



Flood Risk Assessment and Drainage Strategy

Land East of Lodge Road, Hurst

MacTaggart and Mickel Strategic Land

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Basis of Report

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Appendix A Proposed Design

- A1. Proposed Drainage Strategy Drawing.
- A2. Proposed Catchment Plan
- A3. Proposed Flow Hydraulic Calculations (Network 1 and 2)
- A4. Greenfield Runoff Rate Calculation.

Appendix B Existing Information

- B1. Thames Water Public Sewer records.
- B2. Existing Topographical Survey.



Acronyms and Abbreviations

EA	Environment Agency
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
PPG	Planning Policy Guidance
SFRA	Strategic Flood Risk Assessment



1.0 Introduction

1.1 Project Background

SLR has been appointed by MacTaggart and Mickel (the Client) to provide a Flood Risk Assessment (FRA) and Drainage Strategy (DS) to support the outline application for the development at Land East of Lodge Road, Hurst nearest postcode: RG10 0EQ hereafter known as the 'site'. The outline application is for up to 99 new homes, green infrastructure, open space, pedestrian and cycle links, recreational facilities and other associated infrastructure including off-site highway works and access points on Lodge Road and Tape Lane with required improvements (all matters reserved except access).

This report provides an assessment of flooding risk to the site and surrounding area and follows the Government guidance regarding development and flood risk.

Proposals contained or forming part of this report represent the design intent and may be subject to alteration and adjustment in completing the detailed design for the project. Where such adjustments are undertaken as part of the detailed design and are deemed a material deviation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

This Flood Risk Assessment (FRA) and Drainage Strategy (DS) has been prepared under the direction of a Principal Engineer at SLR who specialises in flood risk, drainage and associated planning matters. Reporting has been completed in accordance with guidance presented within the National Planning Policy Framework (NPPF) and its associated Planning Practice Guidance (PPG), taking due account of current best practice documents relating to the assessment of flood risk published by the British Standards Institution BS8533 and local planning policies.

1.2 Site Description

The site lies approximately 8km east of the centre of Reading, south of the village of Twrford. This site is currently greenfield and is used as pasture for horses. The eastern boundary of the site is bounded by Tape Lane, to the west lies Lodge Road (B3030). Residential properties and allotments are located directly adjacent the southern site boundary. Residential properties are also located adjacent the northern boundary of the site, beyond which lies Broadwater Lane (A321).



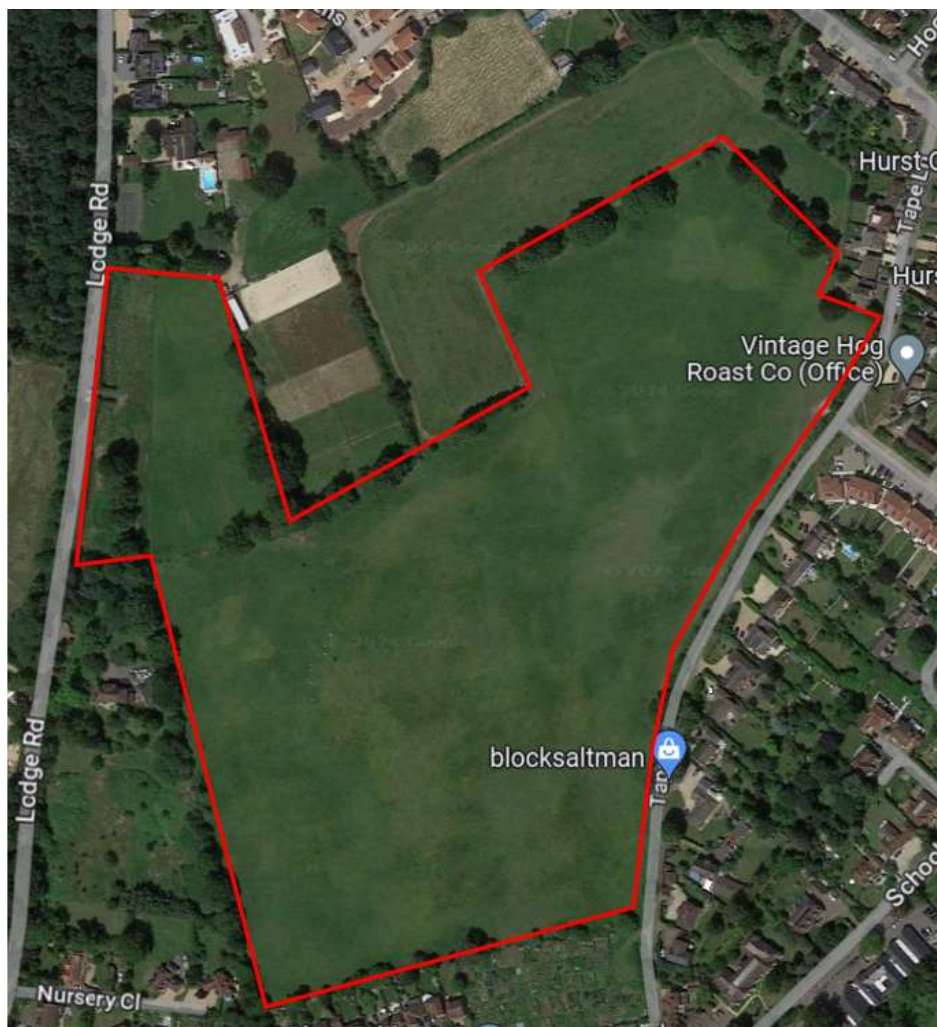
2.0 Existing Site Details

2.1 History and Current Use

The Proposed Site appears to be a greenfield site with no evidence of the land being previously developed. with some trees and access points from the adjacent highway.

As the site seems to be 100% permeable, it is considered greenfield, therefore rates have been calculated using the greenfield run off rate. Total site area is 10.68 hectares.

Figure 1: Site Location



2.2 Existing Drainage, Watercourses and Other Waterbodies

The following waterbodies have been identified within the surrounding area of the proposed site:

- An unnamed watercourse is located along part of the western site boundary, adjacent to Lodge Road. This tributary appears to flow in a northerly direction and is designated as a Main River.
- An unnamed watercourse is location to the west of Lodge Road and appears to flow in a northerly direction.



- An unnamed watercourse lies to the south of Sawpit Road (Sawpit Road is located approximately 180m from the site southern boundary. This watercourse is culverted at the junction of Sawpit Road and Lodge Road.

Refer to the Drainage Strategy drawing in **Appendix A** for further details of the onsite unnamed watercourse.

Thames Water public sewer maps are included in **Appendix B**. In Tape Lane adjacent to the eastern site boundary there are two Thames Water combined public sewers, one is flowing in a northerly direction towards Broadwater Lane. There is a proposed Thames Water foul rising main travelling in a northerly direction adjacent to the western site boundary. This rising main connects into the Thames Water's foul public sewer in Lodge Road which also travels in a northerly direction. These sewers are indicated on the Drainage Strategy drawing in **Appendix A**.

2.3 Topography

A site-specific topography survey is available at the time of writing. The site is relatively level with approximately +/- 1m level difference across the site. The site appears to fall gradually from around 38.5 to 37.0m.

2.4 Geology

The British Geological Survey (BGS) map advises that the superficial deposits is predominantly Kempton Park Gravel Member - Sand and gravel.

The site is not located within a Groundwater Source Protection Zone therefore infiltration could be considered further.



3.0 Policy Status for Proposed Development

As detailed in Annex 3 of the NPPF, the proposed scheme is classified as a “more vulnerable” development type associated with residential developments.

3.1 Flood Zone Classification

The definition of Environment Agency flood zones is provided in PPG *Table 1: Flood Zones*:

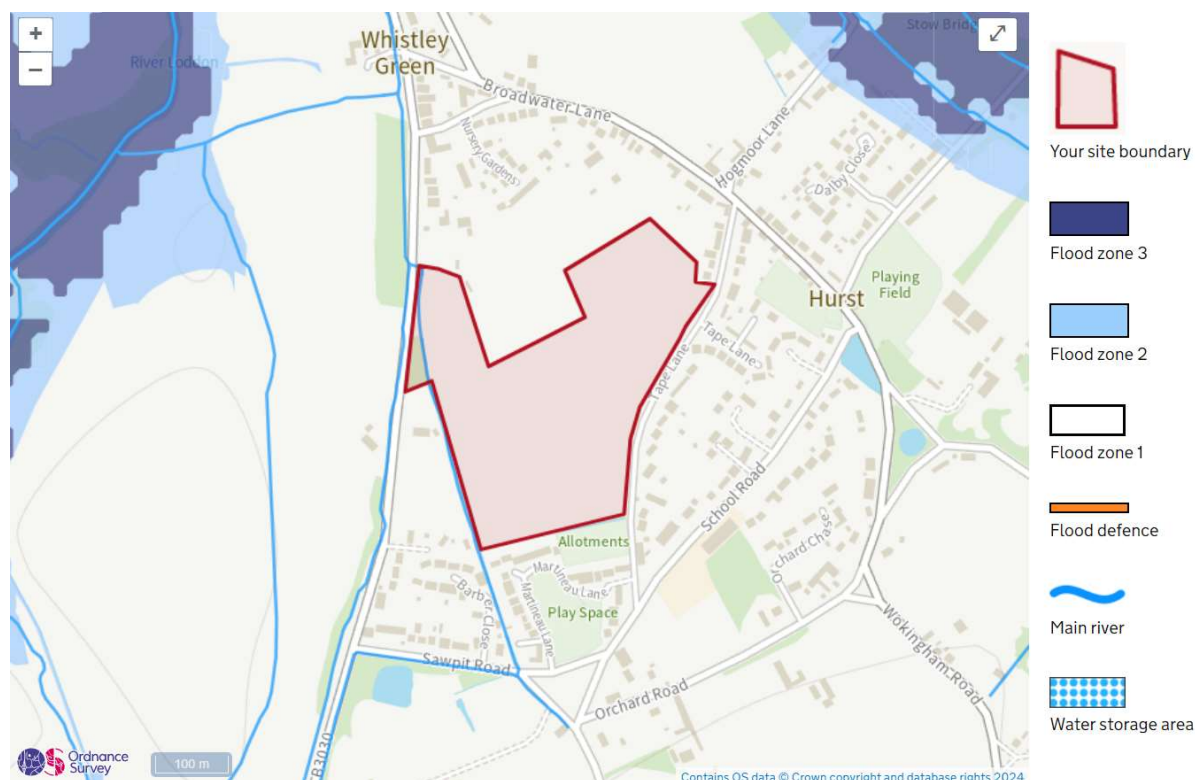
- **Zone 1 - Low Probability** (Flood Zone 1) is defined as land which could be at risk of flooding from fluvial or tidal flood events with less than 0.1% annual probability of occurrence (1:1,000 year) i.e., considered to be at ‘low probability’ of flooding.
- **Zone 2 - Medium Probability** (Flood Zone 2) is defined as land which could be at risk of flooding with an annual probability of occurrence between 1% (1:100 year) and 0.1% (1:1,000 year) from fluvial sources and between 0.5% (1:200 year) and 0.1% (1:1,000 year) from tidal sources i.e., considered to be at ‘medium probability’ of flooding.
- **Zone 3a - High Probability** (Flood Zone 3a) is defined as land which could be at risk of flooding with an annual probability of occurrence greater than 1% (1:100 year) from fluvial sources and greater than 0.5% (1:200 year) from tidal sources i.e., considered to be at ‘high probability’ of flooding.
- **Zone 3b - the Functional Floodplain** (Flood Zone 3b) 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)

An extract of the EA Flood Map for Planning is included overleaf as **Figure 2** and indicates that the site lies in an area designated as **Flood Zone 1**.



Figure 2: Extract of EA Flood Map for Planning



3.2 National Planning Policy

This report has been completed in accordance with the guidance presented in the NPPF and with reference to PPG.

3.2.1 Flood Risk Compatibility

As outlined in **Table 1** of the PPG guidance '*more vulnerable*' development types are considered appropriate within Flood Zone 1 and 2.

Table 1: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classification (PPG Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a	Exception Test Required	x	Exception Test Required	✓	✓
	Zone 3b (functional floodplain)	Exception Test Required	x	x	x	✓

Key: ✓ Development is appropriate x Development should not be permitted



3.2.2 Sequential Test

With reference to the NPPF, the Sequential Test gives preference to locating new development in areas that are at lowest risk of flooding (i.e., Flood Zone 1). The Environment Agency Flood Map for Planning and SFRA are geared to providing the basis for applying this test.

The Sequential Test requires developers to:

“.....demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed. This means avoiding, so far as possible, development in current and future (taking into account of climate change) medium and high flood risk areas considering all sources of flooding including areas at risk of surface water flooding.”

The proposed development areas on the site are located wholly in Flood Zone 1 and therefore at very low risk of flooding from fluvial or tidal sources. The assessment of flood risk in Section 4.0 confirms that all other potential sources of flooding are low or can be reduced to a low / very low risk through mitigation installed implemented within the development scheme. On this basis, the sequential test is not required.



4.0 Hydrological Assessment

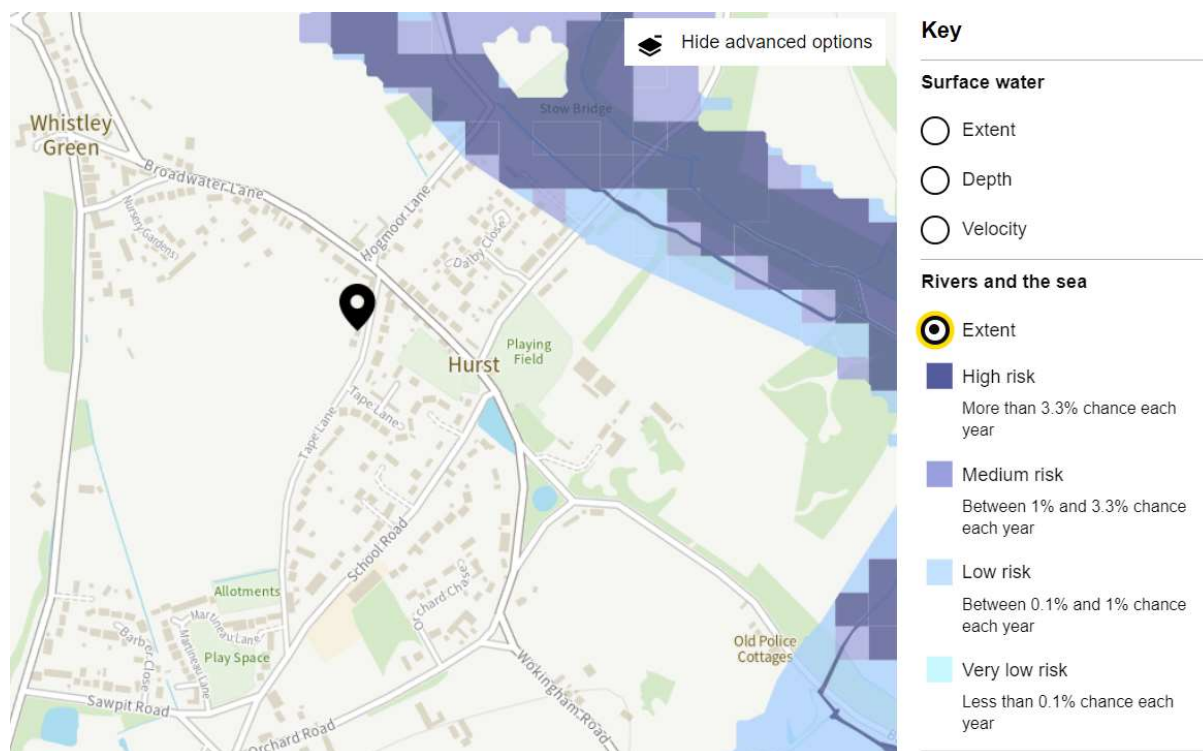
4.1 Sources of Flood Risk

This study assesses the risk from different types of flooding to the development and the risk of flooding from the development, taking into consideration climate change, as well as how flood risks should be managed. The approach to assessing flood risk at the development site was informed by the requirements of NPPF in conjunction with the client and Environment Agency requirements.

4.1.1 Fluvial Flooding (Rivers and Streams)

Figure 3 (below) shows the fluvial flood risk to the site. The map shows the Proposed Site is located in Flood Zone 1 and therefore at risk of flooding in fluvial events is less than 0.1% Annual Exceedance Probability.

Figure 3: Long Term Flood Risk Assessment Map – Flood Risk from Rivers or Seas
(Crown Copyright)

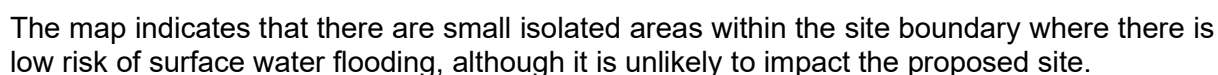


The map shows the site is within the low-risk category. In summary, the site risk of flooding from rivers and seas is considered **low**.



Alongside the published flood risk from rivers and seas, the Environment Agency produces a map showing the risk from surface water. Surface water flood risk is a result of rainfall events and resulting overland flows accumulating in topography features, such as channels and low spots. Surface water flood risk is dealt with by designing a drainage network to ensure any onsite development is protected.

Figure 4: Surface Water Maps for Planning



4.1.3 Flooding from Public Sewer (Infrastructure Failure)

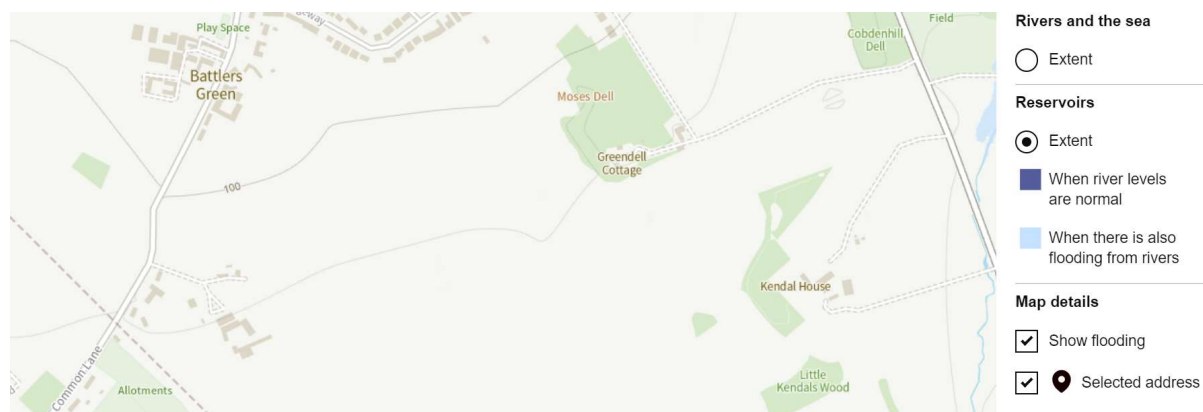
4.1.4 Flood Risk from Manmade Structures

Reservoir flooding is extremely unlikely to happen. The Environment Agency is the enforcement authority and ensures that reservoirs are inspected regularly, and essential safety work is carried out under the Reservoirs Act 1975.

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Figure 5 – Flood Risk from Reservoir Inundation



4.1.5 Flood Risk from Ground Water

The risk of groundwater flooding depends on local hydrogeological and geological conditions at or in close proximity to the site. Groundwater levels rise during wet winter months and can reactivate flow in certain streams. Available BGS data ([BGS Geology Viewer \(BETA\)](#)) shows the site is underlain by the Lambeth Group – Clay, Silt and Sand. The West Berkshire Level 1 Strategic Flood Risk Assessment contains Groundwater Flood Mapping, unfortunately the mapping does not extend to the area of Hurst.

The BGS website contains borehole for a historic borehole (1973) immediately adjacent to Lodge Road in its proximity to the site (borehole log reference SU77SE50). This log record water struck at a level of 36.4m AOD.

Flood risk posed by groundwater is considered to be low, on the basis of the lowest ground level where development is proposed is approximately 37.50m AOD. Further details of flood mitigation measures for this development are provided in Section 4.3.

4.2 Flood Risk Summary

In summary, the site is at the following risk from flooding from each source:

- Flooding from Rivers and Seas: Low
- Flooding from Surface Water: Low
- Flooding From Infrastructure: Low
- Flooding from Reservoirs: Low
- Flooding from Canals: Low
- Flooding from Groundwater: Low

The overall flood risk to the site is considered **low** and appropriate mitigation should be considered to manage the potential flooding to the site.

4.3 Mitigation

As highlighted above, the site is at low risk from flooding from fluvial and surface water sources. However, mitigation is still required to ensure the site is protected against flood risk.

It should be acknowledged that for developments in Flood Zone 1, compensatory storage is not required. Therefore, mitigation suggested here relates to the design and construction of the site.



The finished floor levels for the proposed buildings should be set higher than the equivalent existing ground levels.

The drainage strategy has been carried out and accommodates the 1 in 100 year plus appropriate climate change event and discharge to a suitable location at agreed rates. This will mitigate the impact of direct rainfall. Permeable paving and swales should be considered when designing the final scheme to manage any potential spills and hydrocarbons.



5.0 Drainage Strategy

5.1 Pre-Development Runoff

The Site is currently entirely greenfield. The existing greenfield runoff rate has been calculated using HR Wallingford online tool for calculating greenfield runoff rates (tool can be found at www.uksuds.com). The greenfield rate has been defined as 17.85 litres per second. Refer to **Appendix A** for this calculation.

5.2 Post-Development Runoff

In accordance with the NPPF and local guidance, the proposed site discharge rate will be restricted to 17.85 litres per second. It should be noted that all attenuation rates and measures upstream of the final attenuation measure upstream of the connection point to the existing watercourse are to an extent flexible and will be refined as part of the future detailed design process. The final attenuation measure prior to watercourse connection is not flexible and cannot exceed the rate of 17.85 litres per second.

5.3 Sustainable Drainage Systems (SuDS)

Recent changes to guidance and opinion within the industry have led to greater focus on Sustainable Drainage Systems (SuDS) and long-term sustainable development. In addition, the industry is well versed to controlling the volume of runoff via managed outfalls, the use of SuDS systems creates an environment where the quality of the water is also managed and improved.

CIRIA C753 – the SuDS Manual has set out objectives to minimise the impacts from the development on the quantity and quality of the runoff. The guidance refers to the SuDS Management Train.

5.3.1 The SuDS Management Train

The 'Management Train Approach' should be central to the surface water drainage strategy of a proposed site. The main objective is treatment and control of runoff as near to source as possible, thus protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

- i. Prevention – The use of good site design and housekeeping measures to prevent runoff and pollution and includes rainwater reuse.
- ii. Source Control – Control of runoff at source or as close to source as possible (e.g., cellular storage, petrol interceptors, flow attenuation devices).
- iii. Site Control – Management of water in a local area and can include below ground storage/attenuation, detention basins, tanks, oversized pipes.
- iv. Regional Control – Management of water from a site or various sites and can include wetlands and balancing ponds.

The drainage techniques for this development will seek to include, where possible, prevention, source control and site control measures.

5.3.2 The SuDS Design Philosophy

The SuDS philosophy for a development site is the promotion of Prevention, Source Control and Site Control Techniques.

The following design philosophy is proposed:



- Surface water treatment using the 'Management Train' approach to remove and isolate contamination at all SuDS facilities prior to conveyance to the existing onsite watercourse.
- Surface water discharge to be attenuated to greenfield runoff rate (defined as Qbar).
- Prevention measures, for example the inclusion of water butts.
- Site Control features, in the form of above-ground attenuation storage, to accommodate the additional surface water runoff generated by the development site.

Varied SuDS methods are summarised in the table below to assess and establish which are most feasible for the proposed post development site.

Table 2: SuDS Feasibility Assessment

SuDS Method	Feasibility, Given Site and Project
Basins and Ponds – Above Ground Storage	Basins and ponds increase biodiversity and amenity of the area; provide attenuation; and improve water quality. This method does occupy large areas of developable land and needs to be constructed at the lower levels of the site. Dry basins will be incorporated within the park area to attenuate runoff from surrounding areas and for exceedance flows.
Filter Strips, Swales and Raingardens	Filter strips and raingardens can be used within private or public areas to reduce and treat runoff. Raingardens are recommended where possible for increased runoff treatment.
Swales	Swales are shallow, flat bottomed, vegetated open channels designed to convey and treat surface water runoff. When incorporated into the site design they can be used to enhance the natural landscape and provide aesthetic and biodiversity benefits. A swale is proposed within the park land to attenuate excess runoff from the public highway and for exceedance flows.
Permeable Paving	Permeable paving is a form of pavement construction that allows road runoff to infiltrate through the surface layer to underlying treatment and storage media. They are an efficient means of managing and treating surface water runoff close to its source. Permeable paving with a 30% voids aggregate is proposed across the site within public and private highways and private footpaths.
Tanked / Geocellular Attenuation Systems	Tanked / geocellular attenuation systems provide high storage capacity and can be incorporated within road pavements and under landscaping. However, they do not provide runoff treatment or improve amenity and biodiversity so other forms of SUDS should be used where possible.

5.4 Drainage Hierarchy

Current guidance (NPPF Planning Practice Guidance Paragraph 080) recommends the use of the Drainage Hierarchy when developing a surface water strategy for any site. The purpose of the Drainage hierarchy is to ensure consideration is firstly given to sustainable methods of discharge of surface water runoff by sustainable methods such as infiltration with promotes the 'at source' methodology set out in the SuDS Management Train principals.

Generally, the aim should be to discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

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



4. to a combined water sewer”

As part of this drainage strategy each management method is assessed for suitability.

5.4.1 Infiltration

Infiltration is the preferred primary method of drainage discharge, however the geological strata specified by the BGS indicates poor infiltration potential. In addition, the proximity of a watercourse and the information provided in Section 4.1 suggests a high groundwater table. It is therefore assumed infiltration is not a viable SuDS technique for this development due to the CIRIA design criteria of a metre of unsaturated ground between the water table and the invert of any infiltration system all year round.

5.4.2 Watercourse or Waterbody

As there is an existing watercourse on site, this would be the feasible receptor for the proposed surface water system on site.

5.4.3 Surface Water Sewer

There are no public surface water sewers within the site or surrounding area. **Table 3** summarises the options for the surface water disposal:

Table 3 – Surface Water Disposal Methods

Surface Water Disposal	Potential	Description
Infiltration	X	Infiltration is unlikely given the ground conditions and proximity to the watercourse
Watercourse	✓	A new direct connection to onsite watercourse is appropriate
Surface Water Public Sewer	X	Not considered due to availability of a watercourse
Combined Public Sewer	X	Not considered due to availability of a watercourse

5.5 Treatment / Water Quality

As discussed above, there has been a recent push to improve the quality of water discharge. The CIRIA SuDS Manual C753 (2015) provides a simple framework named the ‘SuDS Indices Method’ to provide guidance on the level and method of treatment recommended for different scenarios. This approach can be categorised into three key steps:

1. Allocate suitable pollution hazard indices for the proposed land use (Table 26.2 from The CIRIA SuDS Manual).
2. Select SuDS with a total pollution mitigation index (Table 26.3 from the CIRIA SuDS Manual) that equals or exceeds the pollution hazard index.
3. Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required, where:

Total SuDS mitigation index = mitigation index1 + 0.5 (mitigation index2)



A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentrations.

Table 4: SuDS Manual Pollution Hazard Indices
(taken from Table 26.2 from the CIRIA SuDS Manual)

TABLE 26.2 Pollution hazard indices for different land use classifications				
Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways ¹	High	0.8 ²	0.8 ²	0.9 ²

Notes

- 1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).
- 2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.



Table 5: SuDS Manual Indicative SuDS Mitigation Indices
(taken from Table 26.3 from the CIRIA SuDS Manual)

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters			
Type of SuDS component	Mitigation indices¹		
	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4 ²	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond ⁴	0.7 ³	0.7	0.5
Wetland	0.8 ³	0.8	0.8
Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

- 1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.
- 2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.
- 3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.
- 4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.
- 5 See **Chapter 14** for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: <http://tinyurl.com/qf7yuj7>
- 6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

In summary, the total suspended solids (TSS) of residential roofs indices and property driveways, residential car parks and low traffic roads (0.2+0.5) is allayed by the mitigation indices provided by the onsite swale system (0.5 indices), permeable paving (0.7 indices) and attenuation ponds (0.7 indices).

The total metals of residential roofs indices and property driveways, residential car parks and low traffic roads (0.2+0.4) is allayed by the mitigation indices provided by the onsite swale system (0.6 indices), permeable paving (0.6 indices) and attenuation ponds (0.7 indices).

The total hydrocarbons of residential roofs indices and property driveways, residential car parks and low traffic roads (0.05+0.4) is allayed by the mitigation indices provided by the onsite swale system (0.6 indices), permeable paving (0.7 indices) and attenuation ponds (0.5 indices).



5.6 Proposed Surface Water Drainage Strategy

The proposed drainage strategy drawing is enclosed within **Appendix A**.

The northern most development plot will be drained via an on-plot gravity sewer system which will incorporate on-plot attenuation measures (below / above ground attenuation, permeable paving) prior to discharging to a swale. The flow into the swale shall be attenuated (attenuation rate to be determined at detailed design). The swale will serve the main road which will run through the development. Immediately downstream of the swale flow shall be attenuated to 7.7 litres per second. A manhole and pipe system shall then discharge to the southern drainage network before ultimately discharging to the onsite watercourse located along the western site boundary. This network is defined in flow as Network 1 and the results are provided in **Appendix A**. The peak flow from Network 1 is 7.0 litres per second.

All development areas south of the main access road described above shall be directed to a swale and basin / pond system, comprising of one detention basin and one attenuation pond connected by a swale. The main difference between the detention basin and the attenuation pond is that the pond shall have a permanent depth of water in it, whereas the detention basin shall be dry apart from when it is holding attenuated surface water runoff. The upstream detention basin in this system (Basin 1) shall serve the development plot to the south of the main road through the site. The flow from Basin 1 shall be attenuated to 19.0 litres per second prior to discharging to the swale. The swale shall then convey flows to the attenuation pond (Pond 1). Flows from Pond 1 shall be attenuated to 10.4 litres per second. This network then connects via a pipe and manhole system to the existing onsite watercourse. Upstream of this connection point the flow of 6.2 litres per second from Network 1 enters this system. This results in the total maximum peak flow entering the existing watercourse being 17.7 litres per second, thus not exceeding the greenfield runoff rate of 17.85 litres per second (defined as Q_{bar} – see **Appendix A**).

NETWORK	CATCHMENT AREA	FINAL DISCHARGE RATE
Network 1		7.7l/s
Network 2		10l/s
TOTAL FINAL DISCHARGE		17.7l/s

Any new development should be designed in accordance with current best practice to provide adequate capacity not the flood for the critical 1 in 30-year storm event and flood water generated for up to the critical 1 in 100-year plus climate change storm event shall be constrained within the areas on site so as not to cause damage to buildings, essential services, adjoining developments, and services. Networks 1 and 2 contain no flooding for up to and including the 1 in 100-year peak storm event with 40% climate change applied.

5.7 Proposed SuDS / Attenuation Features

Based on the current proposed layout of the development, SuDS have been incorporated where practical and are summarised as follows:

- Swale 1 (Network 1) is 1.2m deep with a 0.5m bed and 1in3 side slopes. Total length of swale is 176 metres, total width is 6.5m.



- Swale 2 (Network 2) is 1.2m deep with a 0.5m bed and 1in3 side slopes. Total length of swale is 79m.
- Detention Basin 1 (Network 2) is 2.14m deep with 1in3 sides slopes. Area of pond is 791m². Pond volume is 808m³.
- Attenuation Pond 1 (Network 2) is 1.3m deep with 1in3 sides slopes. Area of pond is 1,196m². Pond volume is 1,855m³.
- 3,375m³ of storage is required within the northern plot area that drains into swale 1. This storage shall be in the form of a combination of permeable paving and above ground and / or below ground attenuation.
- 504m³ of storage is required within the southern plot area that's drains into pond 2. This storage shall be in the form of a combination of permeable paving and above ground and / or below ground attenuation.

The on-plot storage referenced above will need to be developed as part of the future detailed design and may be redistributed across all plots areas to suit the internal layout of the plot.

In accordance with Susdrain guidance

(https://www.susdrain.org/files/resources/fact_sheets/03_14_fact_sheet_attenuation.pdf), as assessment has been undertaken to ensure the 100-year storm event drains down enough for the storage structure to be able to accommodate a subsequent 10-year storm event. A summary of this assessment on Detention Basin 1 and Attenuation Pond 1 is provided below:

Detention Basin 1

- 100-year 360-minute (Winter) event results in 230 cubic metres of volume in Basin.
- 10-year 360-minute (Winter) event results in 578 cubic metres of volume in Basin.
- Total Basin volume is 808 cubic metres (therefore can accommodate above volumes).

Attenuation Pond 1

- 100-year 360-minute (Winter) event results in 1,013 cubic metres of volume in Basin.
- 10-year 360-minute (Winter) event results in 519 cubic metres of volume in Basin.
- Total Basin volume is 1,855 cubic metres (therefore can accommodate above volumes).

The indicative attenuation volumes provide for development plots on Network 1 and Network 2 are indicative only and represent below ground attenuation measures and permeable paving that will form part of the detailed drainage design. These measures shall therefore be assessed in accordance with the Susdrain guidance when they have been individually designed as part of the future detailed design process.

Several flow control chambers have been specified in Network 1 and 2, and are summarised below (further details can be found on the Proposed Drainage Strategy Plan and Flow calculations provided in Appendix A.

- Network 1 Hydrobrake provided upstream of Swale 1. Flow limited to 6.2 l/sec.
- Network 1 Hydrobrake provided downstream of Swale 1. Flow limited to 7.0 l/sec.
- Network 1 has a peak flow of 7.7 l/sec for the 100-year pls 40% climate change peak storm event. This is represented as a design flow in Network 2.
- Network 2 Hydrobrake provided downstream of Detention Basin 1. Flow limited to 18.5 l/sec.



- Network 2 Hydrobrake provided downstream of Attenuation Pond 1. Flow limited to 10.1 l/sec.
- Network 2 final pipe prior to existing watercourse connection has a peak flow of 17.7 l/sec for the 100-year pls 40% climate change peak storm event.

5.8 Catchment Areas

Appendix A contains a catchment plan drawing. This provides details of the proposed catchments that will enter the proposed drainage networks. It also provides details of the existing catchment of the site that has been used to determine the greenfield runoff rate.

All proposed greenfield areas have had a coefficient of 0.2 applied to them. All proposed roads have 100% coefficient. All proposed development parcels have a coefficient of 0.7 applied – this takes into account urban creep as well as the proportion of the development parcels that will be permeable (private garden, public open space, landscaping).

Further details of catchment areas are shown in the table below:

Table 6: Catchment Details

Northern Network							
Pipe Ref	Imp Rd Area (ha)	Imp Areas (plot)	Imp Areas (plot) (coefficient applied 0.7)	Perm Areas (grass)	Perm Areas (grass) (coefficient applied 0.2)	Swale / Pond area	Total into pipe
1.000	0.020	0.747	0.523	0.793	0.159		
	0.048			0.038	0.008		
	0.194				0.000		
	0.056				0.000		
	0.109				0.000		
	0.027				0.000		1.374
1.001	0.024			0.029	0.006	0.013	0.043
1.002	0.015			0.020	0.004	0.013	0.032
1.003	0.020			0.024	0.005	0.013	0.038
1.004	0.010			0.007	0.001	0.013	0.024
1.005	0.030			0.042	0.008	0.013	0.051
1.006	0.027			0.044	0.009	0.012	0.048
1.007	0.024			0.043	0.009	0.012	0.045
1.008	0.015			0.027	0.005	0.012	0.032
1.009	0.014			0.026	0.005	0.012	0.031
1.010	0.020				0.000		0.020
1.011	0.035			0.025	0.005		
	0.132			0.015	0.003		0.422
				1.237	0.247		0.040
1.012							0.003
1.013							0.000



1.014							0.000
1.015							0
1.016							0.379
1.017							
							2.583

Southern Network							
Pipe Ref	Imp Rd Area (ha)	Imp Areas (plot)	Imp Areas (plot) (coefficient applied 0.7)	Perm Areas (grass)	Perm Areas (grass) (coefficient applied 0.2)	Swale / Pond area	Total into pipe
1.000	0.021	0.048	0.034	0.027	0.005		
	0.046	0.433	0.303	0.113	0.023		
	0.036	0.263	0.184	0.120	0.024		
	0.098						0.774
1.001						0.065	0.065
1.002							
1.003				0.175	0.035		
				0.307	0.061		0.096
1.004				0.480	0.096		0.096
1.005				0.463	0.093		
				0.337	0.067		0.160
1.006				0.514	0.103		0.103
1.007							
1.008							
1.009							
1.010	0.042			0.361	0.072	0.119	
				0.263	0.053		0.244
2.000	0.2	0.866	0.606	0.377	0.075		
	0.050	0.690	0.483				
	0.064						1.479
							3.016

5.9 Exceedance

The surface water drainage network has been designed to accommodate runoff for up to the 1 in 100-year plus climate change event, within the site boundary. There is 9m³ of flooding at



the head of Network 1 for the 1 in 100-year (plus 40% climate change) peak storm event that will be held in the surrounding landscaped area. This flooding shall be designed out as part of the detailed design process if possible.

In the event of rare extreme rainfall events, the capacities of proposed drainage infrastructure may become exceeded. Indicative flood exceedance routes are indicated on the Drainage Strategy provided in Appendix A.

This analysis should conclude that proposed buildings are not at risk of flooding and that flood volumes can be safely held within the site area until flood levels subside.

5.10 Approvals

In order to build a new connection onto the existing onsite watercourse an Ordinary Watercourse Consent / Environmental Permit may be required either via the Environment Agency or the Lead Local Flood Authority. Any work carried out within 8m of the watercourse to the west designated a Main River will required an Environmental Permit. A pre-development enquiry has been sent to both the Lead Local Flood Authority and the Environment Agency, setting out the proposals for surface water discharge from the development (new outfall to onsite watercourse, attenuated to green field runoff rate). A response from the Environment Agency and the Lead Local Flood Authority is currently pending and shall be added to this report as an addendum or as a new report iteration.



6.0 Proposed Foul Drainage

The proposed foul drainage strategy for this development is to discharge the on-site foul flows to the existing Thames Water public combined sewer location in Tape Lane. Due to the relative flatness of the site coupled with the distance of the southern-most development area of the site, foul flows will need to be pumped to this combined sewer.

In accordance with Sewer Sector Guidance Appendix C, the peak design flow for dwellings is calculated at 4,000 litres per dwelling per day (0.05 litres per second per dwelling). Peak flow for this development is therefore 0.05×99 (No. of dwellings) = 4.95 l/sec.

The general rule of thumb for pumping rates is that the pump rate is approximately half of the peak flow rate. It is therefore reasonable to assume the pump rate shall be set to 2.5 litre per second. This shall be determined at detailed design stage with technical input provided by a pumping station specialist.

A pre-development enquiry has been sent to Thames Water to ascertain an agreement in principle for this connection point. The response from Thames Water is currently pending and shall be added to this report as an addendum or as a new report iteration. The proposed Drainage Strategy drawing in **Appendix A** also provides further information on the proposed connection point and flow rate into the public sewer that is being proposed.



7.0 Draft Maintenance Strategy

This section is intended to give an overview of the operation and maintenance for the drainage features included in the drainage strategy. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document, unless noted otherwise due to project constraints.

The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.

Where sewers and SuDS features are offered for adoption, the adopting authority will have their own maintenance strategy in place.

This document will evolve through the design and construction phases of the scheme and should be included in a final strategy as part of the Health and Safety file on handover of the final scheme.

7.1 Adoption

The full masterplan surface and foul water networks will be offered for adoption to Thames Water. It is therefore likely that the maintenance regime will be altered to suit the adopting authority's procedures. Highway drainage in the Southern Link Road will be the responsibility of the Local Highways Authority.

7.2 Components

The following components have been included in the masterplan drainage design:

- Pipes
- Gullies
- Swales
- Permeable Paving
- Flow Control Units
- Detention Basin
- Attenuation Pond

The maintenance strategy should be implemented to ensure the drainage network is cleaned regularly and the routine maintenance regime should be documented.

Until such time as the network is adopted formally, the maintenance is the responsibility of an on-site management team that is appointed by the client / developer. It is recommended that a general inspection of the drainage networks is carried out twice a year as a minimum and after any major storm. This consists of a visual inspection survey of the surface visible features such as headwalls to ensure the system is working.

Significant sediment deposition is likely in areas used for storage, so a post storm clean-up operation may be required to remove litter, vegetation, sewerage debris and larger objects.

During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris, or litter.

Sediment / material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as filter drains and associated chambers.



7.3 Inspection, Manhole and Catchpit Chambers

Access points have been located at the head of each run, at the change in direction and at the change in pipe size in accordance with the SSG and Building Regulations Part H.

The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access.

The manhole chambers on site will be designed in accordance with the SSG and Building Regulations Part H guidance which includes appropriately sized covers and access ladders, however untethered enter is not recommended. A suitable hoist and harness system should be used.

7.4 Pipes

Pipes are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed. Regardless of the product used the pipes will be fully compliant with the SLR drainage specification.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

A regular inspection and maintenance regime is important to identify areas which may have been obstructed/clogged and may not be drainage correctly thus exposing the development to a greater level of flood risk.

Table 7: Typical Pipe and Chamber Maintenance Requirements

Maintenance Schedule	Required Actions	Typical Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial Inspection should be provided as post construction CCTV survey.	Not applicable.
Regular Maintenance / Inspection	Inspect for evidence of poor operation via water level in chambers, if required, take remedial action.	3-monthly, 48 hours after large storms.
	Check and remove large vegetation growth near pipe runs	Monthly or as required.
Remedial Action	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs	As required.



7.5 Gullies / Kerb Drainage

Channels and gullies should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned using a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should always be kept clear to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the car park channels.

Kerb Drainage is a proprietary product therefore the manufacturers maintenance regimes should be followed where possible. Whether or not kerb drainage is a suitable proposal for this scheme shall be determined as part of the detailed drainage design process.

Table 8: Typical Gully and Kerb Drainage Maintenance Requirements

Maintenance Schedule	Required Actions	Typical Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required)	Initial inspection	Not applicable.
Regular Maintenance / Inspection	Litter and debris removed	Monthly or as required.
	Inspect for evidence of poor operation via water level in chambers, if required, take remedial action.	Monthly or as required.
	Inspect slit accumulation rates and establish appropriate brushing frequencies. Slit can also be caused by adjacent landscaping area which should be reprofiled to provide a flat area or berm adjacent to the paving.	3-monthly, 48 hours after large storms.
	Inspect for evidence of poor operation and/or weed growth, if required, take remedial action.	Monthly or as required.
Remedial Action	Inspect sumps and outlet pipes and rod through poorly performing channels and outlets as initial remediation.	As required
	If continued poor performance jet and CCTV survey poorly performing runs	As required.

7.6 Permeable Paving

Maintenance regimes for permeable paving will change depending on whether the system is bound or unbound. Concrete block paving (CBPP) systems are a popular choice, and 'under normal conditions will work perfectly well with no maintenance' (Marshalls 2023). However, it



is recommended that some form of sweeping/visual inspections are carried out annually to ensure any defects are picked up early.

Most permeable paving systems are proprietary, and manufacturer's instructions and recommendations should be followed in priority to this document.

7.7 Hydrobrake Chamber

The hydrobrakes chamber should be maintained in a manner similar to that of the standard chambers. Any additional requirements for the hydrobrakes, Manufacturer's instructions should be followed.

7.8 SuDS Features

Table 9: Typical Detention Basin, Pond and Swale Maintenance Requirements

Maintenance Schedule	Required Actions	Minimum Frequency
Regular Maintenance	Remove litter and debris removal	Monthly
	Cut grass in and around basin	Half yearly (spring – before nesting, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (or as required)
	Inspect inlets, outlets, and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, liner, structures, pipework etc. for evidence of physical damage.	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices.	Annually
	Tidy all dead growth before start of growing season.	Annually
	Remove sediment from inlet, outlets and forebay.	Annually (or as required)
	Manage plants in outlet pool – where provided.	Annually
	Removing sedimentation that has become entrained into the outflow	Six monthly or as required
Occasional Maintenance	Re-seed areas of poor vegetation growth.	As required
	Prune and trim any trees and remove cuttings.	Every 2 years or as required
	Remove sediment from inlets, outlets, forebay and main basin when required.	Every 5 years or as required
	Periodic measuring of the bore size	Every 3 years or as required
Remedial Actions	Repair erosion or other damage by reseeding or re-turfing.	As required
	Realignment of rock armour	As required
	Repair/rehabilitation of inlets, outlets, and overflows.	As required
	Relevel uneven surfaces and reinstate design levels.	As required





8.0 Conclusions and Further Recommendations

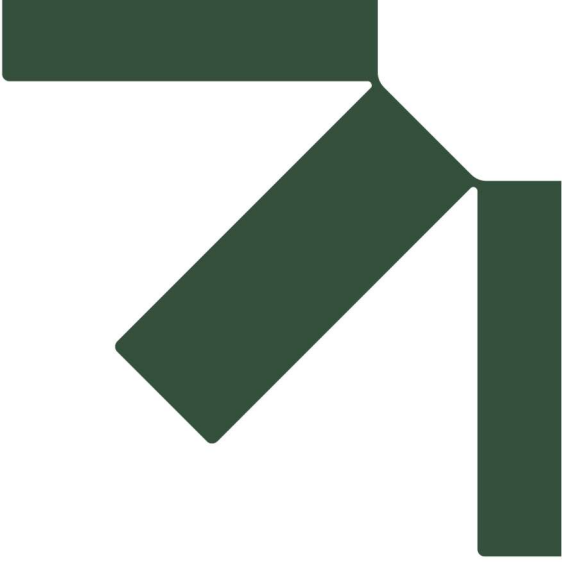
The development has been designed in accordance with current best practice to provide adequate capacity not the flood for the critical 1 in 30-year storm event and flood water generated for up to the critical 1 in 100-year plus 40% climate change storm event shall be constrained within the areas on site so as not to cause damage to buildings, essential services, adjoining developments, and services.

The final discharge rate is 17.7, which is made up of a peak flow from Network 1 of 7 l/sec and a peak flow of network 2 of 10 l/sec.

A pre-development enquiry has been sent to Thames Water in relation to the proposed foul connection that will be required to the public sewer in Tape Lane, via a proposed rising main and pumping station. A pre-development enquiry has also been sent to the Lead Local Flood Authority and The Environment Agency in relation to the proposed surface water discharge into the onsite existing watercourse. Responses to these enquiries are currently pending and will be added to this report as an addendum once received.

In conclusion the drainage strategy set out in this document along with the supporting hydraulics calculations provided in **Appendix A**, is deemed acceptable in proving the strategy provides sufficient flood risk mitigation for the development whilst maintaining greenfield runoff rates from the current site.

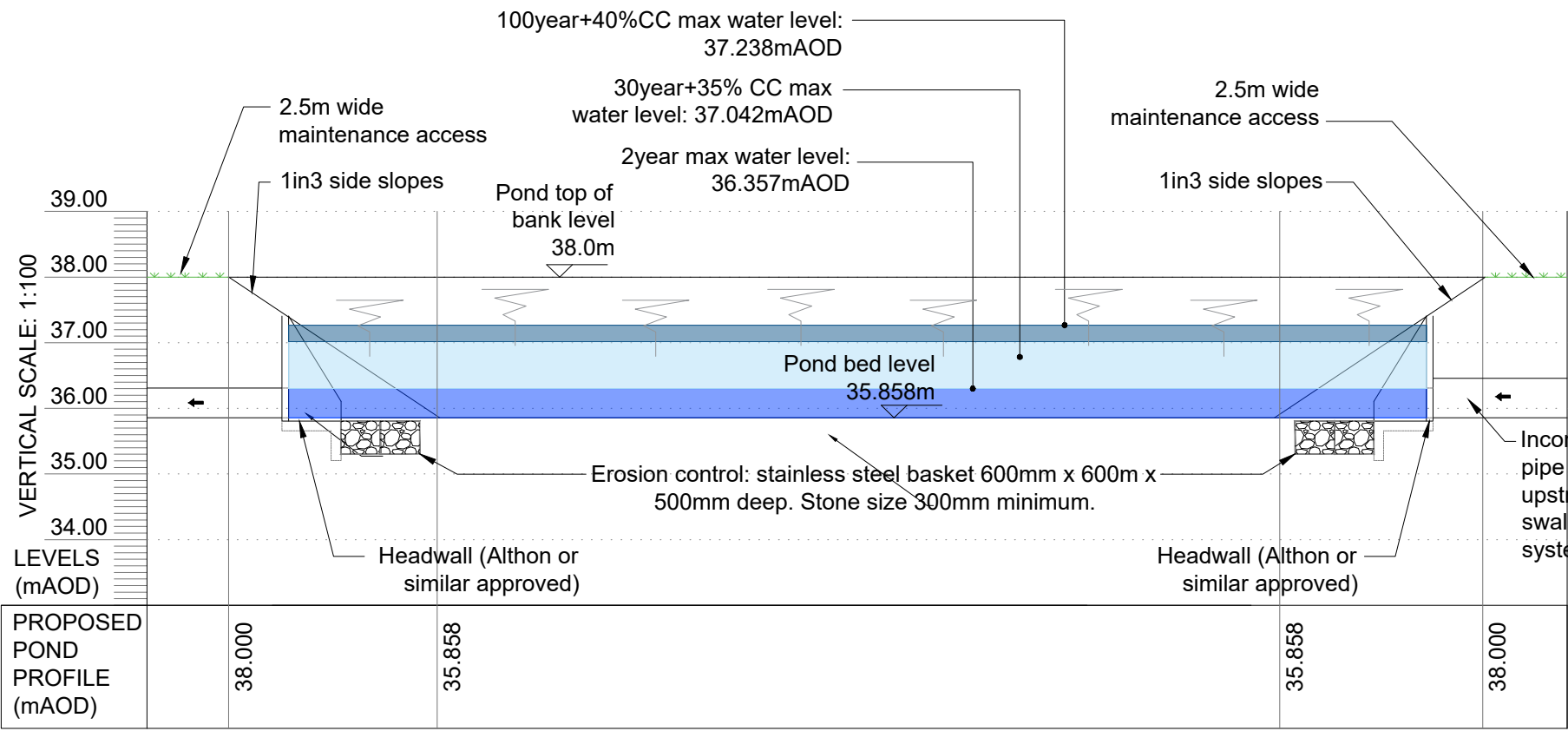




Appendix A Proposed Design

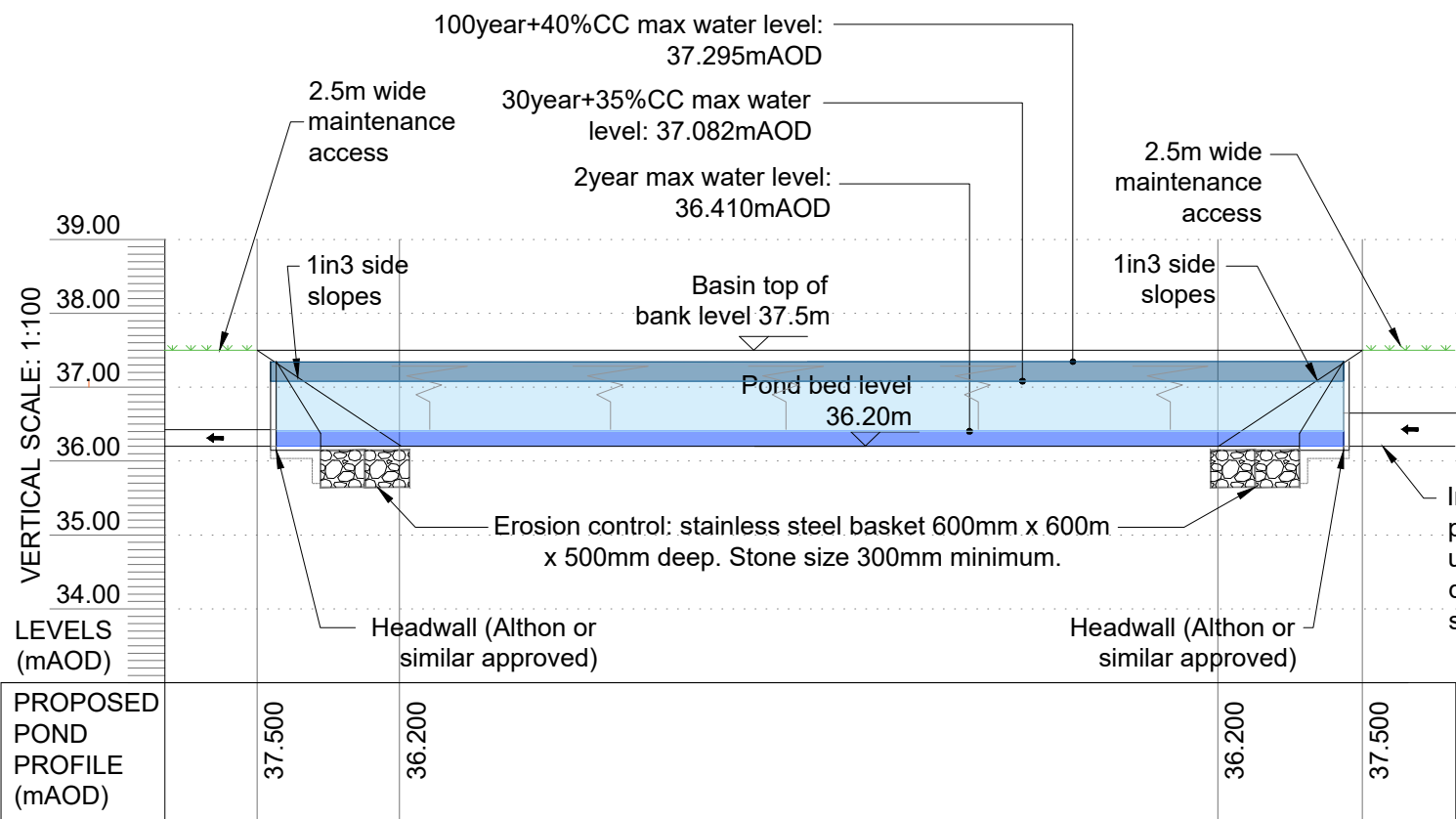
Appendix A1. Proposed Drainage Strategy Drawing

SECTION C-C: SECTION THROUGH PROPOSED POND 1
HORIZONTAL SCALE 1:200



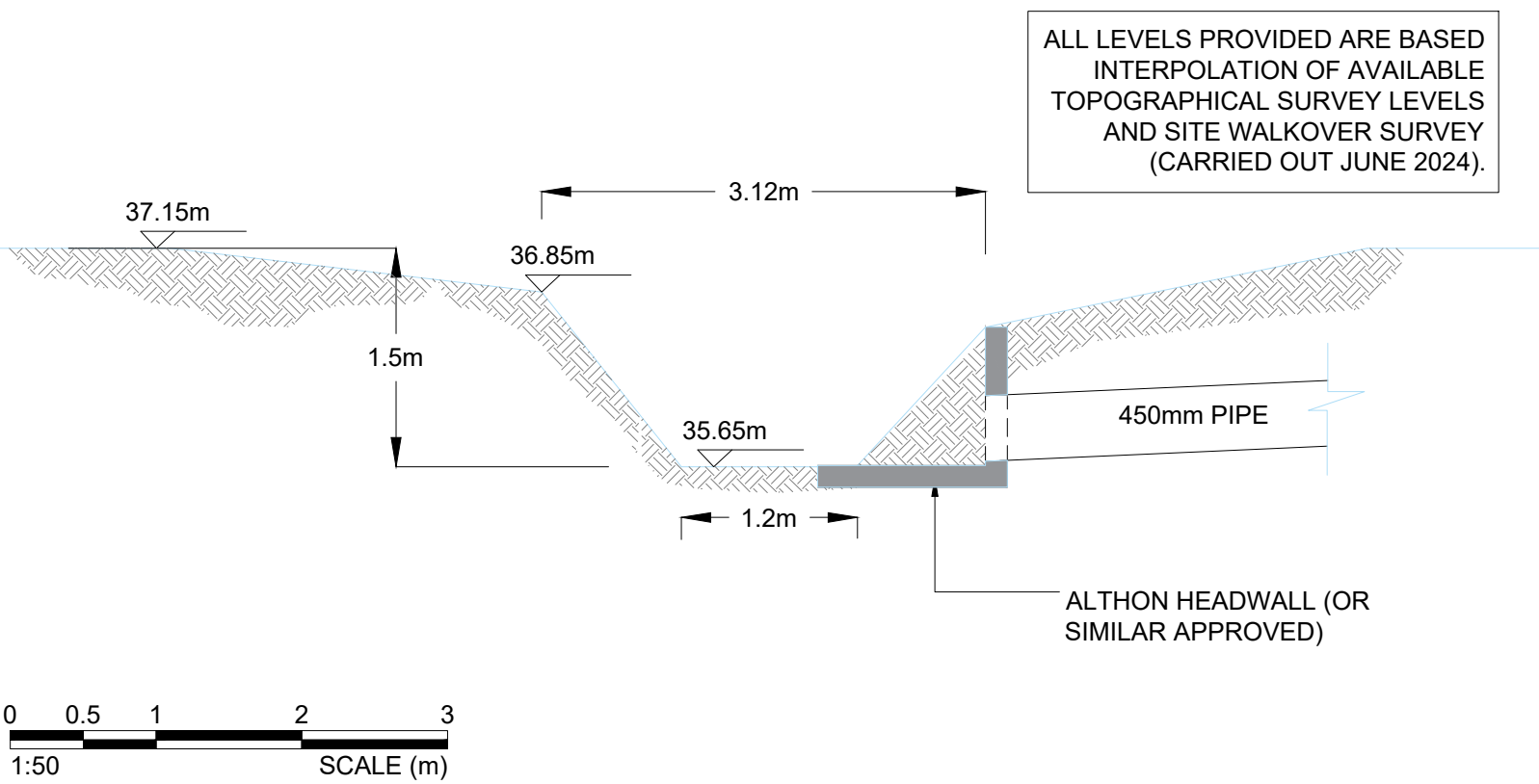
0 2 4 8 12
1:200 SCALE (m)

SECTION B-B: SECTION THROUGH DETENTION BASIN 1
HORIZONTAL SCALE 1:200



0 2 4 8 12
1:200 SCALE (m)

INSET A - SECTION A-A
PROPOSED OUTFALL TO EXISTING DITCH
SCALE 1:50



0 0.5 1 2 3
1:50 SCALE (m)



- Legend:
- APPLICATION BOUNDARY
 - PROPOSED INDICATIVE GROUND LEVEL
 - PROPOSED ATTENUATION SWALE (1in3 SIDE SLOPES)
 - PROPOSED SWALE FEATURE (1in3 SIDE SLOPES)
 - PROPOSED ATTENUATION BASIN / POND (1in3 SIDE SLOPES)
 - PROPOSED 2.5m WIDE MAINTENANCE ACCESS TO BASIN / POND
 - PROPOSED SURFACE WATER PIPE / MANHOLE NETWORK
 - PROPOSED HEADWALL
 - PROPOSED INDICATIVE FLOOD EXCEEDANCE FLOW ROUTES
 - PROPOSED FOUL WATER PIPE / MANHOLE NETWORK
 - PROPOSED FOUL PUMPING STATION AND RISING MAIN
 - PROPOSED HIGHWAY
 - PROPOSED DEVELOPMENT AREAS
 - EXISTING DITCH
 - EXISTING THAMES WATER PUBLIC COMBINED SEWER
 - EXISTING THAMES WATER PUBLIC FOUL RISING MAIN

P04	UPDATES IN ACCORDANCE WITH LATEST MASTERPLAN	19.07.24	PB	DE	DE
P03	MINOR CHANGES TO FLOW RATES	20.06.24	PB	DE	DE
P02	SECOND ISSUE	20.06.24	PB	DE	DE
P01	FIRST ISSUE	12.06.24	PB	DE	DE
Rev	Amendments	Date	By	Chk	Auth



Drawing Status & Suitability Code
FOR INFORMATION S0

Client
MACTAGGART AND MICKEL STRATEGIC LAND

Project
LAND EAST OF LODGE ROAD, HURST

Drawing Title
PROPOSED DRAINAGE STRATEGY

Scale 1:1000	@ A1	SLR Project No. 432.010035.00001
Designed PB	Drawn PB	Checked DE
Date 24.05.24	Date 24.05.24	Date 24.05.24
Drawing Number 409.010068.00001-SLR-HDG-500-01	Rev P04	Authorised DE

Appendix A2. Catchment Plan



- Legend:
- APPLICATION BOUNDARY
 - PROPOSED HIGHWAY
- TOTAL AREA = 1.38 HECTARES
 - PROPOSED DEVELOPMENT AREAS
TOTAL AREA = 3.11 HECTARES
 - PROPOSED GREENFIELD AREAS
TOTAL AREA = 6.19 HECTARES
 - EXISTING GREENFIELD AREAS
TOTAL AREA = 10.68 HECTARES

P01	FIRST ISSUE	19.07.24	PB	DE	DE
Rev	Amendments	Date	By	Chk	Auth
					
www.slrconsulting.com					
Drawing Status & Suitability Code					
FOR INFORMATION					S0
Client					
MACTAGGART AND MICKEL					
Project					
LAND OFF LODGE ROAD, HURST					
Drawing Title					
CATCHMENT PLAN					
Scale		SLR Project No.			
AS SHOWN @ A1		432.010035.00001			
Designed	Drawn	Checked	Authorised		
PB	PB	DE	DE		
Date	Date	Date	Date		
03.07.24	03.07.24	03.07.24	03.07.24		
Drawing Number					Rev
409.010068.00001-SLR-HDG-500-02					P01

Appendix A3. Proposed Flow Hydraulic Calculations (Network 1 and Network 2)

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
N1-HW1	1.374	5.00	38.700		479526.775	173806.019	1.200
N1-SW1	0.043	5.00	38.658		479510.728	173800.522	1.200
N1-SW2	0.032	5.00	38.608		479492.230	173793.017	1.200
N1-SW3	0.038	5.00	38.565		479476.632	173785.541	1.200
N1-SW4	0.024	5.00	38.525		479462.558	173777.976	1.200
N1-SW5	0.051	5.00	38.494		479451.861	173771.471	1.200
N1-SW6	0.048	5.00	38.461		479442.142	173762.663	1.200
N1-SW7	0.045	5.00	38.550		479409.588	173743.961	1.383
N1-SW8	0.032	5.00	38.550		479393.295	173733.495	1.431
N1-SW9	0.031	5.00	38.500		479382.278	173727.361	1.413
N1-HW2	0.020	5.00	38.450		479372.884	173722.879	1.389
N1-CH1	0.422	5.00	38.500	1950	479362.070	173718.536	1.772
N1-CH2	0.000	5.00	38.000	1500	479355.255	173718.205	1.408
N1-CH3	0.000	5.00	37.700	1500	479349.210	173719.507	1.232
N1-CH4	0.000	5.00	37.680	1500	479344.546	173722.180	1.470
N1-CH5			37.680	1500	479340.963	173727.405	1.497
N1-CH6	0.000	5.00	37.600	1500	479338.263	173732.042	1.440
N1-CH7 (HB)			37.500	1500	479322.562	173725.221	1.413
N1-HW3 (Outlet)			37.500	1500	479302.592	173716.546	1.505

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	N1-HW1	N1-SW1	16.962	0.030	37.500	37.458	0.042	400.0	1200	5.08	50.0
1.001	N1-SW1	N1-SW2	19.962	0.030	37.458	37.408	0.050	397.7	1200	5.17	50.0
1.002	N1-SW2	N1-SW3	17.297	0.030	37.408	37.365	0.043	400.0	1200	5.25	49.7
1.003	N1-SW3	N1-SW4	15.978	0.030	37.365	37.325	0.040	400.0	1200	5.33	49.5
1.004	N1-SW4	N1-SW5	12.520	0.030	37.325	37.294	0.031	400.0	1200	5.38	49.3
1.005	N1-SW5	N1-SW6	13.116	0.030	37.294	37.261	0.033	400.0	1200	5.44	49.0
1.006	N1-SW6	N1-SW7	37.544	0.030	37.261	37.167	0.094	400.0	1200	5.62	48.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	3.591	17667.2	186.2	0.000	0.000	1.374	0.0	159	1.196
1.001	3.602	17720.2	192.0	0.000	0.000	1.417	0.0	161	1.209
1.002	3.591	17667.2	195.3	0.000	0.000	1.449	0.0	163	1.212
1.003	3.591	17667.2	199.4	0.000	0.000	1.487	0.0	165	1.219
1.004	3.591	17667.2	201.7	0.000	0.000	1.511	0.0	166	1.221
1.005	3.591	17667.2	207.6	0.000	0.000	1.562	0.0	168	1.230
1.006	3.591	17667.2	211.3	0.000	0.183	1.610	0.0	170	1.237



Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.007	N1-SW7	N1-SW8	19.365	0.030	37.167	37.119	0.048	400.0	1200	5.71	48.1
1.008	N1-SW8	N1-SW9	12.610	0.030	37.119	37.087	0.032	400.0	1200	5.77	47.9
1.009	N1-SW9	N1-HW2	10.408	0.030	37.087	37.061	0.026	400.0	1200	5.82	47.7
1.010	N1-HW2	N1-CH1	11.654	0.600	37.061	36.728	0.333	35.0	525	5.87	47.5
1.011	N1-CH1	N1-CH2	6.823	0.600	36.728	36.592	0.136	50.0	525	5.90	47.4
1.012	N1-CH2	N1-CH3	6.184	0.600	36.592	36.468	0.124	50.0	525	5.94	47.3
1.013	N1-CH3	N1-CH4	5.376	0.600	36.468	36.360	0.108	50.0	525	5.96	47.2
1.014	N1-CH4	N1-CH5	6.335	0.600	36.210	36.183	0.027	236.0	525	6.04	46.9
1.015	N1-CH5	N1-CH6	5.366	0.600	36.183	36.160	0.023	236.0	525	6.10	46.7
1.016	N1-CH6	N1-CH7 (HB)	17.119	0.600	36.160	36.087	0.073	236.0	525	6.29	46.1
1.017	N1-CH7 (HB)	N1-HW3 (Outlet)	21.773	0.600	36.087	35.995	0.092	236.0	525	6.54	45.3

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.007	3.591	17667.2	215.8	0.183	0.231	1.655	0.0	171	1.244
1.008	3.591	17667.2	219.0	0.231	0.213	1.687	0.0	173	1.248
1.009	3.591	17667.2	222.2	0.213	0.189	1.718	0.0	174	1.253
1.010	3.795	1642.9	223.9	0.864	1.247	1.738	0.0	129	2.690
1.011	3.173	686.8	277.6	1.247	0.883	2.160	0.0	232	3.012
1.012	3.173	686.8	276.9	0.883	0.707	2.160	0.0	231	3.009
1.013	3.173	686.8	276.3	0.707	0.795	2.160	0.0	231	3.006
1.014	1.453	314.6	274.8	0.945	0.972	2.160	0.0	382	1.628
1.015	1.453	314.6	273.7	0.972	0.915	2.160	0.0	381	1.627
1.016	1.453	314.6	270.0	0.915	0.888	2.160	0.0	377	1.624
1.017	1.453	314.6	265.3	0.888	0.980	2.160	0.0	371	1.620

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	35	0	0
100	40	0	0

Node N1-CH1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	36.728	Product Number	CTL-SHE-0118-7000-1400-7000
Design Depth (m)	1.400	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	7.0	Min Node Diameter (mm)	1200

Node N1-HW1 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.000	Sump Available	✓
Replaces Downstream Link	x	Product Number	CTL-SHE-0117-6200-1000-6200
Invert Level (m)	37.500	Min Outlet Diameter (m)	0.150
Design Depth (m)	1.000	Min Node Diameter (mm)	1200
Design Flow (l/s)	6.2		

Node N1-HW1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	38.100	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.600
Safety Factor	2.0	Width (m)	79.000	Inf Depth (m)	
Porosity	0.30	Length (m)	79.000		

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	N1-HW1	232	38.266	0.766	44.3	181.0018	0.0000	OK
1440 minute winter	N1-SW1	1410	37.727	0.268	16.9	0.1925	0.0000	OK
1440 minute winter	N1-SW2	1440	37.725	0.317	38.3	0.1692	0.0000	OK
1440 minute winter	N1-SW3	1440	37.725	0.360	23.3	0.2276	0.0000	OK
1440 minute winter	N1-SW4	1440	37.724	0.399	29.1	0.1596	0.0000	OK
1440 minute winter	N1-SW5	1440	37.724	0.430	30.0	0.3653	0.0000	OK
1440 minute winter	N1-SW6	1440	37.724	0.463	42.2	0.3703	0.0000	OK
1440 minute winter	N1-SW7	1440	37.725	0.558	33.8	0.3635	0.0000	OK
1440 minute winter	N1-SW8	1440	37.726	0.607	31.8	0.2713	0.0000	OK
1440 minute winter	N1-SW9	1440	37.726	0.639	30.7	0.2806	0.0000	OK
1440 minute winter	N1-HW2	1440	37.726	0.665	28.2	0.1916	0.0000	SURCHARGED
1440 minute winter	N1-CH1	1440	37.726	0.998	24.3	7.7352	0.0000	SURCHARGED
15 minute summer	N1-CH2	8	36.631	0.039	7.0	0.0688	0.0000	OK
120 minute winter	N1-CH3	28	36.508	0.040	7.0	0.0698	0.0000	OK
120 minute summer	N1-CH4	32	36.268	0.058	7.0	0.1019	0.0000	OK
120 minute summer	N1-CH5	32	36.241	0.058	7.0	0.1016	0.0000	OK
120 minute summer	N1-CH6	32	36.215	0.055	7.0	0.0970	0.0000	OK
180 minute summer	N1-CH7 (HB)	44	36.142	0.055	7.0	0.0967	0.0000	OK
240 minute winter	N1-HW3 (Outlet)	48	36.048	0.053	7.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	N1-HW1	1.000	N1-SW1	11.0	0.517	0.001	3.3294	
1440 minute winter	N1-SW1	1.001	N1-SW2	18.4	0.525	0.001	8.0999	
1440 minute winter	N1-SW2	1.002	N1-SW3	23.0	0.531	0.001	8.8989	
1440 minute winter	N1-SW3	1.003	N1-SW4	25.6	0.539	0.001	9.9456	
1440 minute winter	N1-SW4	1.004	N1-SW5	26.3	0.537	0.001	9.0543	
1440 minute winter	N1-SW5	1.005	N1-SW6	35.5	0.546	0.002	10.7789	
1440 minute winter	N1-SW6	1.006	N1-SW7	23.6	0.528	0.001	39.2196	
1440 minute winter	N1-SW7	1.007	N1-SW8	31.6	0.536	0.002	25.4034	
1440 minute winter	N1-SW8	1.008	N1-SW9	30.5	0.511	0.002	18.6247	
1440 minute winter	N1-SW9	1.009	N1-HW2	28.1	0.479	0.002	16.6804	
1440 minute winter	N1-HW2	1.010	N1-CH1	21.9	0.130	0.013	5.0353	
1440 minute winter	N1-CH1	Hydro-Brake®	N1-CH2	7.0				
15 minute summer	N1-CH2	1.012	N1-CH3	7.0	0.966	0.010	0.0448	
120 minute winter	N1-CH3	1.013	N1-CH4	7.0	1.000	0.010	0.0376	
120 minute summer	N1-CH4	1.014	N1-CH5	7.0	0.548	0.022	0.0808	
120 minute summer	N1-CH5	1.015	N1-CH6	7.0	0.568	0.022	0.0661	
120 minute summer	N1-CH6	1.016	N1-CH7 (HB)	7.0	0.588	0.022	0.2035	
180 minute summer	N1-CH7 (HB)	1.017	N1-HW3 (Outlet)	7.0	0.602	0.022	0.2530	142.4

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	N1-HW1	472	38.564	1.064	78.9	745.1085	0.0000	OK
1440 minute winter	N1-SW1	1410	38.177	0.719	13.5	0.5157	0.0000	OK
1440 minute winter	N1-SW2	1440	38.177	0.769	14.5	0.4101	0.0000	OK
1440 minute winter	N1-SW3	1440	38.178	0.813	17.4	0.5143	0.0000	OK
1440 minute winter	N1-SW4	1440	38.177	0.852	15.9	0.3410	0.0000	OK
1440 minute winter	N1-SW5	1440	38.177	0.883	28.2	0.7509	0.0000	OK
1440 minute winter	N1-SW6	1440	38.177	0.916	20.1	0.7330	0.0000	OK
1440 minute winter	N1-SW7	1440	38.177	1.010	26.2	0.6577	0.0000	OK
1440 minute winter	N1-SW8	1440	38.177	1.058	32.8	0.4728	0.0000	OK
1440 minute winter	N1-SW9	1440	38.177	1.090	29.1	0.4785	0.0000	OK
1440 minute winter	N1-HW2	1440	38.178	1.117	35.2	0.3216	0.0000	FLOOD RISK
1440 minute winter	N1-CH1	1440	38.182	1.454	30.9	11.2679	0.0000	SURCHARGED
1440 minute winter	N1-CH2	1440	36.631	0.039	7.1	0.0694	0.0000	OK
1440 minute winter	N1-CH3	1440	36.508	0.040	7.1	0.0704	0.0000	OK
1440 minute winter	N1-CH4	1440	36.268	0.058	7.1	0.1028	0.0000	OK
1440 minute winter	N1-CH5	1440	36.241	0.058	7.1	0.1025	0.0000	OK
1440 minute winter	N1-CH6	1440	36.215	0.055	7.1	0.0978	0.0000	OK
1440 minute winter	N1-CH7 (HB)	1440	36.142	0.055	7.1	0.0975	0.0000	OK
1440 minute winter	N1-HW3 (Outlet)	1440	36.049	0.054	7.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	N1-HW1	1.000	N1-SW1	10.5	0.513	0.001	27.2742	
1440 minute winter	N1-SW1	1.001	N1-SW2	12.6	0.528	0.001	40.6422	
1440 minute winter	N1-SW2	1.002	N1-SW3	16.7	0.529	0.001	39.3308	
1440 minute winter	N1-SW3	1.003	N1-SW4	15.0	0.527	0.001	39.8964	
1440 minute winter	N1-SW4	1.004	N1-SW5	17.8	0.523	0.001	33.7408	
1440 minute winter	N1-SW5	1.005	N1-SW6	-20.9	0.524	-0.001	37.7771	
1440 minute winter	N1-SW6	1.006	N1-SW7	14.5	0.526	0.001	122.8675	
1440 minute winter	N1-SW7	1.007	N1-SW8	32.4	0.527	0.002	72.1747	
1440 minute winter	N1-SW8	1.008	N1-SW9	28.7	0.530	0.002	50.4019	
1440 minute winter	N1-SW9	1.009	N1-HW2	35.1	0.479	0.002	43.7626	
1440 minute winter	N1-HW2	1.010	N1-CH1	29.2	0.138	0.018	5.0353	
1440 minute winter	N1-CH1	Hydro-Brake®	N1-CH2	7.1				
1440 minute winter	N1-CH2	1.012	N1-CH3	7.1	0.969	0.010	0.0454	
1440 minute winter	N1-CH3	1.013	N1-CH4	7.1	1.005	0.010	0.0380	
1440 minute winter	N1-CH4	1.014	N1-CH5	7.1	0.551	0.023	0.0819	
1440 minute winter	N1-CH5	1.015	N1-CH6	7.1	0.570	0.023	0.0670	
1440 minute winter	N1-CH6	1.016	N1-CH7 (HB)	7.1	0.591	0.023	0.2060	
1440 minute winter	N1-CH7 (HB)	1.017	N1-HW3 (Outlet)	7.1	0.605	0.023	0.2560	653.9

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute winter	N1-HW1	570	38.700	1.200	84.1	1002.9560	9.2222	FLOOD
1440 minute winter	N1-SW1	1410	38.323	0.865	13.4	0.6206	0.0000	OK
1440 minute winter	N1-SW2	1410	38.323	0.915	20.4	0.4879	0.0000	OK
1440 minute winter	N1-SW3	1440	38.324	0.959	31.2	0.6068	0.0000	OK
1440 minute winter	N1-SW4	1440	38.324	0.999	48.6	0.3995	0.0000	OK
1440 minute winter	N1-SW5	1440	38.324	1.030	36.4	0.8755	0.0000	OK
1440 minute winter	N1-SW6	1440	38.324	1.063	41.7	0.8502	0.0000	OK
1440 minute winter	N1-SW7	1440	38.323	1.156	36.1	0.7528	0.0000	OK
1440 minute winter	N1-SW8	1440	38.324	1.205	28.3	0.5386	0.0000	FLOOD RISK
1440 minute winter	N1-SW9	1440	38.323	1.236	26.3	0.5428	0.0000	FLOOD RISK
1440 minute winter	N1-HW2	1410	38.323	1.262	26.5	0.3636	0.0000	FLOOD RISK
1440 minute winter	N1-CH1	1380	38.322	1.594	25.9	12.3552	0.0000	FLOOD RISK
1440 minute winter	N1-CH2	1410	36.632	0.040	7.4	0.0710	0.0000	OK
1440 minute winter	N1-CH3	1440	36.509	0.041	7.4	0.0720	0.0000	OK
1440 minute winter	N1-CH4	1440	36.269	0.059	7.4	0.1051	0.0000	OK
1440 minute winter	N1-CH5	1410	36.242	0.059	7.4	0.1049	0.0000	OK
1440 minute winter	N1-CH6	1410	36.217	0.057	7.4	0.1001	0.0000	OK
1440 minute winter	N1-CH7 (HB)	1410	36.143	0.056	7.4	0.0997	0.0000	OK
1440 minute winter	N1-HW3 (Outlet)	1440	36.050	0.055	7.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute winter	N1-HW1	1.000	N1-SW1	8.1	0.514	0.000	39.8694	
1440 minute winter	N1-SW1	1.001	N1-SW2	12.7	0.526	0.001	56.4181	
1440 minute winter	N1-SW2	1.002	N1-SW3	30.7	0.531	0.002	53.6880	
1440 minute winter	N1-SW3	1.003	N1-SW4	36.5	0.539	0.002	53.7620	
1440 minute winter	N1-SW4	1.004	N1-SW5	23.5	0.537	0.001	45.0149	
1440 minute winter	N1-SW5	1.005	N1-SW6	36.7	0.549	0.002	49.9565	
1440 minute winter	N1-SW6	1.006	N1-SW7	23.5	0.536	0.001	159.7437	
1440 minute winter	N1-SW7	1.007	N1-SW8	27.8	0.545	0.002	92.4461	
1440 minute winter	N1-SW8	1.008	N1-SW9	25.8	0.518	0.001	64.0698	
1440 minute winter	N1-SW9	1.009	N1-HW2	26.4	0.487	0.001	55.2663	
1440 minute winter	N1-HW2	1.010	N1-CH1	23.8	0.137	0.014	5.0353	
1440 minute winter	N1-CH1	Hydro-Brake®	N1-CH2	7.4				
1440 minute winter	N1-CH2	1.012	N1-CH3	7.4	0.982	0.011	0.0469	
1440 minute winter	N1-CH3	1.013	N1-CH4	7.4	1.018	0.011	0.0393	
1440 minute winter	N1-CH4	1.014	N1-CH5	7.4	0.556	0.024	0.0847	
1440 minute winter	N1-CH5	1.015	N1-CH6	7.4	0.577	0.024	0.0693	
1440 minute winter	N1-CH6	1.016	N1-CH7 (HB)	7.4	0.599	0.024	0.2127	
1440 minute winter	N1-CH7 (HB)	1.017	N1-HW3 (Outlet)	7.4	0.613	0.024	0.2643	672.8

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
N2-MH1	0.774	5.00		38.550	1200	479489.767	173746.276	2.313
N2-HW1	0.065	5.00		37.500	1350	479475.899	173741.385	1.300
N2-HW2				37.500	1500	479456.386	173732.315	1.343
N2-HW3	0.096	5.00		37.304		479447.982	173729.327	1.200
N2-SW1	0.096	5.00		37.290		479443.630	173726.067	1.200
N2-SW2	0.160	5.00		37.300		479429.146	173715.133	1.255
N2-SW3	0.103	5.00		37.346		479394.865	173695.990	1.399
N2-SW4				37.500		479387.901	173691.958	1.573
N2-HW4				37.500		479383.328	173686.937	1.590
N2-MH2	1.479	5.00		38.100	1500	479412.470	173620.673	1.200
N2-MH3				38.100	1500	479420.446	173628.489	1.567
N2-MH4				37.800	1500	479405.419	173648.674	1.492
N2-MH5				37.800	1500	479408.872	173657.060	1.530
N2-MH6				37.750	1500	479376.672	173677.481	1.869
N2-HW5	0.244	5.00		38.000	1500	479371.285	173670.012	2.142
N2-HW6				38.000	1500	479363.186	173644.910	2.195
N2-MH7				37.700	1500	479356.415	173638.780	1.918
N2-MH8			7.0	37.500	1500	479338.395	173624.463	1.776
N2-MH9				37.500	1500	479342.920	173609.415	1.815
N2-HW7				37.400	1500	479332.474	173606.007	1.742

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	N2-MH1	N2-HW1	14.705	0.600	36.237	36.200	0.037	397.4	450	5.24	49.8
1.001	N2-HW1	N2-HW2	21.518	0.600	36.200	36.157	0.043	500.4	450	5.64	48.3
1.002	N2-HW2	N2-HW3	8.919	0.600	36.157	36.104	0.053	168.3	225	5.79	47.8
1.003	N2-HW3	N2-SW1	5.438	0.030	36.104	36.090	0.014	388.4	500	5.91	47.4
1.004	N2-SW1	N2-SW2	18.148	0.030	36.090	36.045	0.045	403.3	500	6.35	45.9
1.005	N2-SW2	N2-SW3	39.264	0.030	36.045	35.947	0.098	400.7	1200	6.90	44.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	1.013	161.2	104.5	1.863	0.850	0.774	0.0
1.001	0.902	143.4	109.8	0.850	0.893	0.839	0.0
1.002	1.005	40.0	108.7	1.118	0.975	0.839	0.0
1.003	0.712	711.9	120.1	0.700	0.700	0.935	0.0
1.004	0.699	698.6	128.3	0.700	0.755	1.031	0.0
1.005	1.195	5881.5	142.7	0.055	0.199	1.191	0.0



Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.006	N2-SW3	N2-SW4	8.047	0.030	35.947	35.927	0.020	402.4	500	7.09	43.6
1.007	N2-SW4	N2-HW4	6.831	0.030	35.927	35.910	0.017	401.8	500	7.25	43.1
1.008	N2-HW4	N2-MH6	11.525	0.600	35.910	35.881	0.029	397.4	600	7.41	42.9
2.000	N2-MH2	N2-MH3	11.093	0.600	36.900	36.553	0.347	32.0	300	5.07	50.0
2.001	N2-MH3	N2-MH4	25.164	0.600	36.533	36.308	0.225	111.8	300	5.35	49.4
2.002	N2-MH4	N2-MH5	9.069	0.600	36.308	36.270	0.038	238.7	300	5.50	48.8
2.003	N2-MH5	N2-MH6	38.129	0.600	36.270	36.108	0.162	235.4	300	6.12	47.3
1.009	N2-MH6	N2-HW5	9.209	0.600	35.881	35.858	0.023	400.4	600	7.53	42.4
1.010	N2-HW5	N2-HW6	26.376	0.600	35.858	35.805	0.053	497.7	450	8.02	40.6
1.011	N2-HW6	N2-MH7	9.134	0.600	35.805	35.782	0.023	397.1	450	8.17	40.1
1.012	N2-MH7	N2-MH8	23.015	0.600	35.782	35.724	0.058	396.8	450	8.55	38.8
1.013	N2-MH8	N2-MH9	15.714	0.600	35.724	35.685	0.039	402.9	450	8.81	38.1
1.014	N2-MH9	N2-HW7	10.988	0.600	35.685	35.658	0.027	407.0	450	8.99	37.6

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.006	0.699	699.4	152.9	0.899	1.073	1.294	0.0
1.007	0.700	699.9	151.2	1.073	1.090	1.294	0.0
1.008	1.215	343.6	150.5	0.990	1.269	1.294	0.0
2.000	2.790	197.2	200.4	0.900	1.247	1.479	0.0
2.001	1.486	105.0	198.0	1.267	1.192	1.479	0.0
2.002	1.013	71.6	195.6	1.192	1.230	1.479	0.0
2.003	1.020	72.1	189.6	1.230	1.342	1.479	0.0
1.009	1.211	342.3	318.7	1.269	1.542	2.773	0.0
1.010	0.904	143.8	332.0	1.692	1.745	3.017	0.0
1.011	1.014	161.2	327.9	1.745	1.468	3.017	0.0
1.012	1.014	161.3	317.3	1.468	1.326	3.017	0.0
1.013	1.006	160.1	318.6	1.326	1.365	3.017	7.0
1.014	1.001	159.3	314.5	1.365	1.292	3.017	7.0

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
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Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
10	0	0	0
30	35	0	0
100	40	0	0

Node N2-HW2 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	36.157	Product Number	CTL-SHE-0191-1850-1100-1850
Design Depth (m)	1.100	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	18.5	Min Node Diameter (mm)	1500

Node N2-MH7 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	35.782	Product Number	CTL-SHE-0132-1010-2000-1010
Design Depth (m)	2.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	10.1	Min Node Diameter (mm)	1500

Node N2-HW1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	36.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	450.0	0.0	1.300	791.1	0.0

Node N2-MH2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	36.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	63

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	720.0	0.0	0.700	720.0	0.0	0.701	0.0	0.0

Node N2-HW5 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	35.858
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	538.0	0.0	2.142	1196.1	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.52%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	N2-MH1	8	36.780	0.543	101.3	4.2461	0.0000	SURCHARGED
480 minute winter	N2-HW1	464	36.410	0.210	16.5	101.0203	0.0000	OK
480 minute winter	N2-HW2	464	36.410	0.253	9.3	0.4478	0.0000	SURCHARGED
480 minute winter	N2-HW3	456	36.357	0.253	10.8	0.4054	0.0000	OK
480 minute winter	N2-SW1	456	36.357	0.267	12.3	0.4278	0.0000	OK
480 minute winter	N2-SW2	456	36.357	0.312	14.5	0.7966	0.0000	OK
480 minute winter	N2-SW3	448	36.357	0.410	15.0	0.6041	0.0000	OK
480 minute winter	N2-SW4	448	36.357	0.430	13.4	0.0000	0.0000	OK
480 minute winter	N2-HW4	448	36.357	0.447	12.9	0.0000	0.0000	OK
120 minute summer	N2-MH2	72	37.014	0.114	92.4	85.0843	0.0000	OK
120 minute summer	N2-MH3	72	36.691	0.158	52.3	0.2787	0.0000	OK
120 minute summer	N2-MH4	74	36.525	0.217	52.3	0.3840	0.0000	OK
120 minute summer	N2-MH5	74	36.467	0.197	52.2	0.3486	0.0000	OK
480 minute winter	N2-MH6	448	36.357	0.476	38.9	0.8417	0.0000	OK
480 minute winter	N2-HW5	448	36.357	0.499	43.2	308.9545	0.0000	SURCHARGED
480 minute winter	N2-HW6	448	36.357	0.552	10.1	0.9753	0.0000	SURCHARGED
480 minute winter	N2-MH7	432	36.357	0.575	11.1	1.0161	0.0000	SURCHARGED
480 minute winter	N2-MH8	456	35.828	0.104	16.9	0.1832	0.0000	OK
480 minute winter	N2-MH9	456	35.786	0.101	16.9	0.1790	0.0000	OK
480 minute winter	N2-HW7	456	35.746	0.088	16.9	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	N2-MH1	1.000	N2-HW1	134.6	2.204	0.835	1.1784	
480 minute winter	N2-HW1	1.001	N2-HW2	9.3	0.156	0.065	1.7714	
480 minute winter	N2-HW2	1.002	N2-HW3	9.2	0.742	0.231	0.3441	
480 minute winter	N2-HW3	1.003	N2-SW1	10.6	0.195	0.015	1.8152	
480 minute winter	N2-SW1	1.004	N2-SW2	11.6	0.205	0.017	7.2340	
480 minute winter	N2-SW2	1.005	N2-SW3	13.0	0.184	0.002	22.7628	
480 minute winter	N2-SW3	1.006	N2-SW4	13.4	0.177	0.019	5.9605	
480 minute winter	N2-SW4	1.007	N2-HW4	12.9	0.151	0.018	5.4482	
480 minute winter	N2-HW4	1.008	N2-MH6	12.4	0.309	0.036	2.6814	
120 minute summer	N2-MH2	2.000	N2-MH3	52.3	1.867	0.265	0.3111	
120 minute summer	N2-MH3	2.001	N2-MH4	52.3	1.129	0.498	1.1596	
120 minute summer	N2-MH4	2.002	N2-MH5	52.2	1.007	0.729	0.4706	
120 minute summer	N2-MH5	2.003	N2-MH6	52.3	1.129	0.725	1.7635	
480 minute winter	N2-MH6	1.009	N2-HW5	38.5	0.696	0.112	2.2590	
480 minute winter	N2-HW5	1.010	N2-HW6	10.1	0.229	0.070	4.1791	
480 minute winter	N2-HW6	1.011	N2-MH7	11.1	0.114	0.069	1.4472	
480 minute winter	N2-MH7	1.012	N2-MH8	9.9	0.448	0.061	0.5139	
480 minute winter	N2-MH8	1.013	N2-MH9	16.9	0.624	0.106	0.4259	
480 minute winter	N2-MH9	1.014	N2-HW7	16.9	0.701	0.106	0.2654	1475.6

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.52%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	N2-MH1	6	36.897	0.660	223.3	5.1659	0.0000	SURCHARGED
600 minute winter	N2-HW1	600	36.682	0.482	23.1	248.7581	0.0000	SURCHARGED
600 minute winter	N2-HW2	600	36.682	0.525	10.1	0.9280	0.0000	SURCHARGED
480 minute winter	N2-HW3	472	36.652	0.548	13.7	0.8762	0.0000	SURCHARGED
480 minute winter	N2-SW1	472	36.649	0.559	16.3	0.8941	0.0000	SURCHARGED
480 minute winter	N2-SW2	472	36.649	0.604	20.1	1.5404	0.0000	OK
480 minute winter	N2-SW3	472	36.648	0.701	21.8	1.0322	0.0000	SURCHARGED
480 minute winter	N2-SW4	472	36.650	0.723	28.8	0.0000	0.0000	SURCHARGED
480 minute winter	N2-HW4	464	36.644	0.734	57.1	0.0000	0.0000	SURCHARGED
30 minute winter	N2-MH2	25	37.126	0.226	323.7	168.4797	0.0000	OK
30 minute winter	N2-MH3	25	37.024	0.491	95.5	0.8678	0.0000	SURCHARGED
30 minute winter	N2-MH4	26	36.784	0.476	95.5	0.8402	0.0000	SURCHARGED
180 minute winter	N2-MH5	128	36.670	0.400	87.7	0.7070	0.0000	SURCHARGED
480 minute winter	N2-MH6	472	36.644	0.763	55.2	1.3487	0.0000	SURCHARGED
480 minute winter	N2-HW5	472	36.646	0.788	62.6	522.1790	0.0000	SURCHARGED
480 minute winter	N2-HW6	480	36.645	0.840	10.3	1.4838	0.0000	SURCHARGED
480 minute winter	N2-MH7	472	36.646	0.864	11.9	1.5263	0.0000	SURCHARGED
120 minute summer	N2-MH8	112	35.828	0.104	17.0	0.1834	0.0000	OK
120 minute summer	N2-MH9	112	35.786	0.101	17.0	0.1792	0.0000	OK
120 minute summer	N2-HW7	112	35.746	0.088	17.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	N2-MH1	1.000	N2-HW1	224.6	2.621	1.394	1.2589	
600 minute winter	N2-HW1	1.001	N2-HW2	10.1	0.157	0.070	3.4094	
600 minute winter	N2-HW2	1.002	N2-HW3	9.9	0.728	0.247	0.3547	
480 minute winter	N2-HW3	1.003	N2-SW1	13.2	0.197	0.019	6.4917	
480 minute winter	N2-SW1	1.004	N2-SW2	15.1	0.209	0.022	23.7650	
480 minute winter	N2-SW2	1.005	N2-SW3	21.8	0.184	0.004	63.3160	
480 minute winter	N2-SW3	1.006	N2-SW4	28.8	0.174	0.041	15.1032	
480 minute winter	N2-SW4	1.007	N2-HW4	57.1	0.151	0.082	13.3683	
480 minute winter	N2-HW4	1.008	N2-MH6	28.9	0.323	0.084	3.2463	
30 minute winter	N2-MH2	2.000	N2-MH3	95.5	1.925	0.484	0.7060	
30 minute winter	N2-MH3	2.001	N2-MH4	95.5	1.356	0.909	1.7720	
30 minute winter	N2-MH4	2.002	N2-MH5	95.4	1.355	1.333	0.6386	
180 minute winter	N2-MH5	2.003	N2-MH6	87.7	1.280	1.216	2.6850	
480 minute winter	N2-MH6	1.009	N2-HW5	54.6	0.837	0.160	2.5940	
480 minute winter	N2-HW5	1.010	N2-HW6	10.3	0.237	0.072	4.1791	
480 minute winter	N2-HW6	1.011	N2-MH7	11.9	0.115	0.074	1.4472	
480 minute winter	N2-MH7	1.012	N2-MH8	10.0	0.448	0.062	0.5148	
120 minute summer	N2-MH8	1.013	N2-MH9	17.0	0.625	0.106	0.4265	
120 minute summer	N2-MH9	1.014	N2-HW7	17.0	0.702	0.106	0.2658	1370.4

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.52%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	N2-MH1	945	37.082	0.845	24.7	6.6126	0.0000	SURCHARGED
960 minute winter	N2-HW1	945	37.082	0.882	26.4	501.2262	0.0000	SURCHARGED
960 minute winter	N2-HW2	945	37.082	0.925	8.4	1.6343	0.0000	SURCHARGED
720 minute winter	N2-HW3	705	37.047	0.943	31.1	1.5089	0.0000	FLOOD RISK
720 minute winter	N2-SW1	735	37.041	0.951	45.9	1.5218	0.0000	FLOOD RISK
600 minute winter	N2-SW2	600	37.041	0.996	46.3	2.5394	0.0000	OK
600 minute winter	N2-SW3	600	37.041	1.094	130.8	1.6099	0.0000	SURCHARGED
720 minute winter	N2-SW4	690	37.042	1.115	110.9	0.0000	0.0000	SURCHARGED
720 minute winter	N2-HW4	705	37.044	1.134	115.1	0.0000	0.0000	SURCHARGED
60 minute winter	N2-MH2	47	37.379	0.479	396.0	357.5358	0.0000	SURCHARGED
60 minute winter	N2-MH3	51	37.225	0.692	107.3	1.2230	0.0000	SURCHARGED
180 minute winter	N2-MH4	164	37.046	0.738	96.7	1.3048	0.0000	SURCHARGED
720 minute winter	N2-MH5	705	37.042	0.772	63.6	1.3649	0.0000	SURCHARGED
600 minute winter	N2-MH6	600	37.040	1.159	137.2	2.0487	0.0000	SURCHARGED
600 minute winter	N2-HW5	600	37.040	1.182	133.2	855.4246	0.0000	SURCHARGED
600 minute winter	N2-HW6	600	37.042	1.237	10.2	2.1853	0.0000	SURCHARGED
600 minute winter	N2-MH7	585	37.040	1.258	10.3	2.2226	0.0000	SURCHARGED
15 minute winter	N2-MH8	56	35.828	0.104	17.0	0.1834	0.0000	OK
15 minute winter	N2-MH9	56	35.786	0.101	17.0	0.1792	0.0000	OK
15 minute winter	N2-HW7	56	35.746	0.088	17.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute winter	N2-MH1	1.000	N2-HW1	24.3	0.760	0.151	2.3299	
960 minute winter	N2-HW1	1.001	N2-HW2	8.4	0.154	0.058	3.4094	
960 minute winter	N2-HW2	1.002	N2-HW3	8.3	0.719	0.207	0.3547	
720 minute winter	N2-HW3	1.003	N2-SW1	45.9	0.191	0.065	17.1978	
720 minute winter	N2-SW1	1.004	N2-SW2	43.5	0.197	0.062	60.4079	
600 minute winter	N2-SW2	1.005	N2-SW3	130.8	0.175	0.022	149.3202	
600 minute winter	N2-SW3	1.006	N2-SW4	136.3	0.177	0.195	33.8456	
720 minute winter	N2-SW4	1.007	N2-HW4	115.1	0.156	0.164	29.6871	
720 minute winter	N2-HW4	1.008	N2-MH6	129.7	0.460	0.377	3.2463	
60 minute winter	N2-MH2	2.000	N2-MH3	107.3	1.918	0.544	0.7812	
60 minute winter	N2-MH3	2.001	N2-MH4	107.2	1.522	1.021	1.7720	
180 minute winter	N2-MH4	2.002	N2-MH5	96.6	1.372	1.349	0.6386	
720 minute winter	N2-MH5	2.003	N2-MH6	63.5	0.963	0.880	2.6850	
600 minute winter	N2-MH6	1.009	N2-HW5	133.2	0.908	0.389	2.5940	
600 minute winter	N2-HW5	1.010	N2-HW6	10.2	0.237	0.071	4.1791	
600 minute winter	N2-HW6	1.011	N2-MH7	10.3	0.119	0.064	1.4472	
600 minute winter	N2-MH7	1.012	N2-MH8	9.9	0.448	0.062	0.5147	
15 minute winter	N2-MH8	1.013	N2-MH9	17.0	0.666	0.106	0.4265	
15 minute winter	N2-MH9	1.014	N2-HW7	17.0	0.702	0.106	0.2658	1318.2

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.52%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	N2-MH1	10	37.319	1.082	542.4	8.4637	0.0000	SURCHARGED
960 minute winter	N2-HW1	945	37.294	1.094	34.1	651.9857	0.0000	FLOOD RISK
960 minute winter	N2-HW2	945	37.295	1.138	7.9	2.0100	0.0000	FLOOD RISK
720 minute winter	N2-HW3	720	37.241	1.137	32.6	1.8196	0.0000	FLOOD RISK
720 minute winter	N2-SW1	720	37.238	1.148	55.1	1.8371	0.0000	FLOOD RISK
720 minute winter	N2-SW2	720	37.239	1.194	22.4	3.0446	0.0000	OK
720 minute winter	N2-SW3	720	37.239	1.292	24.2	1.9020	0.0000	FLOOD RISK
720 minute winter	N2-SW4	720	37.240	1.313	33.5	0.0000	0.0000	FLOOD RISK
960 minute winter	N2-HW4	975	37.238	1.328	68.6	0.0000	0.0000	FLOOD RISK
60 minute winter	N2-MH2	50	37.639	0.739	537.5	523.8833	0.0000	SURCHARGED
60 minute winter	N2-MH3	50	37.463	0.930	112.4	1.6438	0.0000	SURCHARGED
720 minute winter	N2-MH4	720	37.240	0.932	68.6	1.6462	0.0000	SURCHARGED
720 minute winter	N2-MH5	720	37.239	0.969	68.5	1.7123	0.0000	SURCHARGED
720 minute winter	N2-MH6	750	37.237	1.356	68.4	2.3964	0.0000	SURCHARGED
720 minute winter	N2-HW5	720	37.238	1.380	76.2	1040.2910	0.0000	SURCHARGED
720 minute winter	N2-HW6	735	37.236	1.431	10.2	2.5293	0.0000	SURCHARGED
720 minute winter	N2-MH7	720	37.238	1.456	10.7	2.5735	0.0000	SURCHARGED
15 minute summer	N2-MH8	458	35.828	0.104	17.0	0.1834	0.0000	OK
15 minute summer	N2-MH9	457	35.786	0.101	17.0	0.1792	0.0000	OK
15 minute summer	N2-HW7	459	35.746	0.088	17.0	0.0000	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	N2-MH1	1.000	N2-HW1	535.4	3.815	3.322	2.3299	
960 minute winter	N2-HW1	1.001	N2-HW2	7.9	0.156	0.055	3.4094	
960 minute winter	N2-HW2	1.002	N2-HW3	7.8	0.716	0.196	0.3547	
720 minute winter	N2-HW3	1.003	N2-SW1	52.9	0.190	0.074	24.4405	
720 minute winter	N2-SW1	1.004	N2-SW2	22.4	0.197	0.032	85.3077	
720 minute winter	N2-SW2	1.005	N2-SW3	19.1	0.175	0.003	206.7930	
720 minute winter	N2-SW3	1.006	N2-SW4	33.5	0.181	0.048	46.2590	
720 minute winter	N2-SW4	1.007	N2-HW4	105.0	0.163	0.150	40.1873	
960 minute winter	N2-HW4	1.008	N2-MH6	13.8	0.328	0.040	3.2463	
60 minute winter	N2-MH2	2.000	N2-MH3	112.4	1.916	0.570	0.7812	
60 minute winter	N2-MH3	2.001	N2-MH4	111.6	1.586	1.063	1.7720	
720 minute winter	N2-MH4	2.002	N2-MH5	68.5	0.994	0.956	0.6386	
720 minute winter	N2-MH5	2.003	N2-MH6	68.4	0.971	0.948	2.6850	
720 minute winter	N2-MH6	1.009	N2-HW5	64.6	0.920	0.189	2.5940	
720 minute winter	N2-HW5	1.010	N2-HW6	10.2	0.239	0.071	4.1791	
720 minute winter	N2-HW6	1.011	N2-MH7	10.7	0.120	0.066	1.4472	
720 minute winter	N2-MH7	1.012	N2-MH8	10.0	0.448	0.062	0.5148	
15 minute summer	N2-MH8	1.013	N2-MH9	17.0	0.666	0.106	0.4265	
15 minute summer	N2-MH9	1.014	N2-HW7	17.0	0.702	0.106	0.2658	1422.0

Appendix A4. Greenfield Runoff Rate Calculation

Calculated by:	Paul Bainbridge
Site name:	Hurst
Site location:	RG10 0DN

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.45753° N
Longitude:	0.85715° W
Reference:	1953419870
Date:	Jul 01 2024 10:10

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	10.68
-----------------------	-------

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Hydrological characteristics

	Default	Edited
SAAR (mm):	650	650
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

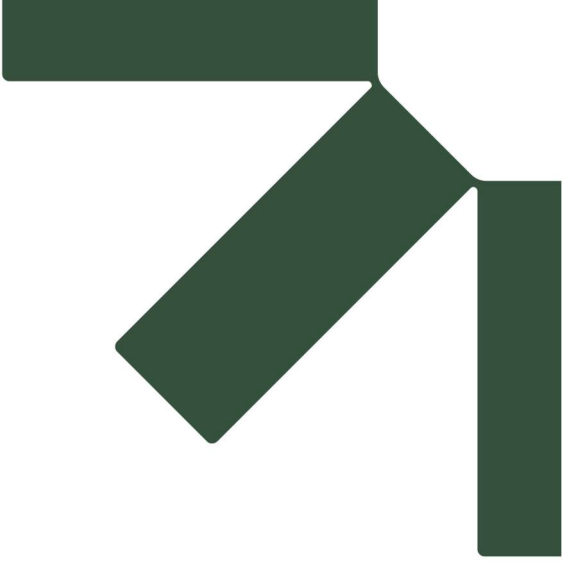
Greenfield runoff rates

Default

Edited

Q_{BAR} (l/s):	17.85	17.85
1 in 1 year (l/s):	15.17	15.17
1 in 30 years (l/s):	41.05	41.05
1 in 100 year (l/s):	56.93	56.93
1 in 200 years (l/s):	66.75	66.75

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.



Appendix B Existing Information

Appendix B1. Thames Water Public Sewer Records

motion
GUILDFORD
GU1 4AU

Search address supplied Green End
Tape Lane
Hurst
Reading
RG10 0DP

Your reference matape 2101005

Our reference ALS/ALS Standard/2021_4372328

Search date 1 March 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

Search address supplied: Green End, Tape Lane, Hurst, Reading, RG10 0DP

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 search provides 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.

The following quartiles have been printed as they fall within Thames' sewerage area:

SU7973NE
SU7973SW
SU7973NW

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.

The following quartiles have been printed as they fall within Thames' water area:

SU7973NE
SU7973SW
SU7973NW

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

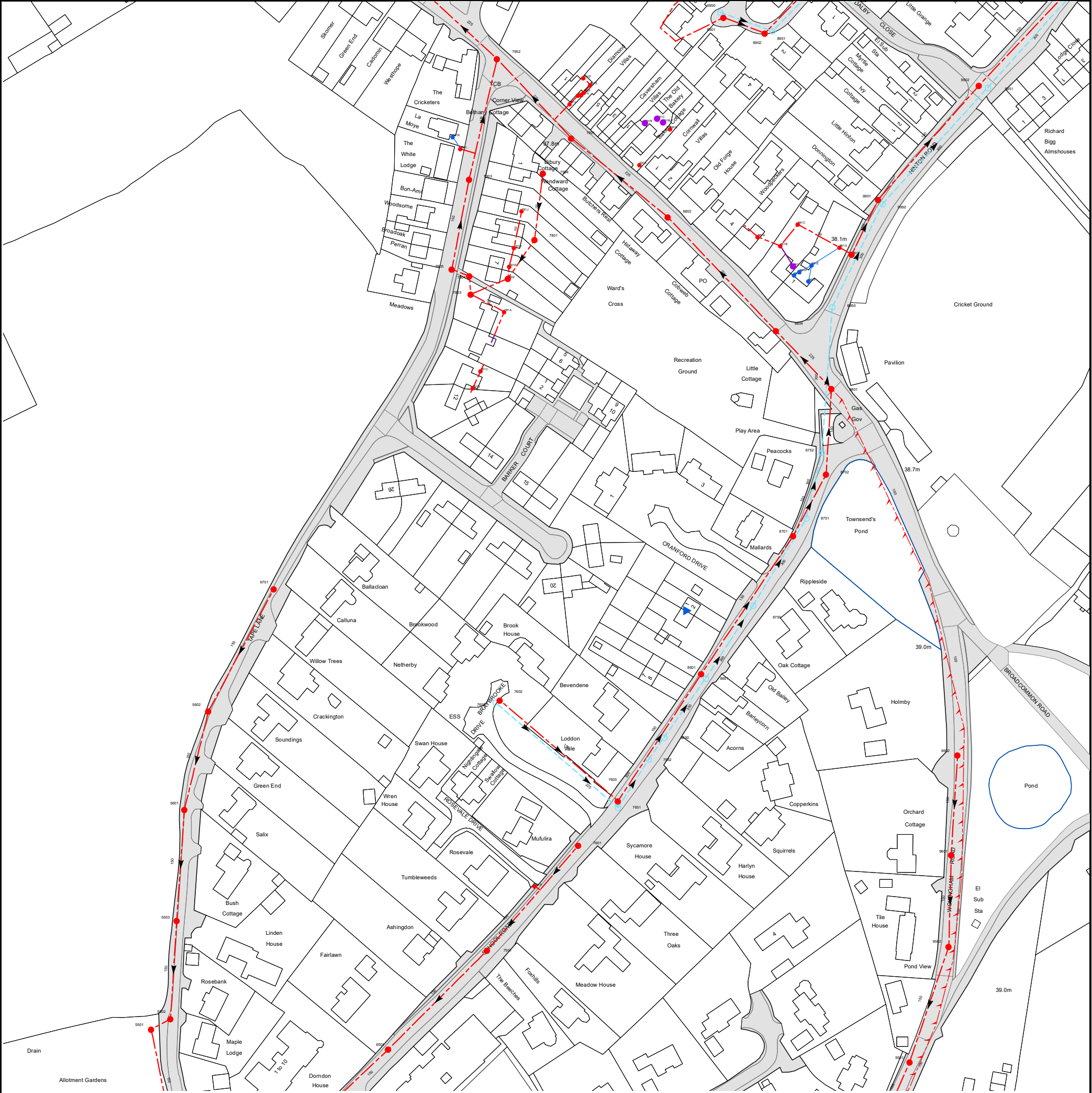
Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

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



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 479750,173750

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

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9501	39.12	36.65
9502	39.08	36.99
9601	39.01	37.27
9602	38.9	37.52
8850	38.46	36.62
8803	38.23	36.39
881G	n/a	n/a
9950	38.04	36.18
9901	38.05	36.28
9951	37.7	35.78
9902	37.73	35.84
8952	n/a	n/a
7501	39.11	37.26
751A	n/a	n/a
7601	39.14	37.6
7651	39.1	37.85
7603	39.13	37.4
7652	39.07	37.64
8650	39.01	37.34
7650	40.16	38.63
7602	40.13	38.62
8651	38.82	37.28
8601	38.82	37.04
8750	38.7	37.15
8701	38.67	36.51
8751	38.62	36.78
8702	38.58	36.33
8752	38.78	36.81
8801	38.83	36.11
781B	n/a	n/a
781C	n/a	n/a
8804	38.52	36.01
781A	n/a	n/a
7803	38.28	36.57
881F	n/a	n/a
7802	38.28	36.61
791E	n/a	n/a
791D	n/a	n/a
7902	37.73	35.14
8902	n/a	n/a
8951	n/a	n/a
8901	n/a	n/a
8950	n/a	n/a
6901	37.75	35.01
7804	38.32	36.04
881D	n/a	n/a
881H	n/a	n/a
7805	38.05	35.83
781E	n/a	n/a
881E	n/a	n/a
781D	n/a	n/a
881B	n/a	n/a
7801	39.1	37.69
881A	n/a	n/a
881C	n/a	n/a
8802	38.18	35.71
791J	n/a	n/a
7903	37.84	35.61
7904	38.84	37.86
791A	n/a	n/a
791L	n/a	n/a
7901	37.79	35.45
791K	n/a	n/a
891A	n/a	n/a
791B	n/a	n/a
891B	n/a	n/a
791C	n/a	n/a
791I	n/a	n/a
791H	n/a	n/a
791G	n/a	n/a
791F	n/a	n/a
6501	39.11	36.81
5501	38.33	36.28
5502	38.2	36.31
5503	38.17	36.4
5601	38.27	36.66
5602	38.51	36.99
6701	38.38	37.41
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.		



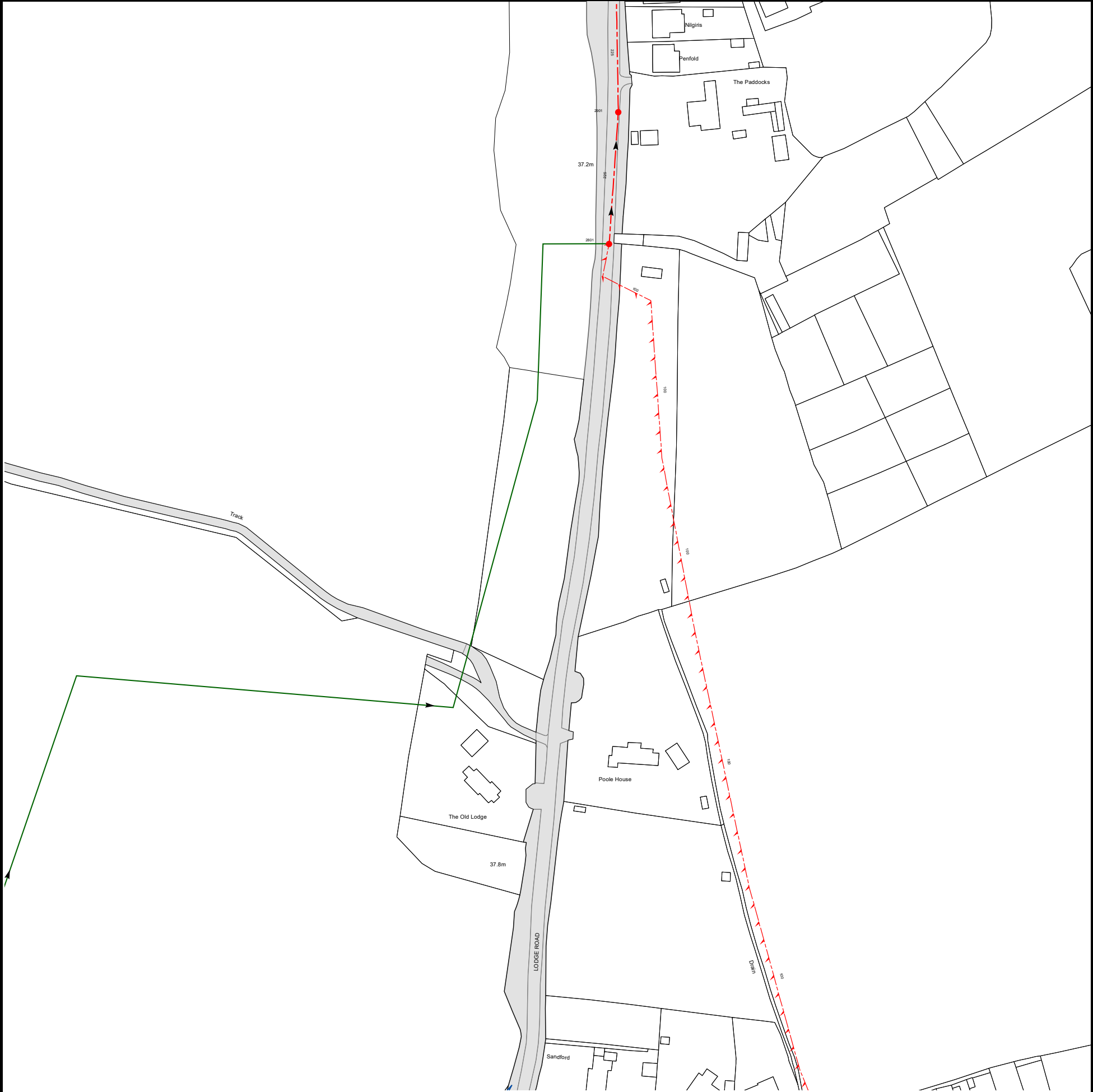
The width of the displayed area is 500m and the centre of the map is located at OS coordinates 479250,173250

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.

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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
4452	38.23	36.85
4402	38.1	36.78
3456	38.14	36.75
2403	n/a	n/a
2401	37.93	n/a
2402	37.9	37.05
2301	n/a	n/a
2404	38.43	37.16
2450	38.44	37.4
3453	38.29	37.25
3402	38.27	36.8
3403	38.14	36.52
341A	n/a	n/a
3452	38.15	37.11
3301	38.25	35.97
3351	38.21	37.14
3350	38.1	37.21
3404	38.24	36.24
3451	38.22	37.03
3303	38.13	35.56
4451	38.22	36.88
441B	n/a	n/a
431A	n/a	n/a
441C	n/a	n/a
441A	n/a	n/a
4401	38.47	36.34
4450	38.57	36.99
4453	39.17	37.02
4454	38.54	37.2
3302	38.13	35.71
4301	38.1	35.53
4303	38.31	34.4
4310	38.2	35.17
4309	38.58	34.77
4350	38.52	37.14
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.		



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 479250,173750

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.

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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
2901	37.95	36.01
2801	37.55	36.05
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

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 'D' on a manhole level indicates that data is unavailable.

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

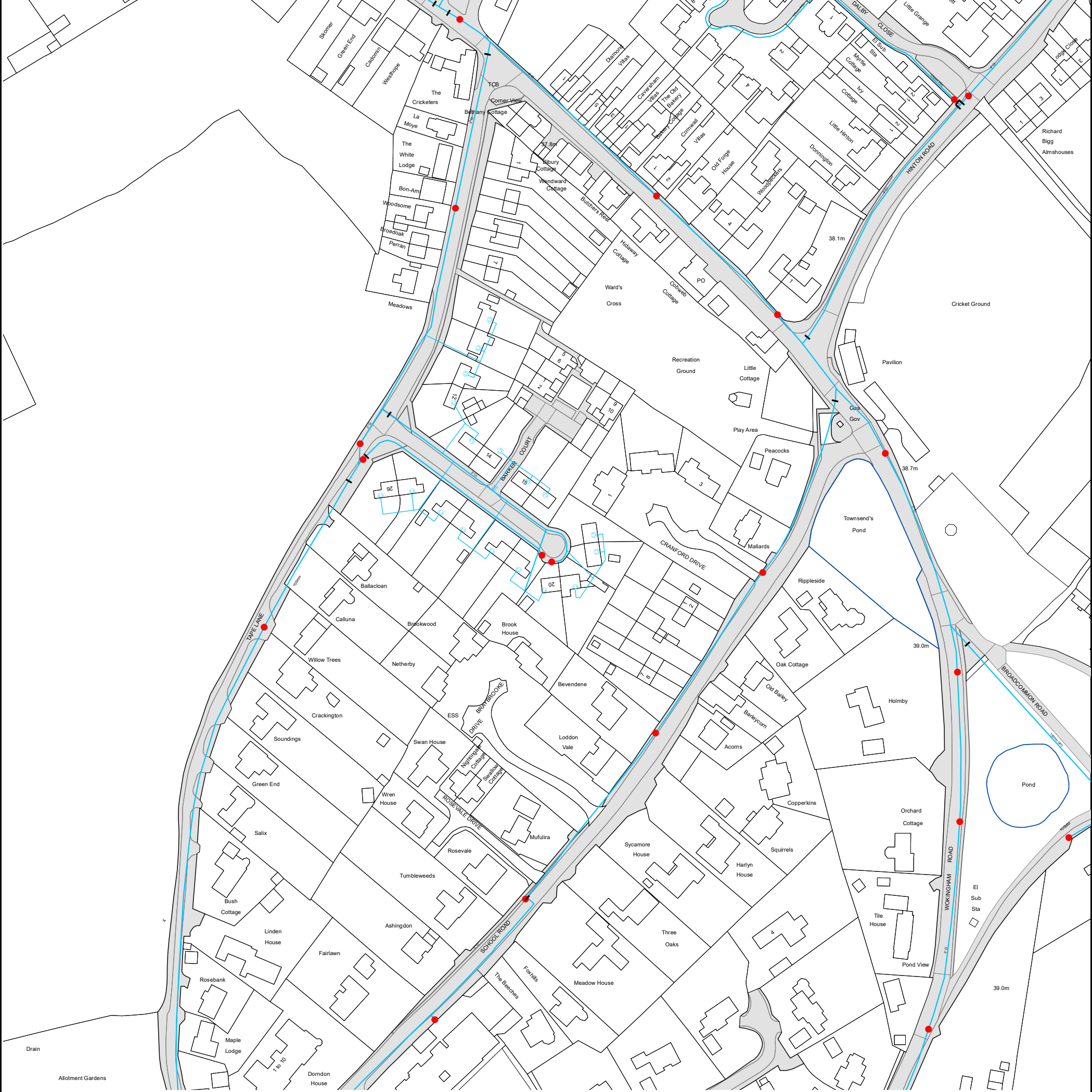
Lines denoting areas of underground surveys, etc.

	Agreement
	Operational Site
	Chamber
	Tunnel
	Conduit Bridge

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

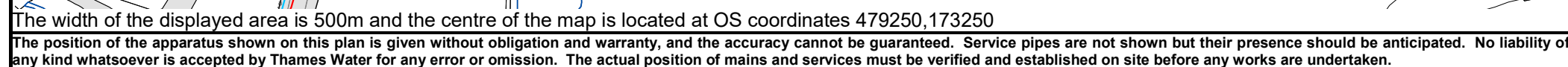
	Foul Sewer		Surface Water Sewer
	Combined Sewer		Gully
	Culverted Watercourse		Proposed
			Abandoned Sewer

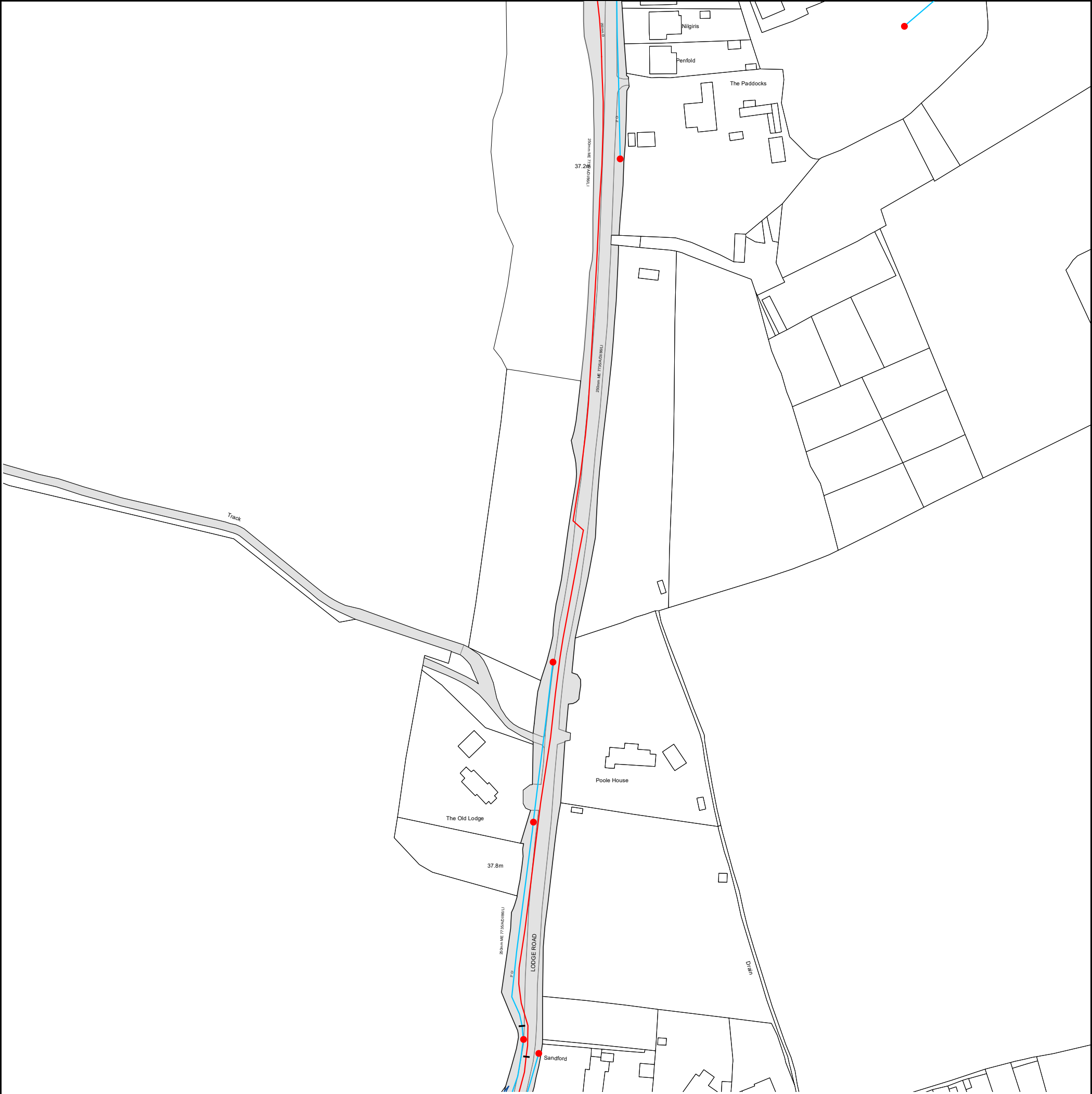
- 6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member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



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 479750,173750
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.

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ALS Water Map 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
---	-------------

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.

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.

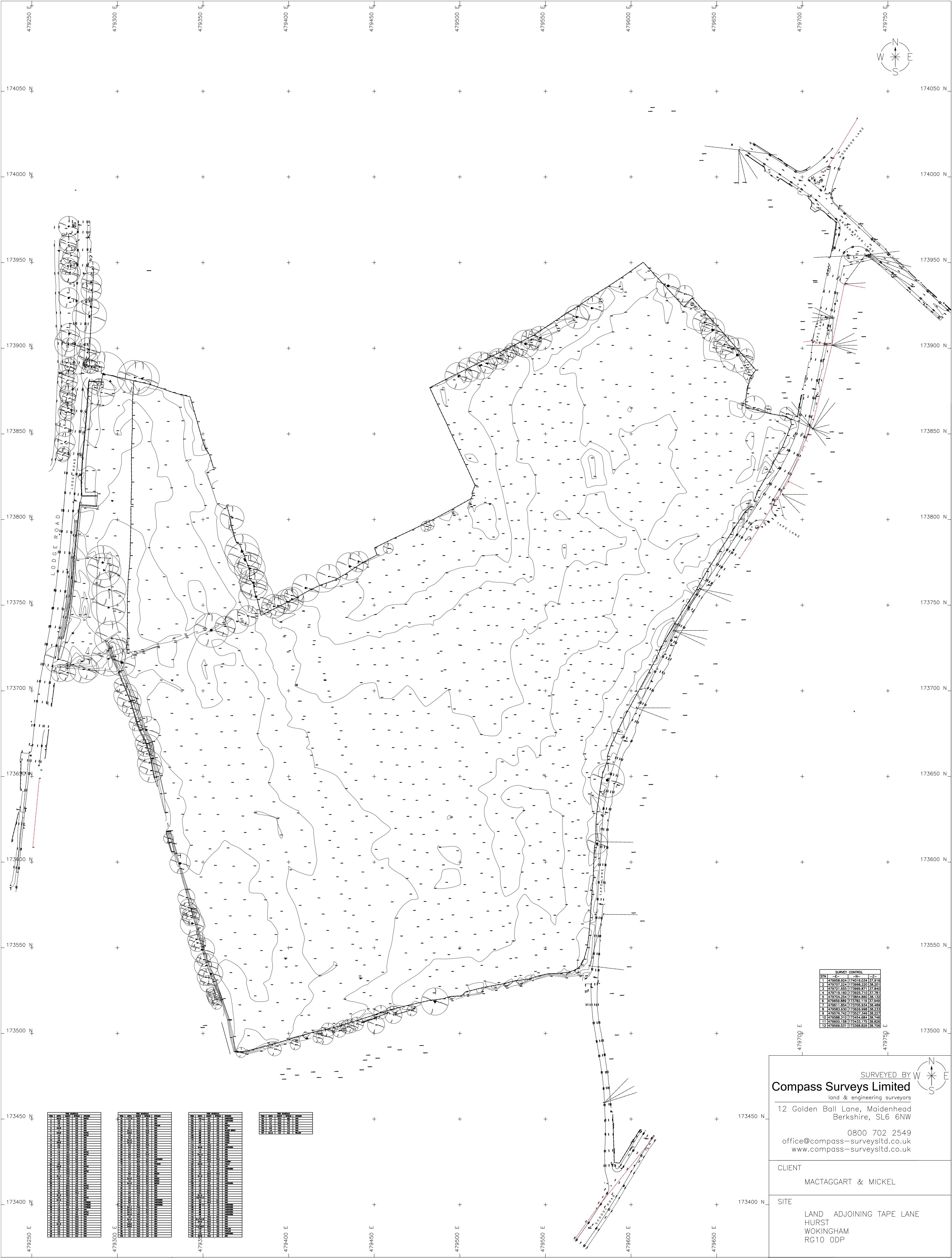
If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria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



SURVEY CONTROL		
BN	E	N
1	479808.924	174019.034
2	479797.224	173998.001
3	479723.655	173969.871
4	479715.160	173925.710
5	479704.254	173884.860
6	479650.885	173782.119
7	479611.854	173705.934
8	479583.530	173628.098
9	479578.742	173527.346
10	479565.310	173444.864
11	479600.158	173433.175
12	479568.531	173358.828

NOTES
Surveyed boundaries are not necessarily the site legal boundaries.
Client should refer to the relevant Land Registry document for confirmation of title.
Drainage and service covers that were buried, obscured or not visible at the time of the survey cannot be shown. Sewer connections between manholes are assumed to be straight and only pipes visible from the cover are shown.
Tree canopy measured values are written as maximum spreads.
Tree species and condition to be confirmed by an arboriculturist.

DATUM
GRID – ORDNANCE SURVEY NATIONAL GRID (OSTN15)
LEVELS – ORDNANCE SURVEY (OSGM15)

LEGEND		FENCE TYPES		FEATURE ABBREVIATIONS	
FEATURE STYLES					
SURVEY CONTROL		POWER LINE (OVERHEAD)		AV	Air Valve
FENCE		TELECOM LINE (OVERHEAD)		BS	Bus Stop
HEDGE		BANKING		BT	British Telecom
FWS				BW	Brick Wall
SWS				CB	Close Board
				CL	Chain Link
				CPL	Conc Panel
				CP	Chestnut Paling
				CW	Chicken Wire
				EB	Electric Box
				EC	Electric Cover
				EP	Electric Pole
				FB	Fire Hydrant
				FL	Floor level
				G	Gully
				GM	Gas Meter
				GV	Gas Valve
				IL	Invert Level
				IC	Inspection Chamber
				KLS	Keep Left Sign
				KO	Kerb Offset
				LB	Letter Box
				LP	Lamp Post
				MKR	Marker
				MP	Metal Post
				MH	Manhole
				MB	Metal Bollard
				P	Post
				PI	Petrol Interceptor
				VP	Vent Pipe
				RNB	Road Name Board
				RS	Road Sign
				RW	Retaining Wall
				SA	Soakaway
				SC	Stopcock
				SV	Sluice Valve
				TP	Telegraph Pole
				TCB	Telephone Box
				TJB	Tel.Junc.Box
				TL	Traffic Light
				V	Valve
				VP	Vent Pipe
				WL	Water Level
				WM	Water Meter
				WO	Water Outlet
				WV	Water Valve

SURVEYED BY

Compass Surveys Limited

land & engineering surveys

12 Golden Ball Lane, Maidenhead
Berkshire, SL6 6NW

0800 702 2549
office@compass-surveysltd.co.uk
www.compass-surveysltd.co.uk

CLIENT

MACTAGGART & MICKEL

SITE

LAND ADJOINING TAPE LANE
HURST
WOKINGHAM
RG10 0DP

TITLE

SITE SURVEY

AS EXISTING

SCALE

1/1000 (A1)

DRAWING No.

01

DATE

MAR 21

JOB No.

1074



Making Sustainability Happen