Site Size	Approximately 440m^2	No change
Risk to Development	**Summary**	**Comment**
EA Flood Zone	Flood Zone 3	
Flood Source	Fluvial/Tidal Breach	River Thames
SFRA Available	Level 1 Strategic Flood Risk Assessment (Richmond Council, 2021)	
Management Measures	**Summary**	**Comment**
Ground floor level above extreme flood levels	To be set no lower than existing	FFLs to be set no lower than those of the existing dwelling
Safe Access/Egress Route	As existing	The proposal is considered a minor development and thus the access/ egress/ refuge arrangements should not differ from the existing situation.
Flood Resilient Design	Yes	Flood resilience and resistance techniques to be included in accordance with 'Improving the flood performance of new buildings' DCLG (2007)

Site Drainage Plan	N/A[1]	See Section 6
Flood Warning and Evacuation Plan	Yes	Recommended to sign up to the Tidal Thames from the River Crane to Teddington Weir Environment Agency (EA) flood warning service.
Offsite Impacts	**Summary**	**Comment**
Displacement of floodwater	Negligible	The proposed development site is within an area at risk of flooding from watercourses with tidal influence. As such, any increase in flood risk elsewhere as a result of floodwater displacement would be considered negligible. Moreover, the proposed development is considered a minor development so should have a negligible impact on flood risk elsewhere in line with paragraph 051 of the PPG
Increase in surface run-off generation	N/A[1]	See Section 6
Impact on hydraulic performance of channels	No	No change

[1] not required for this assessment

[2] data not available.

1. Introduction

1.1. Aegaea were commissioned by Uchechi Okereke & Ellie Okereke to undertake a Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) to facilitate a planning application for the proposed development. This FRA and SWDS has been prepared in accordance with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance.

1.2. This FRA and SWDS is intended to support a full planning application and as such the level of detail included is commensurate and subject to the nature of the proposals.

Site Overview

1.3. The site of the proposed development is 32 Park Road, Twickenham, TW1 2PX (Figure 1).

Figure 1: Site Location (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors)

1.4. It is understood that the proposed development is for the construction of a two storey rear extension to the existing dwelling. A copy of the development proposal drawings can be found in Appendix A of this report.

1.5. In the absence of a topographical survey, Environment Agency Light Detection and Ranging (LiDAR) data Digital Terrain Model has been used to review the topography of the site. The LiDAR data shows the ground elevation of the site varies between approximately 5.51 metres Above Ordnance Datum (m AOD) and 6.00m AOD, with the site shown to slope generally from east to west (Figure 2).

1.6. At the location of the proposed development footprint, existing ground levels range between approximately 5.71m AOD and 5.96m AOD based on EA LiDAR data.

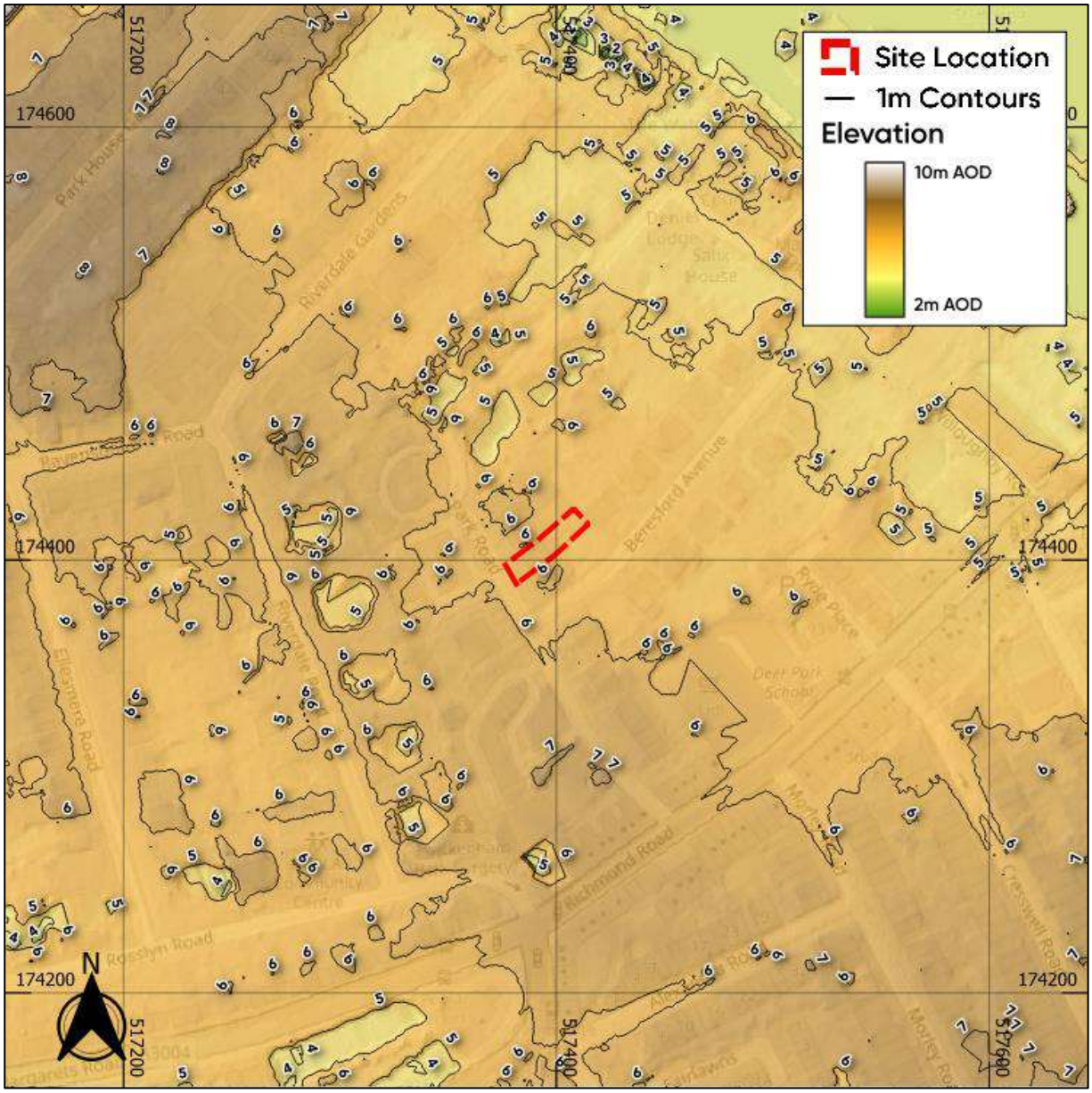

Figure 2: Site Topography (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors. Contains public sector information licensed under the Open Government Licence v3.0)

1.7. Richmond Council is the Local Planning Authority (LPA) for the site and also the designated Lead Local Flood Authority (LLFA). The site sits within the Environment Agency's Kent South London and East Sussex region.

Planning Policy and Guidance

1.8. UK government planning guidance states[1] that an FRA is required for developments which are:

- *in flood zone 2 or 3 including minor development and change of use*
- *more than 1 hectare (ha) in flood zone 1*
- *less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs)*
- *in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency*

1.9. The site is located within Flood Zone 3 and therefore an FRA is required in accordance with the NPPF.

1.10. The objective of this FRA is to demonstrate that the proposals are acceptable in terms of flood risk. This report summarises the findings of the study and specifically addresses the following issues in the context of the current legislative regime:

- Fluvial flood risk
- Surface water flood risk
- Risk of flooding from other sources

[1] **https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications#when-you-need-an-assessment**

2. Planning Policy

2.1. Inappropriate development in a flood risk area could pose significant risk in terms of personal safety and damage to property for the occupiers of the development or for people elsewhere. The approach taken in the assessment of flood risk at the planning stage is set out in national, regional, and local planning policy and associated guidance. This section summarises the key policies and guidance relevant to the proposed development.

National Planning Policy Framework (NPPF)

2.2. The National Planning Policy Framework[2] (NPPF) (DLUHC, 2023) which includes UK Government policy on development and flood risk states:

> *165. Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.*
>
> *173. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:*
>
> *a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
>
> *b) the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;*
>
> *c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*

[2] https://www.gov.uk/guidance/national-planning-policy-framework, **last updated Dec 2023**

d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

174. Applications for some minor development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 59.

2.3. Paragraph 051 of the Flood Risk and Coastal Change Planning Practice Guidance (PPG) states:

Minor development means:

- *minor non-residential extensions (industrial/commercial/leisure etc): extensions with a floorspace not in excess of 250 square metres.*
- *alterations: development that does not increase the size of buildings, e.g. alterations to external appearance.*
- *householder development: for example, sheds, garages, games rooms etc within the curtilage of the existing dwelling,* ***in addition to physical extensions to the existing dwelling itself.*** *This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling (eg subdivision of houses into flats) or any other development with a purpose not incidental to the enjoyment of the dwelling.*

2.4. As such, the proposal would be considered a Minor Development under the PPG.

2.5. Footnote 59 of the NPPF states:

A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

2.6. Flood Zones in England are defined as follows:

Table 1: Flood Zone Definitions

Flood Zone	Definition
Zone 1 Low Probability	Land having less than 1 in 1,000 annual probability of river or sea flooding (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.
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.
Zone 3b The Functional Floodplain	This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise: land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). 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)

2.7. An FRA should be appropriate to the scale, nature, and location of the development. It should identify and assess the risk from all sources of flooding to and from the development and demonstrate how any flood risks will be managed over the lifetime of the development.

2.8. An assessment of hydrological impacts should be undertaken, including to surface water runoff and impacts to drainage networks in order to demonstrate how flood risk to others will be managed following development and taking climate change into account.

2.9. The Planning Practice Guidance, which was substantially revised in March 2015 in relation to drainage, requires that sustainable drainage systems (SuDS) should be considered and included where practicable, in line with Defra Technical Standards[3].

The London Plan

2.10. The London Plan (2021)[4] provides an overall strategic plan for London, it sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. The proposed development lies within the jurisdiction of the London Plan and therefore should consider the policies contained within the document. Policy SI 12 and SI 13, quoted below, contains guidance on flood risk management and sustainable drainage;

> *Policy SI 12 Flood risk management*
>
> *A) 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.*
>
> *B) Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London.*
>
> *C) Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.*

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[3] Technical Standards Accessed Online
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/415773/sustainable-drainage-technical-standards.pdf

[4] https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf

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

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

F) Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.

Policy SI 13 Sustainable drainage

A Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed.

B 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.

C 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.

D 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.

Local Planning Policy

2.11. The Local Plan prepared by the Local Planning Authority, Richmond Council, sets out the policies for development in the local area. The site lies under the jurisdiction of this LPA and therefore will be required to adhere to the local plan policies. The Local Plan (2018)[5] document provides the following policy on flood risk management and sustainable drainage;

Policy LP 21

Flood Risk and Sustainable Drainage

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.

[5] **https://www.richmond.gov.uk/media/15935/adopted_local_plan_interim.pdf**

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.

Sustainable drainage

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:

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

2. 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.

Flood defences

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

1. Retain the effectiveness, stability and integrity of flood defences, river banks and other formal and informal flood defence infrastructure.

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

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

4. 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.

5. 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.

Sequential and Exception Tests

2.12. The Sequential and Exception Tests are applied in specific cases defined by UK Government policy. Their purpose is to drive development to areas of low flood risk and to support developments which improve flood risk for developments in areas at risk of flooding.

2.13. Under the NPPF all new planning applications should undergo a Sequential Test unless a Minor Development or a change of use application in accordance with paragraph 174 and footnotes 59 and 60.

2.14. Paragraph 174 of the 2023 NPPF states that:

> *'174. Applications for some Minor Development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 59.'*

2.15. It is understood that the proposed development is for the construction of a two storey rear extension to the existing dwelling. As such, the proposals could be considered a Minor Development given that it is an extension to the physical dwelling itself (as defined in Paragraph 051 of the PPG). Therefore, the scheme is exempt from the exception or sequential tests but should still meet the requirement for the site-specific flood risk assessments.

3. Consultation and Review

Consultation

3.1. Aegaea hold on record a copy of the Thames (Datchet to Teddington) (2023) flood model and Thames Tidal Upstream Breach Model (2017) flood model obtained from the Environment Agency. The proposed development lies within the modelled flood extents and has been analysed in order to determine the flood risk to the site. Section 4 includes the results of this consultation.

Documents and Online Mapping

3.2. Local Governments and Lead Local Flood Authorities provide documents which contain data and policies on flood risk and new development in their areas. These documents are introduced and briefly summarised below. For the purposes of this FRA, these documents have been reviewed for relevant information and any relevant data is discussed within the appropriate sub heading of this report.

3.3. The following sources of information have been reviewed for this assessment:

- Flood Map for Planning on the Environment Agency website *https://flood-map-for-planning.service.gov.uk/*
- Long Term Flood Risk Information on the Environment Agency website *https://www.gov.uk/check-long-term-flood-risk*
- National Planning Policy Framework (NPPF) (Department for Levelling Up, Housing and Communities, 2023)
- Planning Practice Guidance - Flood Risk and Coastal Change (Department for Levelling Up, Housing and Communities, 2022)
- Geoindex Onshore (British Geological Survey, 2023)
- The London Plan (Greater London Authority, 2021) and Local Plan (Richmond Council, 2018)

- Preliminary Flood Risk Assessment[6] (Richmond Council, 2011)
- Level 1 Strategic Flood Risk Assessment[7] (Richmond Council, 2021)
- Richmond Council Local Flood Risk Management Strategy[8] (Richmond Council, 2015)
- Richmond Council Surface Water Management Plan[9] (Richmond Council, 2021)
- CIRIA C753 SuDS manual[10]

Preliminary Flood Risk Assessment (PFRA)

3.4. The PFRA, published in 2011, is a high-level appraisal of flood risk across Lead Local Flood Authority Richmond Council. The flood risk from all sources, including fluvial, surface water, groundwater, and surcharged sewers is evaluated. It is the basis upon which the Local Flood Risk Management Strategy is produced.

3.5. The PFRA summarises historical flood incidents in Richmond Council.

Strategic Flood Risk Assessment (SFRA)

3.6. The SFRA, published in 2021, provides the evidence base for the Local Planning Authority Richmond Council Local Plan and guidance for consideration when determining planning applications.

3.7. The SFRA seeks to place new development into areas of lower flood risk taking into account current flood risk, future flood risk, and the effect a proposed development would have on the risk of flooding.

3.8. The SFRA mapping provided by Richmond Council has been used throughout production of this report as a source of information, particularly pertaining to historical flood incidents.

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[6] **https://www.richmond.gov.uk/media/4287/pfra_richmond_incl_all_appendices.pdf**
[7] **https://www.richmond.gov.uk/media/20529/sfra_level_1_report.pdf**
[8] **https://www.richmond.gov.uk/media/13402/lfrms_strategic_environment_assessment.pdf**
[9] **https://www.richmond.gov.uk/media/23830/surface_water_management_plan.pdf**
[10] **https://www.ciria.org/CIRIA/Memberships/The_SuDs_Manual_C753_Chapters.aspx**

Local Flood Risk Management Strategy (LFRMS)

3.9. The Local Flood Risk Management Strategy sets out roles and responsibilities for flood risk management, assesses the risk of flooding in the area, where funding can be found to manage flood risk, and the policies, objectives, and actions of the Lead Local Flood Authority.

3.10. The Richmond Council LFRMS is used within this report to identify any flood management infrastructure and historical incidences of flooding.

Surface Water Management Plan (SWMP)

3.11. The SWMP (2021) outlines the preferred surface water management strategy in a given location. In this context surface water flooding describes flooding from sewers, drains, groundwater, and runoff from land, ordinary watercourses and ditches that occurs as a result of heavy rainfall.

3.12. The SWMP has been used to inform the surface water flood risk to the proposed site throughout this report.

CIRIA C753 SuDS manual

3.13. The CIRIA SuDS manual has been used throughout this SWDS in order to determine an appropriate strategy for the proposed development. This guidance covers the planning, design, construction and maintenance of Sustainable Drainage Systems (SuDS) to assist with their effective implementation within both new and existing developments. It looks at how to maximise amenity and biodiversity benefits and deliver the key objectives of managing flood risk and water quality. There is also supporting information covering topics such as materials, landscape design, maintenance, community engagement and costs and benefits.

4. Sources of Flood Risk

Fluvial/Tidal Watercourses

4.1. Flooding from watercourses arises when flows exceed the capacity of the channel, or where a restrictive structure is encountered, resulting in water overtopping the banks into the floodplain.

4.2. Tidal flooding occurs when a high tide and high winds combine to elevate sea levels. An area behind coastal flood defences can still flood if waves overtop the defences or break through them. Tidal flooding can also occur a long way from the coast by raising river levels. Water may overtop the riverbank or river defences when tide levels are high.

Main Rivers and Ordinary Watercourses

4.3. The nearest EA Main River to the site is the River Thames located approximately 190m northeast of the redline boundary. The Thames flows from south to north past the site location and is understood to be both tidally and fluvially influenced at the nearest extent to the site.

4.4. There are no other mapped watercourses within the vicinity of the site.

Historical Flooding

4.5. The EA Recorded and Historical Flood Outlines show that the site lies outside any recorded extents of recorded historical tidal flooding.

EA Flood Map for Planning

4.6. The site is located wholly within Flood Zone 3 (Figure 3). Flood Zone 3 denotes 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.

4.7. The site is also located within an area denoted as benefitting from a 'Reduction in risk of flooding from rivers and sea due to defences'. The Richmond SFRA states;

> *The Thames Tidal Defences (TTD) are a collection of walls, embankments, flood gates, pumping stations and barriers designed to protect at-risk properties against flooding from the River Thames… These flood defences currently protect properties within the floodplain up to a 1 in 1000 year event. The Fluvial & Tidal Map highlights the areas benefitting from flood defences through the 'EA Flood Map for Planning*

(River and Sea) – Areas Benefitting from Flood Defence' [now known as 'Reduction in risk of flooding from rivers and sea due to defences'] operational layer.

4.8. Therefore, the existing Thames Tidal Defences provide protection up to and including the 0.1% AEP tidal flood event.

Figure 3: EA Flood Map for Planning (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors. Contains public sector information licensed under the Open Government Licence v3.0)

Thames Tidal Upstream Breach Model (2017)

4.9. For developments such as this, which rely on protection from flood defences, the NPPF requires the residual risk of flooding, resulting from a failure or 'breach' of the defences being considered.

4.10. The results of the EA's Thames Upriver Breach Modelling study (2017) are shown in Figure 4. This figure shows that the site could be affected by a breach in the linear flood defences on the Thames, in the 2100 epoch.

4.11. In this modelled event, the flood level is given as 6.35m AOD. Based on the existing ground levels provided by EA LiDAR data (ranging between 5.71m AOD and 5.96m AOD), flood depths at the location of the proposed development footprint could range between 0.39m and 0.64m.

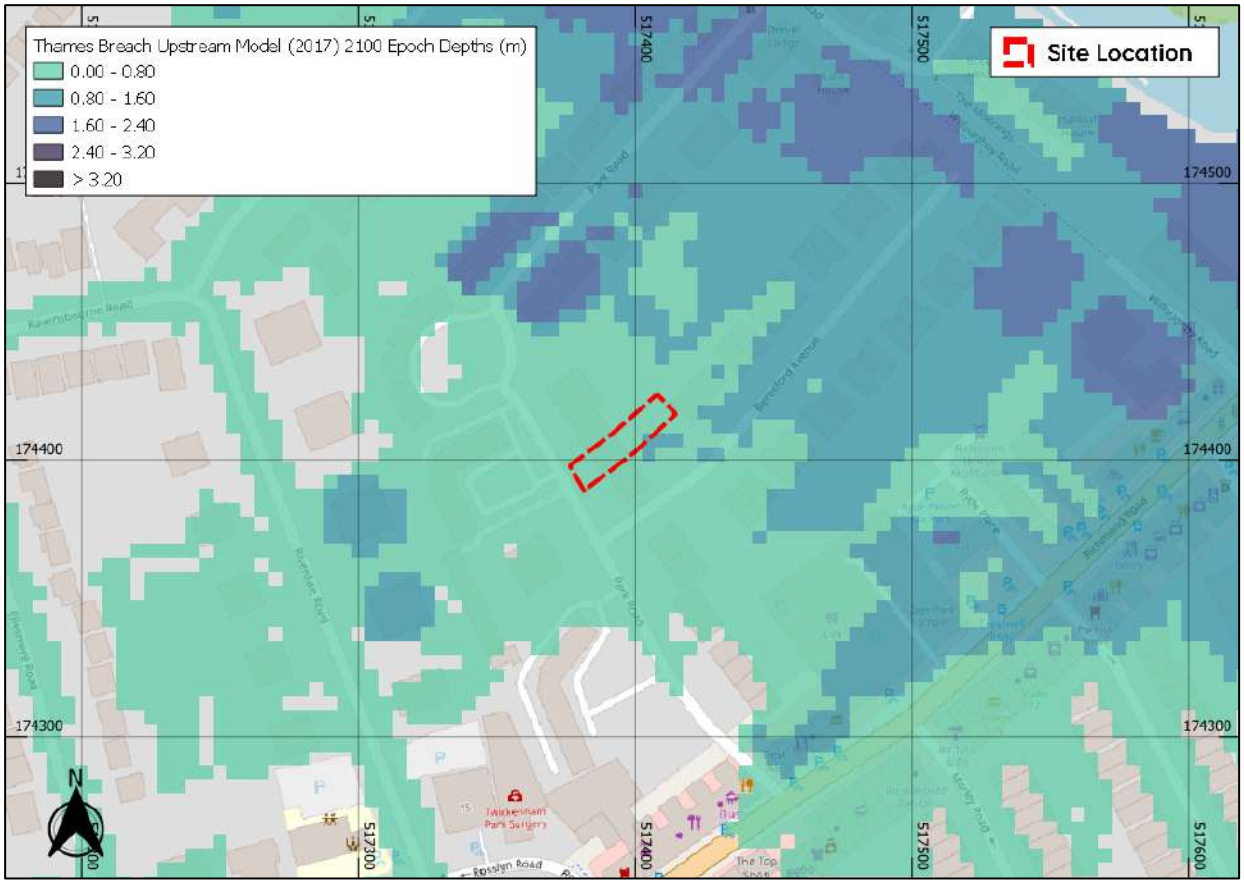


Figure 4: Upstream Thames Tidal Breach Model (2017) Flood Extent and Depths (Source: OpenStreetMaps © Contains public sector information licensed under the Open Government License v3.0)

4.12. In the event of a breach the EA hazard rating attributed to the flood extent is shown in Figure 5. The rating within the immediate vicinity of the front of the site (location of building entrance/exit) is shown to be between 1.25 and 2.00 which represents a 'Moderate' hazard. As such, safe access/egress from the site would not be possible in this event and safe refuge should be sought within the existing dwelling at the first floor level.

4.13. It is also important to note that the proposal is a minor development (extension to the existing dwelling) and thus the access/ egress/ refuge arrangements should not differ from the existing situation.

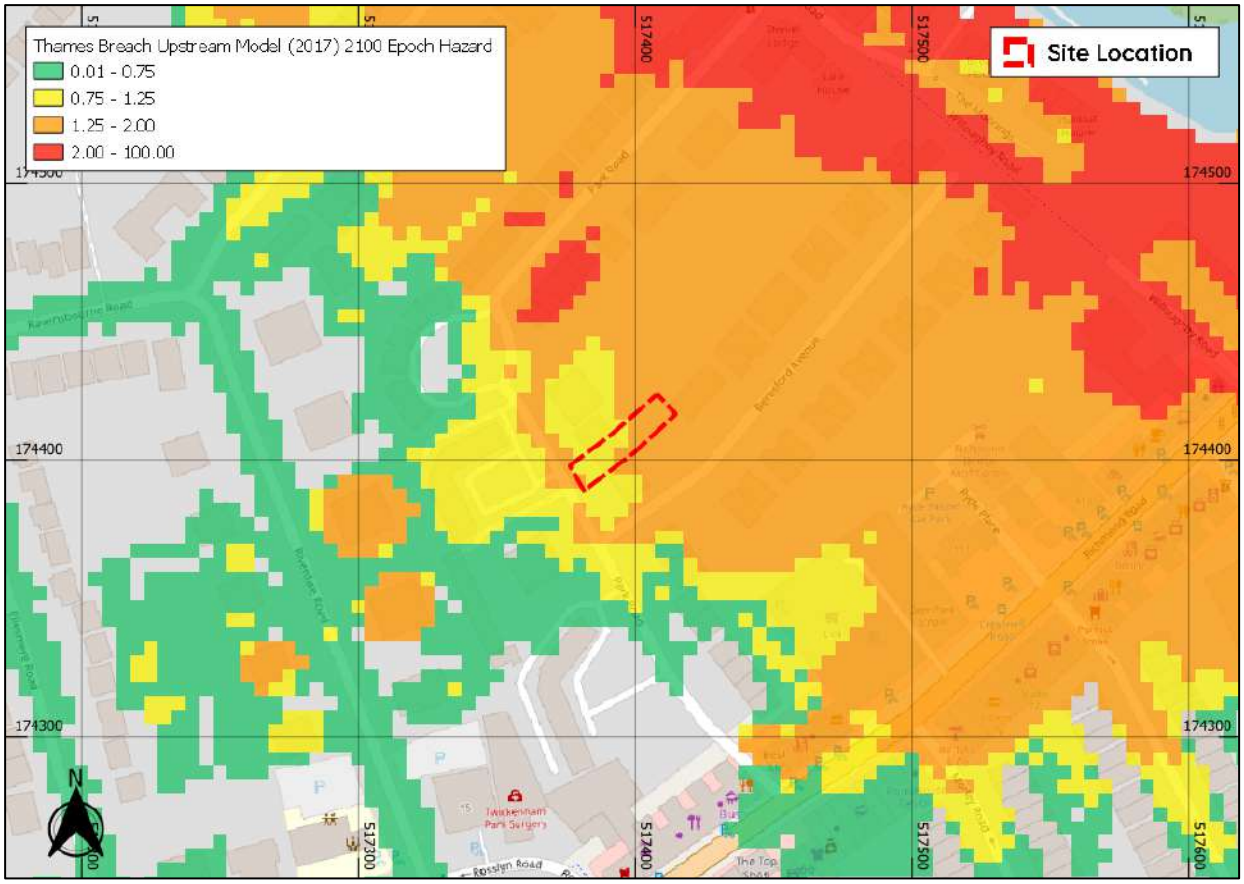


Figure 5: Upstream Thames Tidal Breach Model (2017) Hazard Rating (Source: OpenStreetMaps © Contains public sector information licensed under the Open Government License v3.0)

Thames (Datchet to Teddington) (2023) Model

4.14. In addition to lying within the extent of the Thames Upriver Breach model extent, the site is also shown to lie within the extent of the Thames (Datchet to Teddington) (2023) model. The model includes several return period events in additional to scenarios including various climate change allowances.

4.15. The site location is shown to lie outside the modelled extents for each of the present day 3.3%AEP and 1.0%AEP events, though lies within the extent of the modelled 0.1%AEP event (Figure 6).

4.16. In the modelled 0.1%AEP event, the flood level at the location of the proposed development is 6.09m AOD. Based on the lowest existing ground level at the proposed development location of 5.71m AOD (based on EA LiDAR data), flood depths could range up to 0.38m.

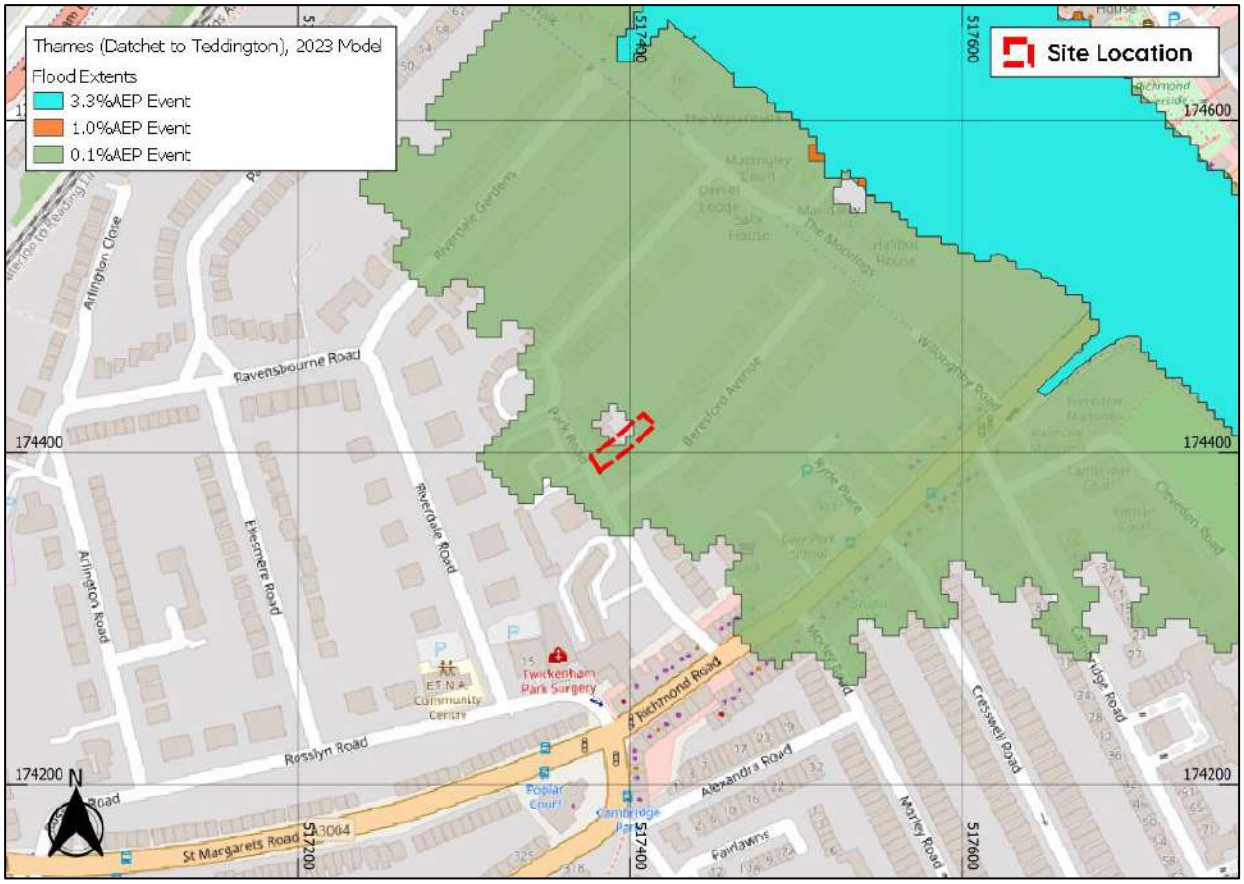


Figure 6: Thames (Datchet to Teddington), 2023 Modelled Flood Extents (Source: OpenStreetMaps © Contains public sector information licensed under the Open Government License v3.0)

Fluvial Climate Change

4.17. The site is located within the London Management Catchment, which has peak flow river allowances for the central scenario of: 10% for the 2020s, 7% for the 2050s, and 17% for the 2080s. As the development is for residential use with a development lifetime of 100-years, the peak flow allowance of 17% for the 2080s would be required for fluvial flood flows.

4.18. The climate change (CC) impact will be analysed via interrogating the Lower Thames model data. The Lower Thames model includes a +20%CC allowance scenario and as such will be used to determine climate change risk to the site as a conservative approach.

4.19. The site is shown to lie outside the extent of the modelled 1.0%AEP+20%CC allowance event (Figure 7).

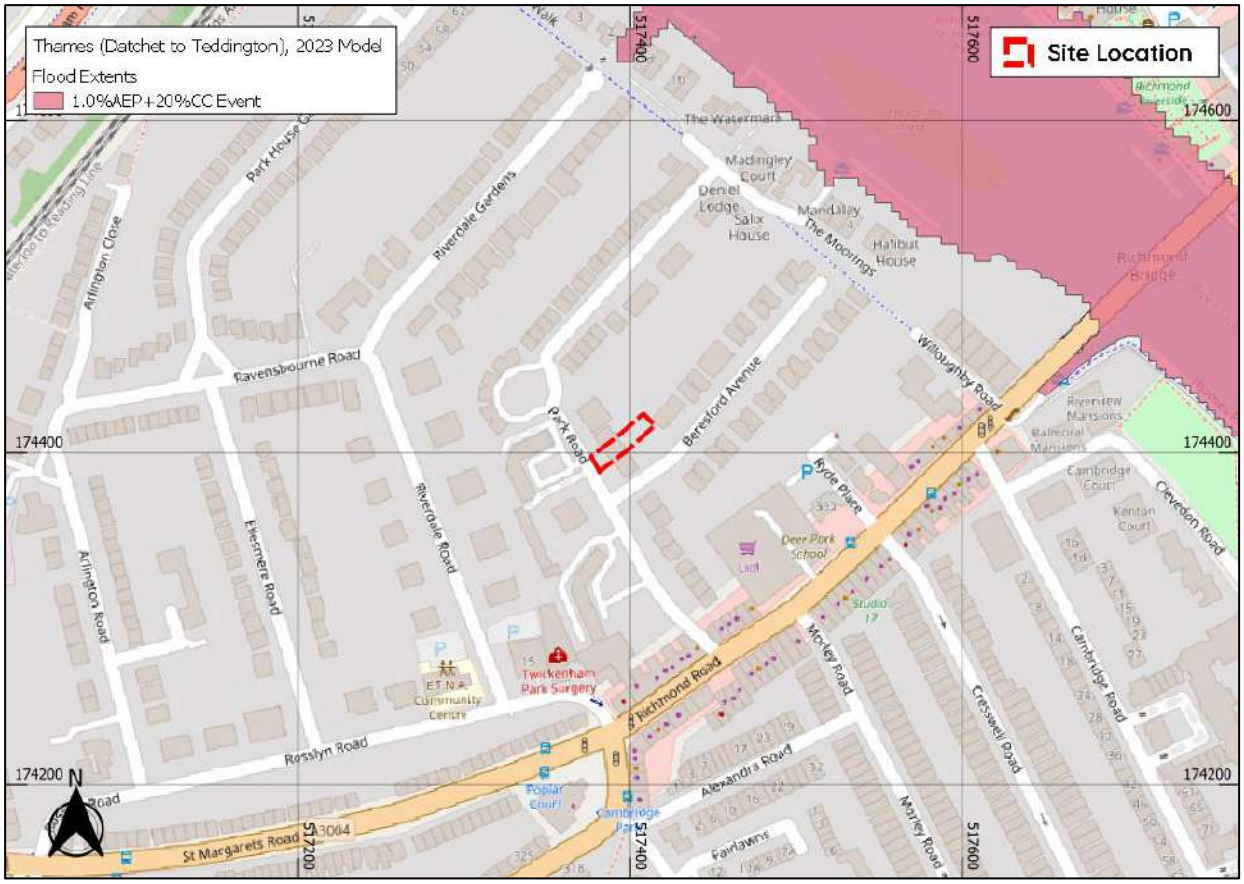


Figure 7: Thames (Datchet to Teddington), 2023 Modelled Flood Extents, Climate Change Scenario (Source: OpenStreetMaps © Contains public sector information licensed under the Open Government License v3.0)

Fluvial/Tidal Flood Risk Summary

4.20. Based on the information above, the actual flood risk (defended) to the proposed development is considered to be low. The Thames tidal defences are designed to protect the site up to the modelled 0.1% AEP event and are expected to protect the site for the development lifetime, as long as the defences remain intact and operational.

4.21. In the event of a breach of the Thames tidal defences the risk is considered to be high.

Canals

4.22. The Canal and River Trust (CRT) generally maintains canal levels using reservoirs, feeders, and boreholes and manages water levels by transferring it within the canal system.

4.23. Water in a canal is typically maintained at predetermined levels by control weirs. When rainfall or other water enters the canal, the water level rises and flows out over the weir. If the level

continues rising it will reach the level of the storm weirs. The control weirs and storm weirs are normally designed to take the water that legally enters the canal under normal conditions. However, it is possible for unexpected water to enter the canal or for the weirs to become obstructed. In such instances the increased water levels could result in water overtopping the towpath and flowing onto the surrounding land.

4.24. Flooding can also occur where a canal is impounded above surrounding ground levels and the retaining structure fails.

4.25. The nearest canal to the proposed development is located at a distance of greater than 1km. Therefore, the site is considered to be at a low risk of canal flooding.

Pluvial

4.26. Pluvial flooding can occur during prolonged or intense storm events when the infiltration potential of soils, or the capacity of drainage infrastructure is overwhelmed leading to the accumulation of surface water and the generation of overland flow routes.

4.27. Annual surface water flood risk is labelled by the EA as:

- 'High Risk'; >3.3% AEP (annual probability greater than 1 in 30).
- 'Medium Risk'; 1.1% to 3.3% AEP (annual probability between 1 in 100 and 1 in 30).
- 'Low Risk'; 0.1% to 1% AEP (annual probability between 1 in 1000 and 1 in 100).
- 'Very Low Risk'; <0.1% AEP (annual probability less than 1 in 1000).

4.28. Examination of the EA's Flood Risk from Surface Water mapping for the modelled High Risk, Medium Risk, and Low Risk AEP flood events shows that the location of the proposed development lies outside the extent of each of the modelled surface water flood extents (Figure 8).

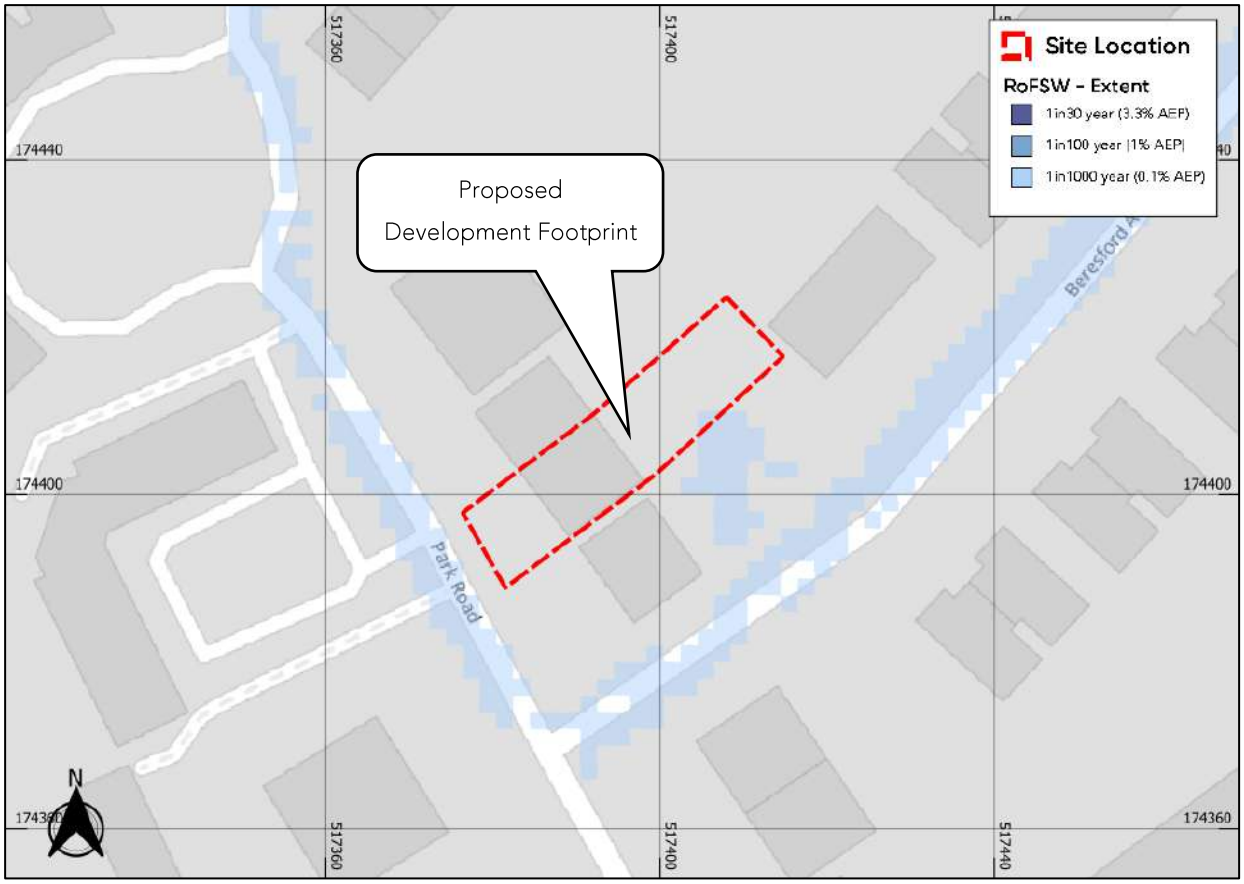


Figure 8: EA Surface Water Flood Risk Mapping (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). © https://www.openstreetmap.org and contributors. Contains public sector information licensed under the Open Government Licence v3.0)

4.29. The SWMP has identified that the site lies within a Critical Drainage Area (CDA) (Figure 9), the CDA is named Catchment H10 - Hanworth & South Twickenham. The SWMP states the following relating to the Hanworth & South Twickenham CDA;

> *Richmond has had 5 historic reports of flooding in the Hanworth and South Twickenham Catchment H10. The incidents align with the predicted risk areas, along the surface water flow paths on The Avenue, the A313 (Park Road), River Way (next to the River Crane) and Church Lane where Hotspots are located.*

4.30. The SWMP includes details of historic surface water flood events. The site is shown to lie outside the vicinity of any recorded surface water flood event.

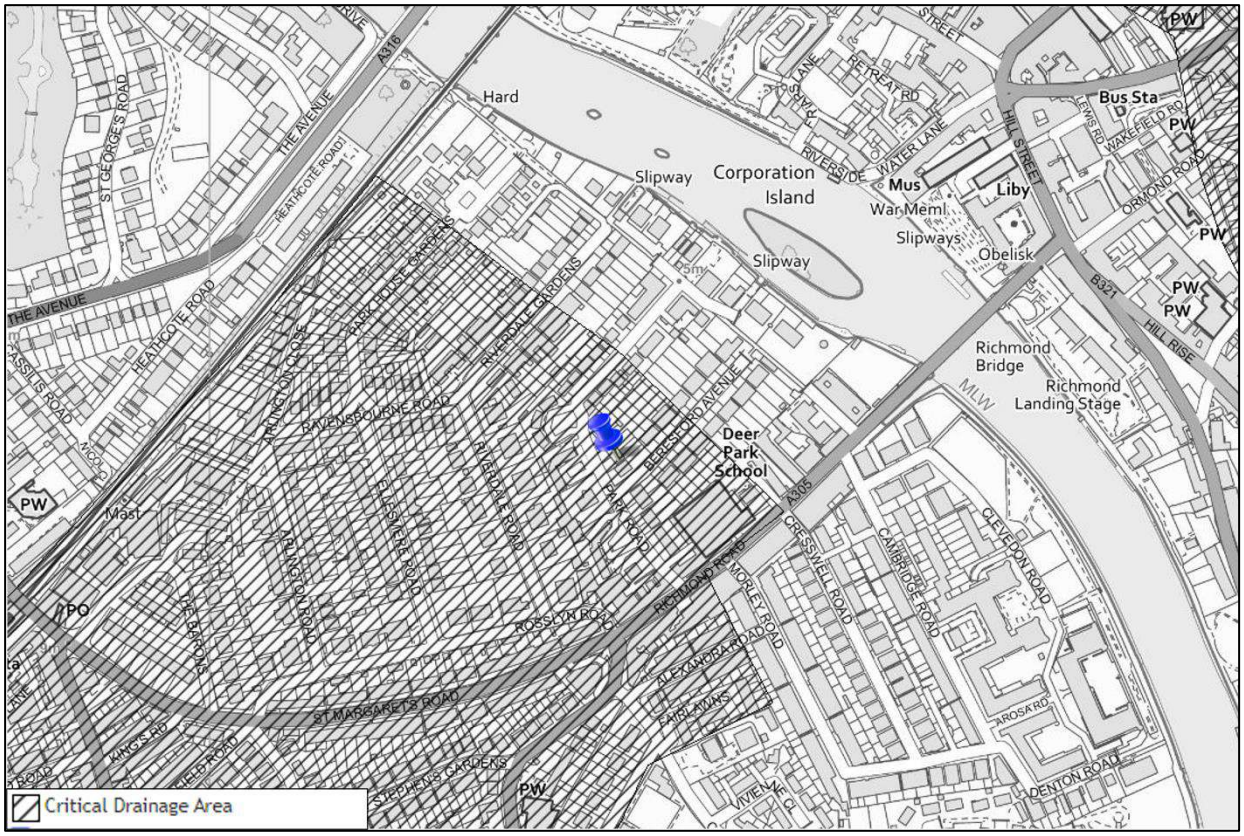


Figure 9: Richmond SWMP – Critical Drainage Areas (Site Located at Pin)

4.31. Based on the information above, the proposed development is considered to be at a low risk of surface water flooding.

Reservoirs

4.32. Flooding can occur from large waterbodies or reservoirs if they are impounded above the surrounding ground levels or are used to retain floodwater. Although unlikely, reservoirs and large waterbodies could overtop or breach leading to rapid inundation of the downstream floodplain.

4.33. According to the EA's Flood Risk from Reservoirs mapping the site is at risk of flooding in the event of a breach at multiple reservoirs (Figure 10). The worst reservoir failure model is a 'wet day' scenario meaning that it would have to happen at the same time as other flooding for there to be enough water to reach the site.

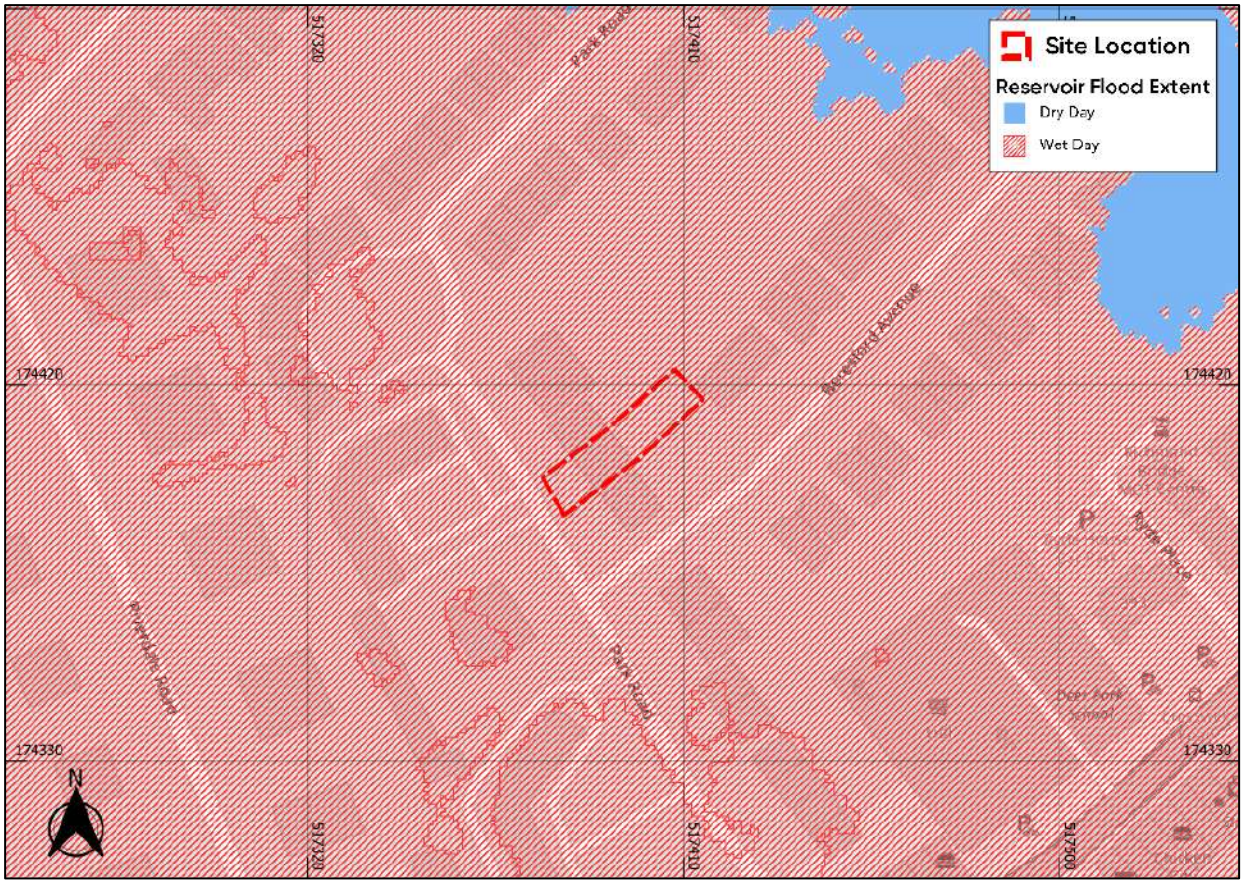


Figure 10: EA Reservoir Flood Risk Mapping (Base map and data from OpenStreetMap and OpenStreetMap Foundation (CC-BY-SA). ©https://www.openstreetmap.org and contributors. Contains public sector information licensed under the Open Government Licence v3.0)

4.34. All large reservoirs must be inspected and supervised by reservoir panel engineers as detailed by the Reservoirs Act 1975 in England and Wales. The EA are responsible to ensure that reservoirs are inspected regularly, and essential safety work carried out. As reservoirs are highly managed the maximum flood extent provided in the EA Risk of Flooding from Reservoirs mapping is considered a worst-case scenario.

4.35. As reservoir flooding is unlikely and the modelled flood depths are based on the worst-case scenario, flooding from this source may be considered as a relatively low risk.

Groundwater

4.36. Groundwater flooding occurs in areas where underlying geology is permeable, and water can rise within the strata sufficiently to breach the surface.

4.37. The British Geological Survey's (BGS) mapping shows superficial deposits of Kempton Park Gravel Member comprised of sand and gravel underlying the site. The bedrock underlying the site is London Clay Formation comprised of clay and silt.

4.38. Historic BGS borehole (ref: TQ17SE109) located approximately 325m west states that groundwater was recorded at 8'6" (2.59m) below ground level. Strata details from the borehole record show sand underlain with London Clay. It should be noted that given that the recorded borehole is located 325m from the site, this may not represent the underlying site geology

4.39. The SFRA presents the EA's Areas Susceptible to Groundwater Flooding mapping, which assesses the future risk of groundwater flooding. The site is within a 1km square grid of which "between 50% and 74.9%" is susceptible to groundwater flooding (Figure 11).

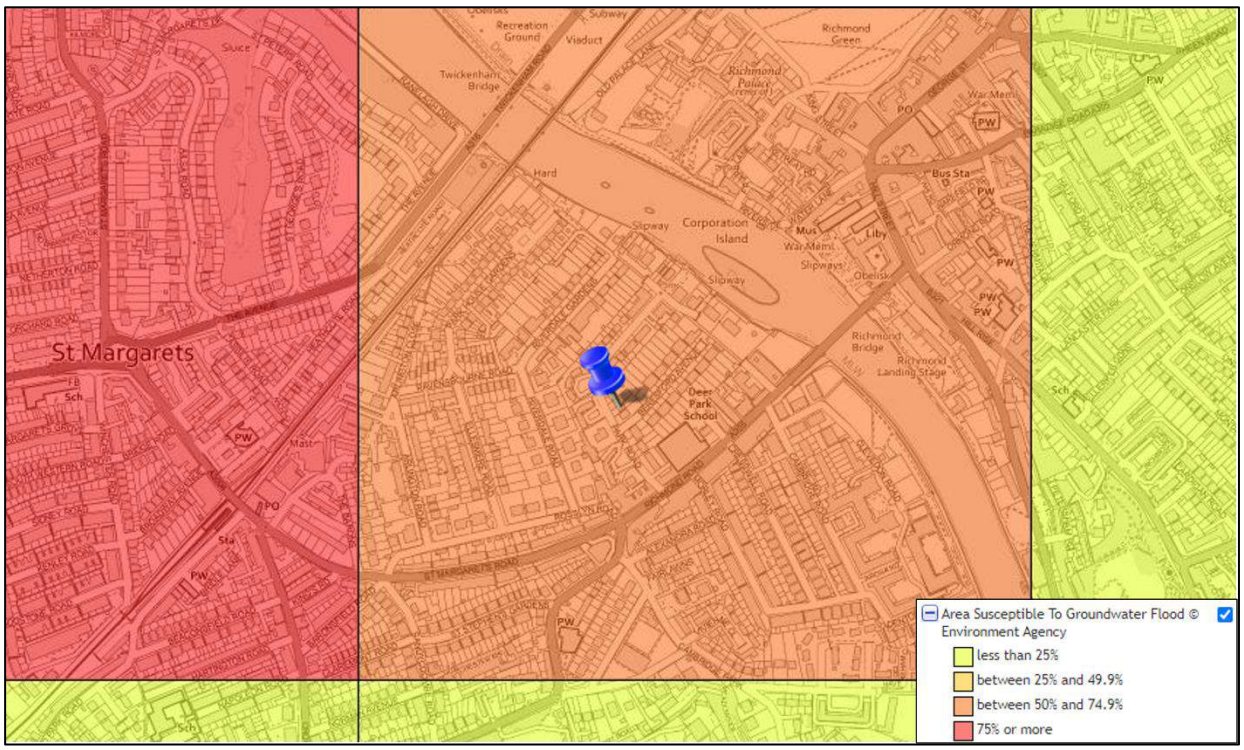


Figure 11: Areas Susceptible to Groundwater Flooding, (Richmond SFRA) (Site Location at Pin)

4.40. Additionally, the SFRA contains information from the GLA Drain London study (Figure 12). The site is located within an area shown to have permeable superficial deposits.

Figure 12: Increased Potential for Elevated Groundwater (Source: Richmond SFRA) (Site Location at Pin)

4.41. Based on the information above, the site is considered to be at a moderate risk of groundwater flooding. This is considering the fact that no subterranean elements are proposed, though superficial deposits overlaying London Clay can increase the risk the groundwater flooding or perched groundwater.

Sewers

4.42. Foul or surface water sewers can be a cause of flooding if the drainage network becomes overwhelmed, either by blockage or due to local development beyond the designed capabilities of the drainage system.

4.43. Thames Water Utilities Ltd (Thames Water), are the Public Sewer Authority covering Richmond. Thames Water provide surface water, foul, and combined sewer systems. Modern sewer systems are designed to be separate surface water and foul water systems, typically accommodating up to 1 in 30 year rainfall events. However, sewer system segments across London vary in capacity due to age. Older segments have a smaller capacity and may not be designed to accommodate rainfall events as significant as 1 in 30 year events.

4.44. The SFRA provides mapping of historical sewer flood incident records (Figure 13). This data has been provided by Thames Water and is broken down into 4-digit postcode areas. The site post code area (TW1 2) is shown to have experience only 1 internal sewer flooding incidents, and 0 external sewer flood incidents.

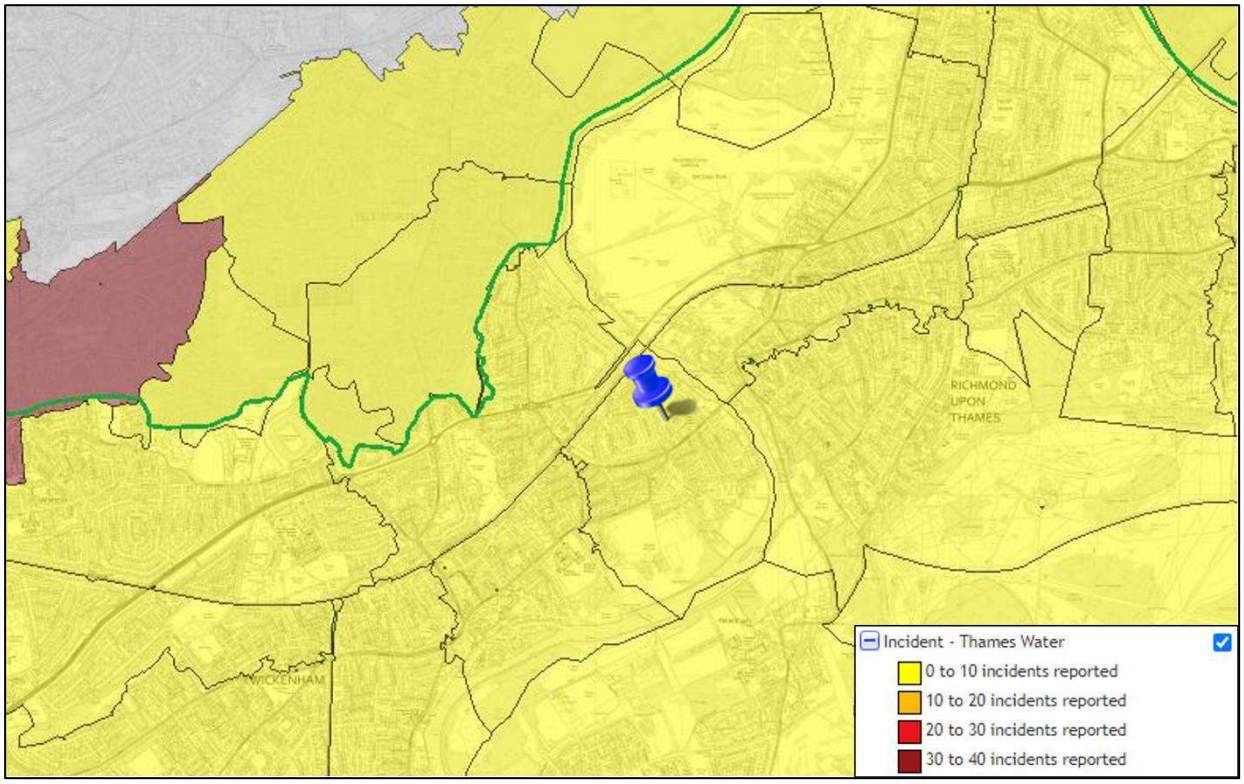


Figure 13: Thames Water Sewer Flooding Incident Record (Site Located at Pin)

4.45. Based on the information above, the site is considered to be at a low risk of sewer flooding.

5. Flood Risk Mitigation

Fluvial/Tidal

5.1. Based on this assessment, the actual tidal flood risk (defended) to the proposed site is considered low. The Thames tidal defences are designed to protect the site up to the 0.1% AEP event, as long as the defences remain intact and operational. In the event of a breach of the Thames tidal defences the risk is considered to be high.

5.2. The EA's Standing Advice for Minor Extensions stipulates that Finished Floor Levels (FFLs) should be set at 600mm above the estimated flood level. The advice notes that this can be reduced to 300mm if there is a higher level of certainty about the flood level, which given that there is detailed flood level information from available for the site location, this can be deemed to be the case.

5.3. Given the nature of the proposed development, it is understood that raising of the FFLs to 300mm above the modelled design flood level would not be feasible. This is due to the fact that level access will need to be provided from the ground level of the existing property to the extension location.

5.4. The Standing Advice notes that if FFLs cannot be feasibly raised, then flood resilience and resistance measures should be incorporated into the proposal design. These measures should be able to protect the property up to at least 600mm above the design flood level.

5.5. Therefore, considering it has been identified that the site could be affected in the unlikely event of a breach based on EA modelling it is recommended that FFLs are set no lower than the existing ground floor level and it is also advised that appropriate flood resilience measures could be incorporated within the proposed development, in accordance with the CLG Report, Improving the Flood Performance of New Buildings - Flood Resilient Construction (2007) including measures such as the below:

- *Raised wiring and power outlets at basement and ground floor level.*
- *Air brick covers to be installed.*
- *Non-return valves should be installed on all new drainage.*
- *All new plumbing insulation to be of closed cell design.*

•Finish shall be water resistant render with lime-based plaster finish, hydraulic lime coating or ceramic tiles. Plasterboard placed horizontally as a sacrificial material, not vertically.

•Insulation to be low adsorption board or semi rigid self-draining wool bats.

5.6. No sleeping accommodation is to be provided at the ground floor level as a consequence of the proposed development.

5.7. As a further precaution and risk reduction, the owner of the site should sign up Tidal Thames from the River Crane to Teddington Weir EA flood warning service. This service allows site owners to register an address, which is at risk of flooding, along with contact details so that in the event of a flood being forecast, the site owner will be sent an alert directly to their chosen method of contact.

5.8. Flood warnings/alerts can be enforced at any time of the day or night. Signing up for this service provides site owners some notice before a flood event. The amount of time afforded before a flood occurs depends on the site specific location (e.g. proximity to the source of flooding, topography of the surrounding area) and the flood mechanism (e.g. bank over topping versus a breach event). Flood alerts and warnings provide site managers with time to take necessary action, e.g. communication of the risk of flooding to occupants etc, evacuation of occupants offsite or to a safe level, removal of valuable items out of reach of flooding and the mounting of site specific flood defences.

Groundwater

5.9. The site is considered to be at a moderate risk of groundwater flooding. However, mitigation measures mentioned to manage the fluvial/tidal flood risk to the site should be adequate to also manage the groundwater risk.

5.10. Additionally, it may be necessary to complete a groundwater monitoring exercise in order to further explore the impact of groundwater flooding to the site, given that there are permeable superficial deposits overlaying London Clay at the site location.

Other Sources

5.11. Flood risk to the proposed development from pluvial, canal, reservoir, and sewer sources is considered to be low and as such, no further specific mitigation is recommended.

5.12. It is recommended that any new drainage associated with the scheme be fitted with non-return valves and that any new plumbing should be constructed in a closed cell design.

Safe Access/Egress

5.13. The proposed development is considered a minor development (extension to the existing dwelling) and thus the access/ egress/ refuge arrangements should not differ from the existing situation.

Increase to Flood Risk Elsewhere

5.14. The proposed development is for the construction of an extension to the existing dwelling on site. As such, the proposal constitutes a Minor Development under the NPPF.

5.15. Paragraph 051 of the Flood Risk and Coastal Change Planning Practice Guidance (PPG) states:

> *Minor developments are unlikely to raise significant flood issues unless:*
>
> - *they would have an adverse effect on a watercourse, floodplain or its flood defences;*
> - *they would impede access to flood defence and management facilities, or;*
> - *where the cumulative impact of such developments would have a significant effect on local flood storage capacity or flood flows.*

5.16. The proposals also include the provision of SuDS within the accompanying surface water drainage strategy, which will seek to manage surface water for up to an including in the 1.0%AEP event + 40%CC allowance as a consequence of this development.

5.17. As such, the proposed development in isolation should have a negligible impact on flood risk elsewhere.

6. Surface Water Drainage Strategy

Nearby Watercourses

6.1. The nearest watercourse to the site is the River Thames (EA Main River) located approximately 190m northeast of the redline boundary. The Thames flows from south to north past the site location and is understood to be both tidally and fluvially influenced at the nearest extent to the site. Providing a connection to the Thames would not be feasible due to need for crossing third party land.

6.2. There are no other mapped watercourses within the vicinity of the site which could provide an outfall for surface water from the site.

Ground Conditions

6.3. The British Geological Survey's (BGS) mapping shows superficial deposits of Kempton Park Gravel Member comprised of sand and gravel underlying the site. The bedrock underlying the site is London Clay Formation comprised of clay and silt.

6.4. As such, an infiltration led strategy may be unfeasible due to the impermeable bedrock deposits at the site location and potentially high groundwater levels within the site vicinity. Some partial infiltration may be possible within the superficial deposit strata, but infiltration tests should be carried out at the detailed design stage to confirm infiltration rates and thus the possibility of this.

6.5. It is recommended that groundwater monitoring and infiltration testing is completed at the detailed design stage in order to confirm the feasibility of infiltrating features.

Existing Drainage Infrastructure

6.6. Thames Water have provided an asset plan for the site location. A full copy of the asset plan will be included in Appendix B of this report. An extract is included in Figure 14. There is shown to be a foul sewer located to the rear of the existing dwelling which flows to the rear of the dwellings to the north of the site, then onto Park Road. The existing foul sewer location is shown to encroach on the proposed development footprint.

6.7. It is recommended that the client engage with Thames Water at the earliest opportunity in order to approve a build over agreement in the first instance. If a build over agreement cannot be reached, a diversion of the existing public asset may be required.

6.8. The asset plan shows that there is also a Thames Water surface water sewer which flows from front garden of the properties to the north before flowing into the main drain beneath Park Road.

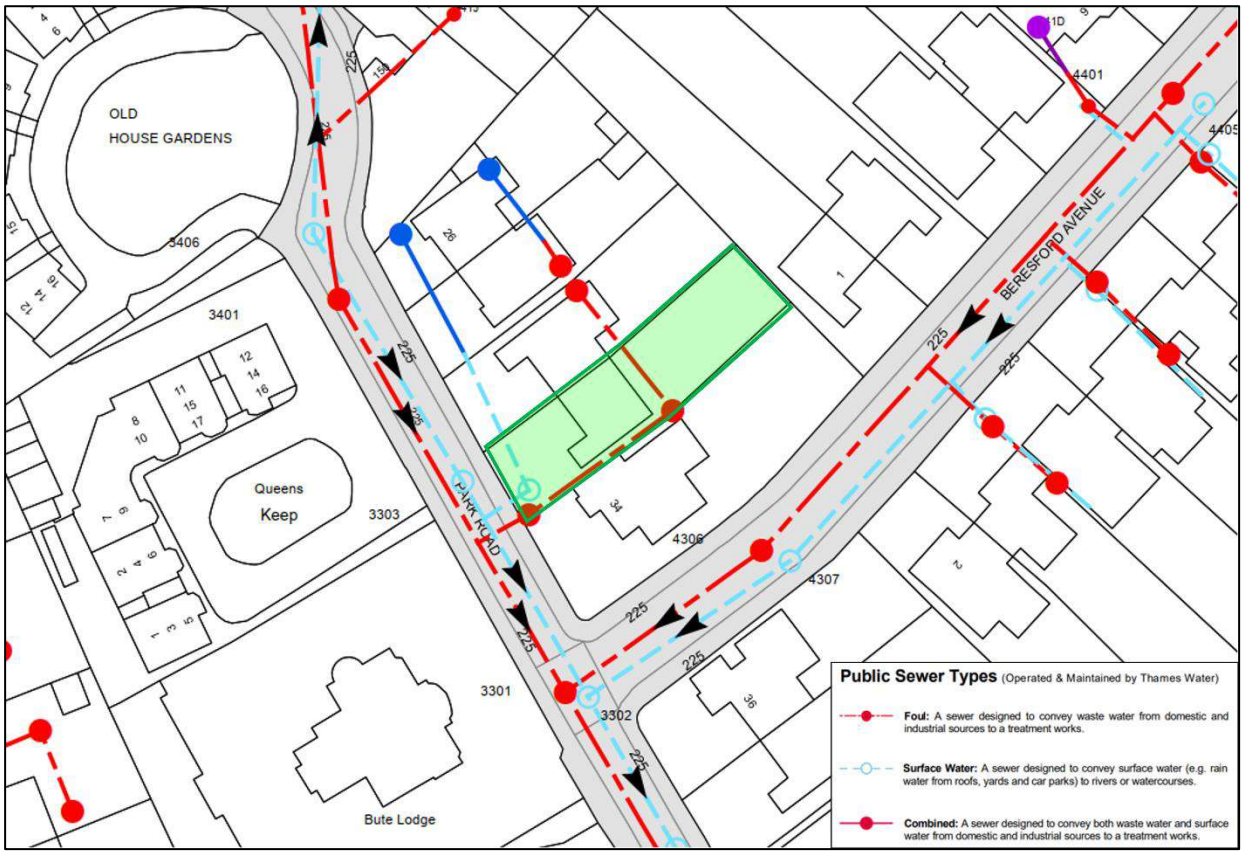


Figure 14: Thames Water Asset Plan Extract (refer to Appendix B)

6.9. In addition to the asset plan, the client has provided a CCTV survey of the existing drainage infrastructure serving the site. A copy of the CCTV results can be found in Appendix C, an extract can be seen in Figure 15.

6.10. The CCTV results confirm the location of the foul sewer located to the rear of the existing dwelling and the public surface water at the front of the property. The existing surface water infrastructure on site is shown to flow into the public surface water sewer.

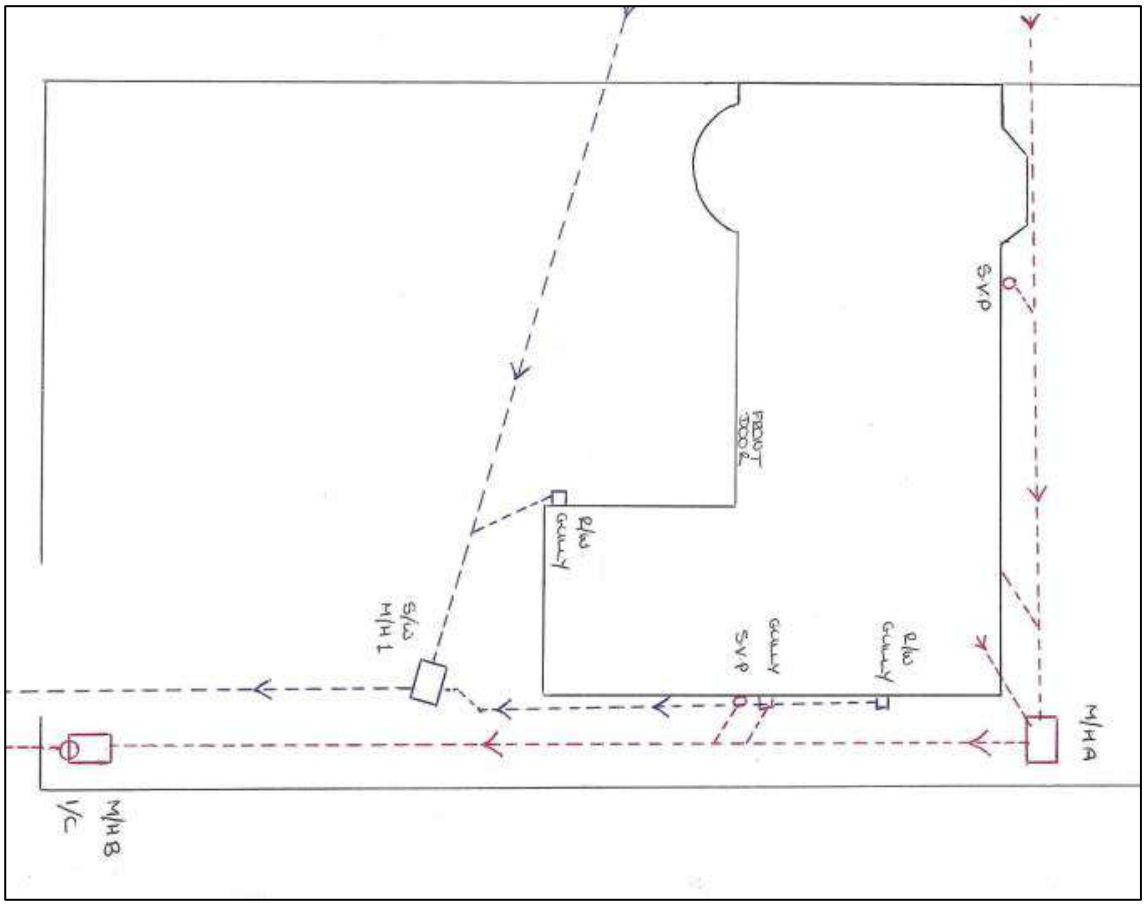


Figure 15: CCTV Survey Plan Drawing (Refer to Appendix C)

Greenfield Runoff Rate

6.11. The total site area is approximately 0.044ha (440m^2).

6.12. The proposed plans indicate that the impermeable area associated with the proposed development is equal to 106m^2 – this is inclusion of the rear facing roof catchment (including the increased roof area due to the proposed extension) and rear patio area. The remaining areas within the site boundary are understood to drain via the existing surface water drainage network serving the dwelling and have been excluded from attenuation calculations. The proposed plans are included as Appendix A.

6.13. The IH-124 method was developed as part of the original Flood Studies Report (FSR) in 1975 and was devised to calculate runoff from small catchments by estimating the mean annual flood flow (Qbar) using the following equation:

$$QBAR_{rural} = 0.00180 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$$

Where:

$Qbar_{rural}$ is the mean annual flood flow from a rural catchment (approximately 2.3 year return period).

AREA is the area of the hardstanding surfaces in ha.

SAAR is the Standard Average Annual Rainfall for the period 1941 to 1970 in mm.

SPR is Standard Percentage Runoff coefficient for the SOIL category. The SOIL category is extracted from UK Winter Rainfall Acceptance Potential (WRAP) map.

6.14. The ICP SuDS variation is a scaled-down version of the IH-124 runoff method for estimating peak flow rates from both undeveloped and partly urbanised catchments that are smaller than 50 ha in size, which is appropriate in this instance.

6.15. The parameters used for estimating the greenfield runoff rates for the site are presented in Table 2.

Table 2: IH-124 Input Parameters

Greenfield Runoff Rates from the Site – Simulation Criteria	
Rainfall Data	FSR
Area	0.011 Ha (rounded to 3 d.p.)
SAAR	600.0
SOIL	0.300
Region	Region 6

6.16. Table 3 displays the estimated Q_{BAR} greenfield runoff rate for an impermeable area of 0.005 Ha. Results <0.05 L/s have been rounded down to 0.0 L/s in the InfoDrainage modelling software.

Table 3: Greenfield Runoff Rates

Return Period	Greenfield Runoff Rate (l/s)
1 in 1 Year	0.0
1 in 2.33 Year (Q_{BAR})	0.0
1 in 30 Year	0.0
1 in 100 Year	0.1

6.17. Guidance from the Richmond Local Plan states the following in relation to runoff rates;

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

2. 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.

6.18. Therefore, any outfall rates should be reduced to as low a rate of feasibly possible. A maximum rate of 1.0 l/s is the lowest acceptable discharge rate that can be incorporated into the proposed drainage strategy without unnecessarily increasing the risk of blockage and sedimentation.

Surface Water Drainage Strategy

6.19. In accordance with the SuDS management train approach, the use of various SuDS measures to reduce and control surface water flows have been considered in detail for the development. The management of surface water has been considered in respect to the SuDS hierarchy below, as detailed in the CIRIA 753 "The SuDS Manual" (section 3.2.3).

Table 4. SuDS Drainage Hierarchy

SUDS DRAINAGE HIERARCHY				
			Suitability	**Comment**
↓	**1.**	**Store rainwater for later use**	✓	There are plot scale opportunities for rainwater harvesting measures such as water butts and these should be implemented where practical.
↓	**2.**	**Use infiltration techniques, such as porous surfaces in non-clay areas**	x	The British Geological Survey's (BGS) mapping shows superficial deposits of Kempton Park Gravel Member comprised of sand and gravel underlying the site. The bedrock underlying the site is London Clay Formation comprised of clay and silt. As such, an infiltration led strategy may be unfeasible due to the impermeable bedrock deposits at the site location and potentially high groundwater levels within the site vicinity. Some partial infiltration may be possible within the superficial deposit strata, but infiltration tests should be carried out at the detailed design stage to confirm infiltration rates and thus the possibility of this.
↓	**3.**	**Attenuate rainwater in ponds or open**	✓/ x	It is understood that there is not feasible enough space to provide larger open water features such as ponds. Though, there

SUDS DRAINAGE HIERARCHY				
			Suitability	Comment
		water features for gradual release		is scope for providing smaller scale bioretention features such as rainwater planters.
	4.	**Attenuate rainwater by storing in tanks or sealed water features for gradual release**	✓	Has been deemed an appropriate option. Attenuation could be provided by permeable paving at the rear patio area before gradual release at a restricted maximum rate of 1.0 L/s.
	5.	**Discharge rainwater direct to a watercourse**	x	There are no watercourses located within the vicinity of the site which could provide an outfall for the proposed development drainage.
	6.	**Discharge rainwater to a surface water sewer/drain**	✓	There is a Thames Water surface water sewer located in the front garden of the site which the current dwellings surface water drainage discharges too. It is understood that the proposed drainage strategy could connect to the existing surface water drainage on site, leading to the Thames Water sewer.
	7.	**Discharge rainwater to Combined Sewer**	x	There are no public combined water sewerage assets within the vicinity of the site.

6.20. On review of the SuDS drainage hierarchy, and with reference to both national and local policy, it is proposed that the surface water runoff from the development is managed via an area of Type C (lined) permeable paving at the rear of the proposed extension where the patio is proposed. Surface water from the proposed development will ultimately be discharged to the existing surface water drainage at a restricted rate of 1.0 l/s by utilising a 36mm orifice plate located within a control flow chamber (Controflow Mini Orifice Plate Chamber – or similar).

6.21. It should be noted again that it is recommended that the client engage with Thames Water at the earliest opportunity in order to approve a build over agreement in the first instance. If a build over agreement cannot be reached, a diversion of the existing public asset may be required.

6.22. Rainwater planter bioretention systems have not been accounted for within the storage calculations in the subsequent sections of this report but would provide additional benefit in terms of biodiversity and amenity. This represents a conservative approach whereby these SuDS features have been assumed to be at full capacity at the onset of the modelled storm events.

6.23. The proposed Surface Water Drainage Layout is included as Appendix D.

InfoDrainage Modelling

6.24. A network model has been produced in InfoDrainage software (v 2025.3.2).

6.25. The model comprises;

- 2no. contributing catchment areas across the proposed development representing the roof and patio impermeable areas. An additional 10% allowance for urban creep has been included in the calculations, this represents a conservative approach whereby an allowance is made for the conversion of permeable areas to impermeable areas over the lifetime of the development.;
- 1no. permeable paving areas (subbase depth: 0.20m, total volume: 5.09m^3, porosity: 95% (geocellular subbase replacement to be used); and;
- 2no. surface water manholes representing the existing SW manhole on site and the proposed flow control chamber.

6.26. The Environment Agency Peak Rainfall Climate Change Allowance guidance was reviewed and subsequently the DEFRA Peak Rainfall Allowances Map was assessed to determine appropriate climate change allowances to inform the surface water drainage strategy. The upper end allowances for the London Management Catchment have been used for both the 1% and 3.3% annual exceedance probability events for the 2070s epoch (2061 to 2125 – 40% and 35% respectively for the 1% and 3.3% events).

6.27. The system is designed to manage the 1 in 100 year (+40% allowance for climate change) storm event.

6.28. Table 5 summarises the simulation criteria for the InfoDrainage model.

Table 5: Simulation Criteria

Catchment Area Simulation Parameters	
Rainfall Data	FSR
Total Area	0.011 Ha
Return Periods	1, 30, 30+35% for climate change, 100, 100 +40% for Climate Change. Summer and Winter
Storm Durations	15, 30, 60, 120, 180, 240, 360, 480, 600, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 minute
Volumetric Runoff Coefficient	0.9 (summer and winter storms)
Percentage Impervious	100%
Time of Concentration	5 minutes
Urban Creep	+10%

6.29. The full calculation outputs can be found in Appendix E of this report although the 1in100 year +40% climate change results have been summarised below:

- The maximum outflow rate from the green roof to the existing surface water drainage would be 1.0 l/s for the critical storm event (60 minute summer).
- The maximum depths in the proposed permeable paving subbase 0.20m deep storage layer would be 0.152m for the critical storm event (60 minute summer).
- No flooding is observed in the critical storm event based on the InfoDrainage model.

6.30. As such, these results indicate that the runoff from the proposed development could be accommodated within a drainage system of the approximate size modelled, with surface water runoff restricted to 1.0l/s.

Maintenance

6.31. Table 6 presents details regarding the maintenance requirements for the proposed SuDS included as part of the development, taken from the CIRIA C753 SuDS manual. Each manufacturer will have bespoke requirements however the below should be used as a guide.

Table 6: Maintenance for Permeable Paving

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturers recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required - once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action	Three-monthly, 48hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

6.32. Maintenance of the surface water drainage infrastructure within the bounds of the site curtilage should be the responsibility of the site owner or maintenance company appointed by the owner.

Designing for Exceedance

6.33. Periods of exceedance occur when the rate of surface water runoff exceeds the drainage system capacity. Conveyance beneath ground cannot, generally, be economically or sustainably constructed to the scale required for the most extreme rainfall events. This may result, on

occasion, in the surface water runoff exceeding the capacity of the drainage network, with excess water (exceedance flow) being conveyed above ground.

6.34. For situations where extreme rainfall intensity exceeds inlet capacities, or for extreme storm events exceeding the design flood event considered for drainage design, surface water would flow toward the rear of the site and away from the proposed development footprint.

Water Quality

6.35. In order to protect the downstream receiving water body, a key element of SuDS is that they have the potential to improve the quality of surface water discharged from a site. In order to assess this, the "Pollution hazard indices for different land use classifications", provided in the CIRIA SuDS Manual (C753) as table 26.2, has been reviewed. The indices use four different methods of assessing pollution potential based on the hazard level, total suspended solids (TSS), Metals, and Hydrocarbons.

6.36. The Pollution Hazard Indices are summarised in Table 7 below (with reference to table 26.3 in the CIRIA SuDS manual).

Table 7: Pollutant Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05

6.37. Runoff from residential roofs is generally considered 'very low' contamination risk and does not usually warrant any significant treatment. Permeable paving is proposed on site. The mitigation indices associated with these SuDS features are shown below in Table 8. Furthermore, silt traps could be fitted upstream of the connection to the existing surface water drainage on site to reduce the pollution from the roofs entering the subsurface piped network.

6.38. The mitigation indices offered by the proposed SuDS features (Table 8) exceed the hazard indices from 'residential roofs'. It is therefore considered that the proposed SuDS features are appropriate and acceptable in terms of water quality.

Table 8: Indicative SuDS Mitigation Indices for Discharge to Surface Water

Land Use	Total Suspended Solids (TSS)	Metals	Hydrocarbons

Permeable Paving	0.7	0.6	0.7

Management During Construction

Visual Inspection/Sweep

6.39. This should include a systematic review of the drainage infrastructure. Each element should be inspected to determine if remedial actions are needed. Where access chambers are provided, these should be used to access below ground infrastructure:

- Rodding eyes / inspection chambers are provided at both ends of all perforated pipes; these should be used to determine the level of silt within the system.
- Non-man entry inspection chambers are provided for the geo-cellular structure.
- Permeable paving should be inspected for vegetation / defects (rocking blocks), it should be swept clear of debris.

Surface Water Management During Construction

6.40. The surface water runoff generated during construction has the potential to have higher concentration of oils and sediments from heavy machinery and earthworks respectively. As such, it is necessary to devise appropriate surface water management plans tailored to specific construction activities and receptors of runoff. Specific considerations are:

- Provision of appropriate bunding/containment for potentially hazardous materials or chemicals.
- Re-fuelling of plant and equipment to take place only within designated areas, with suitable pollution containment.
- Good housekeeping on site to prevent accidental spillages, and spill kits to be provided as appropriate.
- Vehicle wash down areas / wheel cleaning to be located in areas with appropriate pollution control measures.
- If water/spray dust suppression is needed, the run-off should be directed to a temporary containment area and should not be allowed to discharge to the public sewer / infiltration devices.

- The installed surface water drainage network should be routinely inspected during construction, especially the infiltration devices; and,
- Suitable protection measures should be in place during construction to protect the watercourse and groundwater resources.

7. Conclusions

7.1. This FRA and SWDS has been undertaken with reference to the requirements of NPPF and Planning Practice Guidance with respect to the development at 32 Park Road, Twickenham, TW1 2PX. It has been written to support a planning application and prepared with due consideration to the nature of the proposed development to provide the appropriate level of detail.

7.2. An assessment of the risk of flooding from all sources has been undertaken and is summarised in the table below:

Source of Flooding	Flood Risk Summary
Fluvial/Tidal	Based on this assessment, the actual tidal flood risk (defended) to the proposed site is considered low. The Thames tidal defences are designed to protect the site up to the 0.1% AEP event, as long as the defences remain intact and operational. In the event of a breach of the Thames tidal defences the risk is considered to be high. The proposed development is considered to be a minor extension given that the proposals are for a 'household or non-domestic extensions with a floor space of no more than 250 square metres.' As such, FFLs are to be set no lower than those of the existing ground floor. However, it has been identified that the site could be affected in the unlikely event of a breach based on EA modelling. As such, it is also advised that appropriate flood resilience measures could be incorporated within the proposed development, in accordance with the CLG Report, Improving the Flood Performance of New Buildings - Flood Resilient Construction (2007)
Groundwater	The site is considered to be at a moderate risk of groundwater flooding. However, mitigation measures mentioned to manage the fluvial/tidal flood risk to the site should be adequate to also manage the groundwater risk.
Reservoirs Pluvial Sewers Canals	The site is considered to be at low risk from other sources.

7.3. The proposed development is considered a minor development (extension to the existing dwelling) and thus the access/ egress/ refuge arrangements should not differ from the existing situation.

7.4. The development is considered a Minor Development and therefore should constitute a negligible increase in flood risk elsewhere in accordance with paragraph 051 of the PPG. The proposals also include the provision of SuDS within the accompanying surface water drainage strategy, which will seek to manage surface water for up to an including in the 1.0%AEP event + 40%CC allowance as a consequence of this development.

7.5. On review of the SuDS drainage hierarchy, and with reference to both national and local policy, it is proposed that the surface water runoff from the development is managed via an area of Type C (lined) permeable paving at the rear of the proposed extension where the patio is proposed. Surface water from the proposed development will ultimately be discharged to the existing surface water drainage at a restricted rate of 1.0 l/s by utilising a 36mm orifice plate located within a control flow chamber (Controflow Mini Orifice Plate Chamber – or similar).

7.6. It is recommended that the client engage with Thames Water at the earliest opportunity in order to approve a build over agreement for the proposed extension in the first instance. If a build over agreement cannot be reached, a diversion of the existing public asset may be required.

7.7. It is recommended that groundwater monitoring and infiltration testing is completed at the detailed design stage in order to confirm the feasibility of infiltrating features.

7.8. This Flood Risk Assessment and Surface Water Drainage Strategy should be submitted as part of the planning application to satisfy the requirements under NPPF.

Appendix A - Development Proposals

PROPOSED FRONT ELEVATION

PROPOSED SIDE ELEVATION

Scale

0 Metres 2 3 4

1:100

Planning Issue

Elevations Proposed

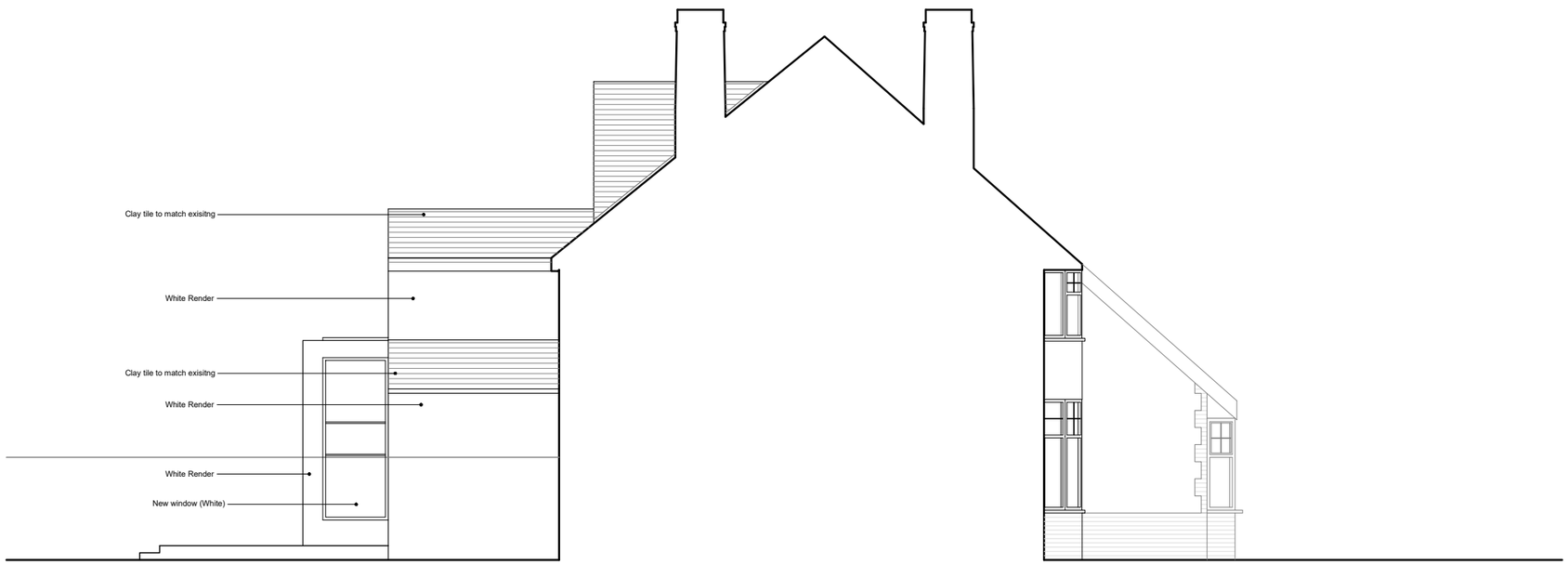
Location: 32 Park Road, Twickenham, TW1 2PX

C h o c k

T +44(0)77 987 03393 **E** cathaltravers@chock.net

Scale: 1/100 @A3
Date: 02/Dec/24
Drwg: 23008-LON-20-400-PD-R0

PROPOSED REAR ELEVATION



PROPOSED SIDE ELEVATION

Scale

0 Metres 2 3 4

1:100

Planning Issue

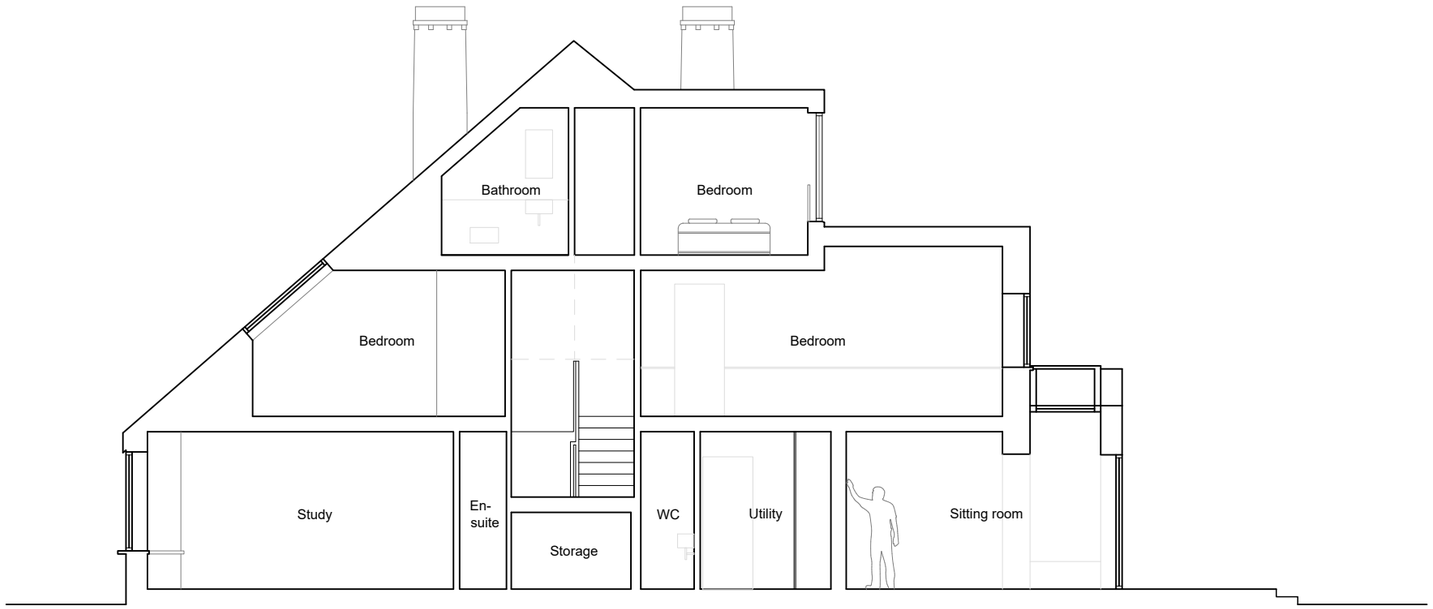
Elevations Proposed

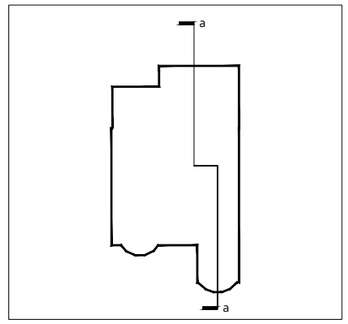
Location: 32 Park Road, Twickenham, TW1 2PX

C h o c k

T +44(0)77 987 03393 **E** cathaltravers@chock.net

Scale: 1/100 @A3 **Date:** 02/Dec/24 **Drwg:** 23008-LON-20-402-PD-R0





PROPOSED SECTION A-A

Scale

0 Metres 2 3 4

1:100

Planning Issue

Section

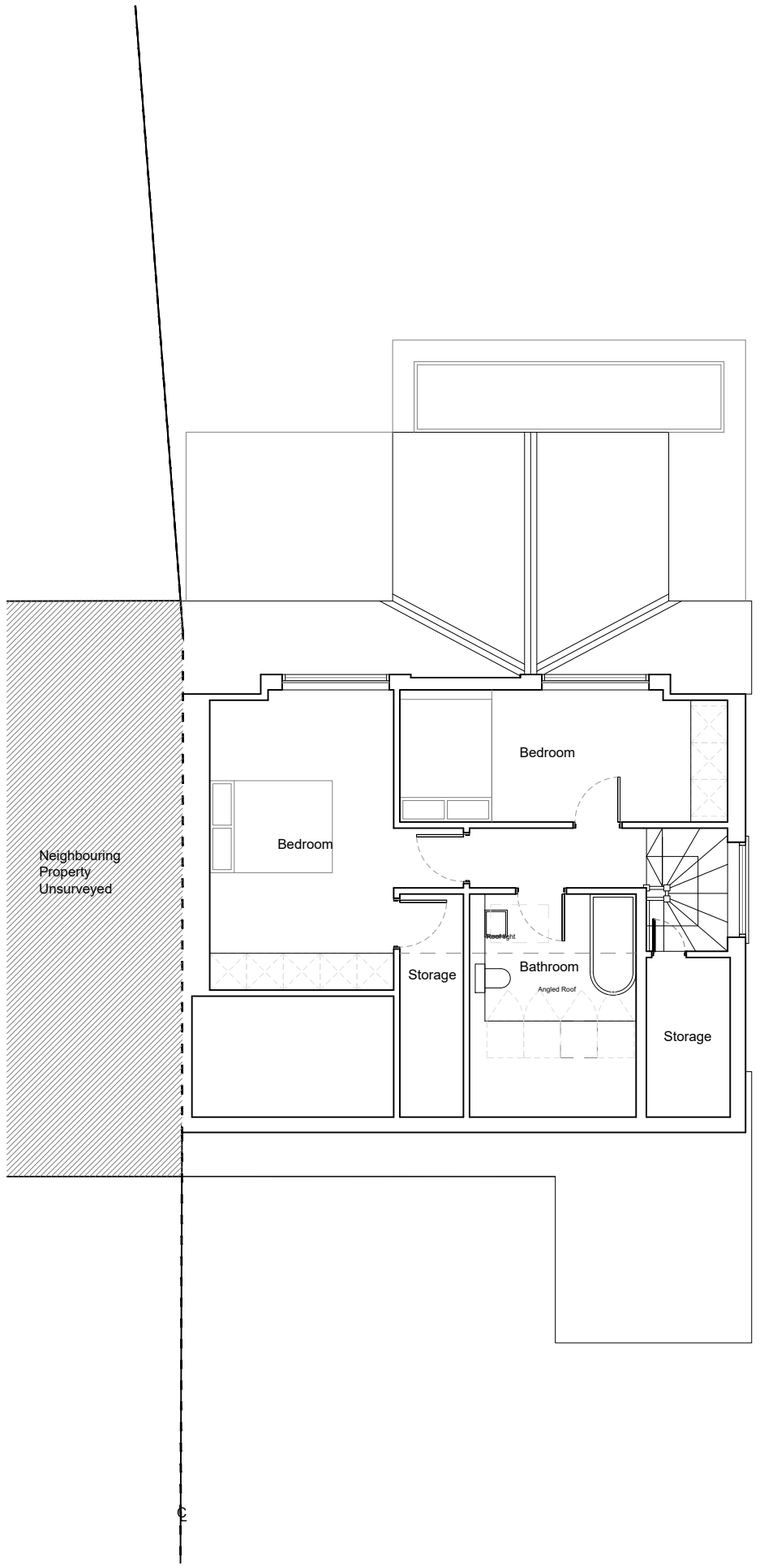
Proposed

Location: 32 Park Road, Twickenham, TW1 2PX

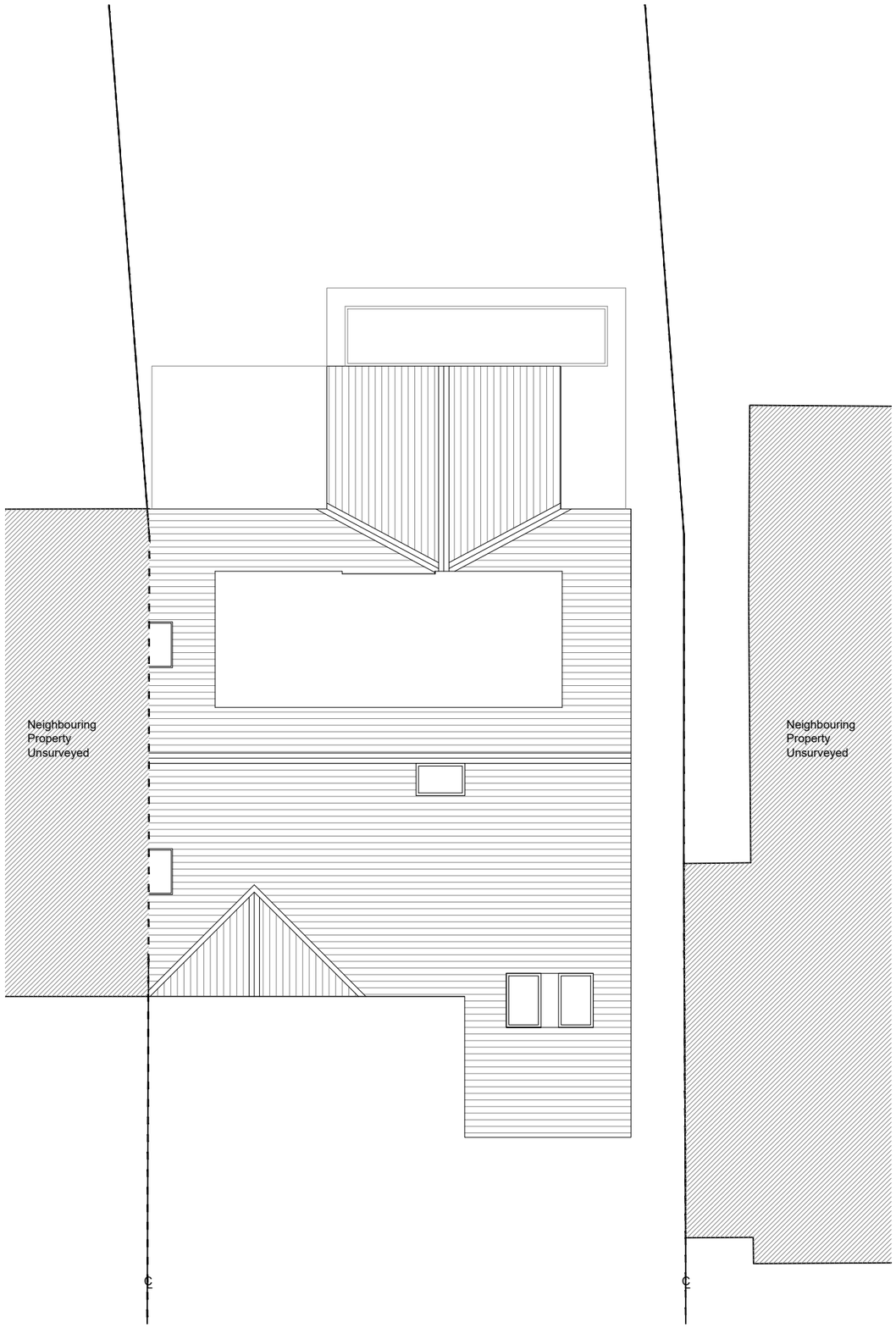
C h o c k

T +44(0)77 987 03393 **E** cathaltravers@chock.net

Scale: 1/100 @A3 **Date:** 02/Dec/24 **Drwg:** 23008-LON-20-300-PD-R0



PROPOSED LOFT FLOOR PLAN



PROPOSED ROOF PLAN

Scale

0 Metres 2 3 4

1:100

Planning Issue

Floor Plans

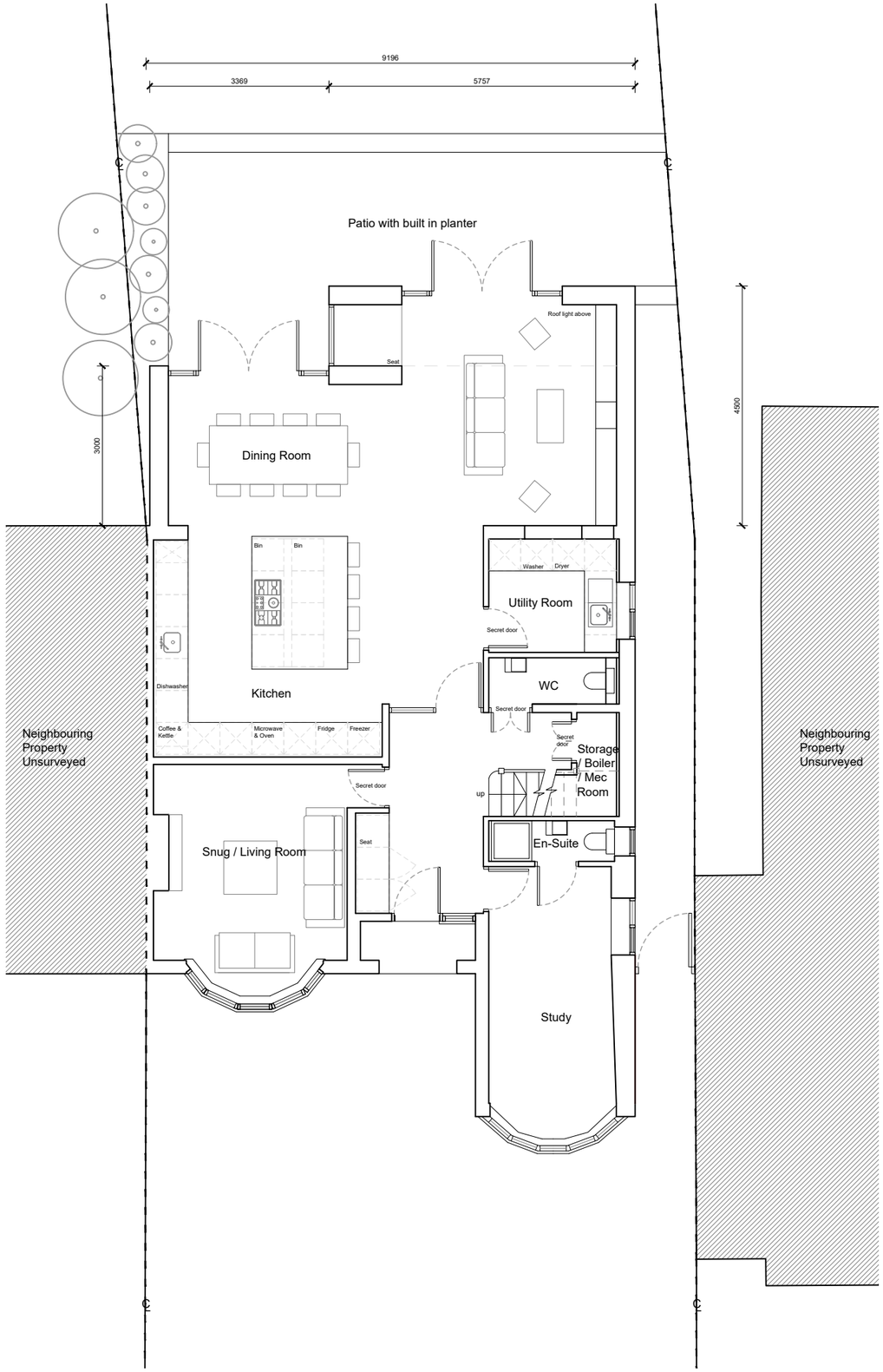
Proposed

Location: 32 Park Road, Twickenham, TW1 2PX

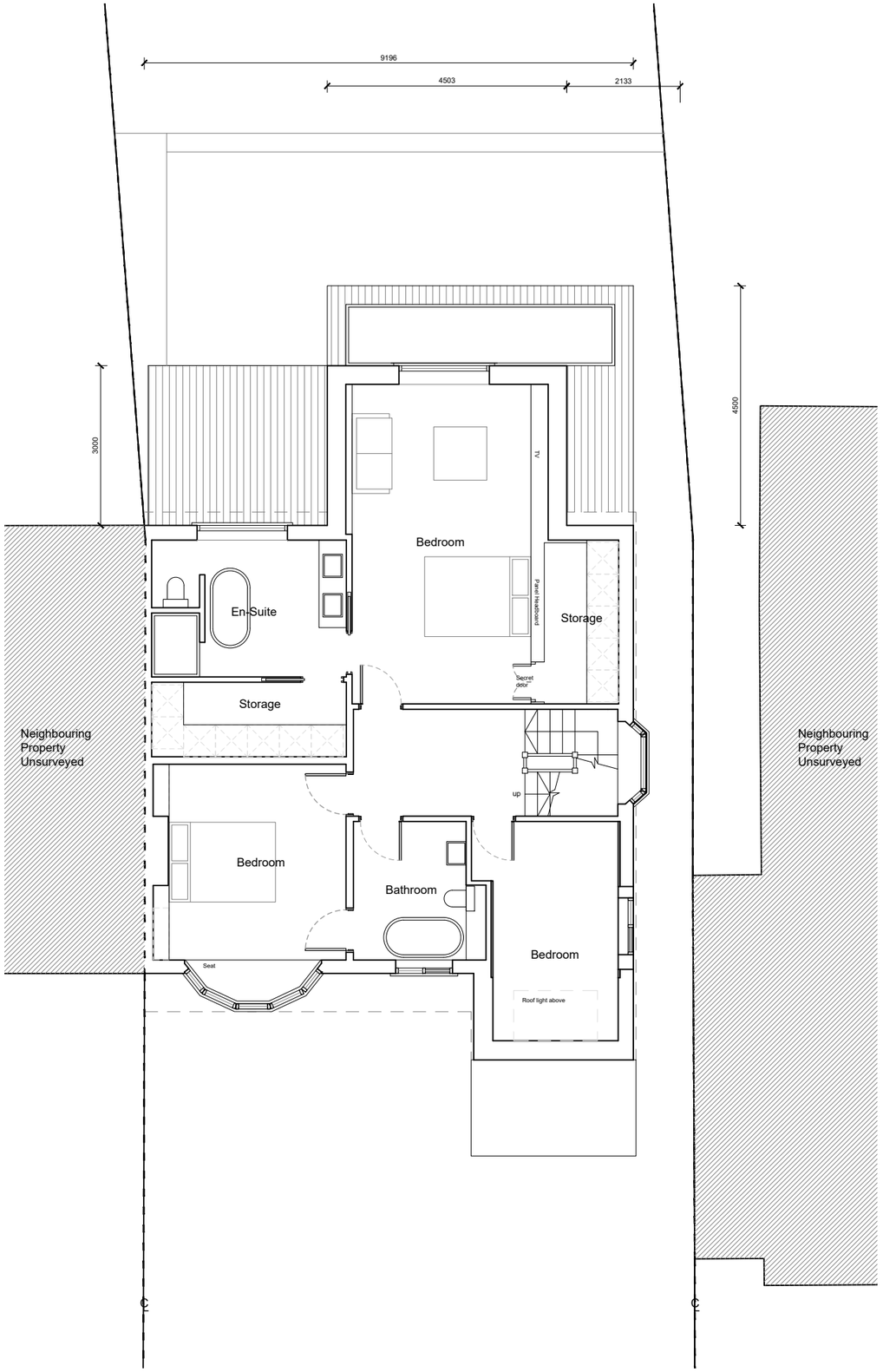
C h o c k

T +44(0)77 987 03393 **E** cathaltravers@chock.net

Scale: 1/100 @A3 **Date:** 02/Dec/24 **Drwg:** 23008-LON-20-102-PD-R0



PROPOSED GROUND FLOOR PLAN



PROPOSED FIRST FLOOR PLAN

Scale

0 Metres 2 3 4

1:100

Planning Issue

Floor Plans

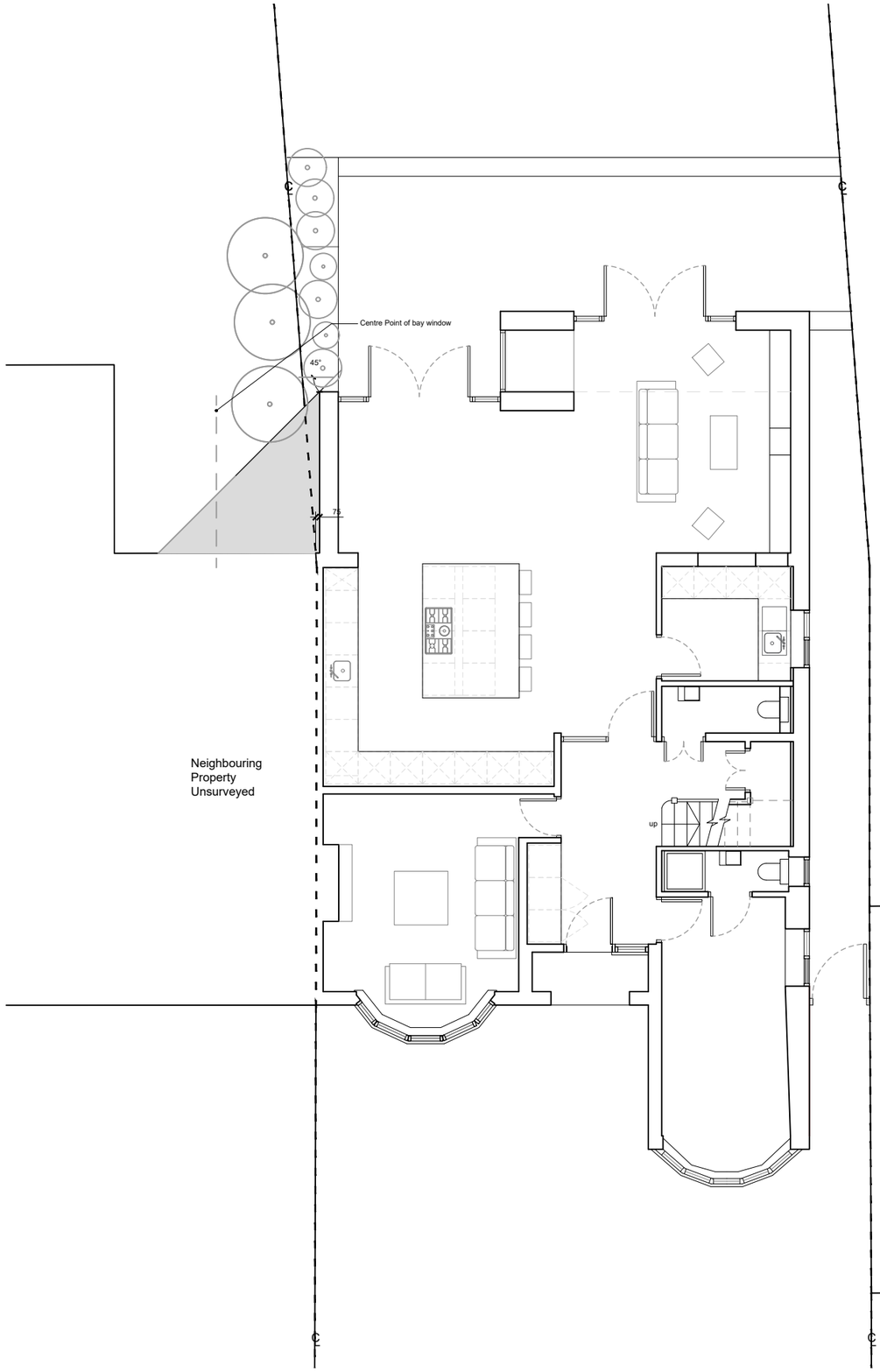
Proposed

Location: 32 Park Road, Twickenham, TW1 2PX

C h o c k

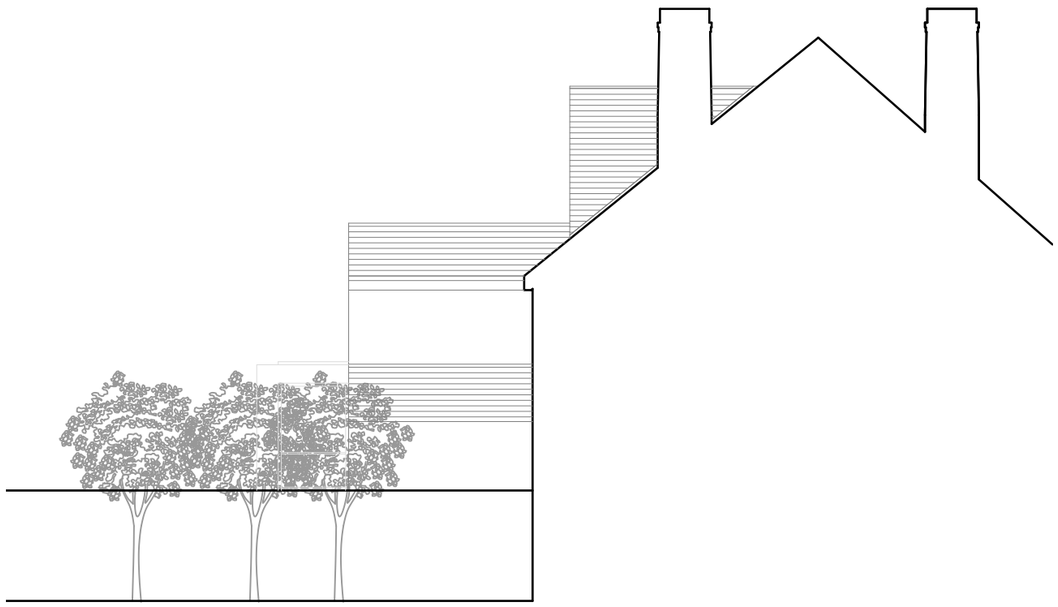
T +44(0)77 987 03393 **E** cathaltravers@chock.net

Scale:	**Date:**	**Drwg:**
1/100 @A3	02/Dec/24	23008-LON-20-100-PD-R0



PROPOSED GROUND FLOOR PLAN - 45 Degree Rule Study

PROPOSED REAR ELEVATION - 45 Degree Rule Study



PROPOSED SIDE ELEVATION - 45 Degree Rule Study

Scale

0 Metres 2 3 4

1:100

Planning Issue

45 Degree Daylight - Study

Proposed

Location: 32 Park Road, Twickenham, TW1 2PX

C h o c k

T +44(0)77 987 03393 **E** cathaltravers@chock.net

Scale:	**Date:**	**Drwg:**
1/100 @A3	12/Dec/24	23008-LON-77-100-R0

Appendix B - Thames Water Asset Plan

Asset location search

Property Searches

Aegaea
66 Swaledale Road
WARMINSTER
BA12 8FJ

Search address supplied 32
Park Road
Twickenham
TW1 2PX

Your reference 3755

Our reference ALS/ALS Standard/2024_4931609

Search date 10 January 2024

Notification of Price Changes

From 1st April 2023 Thames water Property Searches will be increasing the prices of its CON29DW, CommercialDW Drainage & Water Enquiries and Asset Location Searches. Historically costs would rise in line with RPI but as this currently sits at 14.2%, we are capping it at 10%.

Customers will be emailed with the new prices by January 1st 2023.

Any orders received with a higher payment prior to the 1st April 2023 will be non-refundable. For further details on the price increase please visit our website at www.thameswater-propertysearches.co.uk

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

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

0800 009 4540

Asset location search

Property Searches

Search address supplied: 32, Park Road, Twickenham, TW1 2PX

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

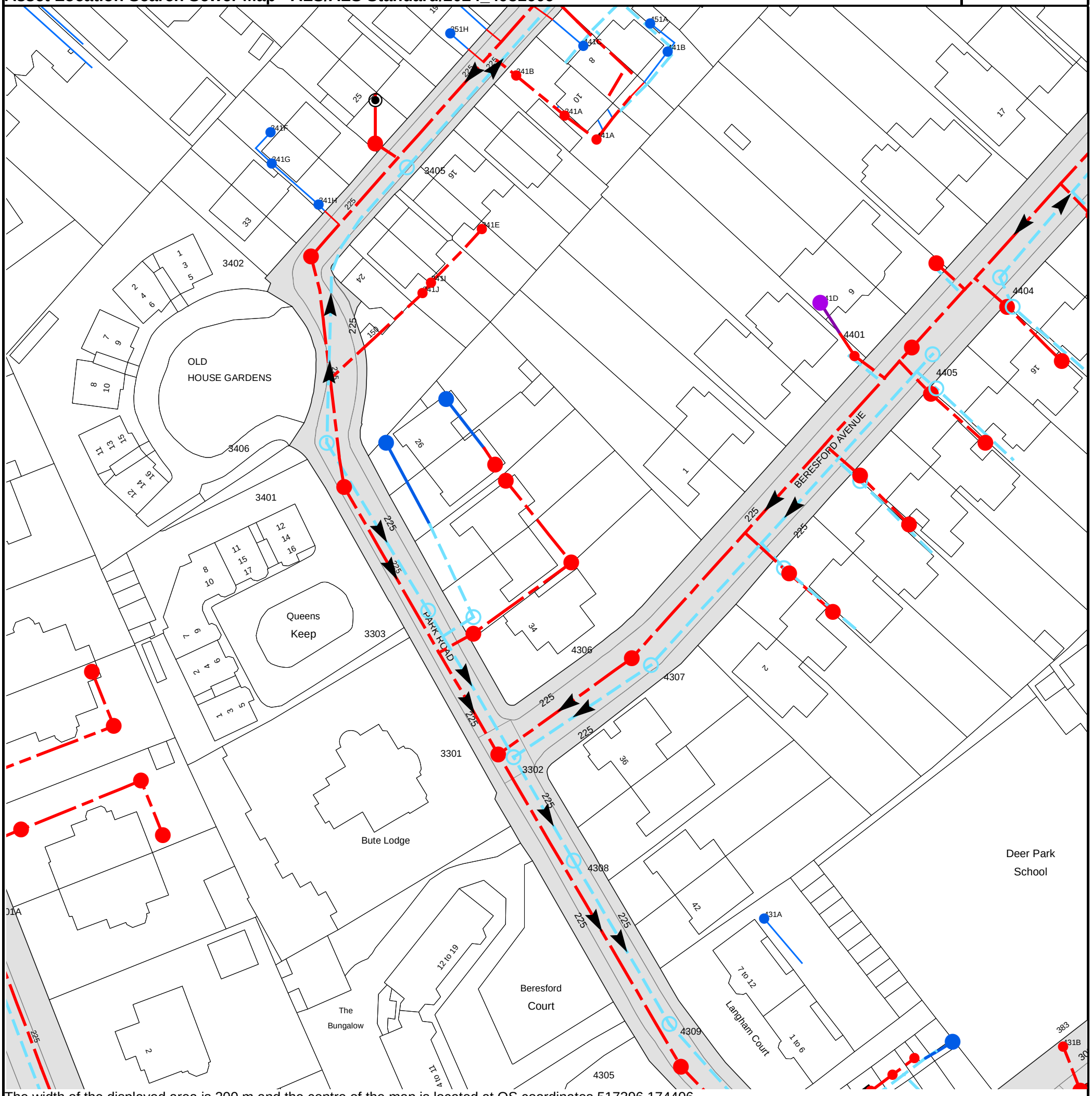
Clean Water queries

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/2024_4931609



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 517396,174406

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
341A	n/a	n/a
341B	n/a	n/a
441B	n/a	n/a
441C	n/a	n/a
351H	n/a	n/a
451A	n/a	n/a
3401	5.76	3.13
34MK	n/a	n/a
34NC	n/a	n/a
3405	n/a	3.82
341J	n/a	n/a
341I	n/a	n/a
34NE	n/a	n/a
341E	n/a	n/a
34NH	n/a	n/a
34NF	n/a	n/a
44JJ	n/a	n/a
441A	n/a	n/a
441D	n/a	n/a
44KE	n/a	n/a
44MF	n/a	n/a
44ML	n/a	n/a
44MJ	n/a	n/a
4401	5.37	3.45
44LL	n/a	n/a
4405	5.36	4.65
44KC	n/a	n/a
44MC	n/a	n/a
44LM	n/a	n/a
4404	n/a	n/a
44LE	n/a	n/a
44LH	n/a	n/a
44LF	n/a	n/a
44KN	n/a	n/a
33NC	n/a	n/a
341F	n/a	n/a
341G	n/a	n/a
3402	5.72	3.19
341H	n/a	n/a
3406	5.85	4.34
43ME	n/a	n/a
4304	5.65	3.03
43MF	n/a	n/a
4305	6.31	3.04
43MH	n/a	n/a
431B	5.7	3.59
43NF	n/a	n/a
4309	6.31	3.77
431A	n/a	n/a
4308	6.02	3.89
3302	5.86	4.03
3301	5.78	3.09
4307	5.64	4.31
4306	5.63	3.18
33NJ	n/a	n/a
33NF	n/a	n/a
43NL	n/a	n/a
3303	5.72	4.13
44MN	n/a	n/a
44ND	n/a	n/a
23NH	n/a	n/a
33MN	n/a	n/a
33NL	n/a	n/a
33NM	n/a	n/a

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

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

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

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

Sewer Fittings

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

- Air Valve
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- Weir

End Items

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

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

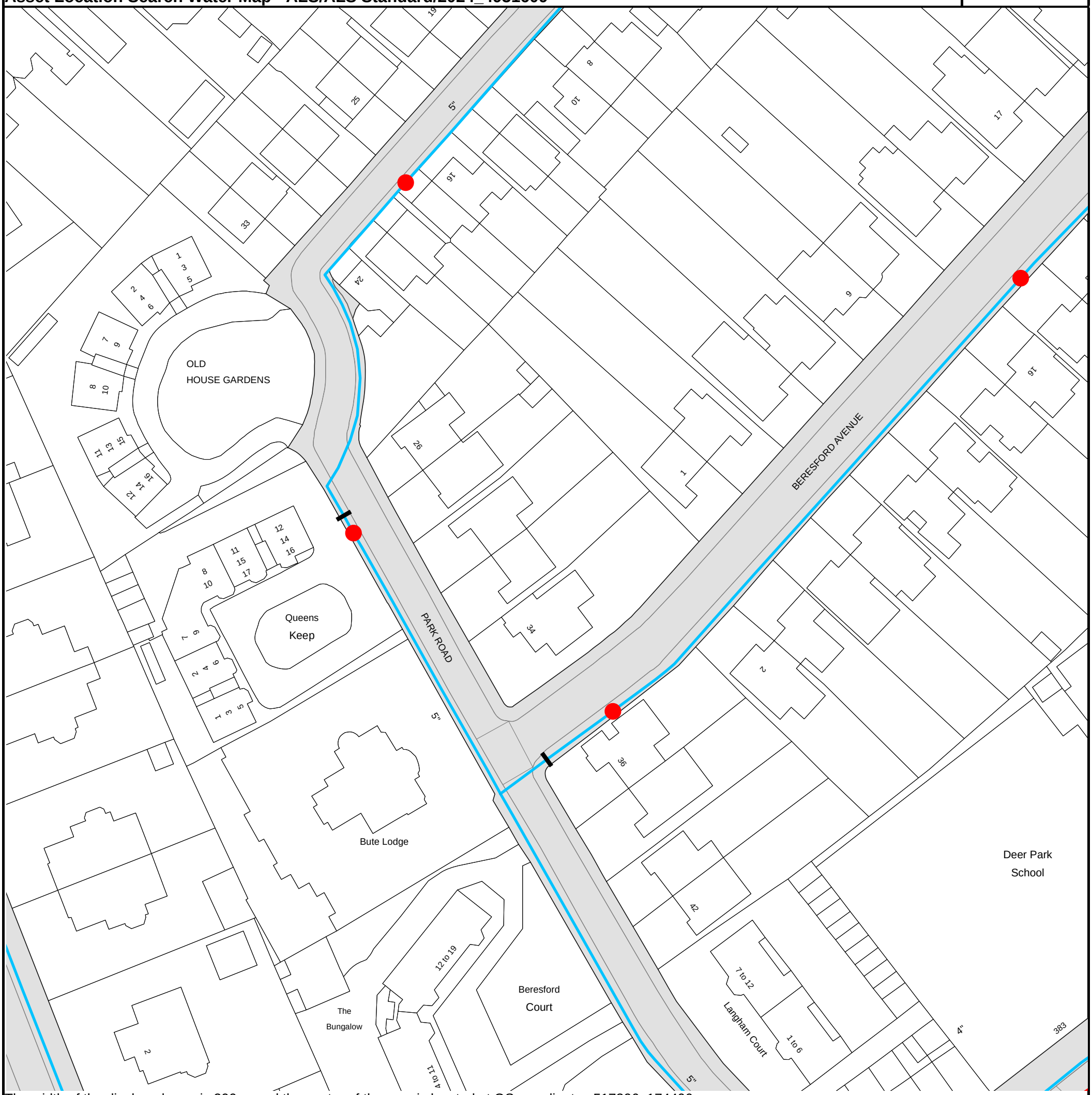
- Casement — Ducts may contain high voltage cables. Please check with Thames Water.
- Conduit Bridge
- Subway
- Tunnel

Notes:

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

If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Asset Location Search Water Map - ALS/ALS Standard/2024_4931609



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 517396, 174406.

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

Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

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

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.

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

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

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

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

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

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

Valves

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

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

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

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

Payment Terms and Conditions

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

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

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

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

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

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

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

Ways to pay your bill

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

Appendix C - CCTV Survey

Project Report

32 PARK ROAD TWICKENHAM SURREY

TW1 2PX

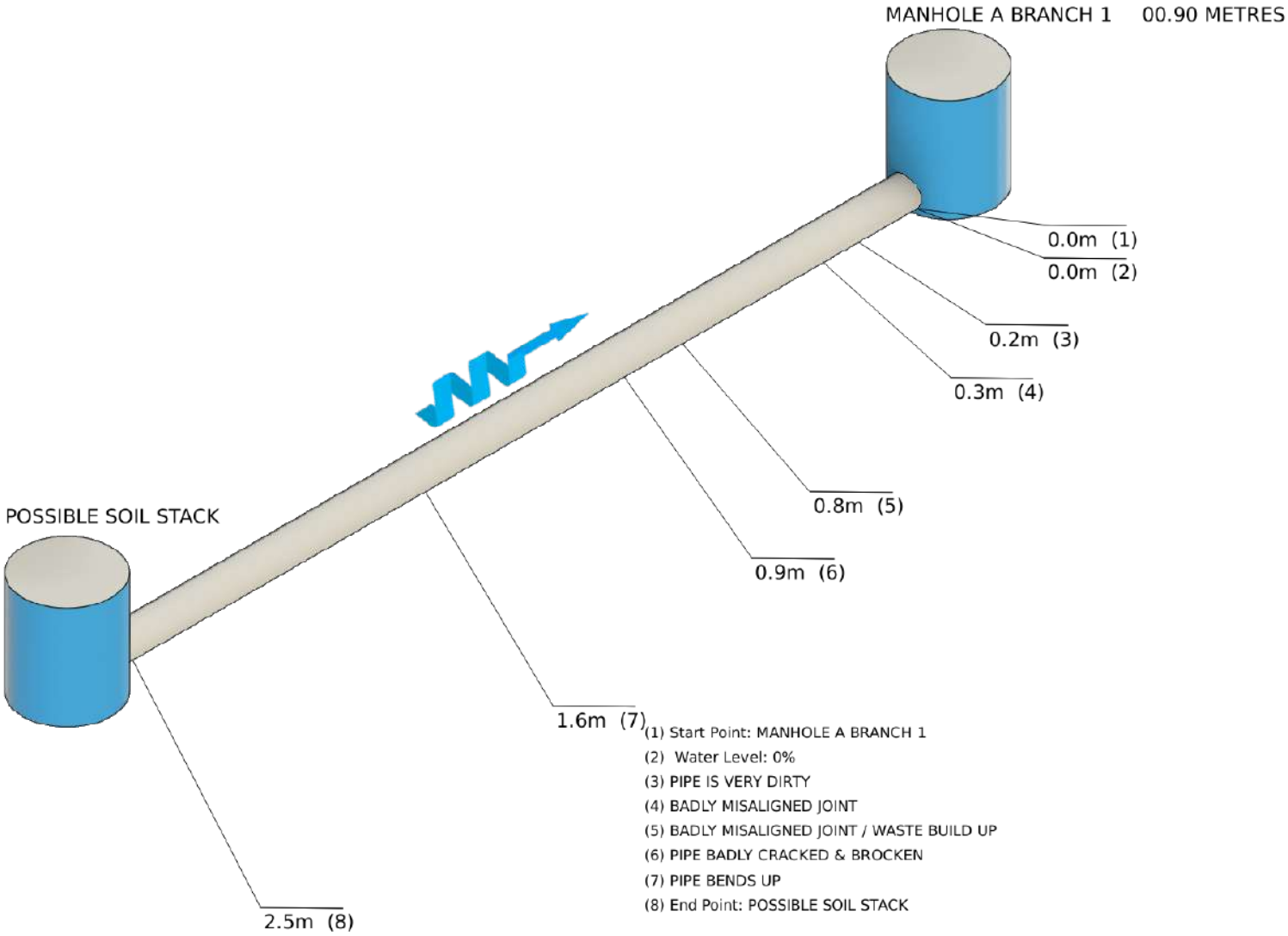
hello@mina.app
www.mina.app
@minasurvey

mina	**Project Information**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Contractor: DTS ltd	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Project Information	
Project Name	32 PARK ROAD
Street	32 PARK ROAD TWICKENHAM SURREY
Postcode	TW1 2PX
Parking Restrictions	YES
Client Name	MR OKEREKE
Contractor Email	draintechsouth@yarhoo.com
Drawing Number	
Reason	house purchase
Contractor	DTS ltd
Export Date	28/06/23
Export Time	01:44 PM

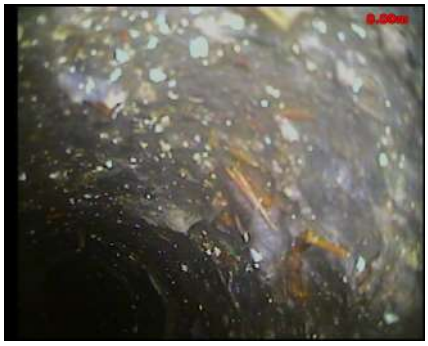
mina	**Section Information**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer: ENGINEER 1	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_1	Start Point: MANHOLE A BRANCH 1	Direction: Upstream	End Point: POSSIBLE SOIL STACK
Pipe Material: Vitrified Clay (VC)	Pipeline Size: 100mm	Pipe Usage: Foul	Depth of Start Point: 00.90 METRES
Date: 28/06/23	Time: 11:57 AM		



mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer: ENGINEER 1	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_1	Start: MANHOLE A BRANCH 1	Direction: Upstream	End: POSSIBLE SOIL STACK



Observation [1]:
Start Point: MANHOLE A BRANCH 1

Observation [3]:
PIPE IS VERY DIRTY

Observation [4]:
BADLY MISALIGNED JOINT

Observation [5]:
BADLY MISALIGNED JOINT / WASTE BUILD UP

mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer: ENGINEER 1	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_1	Start: MANHOLE A BRANCH 1	Direction: Upstream	End: POSSIBLE SOIL STACK

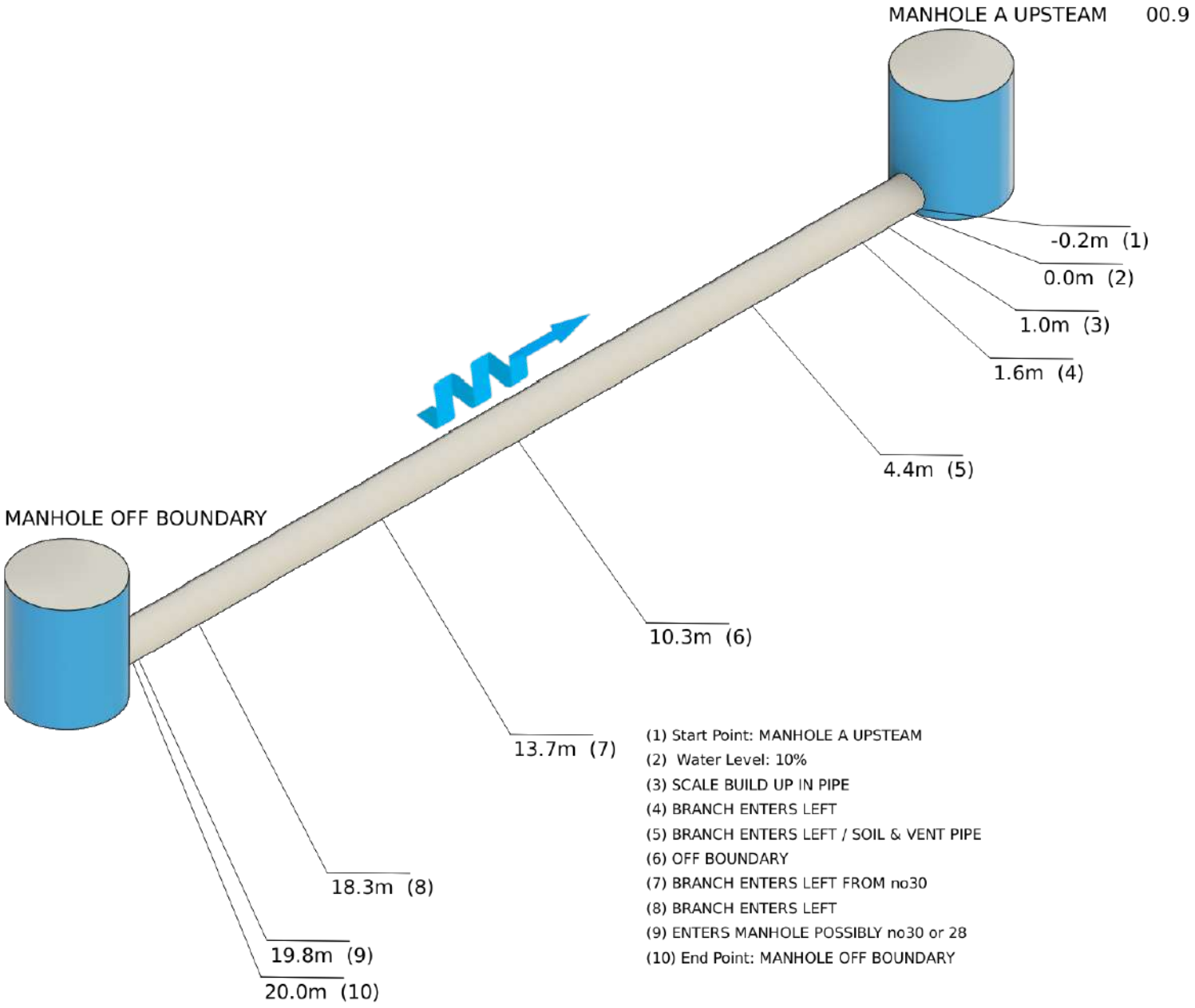
Observation [6]:
PIPE BADLY CRACKED & BROCKEN

Observation [7]:
PIPE BENDS UP

Observation [8]:
End Point: POSSIBLE SOIL STACK

Section Information		32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_2	Start Point: MANHOLE A UPSTEAM	Direction: Upstream	End Point: MANHOLE OFF BOUNDARY
Pipe Material: Vitrified Clay (VC)	Pipeline Size: 150mm	Pipe Usage: Foul	Depth of Start Point: 00.9
Date: 28/06/23	Time: 11:57 AM		



mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_2	Start: MANHOLE A UPSTEAM	Direction: Upstream	End: MANHOLE OFF BOUNDARY

Observation [1]:
Start Point: MANHOLE A UPSTEAM

Observation [3]:
SCALE BUILD UP IN PIPE

Observation [4]:
BRANCH ENTERS LEFT

Observation [5]:
BRANCH ENTERS LEFT / SOIL & VENT PIPE

mina®	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_2	Start: MANHOLE A UPSTEAM	Direction: Upstream	End: MANHOLE OFF BOUNDARY

Observation [6]:
OFF BOUNDARY

Observation [7]:
BRANCH ENTERS LEFT FROM no30

Observation [8]:
BRANCH ENTERS LEFT

Observation [9]:
ENTERS MANHOLE POSSIBLY no30 or 28

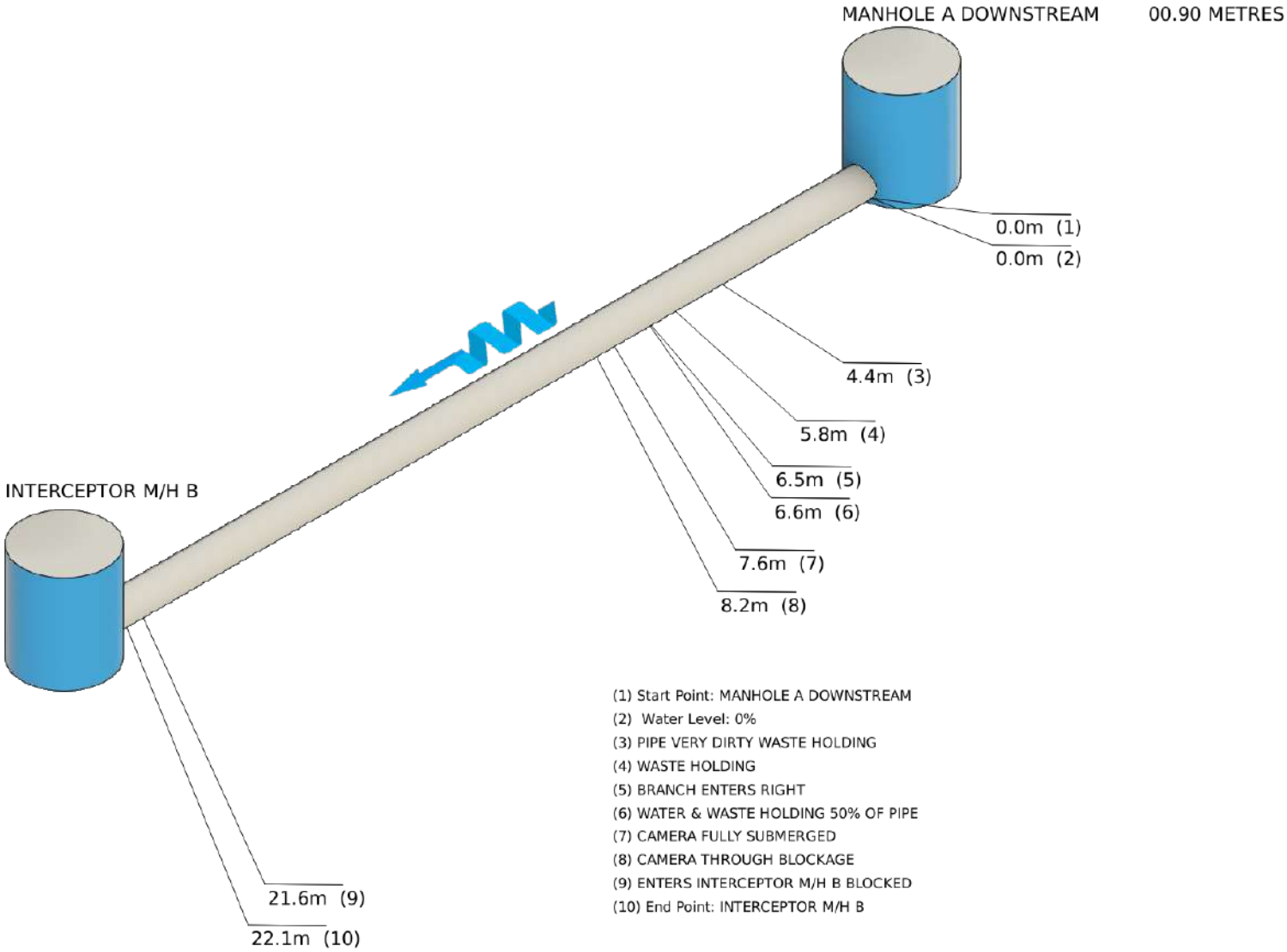
mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_2	Start: MANHOLE A UPSTEAM	Direction: Upstream	End: MANHOLE OFF BOUNDARY

Observation [10]:
End Point: MANHOLE OFF BOUNDARY

mina	**Section Information**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_3	Start Point: MANHOLE A DOWNSTREAM	Direction: Downstream	End Point: INTERCEPTOR M/H B
Pipe Material: Vitrified Clay (VC)	Pipeline Size: 150mm	Pipe Usage: Foul	Depth of Start Point: 00.90 METRES
Date: 28/06/23	Time: 11:57 AM		



mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_3	Start: MANHOLE A DOWNSTREAM	Direction: Downstream	End: INTERCEPTOR M/H B

Observation [1]:
Start Point: MANHOLE A DOWNSTREAM

Observation [3]:
PIPE VERY DIRTY WASTE HOLDING

Observation [4]:
WASTE HOLDING

Observation [5]:
BRANCH ENTERS RIGHT

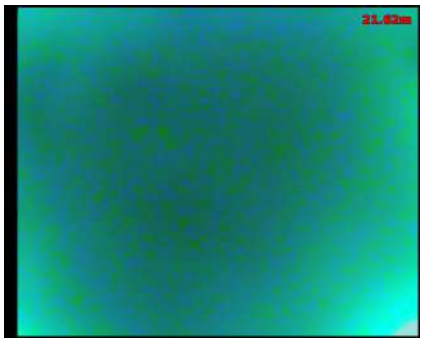
mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_3	Start: MANHOLE A DOWNSTREAM	Direction: Downstream	End: INTERCEPTOR M/H B

Observation [6]:
WATER & WASTE HOLDING 50% OF PIPE

Observation [7]:
CAMERA FULLY SUBMERGED

Observation [8]:
CAMERA THROUGH BLOCKAGE



Observation [9]:
ENTERS INTERCEPTOR M/H B BLOCKED

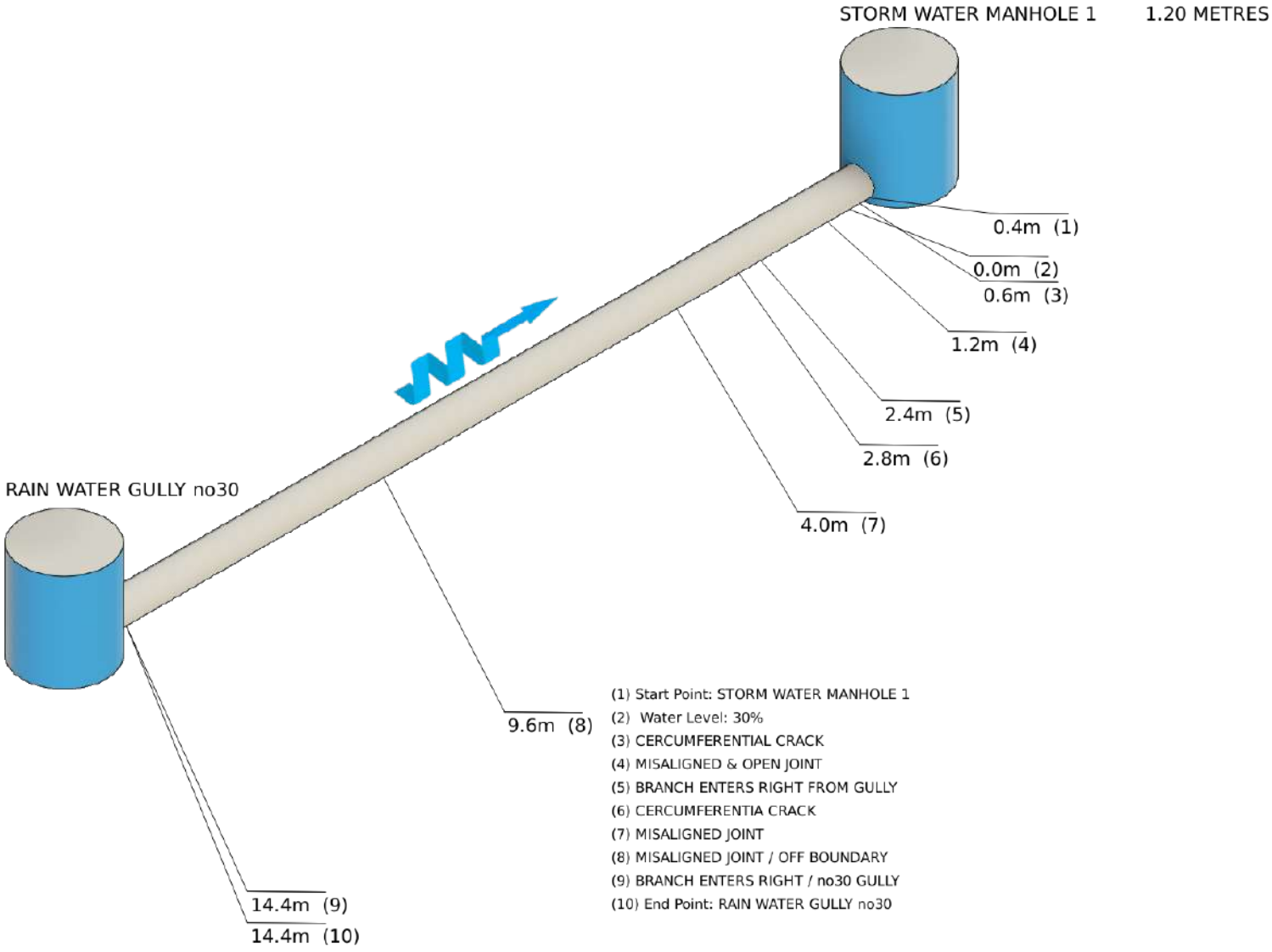
	Section Observations	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_3	Start: MANHOLE A DOWNSTREAM	Direction: Downstream	End: INTERCEPTOR M/H B

Observation [10]:
End Point: INTERCEPTOR M/H B

mina®	**Section Information**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_4	Start Point: STORM WATER MANHOLE 1	Direction: Upstream	End Point: RAIN WATER GULLY no30
Pipe Material: Vitrified Clay (VC)	Pipeline Size: 100mm	Pipe Usage: Storm	Depth of Start Point: 1.20 METRES
Date: 28/06/23	Time: 11:57 AM		



mina®	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_4	Start: STORM WATER MANHOLE 1	Direction: Upstream	End: RAIN WATER GULLY no30

Observation [1]:
Start Point: STORM WATER MANHOLE 1

Observation [3]:
CERCUMFERENTIAL CRACK

Observation [4]:
MISALIGNED & OPEN JOINT

Observation [5]:
BRANCH ENTERS RIGHT FROM GULLY

mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_4	Start: STORM WATER MANHOLE 1	Direction: Upstream	End: RAIN WATER GULLY no30

Observation [6]:
CERCUMFERENTIA CRACK

Observation [7]:
MISALIGNED JOINT

Observation [8]:
MISALIGNED JOINT / OFF BOUNDARY

Observation [9]:
BRANCH ENTERS RIGHT / no30 GULLY

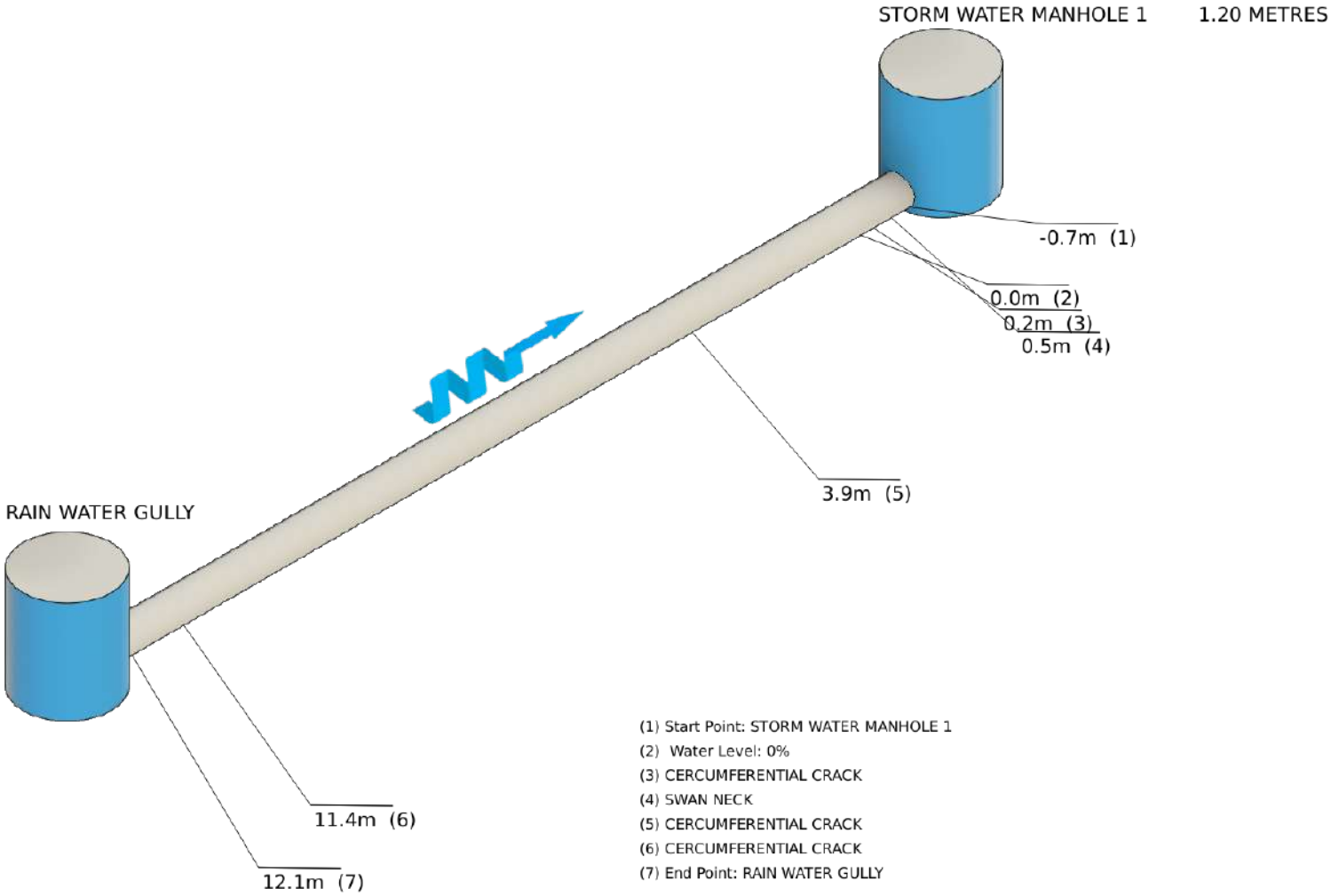
	Section Observations	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_4	Start: STORM WATER MANHOLE 1	Direction: Upstream	End: RAIN WATER GULLY no30

Observation [10]:
End Point: RAIN WATER GULLY no30

mina	**Section Information**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_5	Start Point: STORM WATER MANHOLE 1	Direction: Upstream	End Point: RAIN WATER GULLY
Pipe Material: Vitrified Clay (VC)	Pipeline Size: 100mm	Pipe Usage: Storm	Depth of Start Point: 1.20 METRES
Date: 28/06/23	Time: 11:57 AM		



mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_5	Start: STORM WATER MANHOLE 1	Direction: Upstream	End: RAIN WATER GULLY

Observation [1]:
Start Point: STORM WATER MANHOLE 1

Observation [3]:
CERCUMFERENTIAL CRACK

Observation [4]:
SWAN NECK

Observation [5]:
CERCUMFERENTIAL CRACK

	Section Observations	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

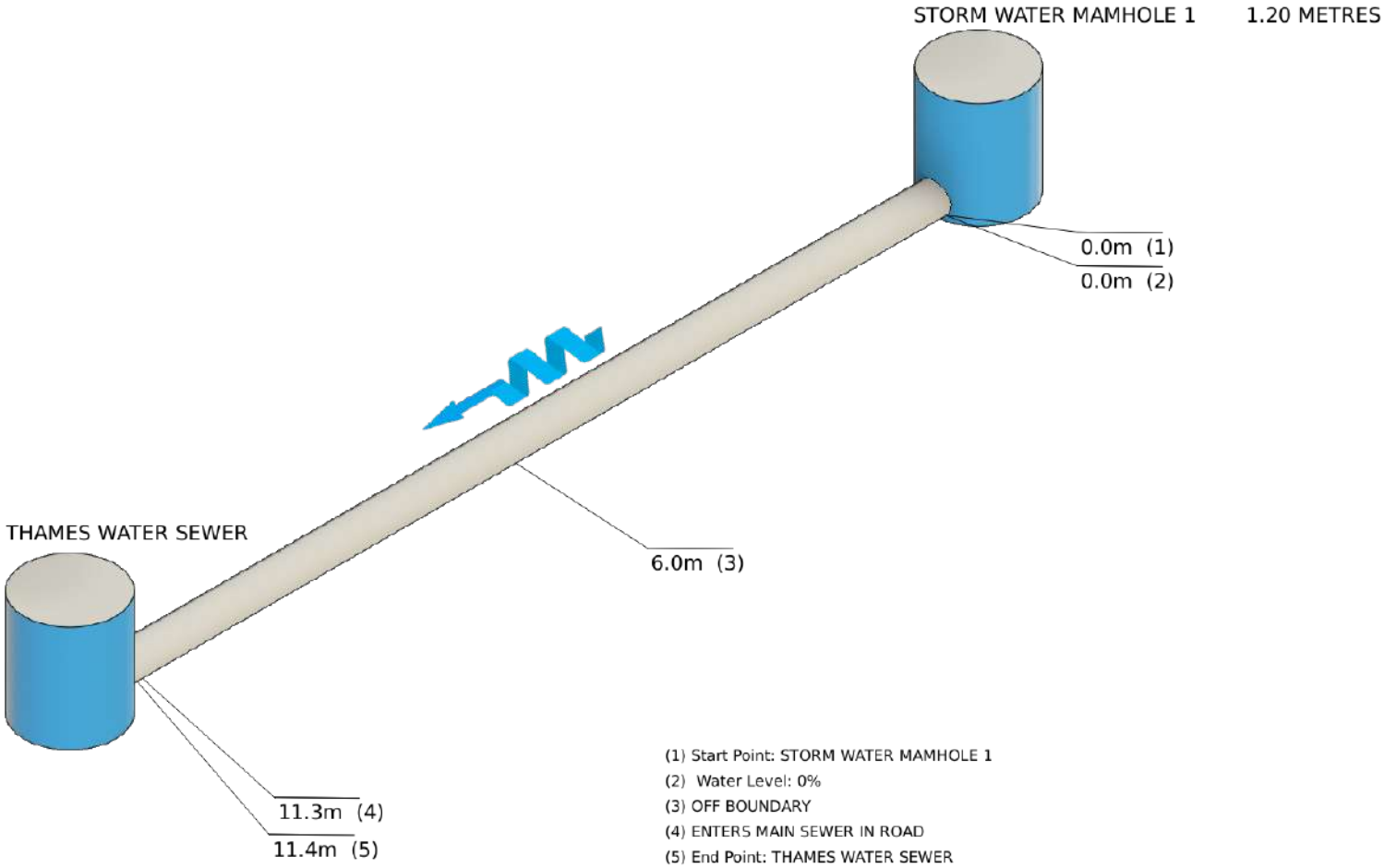
Section Video: section_5	Start: STORM WATER MANHOLE 1	Direction: Upstream	End: RAIN WATER GULLY

Observation [6]:
CERCUMFERENTIAL CRACK

Observation [7]:
End Point: RAIN WATER GULLY

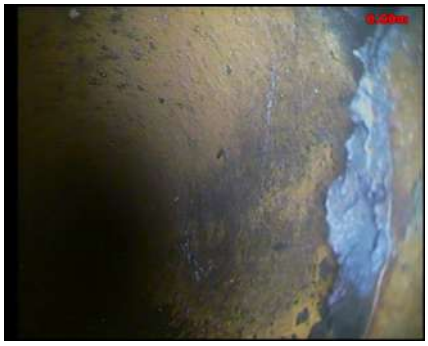
mina	**Section Information**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_6	Start Point: STORM WATER MAMHOLE 1	Direction: Downstream	End Point: THAMES WATER SEWER
Pipe Material: Vitrified Clay (VC)	Pipeline Size: 100mm	Pipe Usage: Storm	Depth of Start Point: 1.20 METRES
Date: 28/06/23	Time: 11:57 AM		



mina	**Section Observations**	32 PARK ROAD TWICKENHAM SURREY TW1 2PX
Engineer:	Date: 28/06/23	Contractor Email: draintechsouth@yarhoo.com

Section Video: section_6	Start: STORM WATER MAMHOLE 1	Direction: Downstream	End: THAMES WATER SEWER

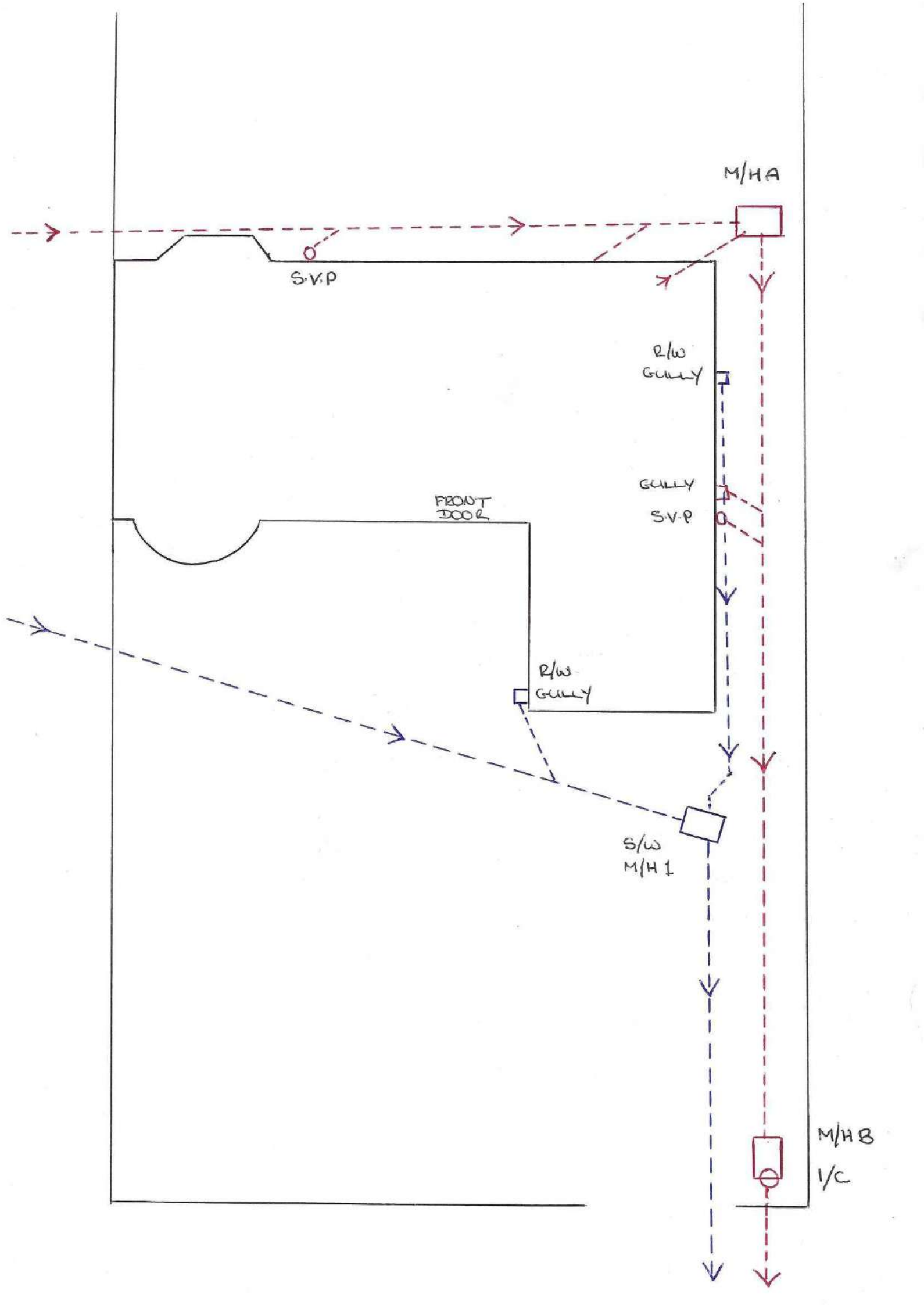


Observation [1]:
Start Point: STORM WATER MAMHOLE 1

Observation [3]:
OFF BOUNDARY

Observation [4]:
ENTERS MAIN SEWER IN ROAD

Observation [5]:
End Point: THAMES WATER SEWER


M/H A
S.V.P
R/W
GULLY
GULLY
S.V.P
FRONT
DOOR
R/W
GULLY
S/W
M/H 1
M/H B
I/C

Appendix D - SWDS Layout

RAINWATER DOWNPIPES TO DISCHARGE DIRECTLY TO THE PERMEABLE PAVING SURFACE.

ALL LEVELS ARE TO METERS ABOVE ORDNANCE DATUM (AOD) UNLESS STATED OTHERWISE.

ATTENUATION OF RUNOFF GENERATED FROM THE DEVELOPMENTS IMPERMEABLE CATCHMENTS TO BE PROVIDED BY TYPE C PERMEABLE PAVING COVERING THE REAR PATIO OF THE SCHEME

SURFACE WATER FROM THE PROPOSED ATTENUATION AREAS WILL ULTIMATELY DISCHARGE TO THE EXISTING SURFACE WATER DRAINAGE INFRASTRUCTURE SERVING THE SITE WHICH THEN DRAINS TO THE PUBLIC THAMES WATER SURFACE WATER SEWER. OUTFLOW RATES TO THE EXISTING DRAINAGE ARE TO BE CONTROLLED TO A MAXIMUM RATE OF 1.0L/s IN THE MODELLED 1 IN 100 YEAR (+CC) EVENT.

ALL PIPE DIAMETERS HAVE BEEN MODELLED AT 100mm UNLESS STATED OTHERWISE.

THE VOLUMETRIC RUNOFF COEFFICIENT (CV VALUE) USED FOR ALL IMPERMEABLE AREAS WAS 0.9.

ATTENUATION IS SIZED APPROPRIATELY TO MANAGE GENERATED SURFACE WATER UP TO AND INCLUDING THE 1 IN 100 YEAR (PLUS 40% ALLOWANCE FOR CLIMATE CHANGE) EVENT.

PROPOSED CONTROL FLOW MANHOLE (CONTROFLOW MINI ORIFICE PLATE CHAMBER - OR SIMILAR).

CL: 5.80m AOD
IL: 5.30m AOD
Depth: 0.50m
Orifice Plate: 36mm Ø

PERMEABLE PAVING UNDER DRAIN TO OUTFALL TO FLOW CONTROL MANHOLE.

THE PROPOSED SURFACE WATER DRAINAGE ASSOCIATED WITH THE DEVELOPMENT IS TO CONNECT TO THE EXISTING INFRASTRUCTURE SERVING THE DWELLING AT A RESTRICTED RATE.

THE EXISTING SURFACE WATER DRAINAGE CONNECTS TO THE THAMES WATER SURFACE WATER SEWER AT THE FRONT OF THE PROPERTY.

THE EXISTING REAR FACING ROOF CATCHMENT INCLUSIVE OF THE ADDITIONAL PROPOSED EXTENSION ROOF SPACE, AND REAR PATIO AREA HAVE BEEN CONSIDERED AS A PART OF THE PROPOSED STRATEGY.

THE PUBLIC FOUL AND SURFACE WATER SEWERS FLOW INTO THE MAIN DRAIN BENEATH PARK ROAD.

TYPE C PERMEABLE PAVING CONSTRUCTION

Aquaflow® BLOCK PAVING OR SIMILAR PERMEABLE SURFACING. Aquaflow® BLOCKS PROVIDE DRAINAGE THROUGH VERTICAL CHANNELS AND ALLOW WATER THROUGH AT A RATE OF APPROXIMATELY 9000mm PER HOUR (9000 LITRES PER m^2 PER HOUR)

TOTAL AVAILABLE AREA: CIRCA. 28.2m^2
SUB-BASE DEPTH: 200mm (SUBJECT TO SITE CBR VALUES)
POROSITY: 95%
TOTAL AVAILABLE STORAGE: 5.09m^3

TO BE UTILISED FOR ATTENUATION, AMENITY, AND TREATMENT

SUB-BASE TO BE LAID FLAT

FINISHED (SUBJECT TO ARCHITECT SPECIFICATION - BLOCK PAVING OR SIMILAR. SUB-BASE TO BE PERMEABLE BLOCK SURFACING

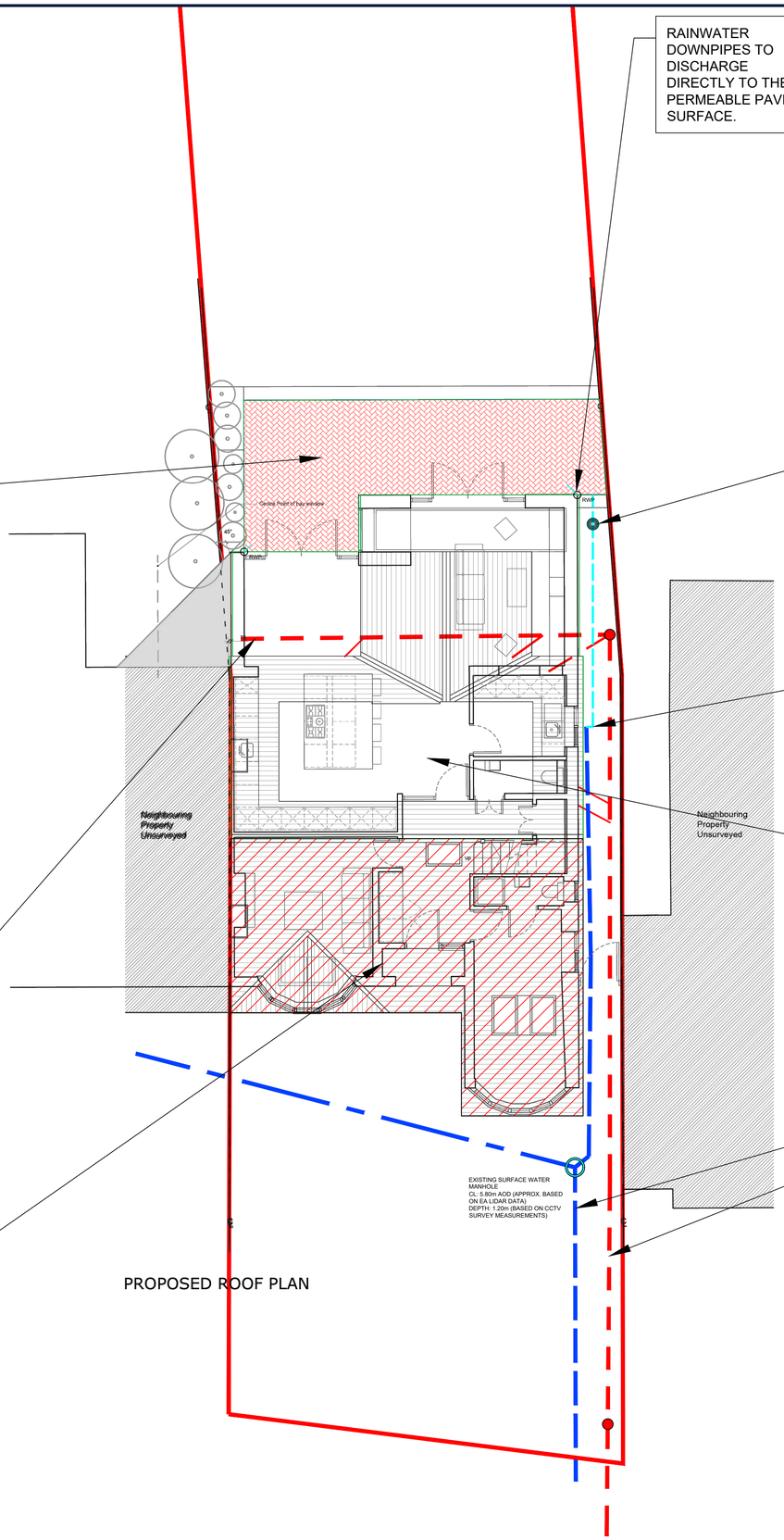
1. LAYING COURSE MATERIAL
2. GEOTEXTILE
3. SUB-BASE - GEOCELLULAR SUBBASE REPLACEMENT - SUBJECT TO SITE CBR'S
4. 50mm Ø UNDERDRAIN
5. IMPERMEABLE LINER

ENSURE SUFFICIENT COVER IS PROVIDED FOR ANTICIPATED LOADING - UP TO MANUFACTURER'S SPECIFICATIONS

BASED ON DETAILS FROM BOTH THE THAMES WATER ASSET PLAN AND CCTV SURVEY PROVIDED BY THE CLIENT, THE PROPOSED EXTENSION FOOTPRINT IS SHOWN TO ENCROACH ON THE ROUTE OF THE EXISTING PUBLIC FOUL SEWER.

IT IS RECOMMENDED THAT THE CLIENT ENGAGES WITH THAMES WATER AT THE EARLIEST OPPORTUNITY TO DISCUSS THE FEASIBILITY OF A BUILD OVER/DIVERSION AGREEMENT FOR THE ASSET.

THE EXISTING FRONT HALF OF THE ROOF AREA OF THE BUILDING (c.51.3m^2) IS TO DRAIN AS PER THE EXISTING SCENARIO. THIS IS DUE TO THE FACT THAT THERE IS NO INCREASE IN IMPERMEABLE AREA PROPOSED FOR THIS AREA.



PROPOSED ROOF PLAN

NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT REPORTS, PLANS AND ARCHITECTURAL DRAWINGS
2. THIS DRAWING SHOULD NOT BE SCALED. THERE SHOULD BE NO RELIANCE ON THIS DRAWING WITH REGARDS TO DIMENSIONS. ALL DIMENSIONS SHOULD BE CONFIRMED ON SITE.
3. ANY DISCREPANCY ON THIS DRAWING SHOULD BE REPORTED TO AEGAEA IMMEDIATELY FOR CLARIFICATION.
4. THE CONTRACTOR IS RESPONSIBLE FOR ALL WORKS AND FOR THE STABILITY, INSTALLATION AND HEALTH AND SAFETY OF THE WORKS.
5. AEGAEA HAVE PRODUCED THIS DRAWING BASED ON THE DRAWINGS AND INFORMATION PROVIDED BY THE CLIENT AVAILABLE AT THE TIME OF PRODUCTION. WE CANNOT ACCEPT RESPONSIBILITY FOR DISCREPANCIES RESULTING FROM NEW PLANS/ INFORMATION BEING ISSUED POST-ISSUE OF THIS DRAWING. THE CONTRACTOR SHOULD REVIEW THIS DRAWING IN LIGHT OF WIDER SITE INFORMATION SUCH AS CONTAMINATION, UTILITIES SURVEYS AND SITE INVESTIGATIONS
6. IT IS THE RESPONSIBILITY OF THE PRINCIPLE CONTRACTOR TO MAKE THE DESIGNER AND CLIENT AWARE OF SITE-SPECIFIC RISKS AND HAZARDS THAT MAY AFFECT THE DRAWING AND SPECIFICATION

LEGEND

- EXISTING PRIVATE S/W DRAIN
- THAMES WATER PUBLIC FOUL SEWER
- PROPOSED SURFACE WATER DRAIN
- THAMES WATER S/W DRAIN
- SURFACE WATER MANHOLE
- PERMEABLE PAVING
- RWP — RAINWATER PIPE
- CATCHMENT AREA
- THAMES WATER FOUL WATER MANHOLE

CLIENT: UCHECHI OKEREKE & ELLIE OKEREKE

SITE: 32 PARK ROAD, TWICKENHAM, TW1 2PX

DRAWING: DRAFT SURFACE WATER DRAINAGE STRATEGY

DRAWING NUMBER: AEG3755_DR01

DATE: 05/12/2024 | **REV: 002**

DRAWN BY: OM

DRAWING SCALE: SEE DRAWING

PRELIMINARY DRAWING FOR PLANNING ONLY - NOT FOR CONSTRUCTION

aegaea
water, civils and environment

0 1 2 3 4 5 10

Appendix E - InfoDrainage Calculations

Project:	Date:		
AEG3755_TW1_Twickenham_07 Surface Water Drainage Strategy - Planning 32 Park Road, Twickenham, TW1 2PX	05/12/2024 Designed by: OM	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	Company Address: Aegaea Ltd		

i 'Ry ³ 'P y k 'l'Ry ³ 'P y

P y'1 y2	9799G

g y 'j

m ³'i 'R ³	97199
g ³ y 'X '1 2	: 99
k ' 'R ³ y '1 2	D

S y ³'j

i 'd	k ' 'R ³ y
j 'm ³'i '	97199
n 'm ³'i '	97199
k ' 'R ³ y '1 2	D
g ³ y 'X '1 2	: 99

gy 'Ry ³ 'P y k 'l'Ry ³ 'P y

P y'1 y2	9799B

g y 'j

m ³'i 'R ³	97199
g ³ y 'X '1 2	: 99
k ' 'R ³ y '1 2	D

S y ³'j

i 'd	k ' 'R ³ y
j 'm ³'i '	97199
n 'm ³'i '	97199
k ' 'R ³ y '1 2	D
g ³ y 'X '1 2	: 99

Project:	Date:		
AEG3755_TW1_Twickenham_07 Surface Water Drainage Strategy - Planning 32 Park Road, Twickenham, TW1 2PX	05/12/2024 Designed by: OM	Checked by:	Approved By:
Report Details: Type: Stormwater Controls Storm Phase: Phase	Company Address: Aegaea Ltd		

g yz 'gy '1gy 2 k 'l'g 'gy

S

T ³ y ³ 'c '1 2	D7G99
S '1 2	97A99
Qy 'c '1 2	D7E99
gy 'cy 'S '1 2	: 9
d z y 'g ³ y '1 8 2	B79
g '1. 2	HD
c '1 2	: 97. FG
c 7j '1: lo2	: 999799
n '1 2	A7FEH
k y 'm '1 2	D79GG

l 'S y

W 'Pz 'Qy '1 2	97999
S y '1 2	D9
e 7 'Qy	:
i y 'W '1 2	97999
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	979: D

X

X

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Q. y 'S y	1e 2
Ry y³ 'k	e 'i ³

X '1: 2

X 'k	cy y 'X
X ³ 'X 1 2	i 'Ry ³ 'P y
Q. y 'S y	1e 2
Ry y³ 'k	e 'i ³

f

f

f 'R ³	: 7999
f 'k	f ³

S y '1 2	979BE
R ³ ' 'S ³ y	97E99
X 'c '1 2	D7E99

P y 3

R 3 '1 8 2 B99979

Project: AEG3755_TW1_Twickenham_07 Surface Water Drainage Strategy - Planning 32 Park Road, Twickenham, TW1 2PX	Date: 05/12/2024		
	Designed by: OM	Checked by:	Approved By:
Report Details: Type: Inflow Summary Storm Phase: Phase	Company Address: Aegaea Ltd		

X 'cyz	R ³ ' k	U '1c8 2	i ' d	P y'1 y2	g ³ y ' X ' 1 2	l zy 'R ' 1 2	P ' g ³ y ' X ' 1 2	P y' P y ' 1 y2
gy ' Ry ³ ' P y	g yz ' gy ' 1gy 2		k ' ' R ³ y	97799B	: 99	: 9	: : 9	97799B
i ' Ry ³ ' P y	g yz ' gy ' 1gy 2		k ' ' R ³ y	97799G	: 99	: 9	: : 9	97799H
kf kPc		979		979: :				979: A

i 'k	S y ³
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i y y

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k l'Uj i

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i y 'i	97C:
j	☑
n	☑

i 'g

i 'g '1 y 2	X³ y 'i y y '1 2
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B979	97999
B979	BD7999
: 9979	97999
: 9979	C97999

j 'S y

S y '1 2	i 'k '1 2
: D	B9
B9	E9
E9	: A9
: A9	AC9
: G9	BE9
AC9	CG9
BE9	FA9
CG9	HE9
E99	: A99
FA9	: CC9
HE9	: HA9
: CC9	AGG9
A: E9	CBA9
AGG9	DFE9
CBA9	GEC9
DFE9	: : DA9
FA99	: CC99
GEC9	: FAG9
: 99G9	A9: E9

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XRg'j l Sj '8'XW: AC

S y

d	XRg'j l Sj
P y'1 y2	979: :
j PPi '1 2	E9979
j	97B
i	i 'E
l zy	9
i 'g '1 y 2	9

i

i	h QPi 'i y ' 1c8 2	h QPi 'l zy ' 1c8 2	h ': '1 y 2' 1c8 2	h 'B9'1 y 2' 1c8 2	h ': 99'1 y 2' 1c8 2
i 'E	979	979	979	979	97:

Uji l': ' y l'X³ y 'i y y '1 2'49l'R ³y 'j 'g 'X l'i y 'Q l'd y 7f

a ³	j 'T	R ' c ' 1 2	X ' c ' 1 2	d y 7 c ' 1 2	d y 7 S ' 1 2	d y 7 X ' 1c8 2	d y 7 i ' m ' 1 2	d y 7 U ' m ' 1 2	d y 7 f ' 1c8 2	k y ' S ³ y ' m ' 1 2	j y
j 8n 'd 8W:	Uji l': ' y l'49'. l' : A9' l'j	DZG99	CE99	CE: A	979: A	97B	97999	97999	97B	: 7DCA	f b
U ' R	Uji l': ' y l'49'. l' : A9' l'j	DZG99	D7B99	D7B: B	979: B	97B	9799:	97999	97B	: 7DCA	f b

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Uji l'B9' y l'X³ y 'i y y '1 2'49l'R ³y 'j 'g 'X l'i y 'Q l'dy 7f

a ³	j 'T	R ' c ' 1 2	X ' c ' 1 2	dy 7 c ' 1 2	dy 7 S ' 1 2	dy 7 X ' 1c8 2	dy 7 i ' m ' 1 2	dy 7 U ' m ' 1 2	dy 7 f ' 1c8 2	k y' S ³ y ' m ' 1 2	j y
j 8n 'd 8W:	Uji l'B9' y l'49' . l'E9' l' j	DŽG99	CÆ99	CÆ: F	979: F	97F	97999	97999	97F	AÆGA	f b
U ' R	Uji l'B9' y l'49' . l'E9' l' j	DŽG99	DŽB99	DŽB: G	979: G	97F	9799:	97999	97F	AÆGA	f b

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Uji l'B9' y l'X³ y 'i y y '1 2'4 BD'R ³y 'j 'g 'X l'i y 'Q l'd y 7f

a ³	j 'T	R ' c ' 1 2	X ' c ' 1 2	d y 7 c ' 1 2	d y 7 S ' 1 2	d y 7 X ' 1c8 2	d y 7 i ' m ' 1 2	d y 7 U ' m ' 1 2	d y 7 f ' 1c8 2	k y ' S ³ y ' m ' 1 2	j y
j 8n 'd 8W:	Uji l'B9' y l'4 BD' . l'E9' l' j	DŽG99	CŒ99	CŒ: H	979: H	97G	97999	97999	97G	B7DE:	f b
U ' R	Uji l'B9' y l'4 BD' . l'E9' l' j	DŽG99	DŽB99	DŽB: H	979: H	97G	97999A	97999	97G	B7DE:	f b

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Uji l': 99' y l'X³ y 'i y y '1 2'49l'R ³y 'j 'g 'X l'i y 'Ql'd y 7f

a ³	j 'T	R ' c ' 1 2	X ' c ' 1 2	d y 7 c ' 1 2	d y 7 S ' 1 2	d y 7 X ' 1c8 2	d y 7 i ' m ' 1 2	d y 7 U ' m ' 1 2	d y 7 f ' 1c8 2	k y' S ³ y ' m ' 1 2	j y
j 8n 'd 8W:	Uji l': 99' y l'49' . l'E9' l' j	DXG99	CÆ99	CÆ: H	979: H	97G	97999	97999	97G	B7CFF	f b
U ' R	Uji l': 99' y l'49' . l'E9' l' j	DXG99	DÆB99	DÆB: H	979: H	97G	97999A	97999	97G	B7CFF	f b

Uji l':99' y l'X³ y 'i y y '1 2'4C9l'R ³y 'j 'g 'X l'i y 'Q l'd y 7f

a ³	j 'T	R ' c ' 1 2	X ' c ' 1 2	d y 7 c ' 1 2	d y 7 S ' 1 2	d y 7 X ' 1c8 2	d y 7 i ' m ' 1 2	d y 7 U ' m ' 1 2	d y 7 f ' 1c8 2	k y' S ³ y ' m ' 1 2	j y
j 8n 'd 8W:	Uji l':99' y l'4C9' . l'E9' l' j	DZG99	CÆ99	CÆEA:	97A:	:79	97999	97999	:79	CÆ:E	f b
U ' R	Uji l':99' y l'4C9' . l'E9' l' j	DZG99	DZB99	DZBA:	97A:	:79	979A	97999	:79	CÆ:E	f b

Uj i l': ' y l'X³ y 'i y y '1 2'49l'R ³y 'j 'g 'X l'i y 'Q l'd y 7f

j y ' R	j 'T	d y 7 l j ' c ' 1 2	d y 7 Sj ' c ' 1 2	d y 7 l j ' S ' 1 2	d y 7 Sj ' S '1 2	d y 7 X ' 1c8 2	d y 7 i ' m '1 2	d y 7 U ' m ' 1 2	k y ' c ' m ' 1 2	d y 7 f ' 1c8 2	k y ' S ³ y ' m ' 1 2	Wy ' S y ' S ' k ' 1 2	g ³ y ' P y yz ' 1 2
g yz 'gy ' 1gy 2	Uj i l': ' y l' 49'. l': A9' l' j	DÆEC:	DÆEBD	979B:	979BD	97G	97GHH	97999	97999	97B	: 7DCG	BD	GA7BAF

j y

f b

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Uj i l'B9' y l'X³ y 'i y y '1. 2'49l'R ³y 'j 'g 'X l'i y 'Q.l'd y 7
f

j y ' R	j 'T	d y 7 l j ' c ' 1 2	d y 7 Sj ' c ' 1 2	d y 7 l j ' S ' 1 2	d y 7 Sj ' S '1 2	d y 7 X ' 1c8 2	d y 7 i ' m '1 2	d y 7 U ' m ' 1 2	k y ' c ' m ' 1 2	d y 7 f ' 1c8 2	k y ' S ³ y ' m ' 1 2	Wy ' S y ' S ' k ' 1 2	g ³ y ' P y yz ' 1 2
g yz 'gy ' 1gy 2	Uj i l'B9' y l'49'. l' E9' l' j	DƷEGG	DƷEG9	979FG	979G9	AƷE	A7. BE	97999	97999	97F	AƷF99	E9	DG79AA

j y

f b

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Uj i l'B9' y l'X³ y 'i y y '1. 2'4 BD1'R ³y 'j 'g 'X l'i y 'Q l'd y 7 f

j y ' R	j 'T	d y 7 l j ' c ' 1 2	d y 7 Sj ' c ' 1 2	d y 7 l j ' S ' 1 2	d y 7 Sj ' S '1 2	d y 7 X ' 1c8 2	d y 7 i ' m '1 2	d y 7 U ' m ' 1 2	k y ' c ' m ' 1 2	d y 7 f ' 1c8 2	k y ' S ³ y ' m ' 1 2	Wy ' S y ' S ' k ' 1 2	g ³ y ' P y yz ' 1 2
g yz 'gy ' 1gy 2	Uj i l'B9' y l'4 BD. l' E9' l' j	D7F: G	D7F: 9	97: 9G	97: : 9	B7D	A7HBC	97999	97999	97G	B7DGB	BF	CA7BCH

j y

f b

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Uj i l': 99' y l'X³ y 'i y y '1 2'49l'R ³y 'j 'g 'X l'i y 'Q l'd y 7 f

j y ' R	j 'T	d y 7 l j ' c ' 1 2	d y 7 Sj ' c ' 1 2	d y 7 l j ' S ' 1 2	d y 7 Sj ' S '1 2	d y 7 X ' 1c8 2	d y 7 i ' m '1 2	d y 7 U ' m ' 1 2	k y ' c ' m ' 1 2	d y 7 f ' 1c8 2	k y ' S ³ y ' m ' 1 2	Wy ' S y ' S ' k ' 1 2	g ³ y ' P y yz ' 1 2
g yz 'gy ' 1gy 2	Uj i l': 99' y l'49'. l' E9' l' j	D7F: D	D7F9F	97: 9D	97: 9F	B7C	A7GD	97999	97999	97G	B7CHH	BF	CB7HF9

j y

f b

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Uj i l': 99' y l'X³ y 'i y y '1 2'4 C9l'R ³y 'j 'g 'X l'i y 'Q l'd y 7 f

j y ' R	j 'T	d y 7 l j ' c ' 1 2	d y 7 Sj ' c ' 1 2	d y 7 l j ' S ' 1 2	d y 7 Sj ' S '1 2	d y 7 X ' 1c8 2	d y 7 i ' m '1 2	d y 7 U ' m ' 1 2	k y ' c ' m ' 1 2	d y 7 f ' 1c8 2	k y ' S ³ y ' m ' 1 2	Wy ' S y ' S ' k ' 1 2	g ³ y ' P y yz ' 1 2
g yz 'gy ' 1gy 2	Uj i l': 99' y l'4 C9'. l' E9' l' j	DFEA	DFDB	97: DA	97: DB	CG	C9HD	97999	97999	: 79	CECD	CC	: HD: E

j y

f b