Sheengate Flood Risk Assessment

14 MAY 2021

Aegaea Limited

Project Number AEG0119

Aegaea

FLOOD RISK, WATER AND ENVIRONMENT

Document Control

This report has been checked and reviewed in line with Aegaea quality standards.

Originator	Date	Reviewed	Date
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The conclusions contained herein are limited to those given the general availability of background information and the planned usage of the site.

Third party information has been used in the preparation of this report, which Aegaea, by necessity assumes is correct at the time of writing. While all reasonable checks have been made on data sources and the accuracy of data, Aegaea accepts no liability for the same.

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1. Introduction

1.1. Aegaea were commissioned by William Smalley Architects to undertake a Flood Risk Assessment (FRA) to facilitate a planning application for the proposed development. This FRA 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 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 sits on 264 Sheen Lane, East Sheen, London, SW14 8RL. The site is bound to the east by Sheen Lane, to the south by Fife Road, and to the north and west by residential dwellings.

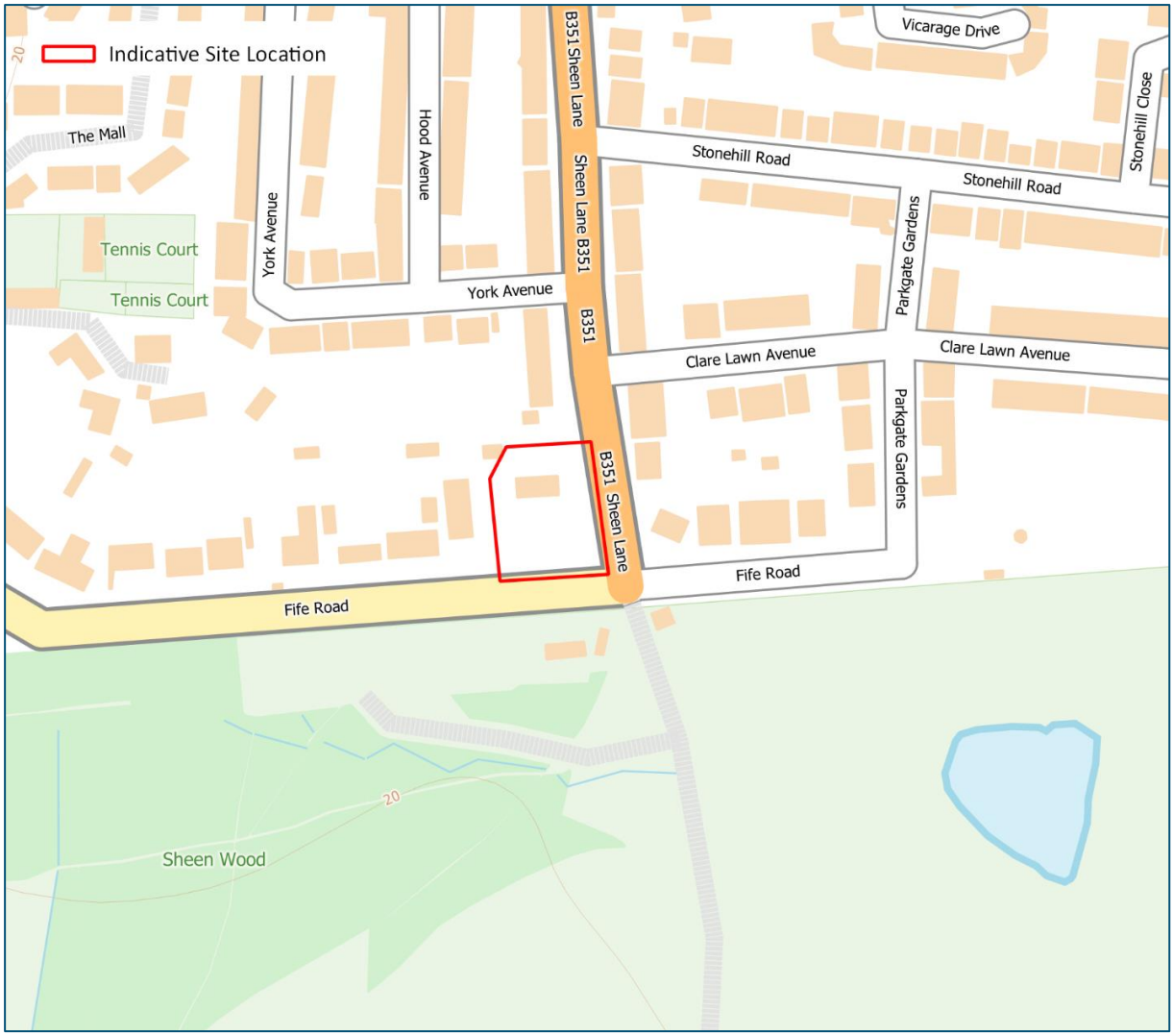


Figure 1: Site Location

1.4. The existing site currently comprises a single dwelling. It is proposed to add a 200m^2 single-storey extension to the property.

1.5. In the absence of a topographical survey, Environment Agency Light Detection and Ranging (LiDAR) data Digital Terrain Model (1m resolution) has been utilised to review the topography of the site. The LiDAR data shows the ground elevation of the site to vary between 18 metres Above Ordnance Datum (mAOD) in the south of the site to 19.1mAOD in the north of the site.

Figure 2: Site Topography (mAOD)

1.6. Richmond Council is the designated Lead Local Flood Authority (LLFA) for the site and the site sits within the Environment Agency's (EA) Kent, South London and East Sussex region.

Planning Policy and Guidance

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

- *In Flood Zone 2 or 3 including minor development and change of use,*
- *More than 1 hectare 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 river and the sea (for example surface water drains or reservoirs),*
- *In an area within Flood Zone 1 which has critical drainage problems as notified by the Environment Agency.*

1.8. The site is located within Flood Zone 1 and is not over 1ha. However, pre-application advice from the Local Planning Authority has identified a need for an FRA.

1.9. 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; and
- Risk of flooding from other sources.

1.10. A Sustainable Drainage Statement is also included within this report on page 18 as has been requested by the LLFA.

2. National Planning Policy Framework

2.1. The potential consequences of inappropriate development in a flood risk area for occupiers, either of the development or elsewhere, pose significant risks in terms of personal safety and damage to property. 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. The following section summarises the key policies and guidance relevant to the proposed development.

2.2. The National Planning Policy Framework[2] (NPPF) (DCLG, 2019) includes Government policy on development and flood risk stating that:

[1] **https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications#when-you-need-an-assessment**
2 https://www.gov.uk/guidance/national-planning-policy-framework, last updated June 2019

"155. 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….

163. 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:

- *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;*
- *the development is appropriately flood resistant and resilient;*
- *it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;*
- *any residual risk can be safely managed; and*
- *safe access and escape routes are included where appropriate, as part of an agreed emergency plan.*

164. 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 50. "

2.3. Footnote 50 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.

To comply with the NPPF, an FRA must be submitted for planning applications for developments within flood zones 2 and 3 (medium or high risk of fluvial or tidal flooding) and for all developments of 1 hectare or greater located in flood zone 1 (low risk)."

2.4. Flood Zones in England are defined in Table 1[3] as follows:

Table 1: Flood Zone Definitions

[3] **https://www.gov.uk/guidance/flood-risk-and-coastal-change**

Flood Zone	Definition
Zone 1 Low Probability	Land having less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zone 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. (Lan shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in her 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)

Table 1: Flood Zone Definitions

2.5. An FRA should be appropriate to the scale, nature and location of the development and 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.

2.6. An assessment of any hydrological impacts should be assessed including an assessment of impacts on surface water runoff and impacts to the drainage network in order to demonstrate how flood risk to others will be managed following development and taking climate change into account.

2.7. The Planning Practice Guidance (substantially revised in March 2015 in relation to drainage) requires that sustainable drainage systems should be considered and included where practicable, in line with DEFRA Technical Standards[4].

Local Core Strategy

2.8. The London Borough of Richmond Upon Thames Local Development Framework Core Strategy sets out the policies for development in the local area.

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

2.9. The strategy states that the preferred approach is to prevent new development in areas of high flood risk.

Greater London Plan

2.10. The Greater London Plan (2021) is the Spatial Development Strategy for Greater London. It sets out a framework of how London will develop over the next 20 to 25 years, as well as the Mayor's vision for Good Growth.

2.11. The Greater London Plan details London's response to climate change. Key policies relevant to sustainable design and construction are as follows:

- Developers should maximise all opportunities to achieve greenfield runoff rates in their developments (Policy 5.12, 5.13)
- When designing their schemes developers should follow the drainage hierarchy set out in London Plan Policy 5.13 (Policy 5.13).
- The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime (Policy 5.3).
- Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process (Policy 5.3).
- Developers should design Sustainable Drainage Systems (SuDS) into their schemes that incorporate attenuation for surface water runoff as well as habitat, water quality and amenity benefits (Policy 5.3, 5.13, 5.14).

2.12. The Greater London Plan has been taken into consideration in the production of this Flood Risk Assessment.

Sustainable Design and Construction

2.13. The Sustainable Design and Construction Supplementary Planning Guidance (2014) provides support to the polices in the Greater London Plan.

2.14. Section 3.4 'Flooding' provides guidance on sustainable drainage. Key messages include:

- The capture and storage of rainwater for later use is always the priority in order to also meet the objective of making efficient use of water resources.
- Where there are no opportunities to collect and reuse rainwater, the site, where practical should drain to the ground to recharge groundwater resources. Where infiltration is not possible, surface water should be stored on-site in open water features such as ponds and wetlands and then released at a controlled rate.

- The final option is to store surface water in tanks or cellular storage before it is released at a controlled rate. This is the least preferable storage option as it does not provide wider sustainability benefits such as habitat provision or water quality improvements.
- Development should utilise SuDS unless there are practical reasons for not doing so.

2.15. The Sustainable Design and Construction Supplementary Planning Guidance has been taken into consideration in the production of this Flood Risk Assessment.

Sequential and Exception Tests

2.16. 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.

Sequential Test

2.17. The Sequential Test is applied to developments in Flood Zones 2 and 3. The site is wholly within Flood Zone 1 and so does not apply.

Exception Test

2.18. The Exception Test is applied to sites based on the Flood Zone and the nature of the development. As the proposed development consists of residential development buildings it would be classed as “more vulnerable” in line with government development use classes.

2.19. The Flood Risk Vulnerability Classification table[5], provided below in Table 2 shows which vulnerabilities are appropriate in each Flood Zone.

2.20. The proposed development sits wholly within Flood Zone 1 and is therefore considered an appropriate development for the Flood Zone without the need for an Exception Test.

5 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/575184/Table_3_-_Flood_risk_vulnerability_and_flood_zone__compatibility_.pdf

Table 2: Flood Risk Vulnerability Classification Table

	Flood Risk Vulnerability Classification				
Flood Zones	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	x	Exception Test required	✓	✓
Zone 3b	Exception Test required	x	x	x	✓

3. Consultation and Review

Sources of Information

Consultation

3.1. The site is in the London Borough of Richmond Upon Thames. Consultation has been undertaken with Richmond Council and the EA Kent, South London and East Sussex Region in April 2021. Responses to these consultations are outstanding at time of writing, however it is not expected that anything above the standard information will be returned due to the site's Flood Zone 1 status.

3.2. Consultation has also been undertaken with Thames Water to obtain information in relation to their assets within the site's vicinity and to investigate the potential to accept discharge from the site if required.

3.3. These will be included within Appendix B upon receipt.

Documents

3.4. 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.

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

- The Interactive Flood Risk Mapping available on the Environment Agency (EA) website[6].
- The National Planning Policy Framework (NPPF) technical guide (Communities and Local Government, 2019).
- The Greater London Plan (2021).
- Sustainable Design and Construction Supplementary Planning Guidance (2014).
- British Geological Survey - Geology of Britain Viewer (British Geological Society, 2017).
- London Borough of Richmond Upon Thames Local Development Framework Core Strategy [7] (2009).
- London Borough of Richmond Upon Thames Local Flood Risk Management Strategy[8] (LFRMS) (2014).
- London Borough of Richmond Upon Thames Preliminary Flood Risk Assessment[9] (PFRA), (2011).
- London Borough of Richmond Upon Thames Strategic Flood Risk Assessment[10] (SFRA) (2021).

London Borough of Richmond Upon Thames Preliminary Flood Risk Assessment (PFRA)

3.6. The PFRA, adopted in 2011, is a high-level appraisal of flood risk across the Richmond area. 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 (described below) is produced.

3.7. The PFRA identifies that Richmond has experienced a number of past surface water flooding events, however they have not been deemed to have had significant consequences for human health, economic activity, the environment and cultural heritage.

3.8. The PFRA summarises historical flood incidents in the Richmond area. The site is recorded as being located within the vicinity of a 'Groundwater Flood Incident'. This is discussed further in the groundwater flood risk section.

London Borough of Richmond Upon Thames Local Flood Risk Management Strategy (LFRMS)

6 Environment Agency, Flood Map for Planning, https://flood-map-for-planning.service.gov.uk/, 2017
7 London Borough of Richmond Upon Thames Local Development Framework Core Strategy, 2009
8 London Borough of Richmond Upon Thames, Local Flood Risk Management Strategy, 2014
9 London Borough of Richmond Upon Thames, Preliminary Flood Risk Assessment, 2011
10 London Borough of Richmond Upon Thames, Strategic Flood Risk Assessment, 2021

3.9. Adopted in 2014, the purpose of the LRMS is to take a broad look at the flood risk across the Richmond area and to identify communities which are at risk from flooding from a variety of sources.

3.10. The objectives identified to manage local flood risk include:

- Encouraging direct involvement in decision making through the establishment of and maintaining partnerships with key organisations, including the Environment Agency and Thames Water.
- Improving knowledge and understanding of the interactions between different sources of flooding in Richmond Borough.
- Encouraging residents, businesses and local landowners to take action and contribute to the management and reduction of flood risk.
- Targeting resources where they have the greatest effect by adopting a risk-based approach.
- Contributing to wider social, economic and environmental outcomes by encouraging sustainable multi-benefit solutions for the management of local flood risk.

London Borough of Richmond Upon Thames Strategic Flood Risk Assessment (SFRA)

3.11. The SFRA, updated in 2021, provides the evidence base for the London Borough of Richmond Upon Thames Local Core Strategy and guidance for consideration when determining planning applications. 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.

3.12. The SFRA provides recommendations for completing FRAs and refers back to the NPPF and Planning Policy Guidance (PPG). Where a development is proposed within Flood Zone 1 (as in this case) the SFRA makes the following recommendations:

- A site-specific FRA is required for all development proposals where there is evidence of risk from other sources of flooding, including groundwater and sewer flooding.
- Flood risk from all sources should be assessed, including the potential impacts of climate change over the development's lifetime.
- The EA's 2016 climate change allowances (including subsequent updates) must be used when assessing peak river flows and peak rainfall intensities.

London Borough of Richmond Upon Thames Surface Water Management Plan (SWMP)

3.13. The SWMP (2011) outlines the preferred surface water management strategy for the London Borough of Richmond upon Thames including consideration of flooding from sewers, drains, groundwater and runoff from land, small watercourses and ditches that occur as a result of heavy rainfall.

3.14. The SWMP provides details of SuDS suitability for the Richmond area. It has been considered within the production of this report.

4. Sources of Flood Risk

Fluvial Flood Risk

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. The site is located within Flood Zone 1 (Figure 3). Flood Zone 1 denotes an area with a lower than 1 in 1000 risk of flooding from fluvial or tidal sources and therefore is very low risk.

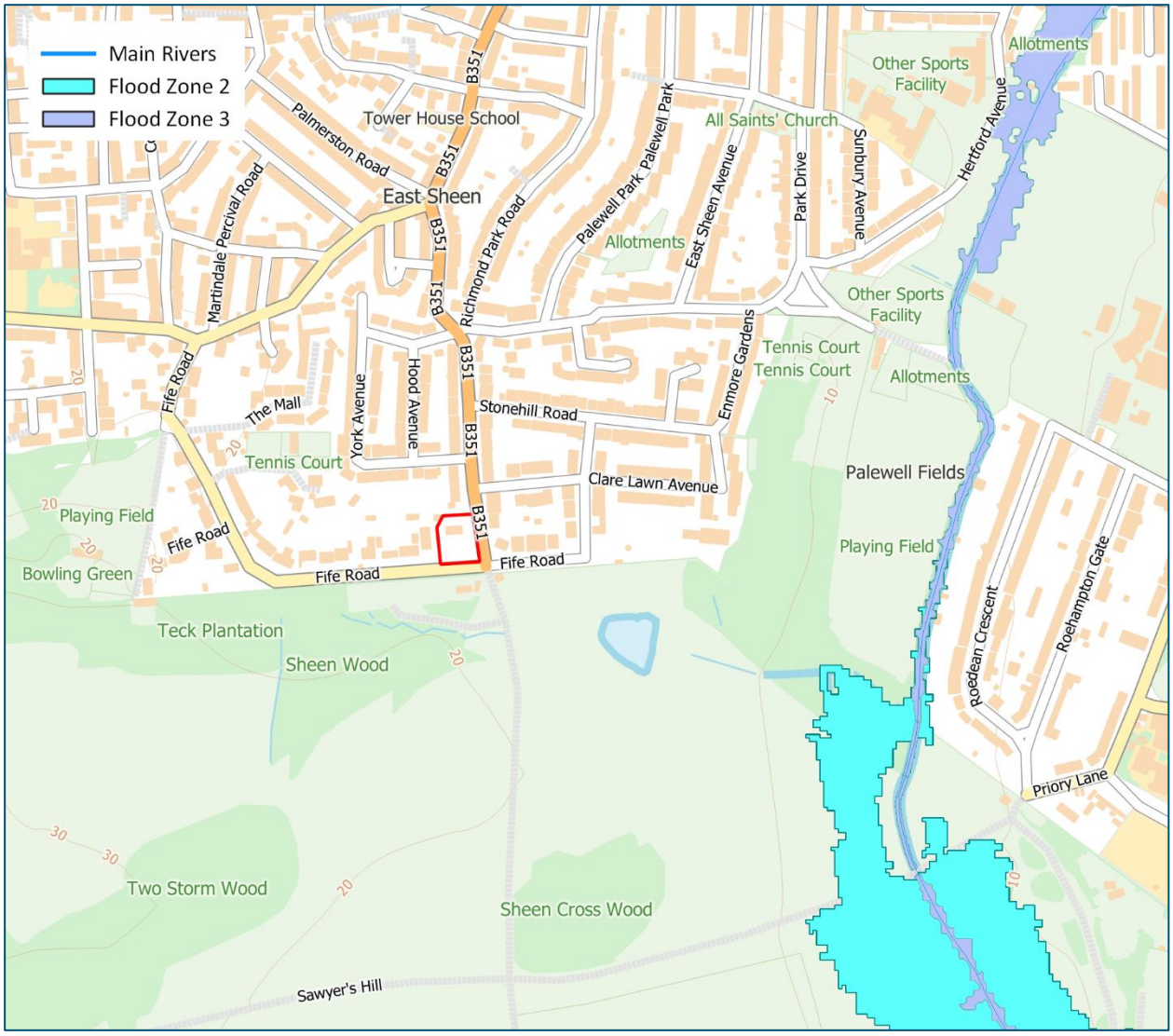


Figure 3: EA Flood Mapping for Planning

Main Rivers

4.3. The nearest Main River to the site is the Beverley Brook which runs south to north approximately 640m east of the site. The nearest Flood Zones 2 and 3 extents are associated with the Beverley Brook, with

the nearest extent located 500m to the south-east of the site. In addition to this, LiDAR indicates that the left bank of the Beverley Brook has an elevation of 8mAOD and is therefore located approximately 10 metres below site levels.

4.4. The site is located a sufficient distance from Main Rivers, including a consideration for climate change, and the risk is therefore considered to be low.

Ordinary Watercourses

4.5. There is an Ordinary Watercourse located approximately 100m to the south of the site. The Flood Estimation Handbook (FEH) does not provide catchment descriptors for the watercourse, indicating that the watercourse has a catchment of less than 0.5km^2.

4.6. This watercourse is not represented within the EA Flood Map for Planning. In this instance, the EA surface water flood risk mapping can be utilised to assess the potential risk posed by an unmapped watercourse. This is discussed further in the Pluvial Flood Risk section below.

Historic Flooding

4.7. The Environment Agency's Historic Flood Map dataset shows the site has no recorded flood history. The nearest historic flood extent is associated with the River Thames, 4km to the north-east of the site.

Pluvial Flood Risk

4.8. 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.

4.9. Examination of EA surface water flood risk mapping (Figure 4) for the 3.3%, 1% AEP and 0.1% AEP flood events shows that the site has a low (0.1% AEP) to medium probability (1% AEP) of surface water flooding. This is associated with a topographical depression present in this location, as is visible in Figure 2. Anticipated flood depths are below 300mm for the medium risk event.

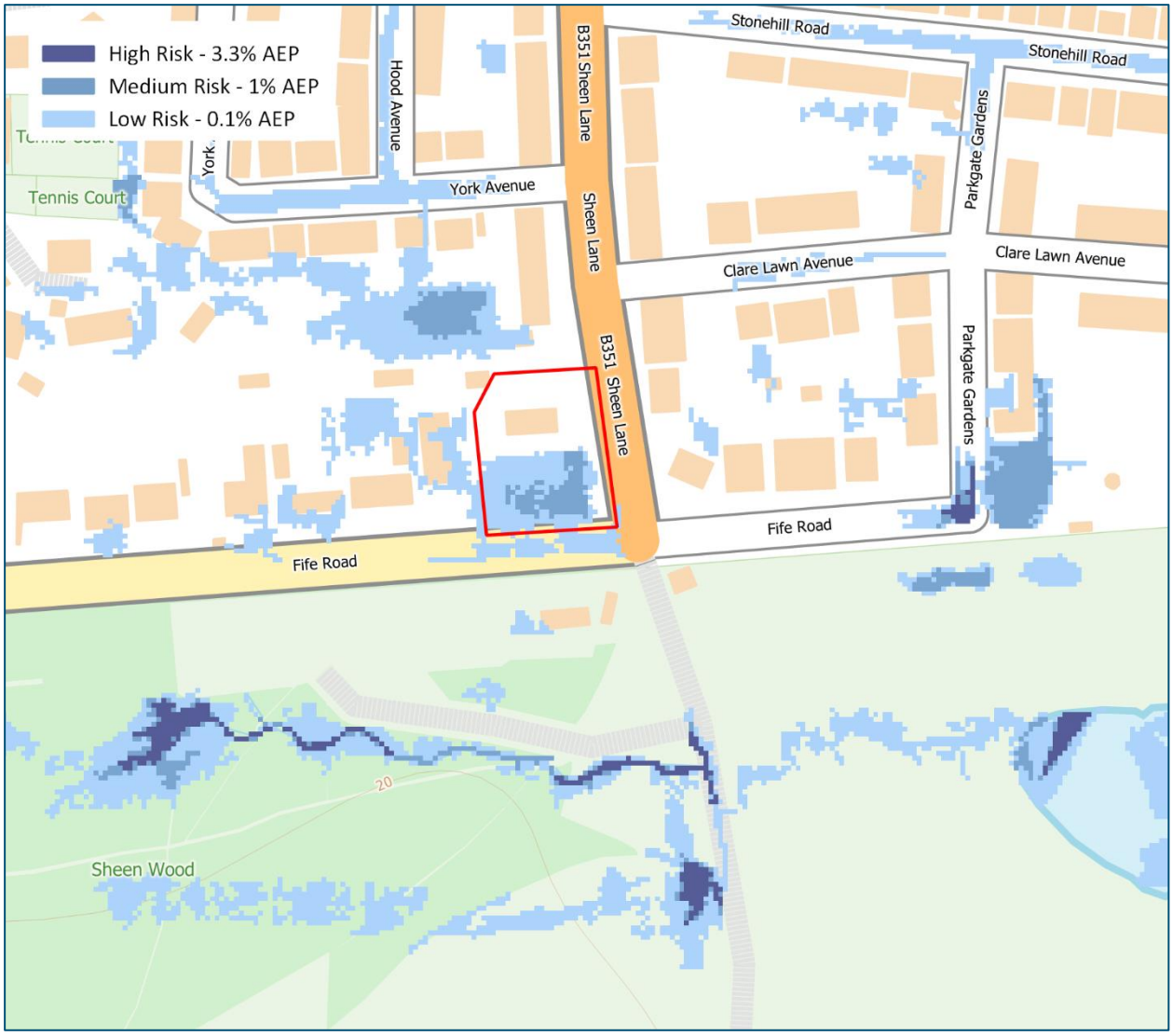


Figure 4: EA Surface Water Flood Risk Mapping

4.10. The building footprint and proposed extension is shown to be located outside the area of surface water risk. Sheen Lane, the site's access, is also located outside the area of surface water risk. Fife Road, to the south of the site, is shown to be at low risk.

4.11. The pluvial flood risk to the site is therefore considered to be medium, and the risk to the proposed development and access is considered to be low.

4.12. The Ordinary Watercourse to the south of the site is shown to have a small associated floodplain, from which the site is significantly removed. The Ordinary Watercourse is therefore not considered to pose a risk to the site.

Reservoirs

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

4.14. According to EA Flood risk from reservoirs mapping (Figure 5) shows the site is not considered to be at risk from reservoirs.

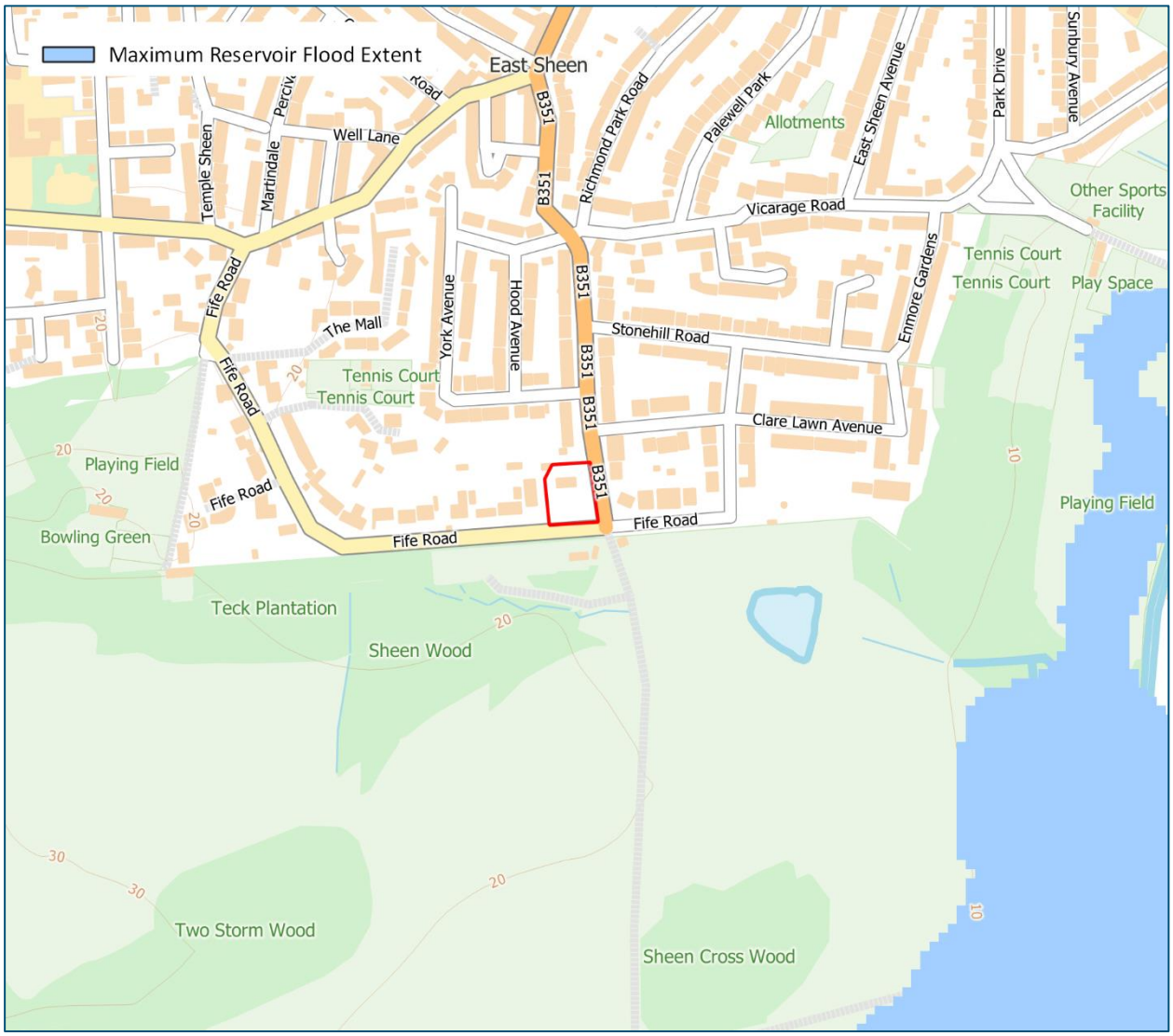


Figure 5: EA Flood Risk from Reservoirs

Canals

4.15. 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.

4.16. 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.

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

4.18. There are no canals in the vicinity of the site and the risk of flooding from a canal is therefore very low.

Groundwater

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

4.20. The British Geological Survey's (BGS) mapping shows the site to be underlain by London Clay Formation (Clay and Silt), which is designated by the EA as an Unproductive Aquifer. These are defined as rock layers of drift deposits with low permeability that have negligible significance for water supply or river base flow.

4.21. The site is expected to have Taplow Gravel Member (Sand and Gravel) superficial deposits present, as indicated by the BGS mapping. These are designated by the EA as a Secondary A Aquifer. Secondary A Aquifers are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

4.22. Historic BGS boreholes within the vicinity of the site confirm that the site is underlain by sand, gravel and clay. Water was identified as being struck at 1.2m below ground level.

4.23. The SFRA states that the bedrock geology for the entirety of the London Borough of Richmond upon Thames is London Clay, one with very low permeability. This geological unit generally has a low hydraulic conductivity, which means water does not easily move through it. The superficial geology for the London Borough of Richmond upon Thames is predominantly a range of different river terrace deposits, including the Kempton Park Gravel Member, Taplow Gravel Member, Boyn Hill Gravel Member, and Black Park Gravel Member. Each of these geological units are comprised of sand and gravel, geology with a higher hydraulic conductivity than those comprised of clay and silt.

4.24. The SFRA shows the site to be located in an area of between 50% and 75% susceptibility to groundwater flooding, however this is based on a grid with a $1km^2$ cell size and may not be applicable to the site.

4.25. The SWMP does not identify the site as being within an area with increased potential for local groundwater, however an 'Groundwater Flood Incident' has been recorded within the site vicinity by the EA. This is recorded as a flooded cellar, which occurred in 2010. No further incidents have been recorded.

4.26. As the development proposals do not include any proposed basements, the risk from groundwater to the development is therefore considered to be low.

Surface and Foul Sewers

4.27. Surface water sewers can be a cause of flooding where the drainage network has become overwhelmed, either by blockage or due to local development beyond the designed capabilities of the drainage system.

4.28. Thames Water asset records (Appendix B) show two sewers within the vicinity of the site, a foul and a surface water sewer both with 225mm diameters. Manhole details confirm the sewers to be approximately 2.9m and 1.3 metres below ground level respectively.

4.29. Areas at risk of surface water flooding are discussed on page 14. These areas would be at an increased risk of flooding should surface water sewers become surcharged. It is considered that, in line with the surface water mapping, should the sewers surcharge, the proposed development will be located outside the area at risk.

4.30. Thames Water keeps a record of flooding incidents within their remit under a DG5 register. According to the PFRA, the DG5 register shows the site to be located within an area with 6-10 recorded sewer flood incidents.

4.31. The SWMP does not identify the site as being located within a Critical Drainage Area.

4.32. The development is therefore considered to be at low risk of flooding from sewers.

5. Flood Risk Mitigation

Fluvial

5.1. No fluvial flood risk mitigation is required as the site and its access are located entirely within Flood Zone 1 and is considered to be at low risk from fluvial sources.

Pluvial

5.2. The site is shown to be at low to medium pluvial risk, however the building footprint and proposed extension is at very low pluvial risk. This residual risk will be mitigated as part of the site's surface water drainage strategy.

5.3. Ground levels should be profiled to encourage pluvial runoff and overland flows away from the built development and towards the nearest drainage point.

Reservoirs, Canals, Groundwater and Sewers

5.4. Flood risk from other sources is deemed to be low, therefore mitigation is not required.

Surface Water Drainage Statement

5.5. This statement sets out the principles of drainage design for the development proposals and summarises the key considerations and requirements to inform any future design work. This includes a consideration of national and local guidance as well as potential SuDS features appropriate to the site.

Sustainable Drainage Guidance

5.6. The Greater London Plan, the Sustainable Design and Construction Supplementary Planning Guidance and the SWMP set out the specific requirements for development within the Richmond Borough.

5.7. Key policies relevant to sustainable design and construction are as follows:

- Developers should maximise all opportunities to achieve greenfield runoff rates in their developments (London Plan Policy 5.12, 5.13)
- When designing their schemes developers should follow the drainage hierarchy set out in London Plan Policy 5.13 (London Plan Policy 5.13).
- The highest standards of sustainable design and construction should be achieved in London to improve the environmental performance of new developments and to adapt to the effects of climate change over their lifetime (London Plan Policy 5.3).
- Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process (London Plan Policy 5.3).

- Developers should design Sustainable Drainage Systems (SuDS) into their schemes that incorporate attenuation for surface water runoff as well as habitat, water quality and amenity benefits (London Plan Policy 5.3, 5.13, 5.14).

5.8. The LLFA are the SuDS Approval Body (SAB) for the local area and will need to be consulted on the implementation of SuDS at the site.

Drainage Hierarchy

5.9. The Greater London Plan states that surface water run-off should be managed as close to source as possible in line with the following drainage hierarchy:

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

Recommendations

5.10. It is understood that the existing building is currently positively drained, likely into the local sewer network.

5.11. As part of the proposals, the footprint of the building will be extended by approximately 200m^2. In line with the drainage hierarchy, where possible, the additional surface water should be collected and stored on site for later use. Examples of water conservation options are discussed below.

Water Butts

5.12. The SWMP states that one of the preferred measures to reduce peak discharges and downstream flood risk, is the implementation of water butts on all new development within the Borough. Water butts are large containers used to capture and store rainwater. When attached to a downpipe, the water butt collects the rainwater that lands on the roof of a building for later use.

Blue / Green Roof

5.13. A blue roof is a roof designed for the retention of rainwater above the waterproofing element of the roof. This is as opposed to more conventional roofs which allow for rainwater to drain from the roof. Blue roofs are typically flat, without any fall, with control devices regulate drainage outlets that enable water to be retained or drained.

5.14. A green roof is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. Green roofs can reduce or eliminate run-off from roof areas and provide a habitat for wildlife.

Rainwater Harvesting

5.15. Rainwater from roof areas is passed through a filter and stored within underground tanks. When water is required, it is delivered from the storage tank to toilets, washing machines and garden taps for use. If the tank becomes low on stored water, demand is topped up from the mains supply. Any excess water can be discharged via an overflow to a soakaway or local drainage network.

5.16. The Rainwater Harvesting Tank Sizing tool developed by HR Wallingford indicates that, in combination with a green roof, indicates a tank of 11.7m^3 would be sufficient to provide control of the design storm rainfall depth. Alternatively, if a pitched roof were preferred, a tank of 1.7m^3 would be suitable to be used as a means of non-potable water supply, with excess surface water run-off being managed via other measures. Please note these calculations are indicative only. Supporting calculations are included within Appendix C.

Infiltration

5.17. In line with the SuDS hierarchy, any excess surface water that cannot be stored on site should be discharged via infiltration if viable.

5.18. Estimated infiltration rates for Taplow Gravel Member were obtained from BGS and the SuDS Manual and the Infiltration Systems Design Tool developed by HR Wallingford has been utilised to determine the approximate dimensions of the associated soakaway, including a safety factor of 1.5. The results of this exercise are summarised in Table 3 and the supporting calculations are included within Appendix C.

Table 3: Potential Infiltration Rates and Corresponding Soakaway Dimensions

Infiltration Rate (m/s)	Source	Soakaway Dimensions (m)	Half emptying time (h)
1 x 10^{-5} (lowest viable rate for infiltration)	BGS	5 (w) x 5 (l) x 2.25 (d)	4.04
3 x 10^{-5}	SuDS Manual	4.5 (w) x 4.5 (l) x 2.09 (d)	1.23
1 x 10^{-3}	BGS	2 (w) x 2 (l) x 1.74 (d)	0.02
3 x 10^{-3}	SuDS Manual	1 (w) x 1 (l) x 1.42 (d)	0

5.19. This exercise shows that the infiltration rate significantly alters the required soakaway dimensions. However, the lowest viable rate of 1 x 10^{-5} m/s, representing the worst-case scenario, is shown to require soakaway dimensions which can be accommodated within the site boundary.

5.20. Should a soakaway form part of the detailed design, then it is likely that infiltration testing will be required to confirm the infiltration rate.

5.21. If rainwater harvesting techniques are implemented, the volume of the soakaway can be reduced. This is in line with the "combination" approach of the SWMP and guidance documents.

5.22. It should be noted that any soakaway features should be located a minimum of 5m away from any buildings and 2.5m away from the site boundary. The recorded 'Groundwater Flood Incident' indicates that groundwater may be less than 3m below the ground surface for at least part of the year. The depth of the water table should be investigated and considered as part of the design for any soakaways within the site.

Sewer Network

5.23. Should infiltration rates prove not to be viable, discharging to the local sewer network should be investigated.

5.24. It is understood that any additional foul flows will be accommodated by the existing foul drainage network currently serving the property. A consultation has been submitted to Thames Water to seek confirmation.

6. Conclusions

6.1. This FRA has been undertaken with reference to the requirements of NPPF and Planning Practice Guidance with respect to the development at 264 Sheen Lane, East Sheen, London, SW14 8RL. It has been written to support a full planning application and has been prepared with due consideration to the nature of the proposed development to provide the appropriate level of detail.

6.2. The FRA supports the planning application and demonstrates that there is an acceptable level of flood risk to the site if the mitigation strategies recommended are implemented in the scheme. The development does not increase flood risk off site or to the wider area.

Source of Flooding	Flood Risk Summary Table
Fluvial	The site and its access are located within Flood Zone 1 and are at low risk from fluvial sources.
Pluvial	The site is shown to be at low to medium from pluvial sources. The residual risk will be mitigated as part of the site's surface water drainage strategy. Ground levels should be profiled to encourage pluvial runoff and overland flows away from the built development and towards the nearest drainage point.
Reservoirs **Canals** **Groundwater** **Sewers**	The site is considered to be at low risk from other sources.

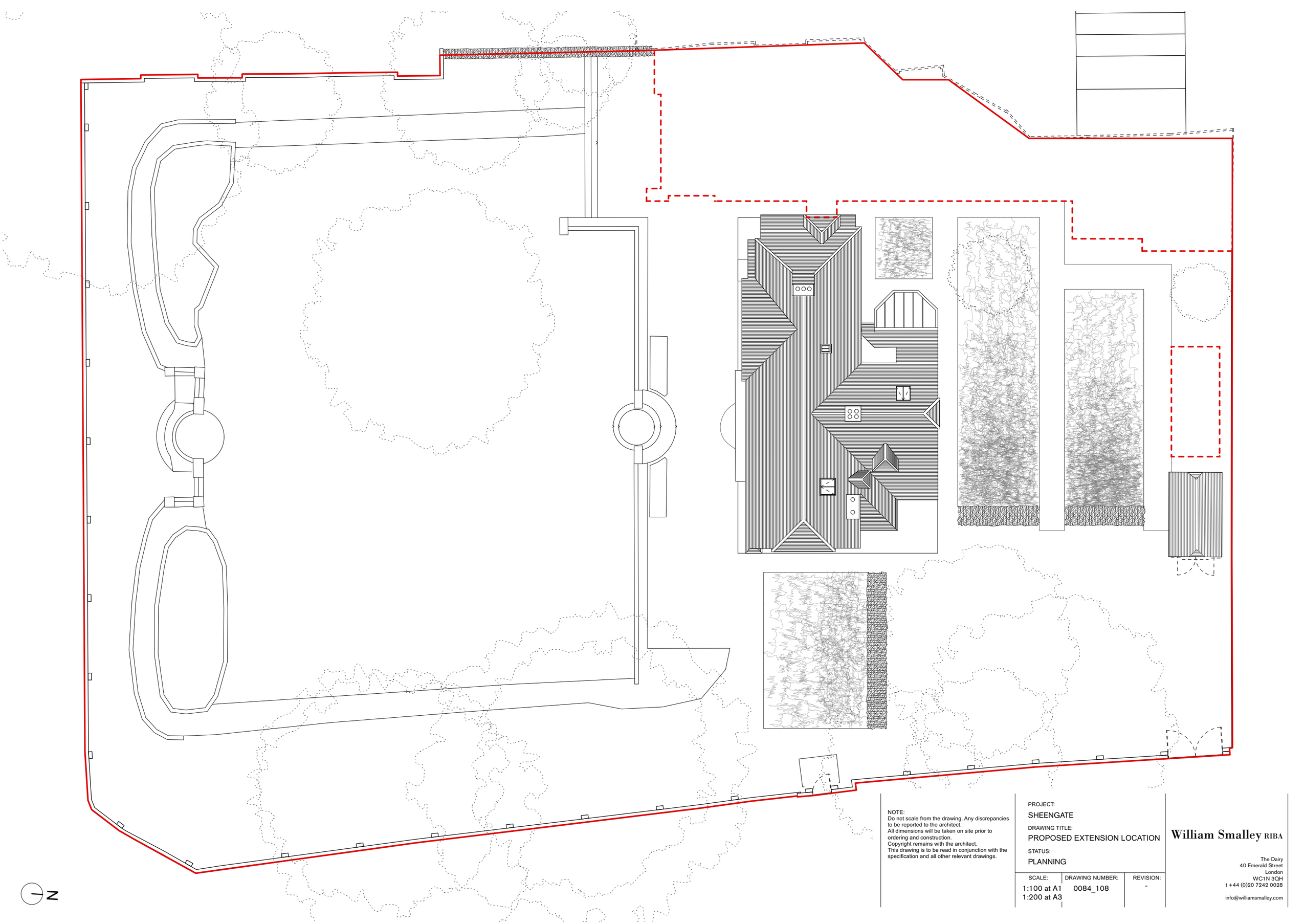
Surface and Foul Drainage Design	It is recommended that surface water is retained on site for later use where possible, in line with the drainage hierarchy. Any additional surface water should be discharged via infiltration where possible. It is recommended infiltration tests are undertaken at the detailed design stage to confirm this is viable. If infiltration is not viable, consultation with the sewerage undertaker should confirm if they can accept the additional runoff. It is understood that any additional foul flows will be accommodated by the existing foul drainage network currently serving the property. This is awaiting confirmation from the local sewerage undertaker, Thames Water.

6.3. The following conclusions can be drawn from this level 1 FRA:

- This FRA has identified no prohibitive engineering constraints in developing the proposed site for the proposed usage.
- The site is at low to medium pluvial risk; however, the building footprint and proposed extension is at very low pluvial risk. This residual risk will be mitigated as part of the site's surface water drainage strategy.
- The site is at low risk from all other sources.
- The proposed development is not expected to cause an increase in flood risk either onsite or elsewhere over the lifetime of the development taking climate change into account.

6.4. This Flood Risk Assessment should be submitted as part of the planning application to satisfy the requirements under NPPF.

Appendix A - Development Proposals



NOTE:
Do not scale from the drawing. Any discrepancies to be reported to the architect.
All dimensions will be taken on site prior to ordering and construction.

This drawing is to be read in conjunction with the specification and all other relevant drawings.

PROJECT:
SHEENGATE

DRAWING TITLE:
PROPOSED EXTENSION LOCATION

STATUS:
PLANNING

SCALE:	DRAWING NUMBER:	REVISION:
1:100 at A1 1:200 at A3	0084_108	-

William Smalley RIBA

The Dairy
40 Emerald Street
London
WC1N 3QH
t +44 (0)20 7242 0028

info@williamsmalley.com

Appendix B - Consultation

Asset location search

Property Searches

Aegaea
3 South View Court 3 South View Court

SOLIHULL
B90 3FS

Search address supplied 264
Sheen Lane
London
SW14 8RL

Your reference AEG0121 Sheengate

Our reference ALS/ALS Standard/2021_4422988

Search date 7 May 2021

Knowledge of features below the surface is essential for every development

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

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

Contact us to find out more.

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

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

0800 009 4540

Asset location search

Property Searches

Search address supplied: 264, Sheen Lane, London, SW14 8RL

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

Waste Water Services

Please provide a copy extract from the public sewer map.

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

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

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

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

For your guidance:

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

Clean Water Services

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

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

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

For your guidance:

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

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

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

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

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

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

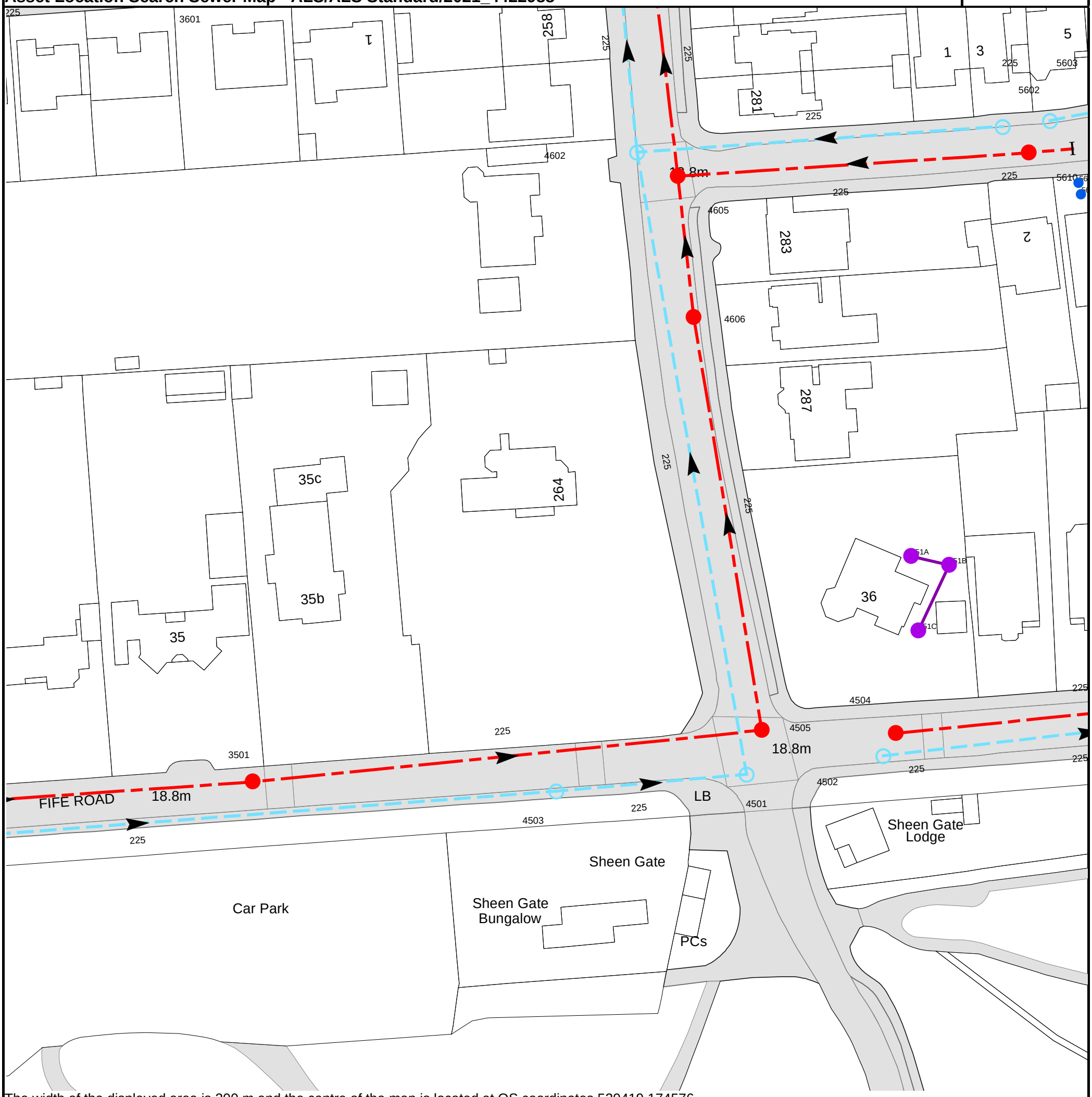
Clean Water queries

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

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

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

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4422988



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 520419,174576

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
4605	18.73	15.59
4606	18.73	15.68
4501	18.5	17.2
4505	18.8	15.87
4502	18.36	16.15
4504	18.4	16.41
451A	n/a	n/a
451C	n/a	n/a
451B	n/a	n/a
5610	18.19	16.3
561C	n/a	n/a
561B	n/a	n/a
5602	21.26	17.4
5603	18.17	16.14
3501	18.72	16.05
4503	18.57	17.3
4602	18.65	16.82

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

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

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

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

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

Control Valve

Drop Pipe

Ancillary

Weir

End Items

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

Outfall

Undefined End

Inlet

Other Symbols

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

Public/Private Pumping Station

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

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

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

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

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

2) All measurements on the plans are metric.

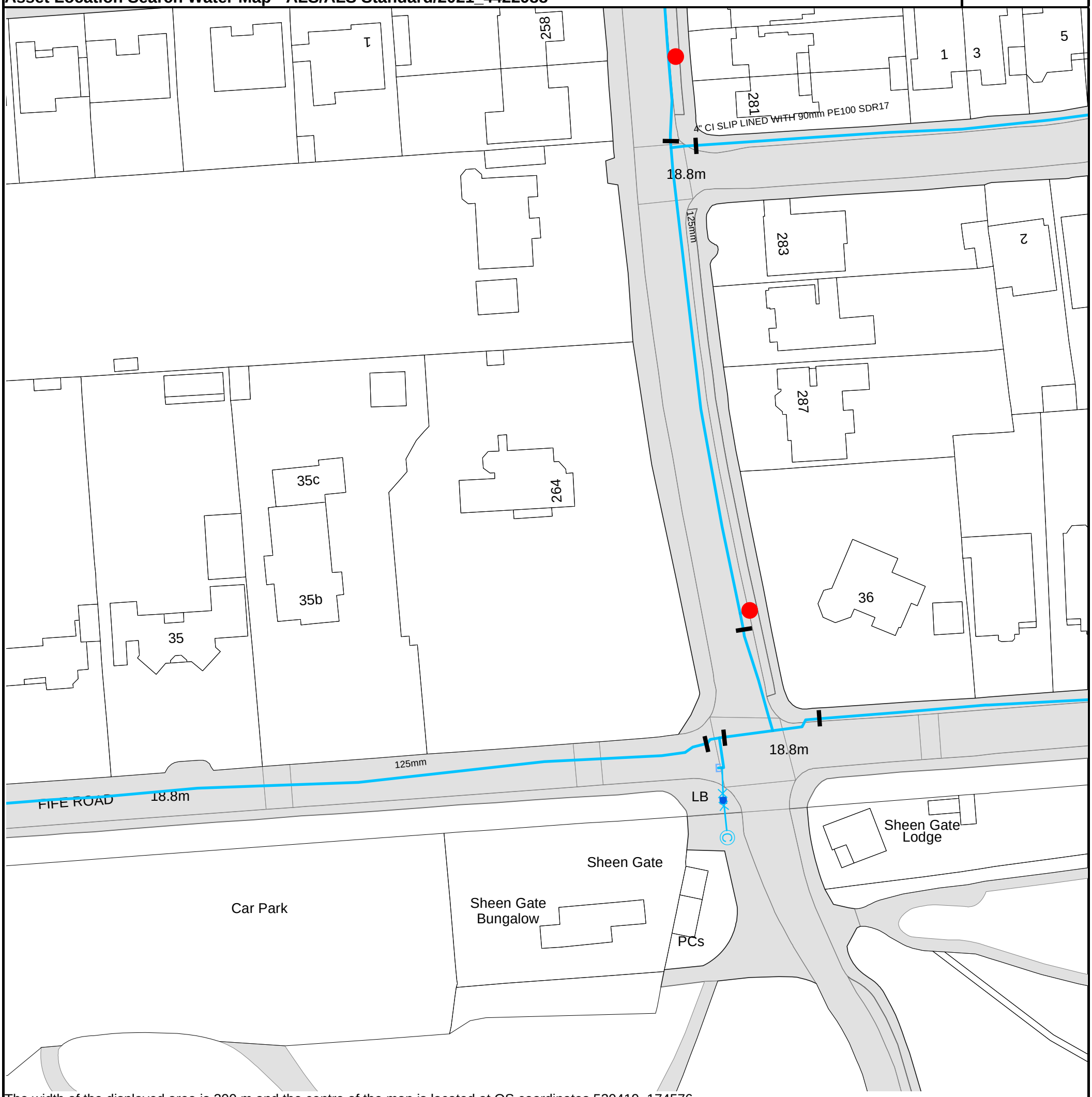
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.

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

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

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

Asset Location Search Water Map - ALS/ALS Standard/2021_4422988



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 520419, 174576.

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

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

16"

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

3" SUPPLY

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

3" FIRE

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

3" METERED

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

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

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

Valves

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

Hydrants

- Single Hydrant

Meters

- Meter

End Items

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

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

Operational Sites

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

Other Symbols

- Data Logger

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

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

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

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

Terms and Conditions

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

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

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

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

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

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

Ways to pay your bill

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

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

Appendix C – Surface Water Storage Requirement Calculations

Rainwater Harvesting Tank Sizing for Individual Residential Properties

Site name: Sheen Lane
Site location: Richmond
House reference: 264
Roof type: Standard pitch
No. of bedrooms: 3

Reference: 1619640885731
Date: 28/4/2021

This report provides an assessment of the volume of rainwater harvesting system storage required for the property to provide stormwater management control for a specific design storm event in addition to the non-potable water supply benefit. The report also provides compliance information (the probability of providing effective stormwater control) for the property.

• Input Data

No. of occupants:	2.35 (Default)
Standard deviation of occupants:	1.02 (Default)
Roof area (m^2):	200 (User-entry)
Daily consumption per person (l/p/d):	40 (Default)
Average annual rainfall depth (mm):	617 (User-entry)
No. of rainfall events per year:	150 (Default)
Depression storage loss (mm):	0.5 (Default)
Runoff proportion coefficient:	0.9 (Default)
Filter coefficient:	0.9 (Default)
Design rainfall depth (mm):	60 (Default)

• Results

Ratio Y/D: 2.56
The ratio of Yield to Demand (Y/D) is bigger than 0.95 (i.e. on average, demand exceeds supply), which indicates that the rainwater harvesting tank is only suitable to be used as a means of non-potable water supply.

Tank size (m^3): 1.7
This is the estimated tank size that will be valid for non-potable water supply only.
Compliance: Not applicable!
As Ratio Y/D is bigger than 0.95, compliance is not calculated.

HR Wallingford is not liable for the actual performance of any tank designed using this tool. Considering the uncertainties associated with rainfall and house occupancy, the results should be regarded as a best estimate based on current science of the storage required. Appropriate consideration of the implications of both larger events and unusually wet seasons occurring, should be carried out.

Rainwater Harvesting Tank Sizing for Individual Residential Properties

Site name: Sheen Lane
Site location: Richmond
House reference: 264
Roof type: Green roof
No. of bedrooms: 3

Reference: 1619640635823
Date: 28/4/2021

This report provides an assessment of the volume of rainwater harvesting system storage required for the property to provide stormwater management control for a specific design storm event in addition to the non-potable water supply benefit. The report also provides compliance information (the probability of providing effective stormwater control) for the property.

• Input Data

No. of occupants:	2.35 (Default)
Standard deviation of occupants:	1.02 (Default)
Roof area (m^2):	200 (User-entry)
Daily consumption per person (l/p/d):	40 (Default)
Average annual rainfall depth (mm):	617 (User-entry)
No. of rainfall events per year:	150 (Default)
Depression storage loss (mm):	3.0 (Default)
Runoff proportion coefficient:	0.7 (Default)
Filter coefficient:	0.9 (Default)
Design rainfall depth (mm):	60 (Default)

• Results

Ratio Y/D: 0.61

The ratio of Yield to Demand (Y/D) does not exceed 0.95 (i.e. on average, demand exceeds supply), which indicates that the rainwater harvesting tank is suitable to be used as a means of effective stormwater management.

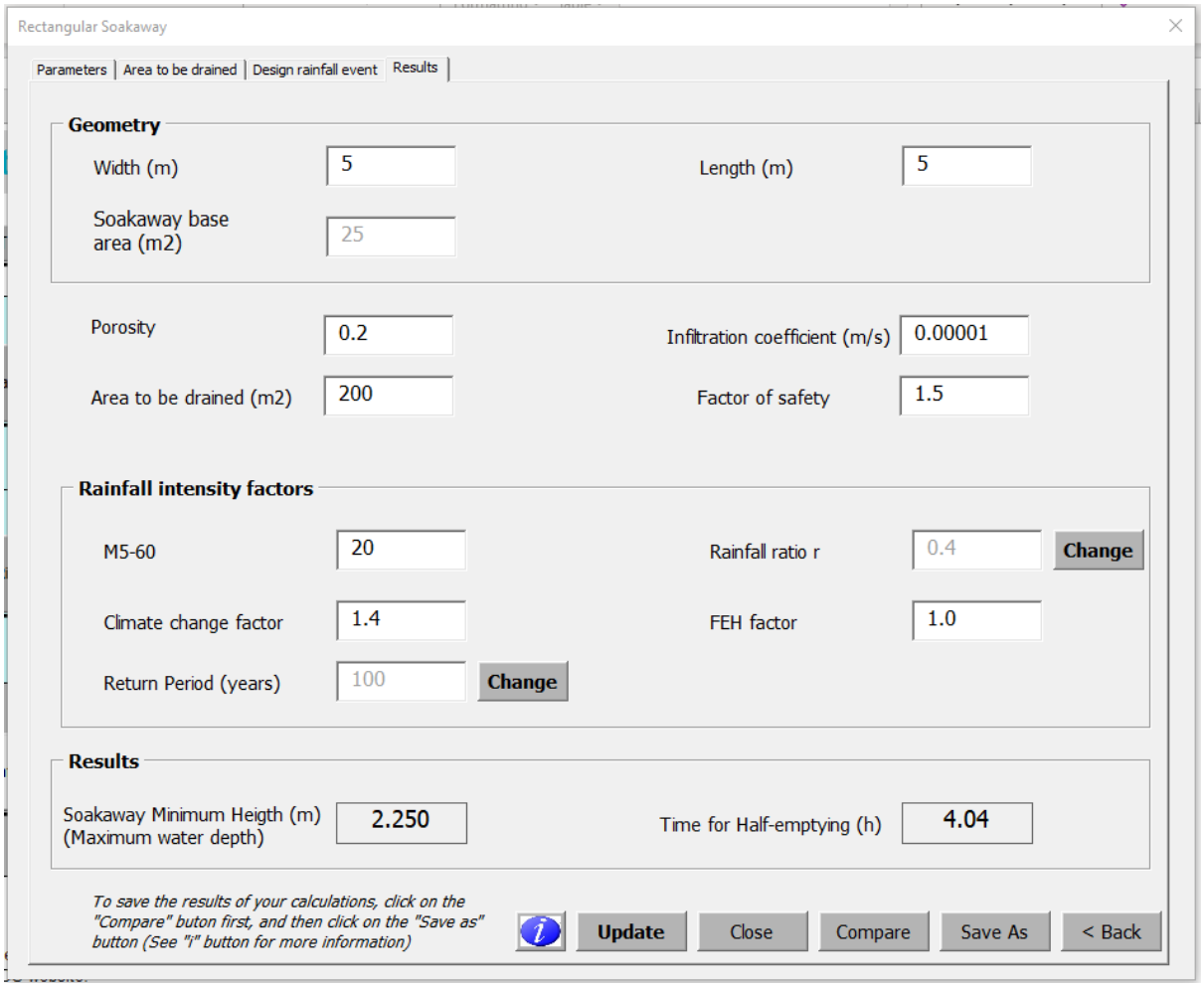
Tank size (m^3): 11.7

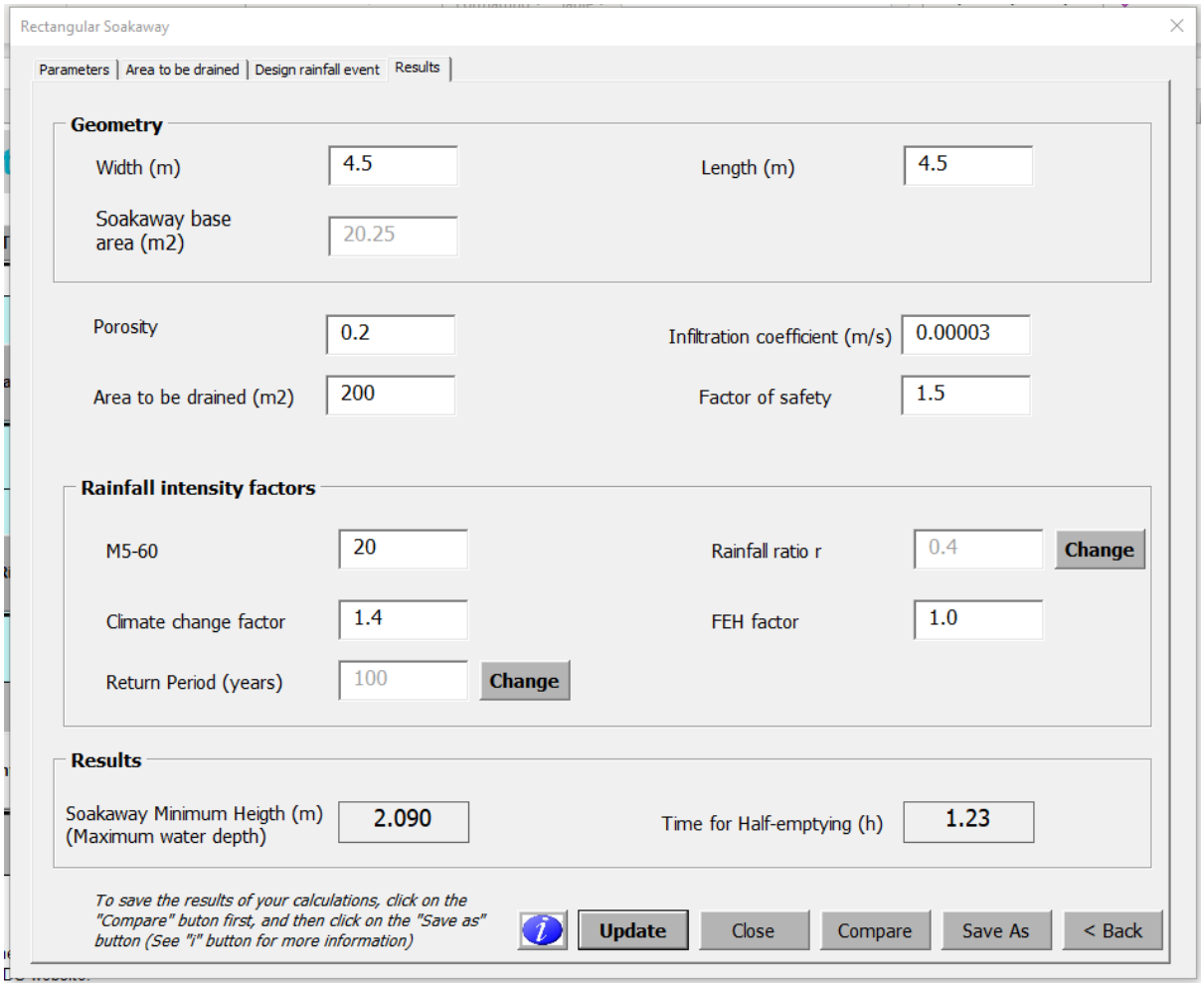
This is the estimated tank size that will be required to provide control of the design storm rainfall depth.

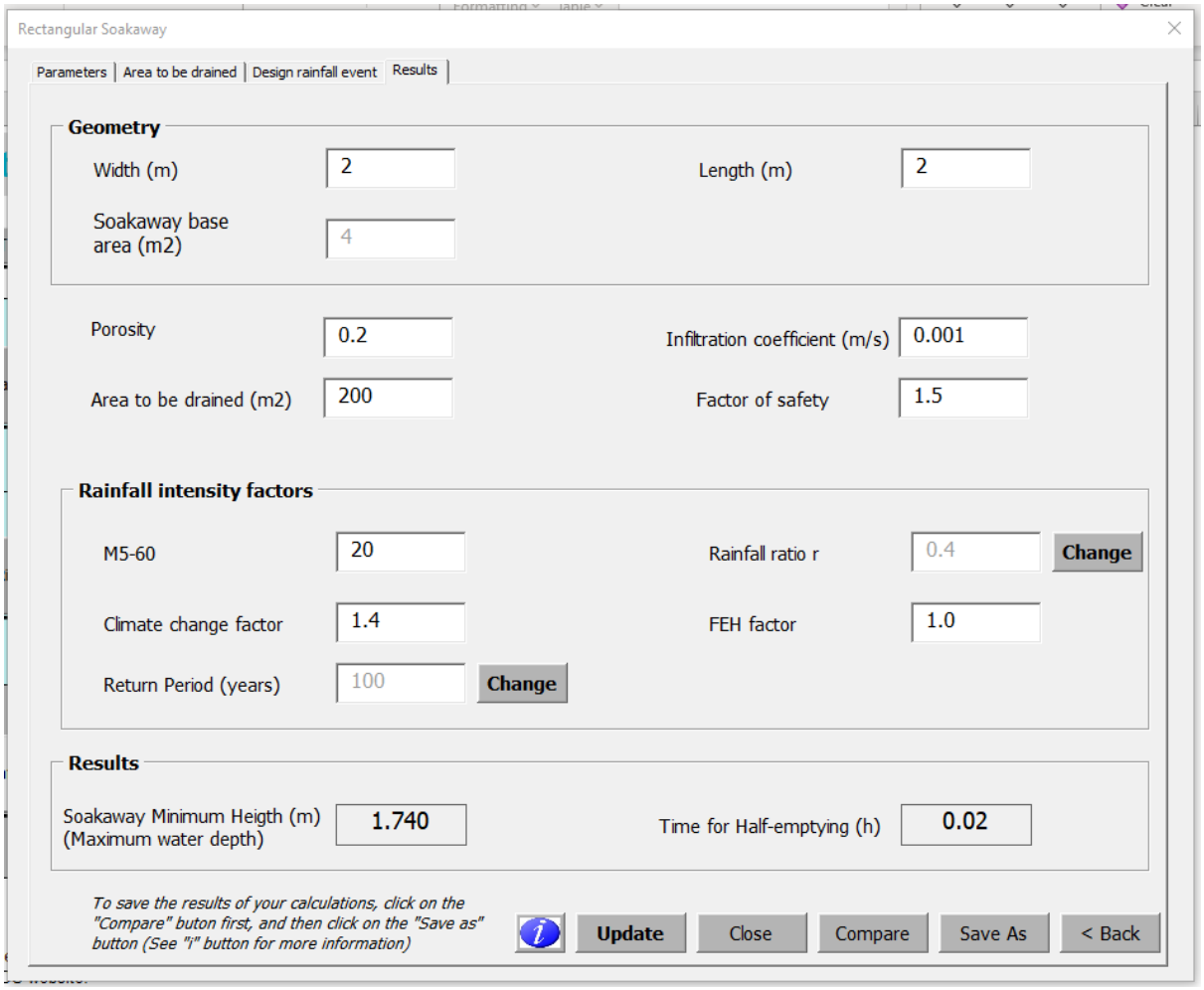
Compliance: 78%

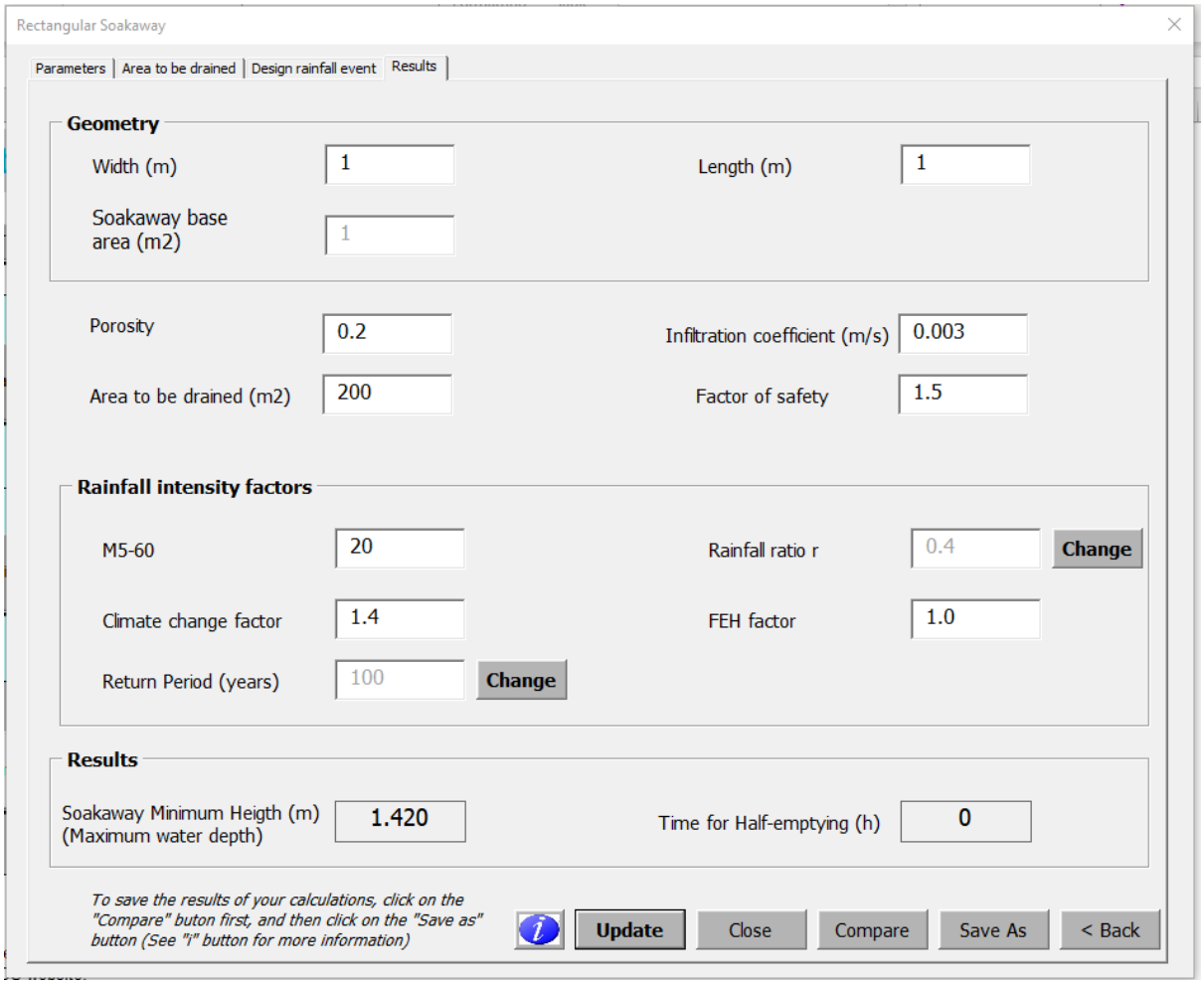
This is the estimated probability that a property of the type specified will comply ie that spillage will not occur from the rainwater harvesting tank. The probability is likely to be less than 100% unless the number of occupants is known and remains unchanged.

HR Wallingford is not liable for the actual performance of any tank designed using this tool. Considering the uncertainties associated with rainfall and house occupancy, the results should be regarded as a best estimate based on current science of the storage required. Appropriate consideration of the implications of both larger events and unusually wet seasons occurring, should be carried out.


Rectangular Soakaway
Parameters
Area to be drained
Design rainfall event
Results
Geometry
Width (m)
5
Length (m)
5
Soakaway base area (m2)
25
Porosity
0.2
Infiltration coefficient (m/s)
0.00001
Area to be drained (m2)
200
Factor of safety
1.5
Rainfall intensity factors
M5-60
20
Rainfall ratio r
0.4
Change
Climate change factor
1.4
FEH factor
1.0
Return Period (years)
100
Change
Results
Soakaway Minimum Heigth (m) (Maximum water depth)
2.250
Time for Half-emptying (h)
4.04
To save the results of your calculations, click on the "Compare" buton first, and then click on the "Save as" button (See "i" button for more information)
Update
Close
Compare
Save As
< Back


Rectangular Soakaway
Parameters
Area to be drained
Design rainfall event
Results
Geometry
Width (m)
4.5
Length (m)
4.5
Soakaway base area (m2)
20.25
Porosity
0.2
Infiltration coefficient (m/s)
0.00003
Area to be drained (m2)
200
Factor of safety
1.5
Rainfall intensity factors
M5-60
20
Rainfall ratio r
0.4
Change
Climate change factor
1.4
FEH factor
1.0
Return Period (years)
100
Change
Results
Soakaway Minimum Heigth (m) (Maximum water depth)
2.090
Time for Half-emptying (h)
1.23
To save the results of your calculations, click on the "Compare" buton first, and then click on the "Save as" button (See "i" button for more information)
Update
Close
Compare
Save As
< Back


Rectangular Soakaway
Parameters
Area to be drained
Design rainfall event
Results
Geometry
Width (m)
2
Length (m)
2
Soakaway base area (m2)
4
Porosity
0.2
Infiltration coefficient (m/s)
0.001
Area to be drained (m2)
200
Factor of safety
1.5
Rainfall intensity factors
M5-60
20
Rainfall ratio r
0.4
Change
Climate change factor
1.4
FEH factor
1.0
Return Period (years)
100
Change
Results
Soakaway Minimum Heigth (m) (Maximum water depth)
1.740
Time for Half-emptying (h)
0.02
To save the results of your calculations, click on the "Compare" buton first, and then click on the "Save as" button (See "i" button for more information)
Update
Close
Compare
Save As
< Back


Rectangular Soakaway
Parameters
Area to be drained
Design rainfall event
Results
Geometry
Width (m)
1
Length (m)
1
Soakaway base area (m2)
1
Porosity
0.2
Infiltration coefficient (m/s)
0.003
Area to be drained (m2)
200
Factor of safety
1.5
Rainfall intensity factors
M5-60
20
Rainfall ratio r
0.4
Change
Climate change factor
1.4
FEH factor
1.0
Return Period (years)
100
Change
Results
Soakaway Minimum Heigth (m) (Maximum water depth)
1.420
Time for Half-emptying (h)
0
To save the results of your calculations, click on the "Compare" buton first, and then click on the "Save as" button (See "i" button for more information)
Update
Close
Compare
Save As
< Back