PATRICK PARSONS

Drainage Strategy

1-6 Station Parade
Ickenham Rd, Ruislip HA4 7DL

for

B&M Investments Limited

A20032

February 2021

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1.0	24/02/2020	Initial Issue	AJ	DB
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Executive Summary

Description	
Patrick Parsons has been instructed by B&M Investments Limited, to produce a Drainage Strategy report to support the Planning Application for the site at 1-6 Station Parade, Ickenham Rd, Ruislip HA4 7DL.	
Site Parameters	
Total Area: Greenfield: Brownfield: Mixed Green and Brownfield: Existing Runoff Location: Ground Conditions: Method of Study: Ground Infiltration Potential:	770m² (0.077 Ha) NO YES NO SW Sewer Clay Desk Investigation Low
Flood Risk Assessment	
Coastal: Fluvial: Pluvial: Groundwater: Other sources:	Zone 1 Zone 1 Low Low Low
Drainage Strategy / SuDS	
Infiltration Viable: Discharge Point (SW): Flow Control: Storage Provided: Discharge Point (FW):	NO SW Sewer 2.0 l/s 1 in 100 Year + 40% Climate Change Sewer
SuDS Elements: Water Quality Measures: Exceedance flows:	Porous Surfacing Catchpits, Geotextiles Managed within site
Conclusions	
Infiltration is not viable on site so the surface water will be released to the sewer at a controlled rate and managed within site with porous surfacing.	

Contents

Appendices

1.0 Introduction

1.1.1 B&M Investments Limited is planning a proposed development on the site at 1-6 Station Parade, Ickenham Rd, Ruislip HA4 7DL.

1.1.2 Patrick Parsons has been instructed by B&M Investments Limited, to produce a Drainage Strategy to support the Planning Application.

1.1.3 This report aims to demonstrate that a reduction in surface water run-off from the site can be achieved.

1.1.4 The general limitations of this assessment are that:

- Several data sources have been used in compiling this report. Whilst Patrick Parsons believe them to be trustworthy; it is unable to guarantee the accuracy of the information that has been provided by others.
- This report is based on information available at the time of preparation. There is potential for further information to become available, which may create a need to modify conclusions drawn in this report.

2.0 Location of Site

2.1.1 The site is located off Ickenham Road in Ruislip. A location plan is enclosed in **Appendix A**.

2.1.2 The Local Authority is the London Borough of Hillingdon.

3.0 Site Description

3.1 Existing Site

3.1.1 The site is currently No's. 1-6 Station Parade. A Topographical Survey has been commissioned for the site and can be found in **Appendix B**.

3.1.2 The site is relatively flat, with levels ranging between 47.60m AOD and 48.10m AOD.

3.2 Existing Drainage System

3.2.1 Sewer records were obtained from Thames Water and can be found at **Appendix C**. There are public foul water and surface water sewers located within Ickenham Road.

3.2.2 There is a public 225mm diameter foul water sewer within Ickenham Road. The closest public manhole is No. 4802 with cover level 47.58m AOD and an invert level of 45.34m AOD.

3.2.3 There is a public 225mm diameter surface water sewer within Ickenham Road. The closest public manhole is No. 4905 with cover level 47.48m AOD and an invert level of 46.28m AOD.

3.3 Existing Geology

3.3.1 The geology of the site has been ascertained by reference to the 1:50,000 British Geological Survey website. The data provided on the website indicates the bedrock and superficial drift geology for the site.

3.3.2 The strata of the site (bedrock geology) comprises London Clay formation, described as follows:

"London Clay Formation - Clay, Silt and Sand. Sedimentary Bedrock formed approximately 48 to 56 million years ago in the Palaeogene Period. Local environment previously dominated by deep seas. These sedimentary rocks are marine in origin. They are detrital and comprise coarse- to fine-grained slurries of debris from the continental shelf flowing into a deep-sea environment, forming distinctively graded beds."

3.4 Geological Assessment

3.4.1 Boreholes in the local area indicate the underlying strata to be predominantly clay.

3.4.2 It has not been possible to undertake site investigations at the time of writing this report to determine the underlying geology. It is recommended that a full geotechnical investigation be completed prior to any detailed design of the scheme.

3.4.3 Based on the desk study information on the geology of the site, infiltration is not likely to be suitable for the development. The requirement for a positive surface water discharge has been considered in this report.

3.5 Hydrogeology Setting

3.5.1 The Environment Agency (EA) mapping service, as provided by Magic Map, indicates the aquifer designation for the bedrock and superficial drift geology and the groundwater vulnerability in the area. The mapping, as included at **Appendix D**, provide the following information for the site:

Geology Map	Site Description
Aquifer Designation (Bedrock)	Unproductive
Aquifer Designation (Superficial Drift)	Unproductive
Groundwater Vulnerability	Unproductive
Groundwater Source Protection Zone	None

3.6 Hydrology

3.6.1 The nearest strategic watercourse is the River Pinn located approximately 650m to the north west of the site. The River Crane is also present to the west of the site.

4.0 Site Run-Off

4.1 Existing Surface Water Runoff

4.1.1 The site has been previously developed, but an analysis of the Greenfield run-off rate is appropriate and will be made for the developable site area of 0.077 hectares.

4.1.2 The Greenfield run-off rates have been calculated for the existing site. The existing site run-off rates have been calculated based on the Interim Code of Practice for Sustainable Drainage Systems, Chapter 6 using the Micro Drainage design software. The output from the software analysis can be found at **Appendix E**.

4.1.3 The Qbar (rural) value for the site is 0.4 litres per second. A conservative value of 70% hardstanding has been used to calculate the urban run-off from site. The Qbar (urban) value for the site is 1.0 litres per second.

4.1.4 A technical assessment has been made for the site of the most appropriate flow rate suiting the site constraints as follows:

Flow Rate (Standard)	Flow Rate (l/s)	Method of control	Constraints
Qbar Rural	0.4	-	Too low for a flow control
Qbar Urban	1.0	-	Too low for a flow control
3 x Qbar	1.2	-	Too low for a flow control
-	2.0	Hydro-Brake	1. Low flow rate indicates high level of silt removal required. 2. Hydrobrake chamber must be constructible.
-	5.0	Orifice	Minimum flow rate of 5.0 l/s to prevent blockages (or 50mm diameter orifice)
Infiltration	0	None	Site must be suitable for infiltration

4.2 Hardstanding Assessment

4.2.1 An assessment of the existing and proposed hardstanding areas for the site has been undertaken to provide guidance as to the most appropriate flow rate on site.

4.2.2 Brownfield run-off has been calculated using the Modified Rational Method for a 1 in 1 year storm event. The information is as follows:

	Hardstanding / Roof (m^3)	Porous Hard Surfaces (m^3)	Green Space / Landscaping (m^3)	Brownfield Flow Rate (l/s)
Existing	650	-	-	10.46

4.2.3 The maximum flow allowable from site is a 50% reduction on the brownfield flow rate, equal to 5.2 litres per second.

4.3 Greenfield Run-Off Assessment

4.3.1 An assessment of the most appropriate flow restriction on site can be made with an engineering judgement made on the following parameters:

- Proposed depth of surface water system. Shallow systems will not be able to construct certain flow controls.
- Risk of blockages, open drainage systems and conventional piped systems will have a significantly higher chance of blockage.
- Potential for soakage or a hybrid solution with some infiltration and some positive discharge.
- The existing use of the site (green/brown field) and the most appropriate reduction in surface water flows from the proposed development.
- Potential development costs and the viability of achieving very low flow rates on sites.
- Manufacturer limits, with Hydro-International stating they can achieve between 0.7 and 550 l/s on their product range.

4.3.2 Infiltration has not been selected, based on the geotechnical information provided within this report.

4.3.3 Greenfield run-off rates cannot be achieved due to the small size of the development site.

4.3.4 An assessment of the existing run-off from the brownfield site using the modified rational method indicates a 1 in 1 year existing flow rate of approximately 10.46 litres per second.

4.3.5 A proposed flow control of 2.0 litres per second has been proposed, which is greater than a 50% reduction on the existing flow rate and the minimum recommended to prevent blockages.

5.0 Proposed Development

5.1.1 The proposal is for 22 No. residential units. A site layout can be found at **Appendix F**.

5.2 Infiltration Potential

5.2.1 The geotechnical information provided in this report indicates that standard infiltration methods will not be suitable on site, subject to BRE testing. In addition, there is limited space to site any infiltration devices.

5.2.2 The table below summarises the potential for infiltration.

Low infiltration potential: There is a low potential for infiltration SuDS in parts of the Site. **Comments:** It is likely that the underlying geology at the Site, or in areas of the site, is relatively impermeable which would limit the effectiveness of a proposed infiltration SuDS scheme. **Recommendations:** Infiltration SuDS should be focused in more suitable parts of the site. If a site investigation confirms that infiltration SuDS are not possible at the site, then attenuation SuDS with a controlled discharge into a nearby surface water feature or existing surface water drainage is recommended.	**YES**
Moderate infiltration potential: There is a moderate potential for infiltration SuDS in parts of the Site. **Comments:** It is likely that the permeability of the underlying material at the site would be suitable for infiltration drainage. However, there may be constraints on the use of infiltration SuDS because of any of the following: a high water-table, the limited thickness of the receiving formation, the potential for a significant range in permeability in the underlying geology and confirmation of the infiltration capacity is recommended. **Recommendations:** A site investigation is recommended to investigate groundwater levels and formation thickness and to confirm that infiltration rates at the site are sufficient to accommodate an infiltration SuDS feature. If a site investigation confirms that infiltration SuDS are possible at the Site then assorted options can be considered for infiltration SuDS and these include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.	**NO**
High infiltration potential: There is a high potential for infiltration SuDS in parts of the Site. **Comments:** It is likely that the underlying geology at the Site is highly permeable and an infiltration SuDS scheme should be possible at the Site. Groundwater levels are expected to be sufficiently deep at the site. **Recommendations:** A site investigation is recommended to confirm the high infiltration capacity and the depth of the winter water table. Assorted options can be considered for infiltration SuDS and these include infiltration trenches, soakaways, swales, permeable pavements and infiltration basins without outlets.	**NO**

6.0 Sustainable Drainage Assessment

6.1 SuDS Hierarchy

6.1.1 Options for the destination for the run-off generated on site have been assessed in line with the prioritisation set out in the Building Regulations Part H document and DEFRA's Draft National Standards for SuDS as follows:

Discharge to Ground	**Not viable based on desk study**
Discharge to Watercourse	**No watercourses in area**
Discharge to Surface Water Sewer	**Selected Option**
Discharge to Other Sewer	**N/A**

6.1.2 The indicative potential for different SuDS devices has been assessed and can be seen in the table below:

SuDS Feature	Environmental benefits	Water quality improvement	Suitability for low permeability soils (k<10^{-6})	Ground-water recharge	Suitable for small / confined sites?	Site specific restrictions	Appropriate for subject site?
Wetlands	✓	✓	✓	X	X	Site Constraints	No
Retention ponds	✓	✓	✓	X	X	Site Constraints	No
Detention basins	✓	✓	✓	X	X	Site Constraints	No
Infiltration basins	✓	✓	X	✓	X	Site Constraints	No
Soakaways	X	✓	X	✓	✓	Poor Ground	No
Underground storage	X	X	✓	X	✓	None	Yes
Swales	✓	✓	✓	✓	X	Site Constraints	No
Filter strips	✓	✓	✓	✓	X	Site Constraints	No
Rainwater harvesting	X	✓	✓	✓	✓	None	Yes
Permeable paving	X	✓	✓	✓	✓	None	Tanked
Green roofs	✓	✓	✓	X	✓	Site Constraints	No
Rain Garden (external)	✓	✓	✓	X	X	Site Constraints	No
Rain Garden (planter)	✓	✓	✓	X	X	None	Possible

6.2 Detailed SuDS Assessment

6.2.1 To maximize the potential use of SuDS at the site, a review has been undertaken in accordance with the SuDS Hierarchy (refer to SuDS: A Practical Guide prepared by the Environment Agency).

6.2.2 The following table indicates the potential setting for SuDS elements:

	Description	Setting	Required Area
Green Roof	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation.	Building	Building integrated
Rainwater Harvesting	Rainwater is collected from the roof of a building or from other paved surfaces and stored in an overground or underground tank for treatment and reuse locally. Water could be used for toilet flushing and irrigation.	Building	Water storage (underground or above ground)
Soakaway	A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.	Open Space	Dependant on Run-off volumes and soils
Filter Strip	Filter strips are grassed or planted areas that runoff can run across to promote infiltration and cleansing.	Open Space	Maximum length 5 metres
Permeable Paving	Paving which allows water to soak through. Can be in the form of paving blocks with gaps between solid blocks or porous paving where water filters through the block itself. Water can be stored in the sub-base beneath or allowed to infiltrate into ground below.	Street / Open Space	Can typically drain double its area
Bioretention Area	A vegetated area with gravel and sand layers below designed to channel, filter and cleanse water vertically. Water can infiltrate into the ground below or drain to a perforated pipe and be conveyed elsewhere. Bioretention systems can be integrated with tree-pits or gardens.	Street / Open Space	Typically, surface area is 5-10% of drained area with storage below.
Swale	Swales are vegetated shallow depressions designed to convey and filter water. These can be ‘wet’ where water gathers above the surface, or ‘dry’ where water gathers in a gravel layer beneath. Can be lined or unlined to allow infiltration.	Street / Open Space	Account for width to allow safe maintenance typically 2-3 metres wide.
Hardscape Storage	Hardscape water features can be used to store run-off above ground within a constructed container. Storage features can be integrated into public realm areas with a more urban character.	Open Space	Could be above or below ground and sized to storage need.
Pond / Basin	Ponds can be used to store and treat water. ‘Wet’ ponds have a constant body of water and run-off is additional, while ‘dry’ ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	Open Space	Dependant on runoff volumes and soils.
Wetland	Wetlands are shallow vegetated water bodies with a varying water level. Specially selected plant species are used to filter water. Water flows horizontally and is gradually treated before being discharged. Wetlands can be integrated with a natural or hardscape environment.	Open Space	Typically, 5-15% of drainage area to provide good treatment.
Underground Storage	Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation.	Open Space	Dependant on runoff volumes and soils.

6.2.3 This review highlights the components referenced in the SuDS Hierarchy and provides recommendations on whether the components could be incorporated into the development.

Component	Recommendation / Opinion	
Green (living) roofs or Blue/Green roof systems	There is no potential for green or blue roof systems on the development	↓
Basins and Ponds	There is no potential for basins and ponds on the site.	↓
Filter Strips and Swales	There is no scope for use of surface mounted SuDS on the scheme to convey water.	↓
Infiltration Devices	Infiltration devices will not be viable on site	↓
Permeable Surfaces and Filter Drains	Porous surfaces are viable on site in a tanked configuration.	↓
Tanked Systems	It is unlikely that these will be required.	↓

6.2.4 The proposed drainage system incorporates sustainable drainage features in accordance with the SuDS hierarchy, current legislation and best practice as much as practicable on site.

6.2.5 There may be opportunity for small scale bespoke SuDS elements (such as planters and filtration beds) to be included as part of the landscaping proposals. These should be considered fully before construction commences.

7.0 Drainage Proposal

7.1 Surface Water Drainage

7.1.1 Surface water drainage at the site will follow the Sustainable Drainage Systems (SuDS) management train. The surface water from the site will discharge into the existing public sewer at a restricted rate. A Drainage Plan can be found at **Appendix G**.

7.1.2 New climate change allowances have been in force since February 19th 2016. The new allowances take into consideration the design life of the development, flood zone, development type and geographical location.

7.1.3 Based on these parameters, the Central value for rainfall intensity should be used. Based on Table 2 (shown below), this is a range between 20% and 40% for the central and upper end values. Therefore, it is appropriate to use 40% on this development for design.

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

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

7.1.4 Any water up to a 1 in 100 year storm event including 40% climate change will be attenuated within the curtilage of the site in the proposed drainage system.

7.1.5 National SuDS standards and Sewers for Adoption recommend that the 1 in 30 year storm event is managed below ground with exceedance flows managed above ground.

7.1.6 As there is limited scope for exceedance flow management within the site, the surface water for the 1 in 100 year storm event including 40% climate change will be stored within the drainage system.

7.1.7 MicroDrainage calculations have been undertaken, which can be found at **Appendix H**.

7.1.8 Porous surfacing will provide the main form of attenuation on site and is adequate for the 1 in 100 year storm + 40% climate change.

7.1.9 Rainwater planters could be introduced (suiting the spatial constraints) at detailed design stage under rainwater pipes to provide additional water treatment.

7.2 Urban Creep

7.2.1 Urban Creep is the conversion of permeable surfaces to impermeable over time. e.g. impermeable surfacing of front gardens to provide additional parking spaces, extensions to existing buildings, creation of large patio areas. The consideration of urban creep (is best) assessed on a site by site basis but is limited to residential development only.

7.2.2 It is important that the appropriate allowance for urban creep is included in the design of the drainage system over the lifetime of the proposed development. The allowances set out below are applied to the impermeable area within the property curtilage:

Residential development density Dwellings per hectar	Change allowance % of impermeable area
≤ 25	10
30	8
35	6
45	4
≥ 50	2
Flats & apartments	0

7.2.3 Note where the inclusion of the appropriate allowance would increase the total impermeable area to greater than 100%, 100% should be used as the maximum.

7.2.4 The proposed development has limited scope for expansion. Based on this, zero allowance for urban creep is required for the development.

7.3 Designing for Exceedance Events

7.3.1 Current best practice guidance on flood risk requires an evaluation of how rainfall events beyond the design capacity of the proposed drainage system would be managed and what effects they are likely to have on flood risk at the site or surrounding areas.

7.3.2 Should a rainfall event exceeding the 1.0% AEP (1 in 100 year) event plus climate change event occur, the proposed storage and flow paths of surface water should be considered.

7.3.3 The surface water SuDS features included for the 1 in 100 year storm will be designed with sufficient resilience to manage and convey exceedance flows away from any properties to minimise risk.

7.3.4 Indicative exceedance pathways have been shown on the drainage layout, with further information to be defined once the detailed levels of the scheme have been developed.

7.4 Designing for System Failure

7.4.1 Current best practice on sustainable drainage design should consider failure of the surface water system and potential blockages from multiple sources.

7.4.2 The potential risks to the surface water system have been indicated below:

Risk	Description	Comments / Recommendations
Blockage	Potential blockage of outfall from surface water system	Regular inspection and maintenance of the surface mounted SuDS should be undertaken in line with the findings of this report.
Failure	Potential blockage of outfall from flow control failure or build-up of debris	Regular inspection and maintenance of the surface mounted SuDS should be undertaken in line with the findings of this report.
Surcharge	Potential back-up of system due to surcharging or poorly maintained public surface water infrastructure or watercourse	Regular inspection and maintenance of the surface mounted SuDS should be undertaken in line with the findings of this report.
Blockage	Potential risk of flooding due to build-up of sediment within system	Catchpit manholes have been provided to remove solids and sediment. Regular inspection and maintenance of the drainage system should be undertaken in line with the findings of this report.
Failure	Potential risk of surface water flows from poor maintenance of surface mounted SuDS features (such as porous paving or swales)	Regular inspection and maintenance of the surface mounted SuDS should be undertaken in line with the findings of this report.
Surcharge	Potential risk of additional surface water flows or overland flows from extreme (exceedance storm) events in adjacent sites causing the surface water system to be overloaded.	Exceedance flow routes have been assessed and shown on the drainage layout.
Failure	Potential risk from failure of third-party specialist equipment such as pump stations or interceptors	Any pump stations or interceptors installed on site should be maintained in line with the specialist manufacturer's recommendations.
Blockage	Potential risk from poor maintenance of gullies	Regular inspection and maintenance of the underground drainage system should be undertaken in line with the findings of this report.
Blockage	Potential reduction in infiltration on site from compaction of soils during the construction phase	Ground consolidation should not have a major impact.

7.5 Construction Phase Drainage

7.5.1 It is an offence to cause or knowingly permit the entry of poisonous, noxious or polluting material into the water environment. Prosecution may ensue if the pollution is serious enough to lower the ecological status of the water body in terms set by the Water Framework Directive (2000/60/EC).

7.5.2 The polluter does not have to be prosecuted first for remediation of damage to be required. If water pollution is serious enough to be classed as environmental damage the damage will require to be remediated such that the area is returned to the condition it would have been in if the damage had not occurred.

7.5.3 An offence may also be committed if environmental damage or the threat of environmental damage is not reported by the polluter or if no action is taken by the polluter to prevent further damage. Third parties (e.g. private water supply users, landowners, recreational users and the public) who may be affected by possible damage may also report 'risk' of environmental damage to the enforcing authority; in this instance an offence may be committed if action is not taken to prevent the potential environmental damage occurring.

7.5.4 The principles of Sustainable Drainage Systems (SuDS) shall be applied to all components of design and construction regarding surface water management. Any design or site works that may impact on the site drainage or water quality shall:

- Soakaway where soils allow
- Consider and manage erosion
- Retain any silts on site and prevent silts from discharging into watercourses or drains
- Remove pollutants in surface water
- Keep runoff rates at existing greenfield runoff
- Prevent accidental spillages reaching watercourses.

7.5.5 As infiltration is not expected to be viable on site, the temporary drainage for the development will be in the form of land drainage with discharge into the existing sewer, with the appropriate levels of treatment.

7.5.6 Pollution will be controlled via the use of catchpit manholes and geotextiles.

7.5.7 Any potentially hazardous substances (i.e. form plant / deliveries) will be within a controlled compound with a separate drainage system that will contain a penstock valve / containment kit in the event of a spillage.

7.6 Foul Water Drainage

7.6.1 The foul water for the development will discharge into the existing public sewer. Foul water flows are anticipated to be 1.018 litres per second based on 4000 litres per dwelling per day in accordance with Sewers for Adoption 7th Edition.

8.0 Water Quality

8.1 Water Quality Overview

8.1.1 A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution. This can be effectively managed by an appropriate "train" or sequence of SuDS components that are connected in series.

8.1.2 The frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10 mm of rainfall (first flush) should be adequately treated with SuDS.

8.1.3 The minimum number of treatment stages will depend on the sensitivity of the receiving water body and the potential hazard associated with the proposed development SuDS Manual (CIRIA, 2015).

8.1.4 The proposed development is a combination of very low (roof water) to low hazard (runoff from small car parking areas), as indicated on the table below:

Hazard	Source of Hazard	Present
Very Low	Residential Roof drainage.	**YES**
Low	Residential amenity uses including low usage car parking spaces and roads, other roof drainage	**YES**
Medium	Commercial, industrial uses including car parking spaces and roads (excluding low usage road, trunk roads and motorways)	**NO**
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste	**NO**

8.1.5 The site does lie within a source protection zone and therefore additional treatment stages are required.

8.1.6 The treatment processes provided by different SuDS components will have varying capabilities for removal of different types of contaminants as per the table below:

Hazard	Requirements for discharge to surface water and groundwater	Present
Very Low	Removal of gross solids and sediments only.	**YES**
Low	Simple index approach	**YES**
Medium	Surface water: Simple index approach Ground water: Simple index approach and risk screening	**NO**
High	Guidance and risk assessment process in HA (2009). Discharge may require environmental permit or licence. Obtain pre-permitting advice from environmental regulator. Risk assessment likely to be required.	**NO**

8.2 Simple Index Approach

8.2.1 The index approach as defined by CIRIA C753 (the SuDS Manual) defines the index approach to water quality in three steps as defined in Box 26.2 below:

BOX 26.2 Steps of the simple index approach

Step 1 – Allocate suitable pollution hazard indices for the proposed land use

Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index

Step 3 – Where the discharge is to protected[1] surface waters or groundwater, consider the need for a more precautionary approach

Note:

1 Designated as those protected for the supply of drinking water (Table 4.3).

8.3 Step 1- Allocate Potential Hazards

8.3.1 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Total SuDS mitigation index ≥ pollution hazard index

(for each contaminant type) (for each contaminant type)

8.3.2 Where the only destination of the runoff is to a surface water – that is there is no infiltration from the SuDS to groundwater – the surface water indices should be used.

8.3.3 In England and Wales, where the principal destination of the runoff is to a surface water, but small amounts of infiltration may occur from unlined components (Interception), then the groundwater indices should be used for the discharge to groundwater, and the surface water indices should be used for the main surface water discharge (as suggested in Table 26.3).

8.3.4 Where the principal destination of the runoff is to groundwater, but discharges to surface waters may occur once the infiltration capacity is exceeded, the groundwater indices should be used, as suggested in Table 26.4. The risk to surface waters will be low, as dilution will be high for large events, so treatment is not required.

8.3.5 The pollution indices for this site have been selected using the guidance in CIRIA C753 and are as per Table 26.2 below:

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.

Where a site land use falls outside the defined categories, the indices should be adapted (and agreed with the drainage approving body) or else the more detailed risk assessment method should be adopted.

Where nutrient or bacteria and pathogen removal is important for a particular receiving water, equivalent indices should be developed for these pollutants (if acceptable to the drainage approving body) or the risk assessment method adopted.

8.3.6 The identified hazard levels are as follows:

- Total Suspended Solids (TSS) 0.70
- Metals 0.60
- Hydrocarbons 0.45

8.3.7 Treatment has been provided in the form of catchpit manholes to remove sediment and contaminated particles and geotextiles within the porous paving as a filter medium.

8.3.8 Additional treatment is provided in the pond with appropriate planting and reeds.

8.4 Treatment with Discharge to Surface Water

8.5 As the site is discharging to a watercourse or sewer, Table 26.3 of the CIRIA C753 manual is used to evaluate the water quality mitigation measures offered by the proposed drainage system.

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**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.

8.5.1 The identified hazard remediation levels are as follows:

		Hazard	Treatment	Result
–	Total Suspended Solids (TSS)	0.70	0.70	0
–	Metals	0.60	0.60	0
–	Hydrocarbons	0.45	0.45	0

9.0 Flooding Information

9.1.1 As set out in the National Planning Policy Framework (NPPF), inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere. For these purposes:

- "areas at risk of flooding" means land within Flood Zones 2 and 3; or land within Flood Zone 1 which has critical drainage problems, and which has been notified to the local planning authority by the Environment Agency;
- "flood risk" means risk from all sources of flooding - including from rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources.

9.1.2 Flooding information for Planning from the Environment Agency (EA) has shown that the site lies within Flood Zone 1, as found in the map at **Appendix J**.

9.1.3 As the site is within Flood Zone 1, no further data was requested from the Environment Agency.

9.1.4 As part of the data capture, data and mapping from the Hillingdon Strategic Flood Risk Assessment (SFRA) was sought. This will be included and references in the relevant sections below.

10.0 Flood Risk

10.1.1 The data on the EA's website in their updated mapping, shows the site has a "very low" risk of flooding.

10.1.2 The EA confirmed that the proposed development site is located in Flood Zone 1 for Planning.

10.1.3 According to Table 2 of National Planning Policy Framework (NPPF), the development, being residential, is classed as 'more vulnerable'.

10.1.4 According to NPPF Table 3 'Flood Risk Vulnerability and Flood Zone Compatibility', the development should be permitted.

Table 3: Flood risk vulnerability and flood zone 'compatibility'

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

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

10.2 Sequential Test

10.2.1 Local Planning Authorities (LPA) are encouraged to take a risk-based approach to proposals for development in or affecting flood risk areas through the application of the Sequential Test and the objectives of this test are to steer new development away from high risk areas towards those at lower risk of flooding.

10.2.2 However, in some areas where developable land is in short supply, there can be an overriding need to build in areas that are at risk of flooding. In such circumstances, the application of the Sequential Test is used to ensure that the lower risk sites are developed before the higher risk ones.

10.2.3 NPPF (PPS25) states that the Sequential Test should be applied at all stages of the planning process and the starting point is generally the Environment Agency's flood zone maps.

10.2.4 These maps and the associated information are intended for guidance and cannot provide details for individual properties. They do not consider other considerations such as existing flood defences, alternative flooding mechanisms and detailed site-based surveys. They do, however, provide high level information on the type and likelihood of flood risk in any area of the country.

10.2.5 The site is within Flood Zone 1 and therefore the sequential test is not applicable.

10.3 Exception Test

10.3.1 The Exception Test is an additional test to be applied by decision-makers following application of the Sequential Test. The Exception Test has two elements as shown below, both of which must be satisfied for development in a flood risk area to be considered acceptable.

10.3.2 The Exception Test is only appropriate for use when there are large areas in Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some continuing development is needed for wider sustainable development reasons, considering the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during floods.

10.3.3 For the Exception Test to be passed:

a. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA; and,
b. A site-specific FRA must demonstrate that the development will be safe for its lifetime, without increasing flood risk elsewhere and, where possible, reducing flood risk overall.

10.3.4 The NPPF does not request an exception test.

10.4 Fluvial Flooding Risk

10.4.1 The Environment Agency flood information there is no risk of fluvial flooding on site.

10.5 Historic Flood Data

10.5.1 The Environment Agency and Hillingdon Council have no information indicating that the site was flooded historically from fluvial sources.

10.6 Groundwater

10.6.1 Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A ground water flood event results from a rise in ground water level, enough for the water table to intersect the ground surface and inundate low lying land. Groundwater floods may emerge from either a single point or diffuse locations.

10.6.2 The underlying strata throughout the area and investigations into the SFRA geology data suggest that there is a risk of groundwater emergence which is likely to relate to the geology of the area. However, groundwater flooding risks are often highly localised, and dependent upon geological interfaces between permeable and impermeable subsoils. Therefore, sustainable construction techniques for surfacing will minimise any potential groundwater risk.

10.6.3 The Hillingdon SFRA (West London GIS Mapping) has no information indicating that the site is at an elevated risk of groundwater flooding, with the groundwater susceptibility at less than 25% and the site does not lie in a vulnerable area.

10.7 Flooding from Sewers

10.7.1 Flooding from sewers can occur because of different reasons; if sewers are blocked during the heavy rainfalls, or if sewer cannot provide adequate capacity, then flooding can cause a large amount of damage.

10.7.2 The Hillingdon SFRA (West London GIS Mapping) has no records indicating the site has been flooded by sewers historically.

10.8 Flooding from Reservoirs

10.8.1 Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensures that reservoirs are inspected regularly, and essential safety work is carried out.

10.8.2 However, in the unlikely event that a reservoir dam failed, a large volume of water would escape at once and flooding could happen with little or no warning. If the site is within a risk area, plans should be made for safe evacuation and escape. Residents may need to evacuate immediately, know the safest route to safety, and be ready to follow the advice of emergency services.

10.8.3 The EA data indicates that the site is not at risk from reservoir flooding.

10.9 Surface Water Flooding

10.9.1 Overland flow / surface water flooding typically arise because of intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems. It can run quickly off land and result in localised flooding.

10.9.2 The Environment Agency has produced illustrative mapping (Flood Map for Surface Water) relating to flooding risks from surface water. They are classified as Flood Hazard Maps for the purpose of the Flood Risk Regulations 2009. These maps are the next generation on from the previous “Area Susceptible to Surface Water Flooding” maps, which are contained within the SFRA.

10.9.3 The EA maps show high resolution image and indicative flow paths for pluvial events. The maps are based on coarse level data and indicate ridges, valleys and flat spots where water would collect. Typically, the flow paths follow valleys, rivers and watercourses.

10.9.4 The surface water maps and the associated information are intended for guidance only and cannot provide details for individual properties. They do, however, provide high level information and indicate areas in which surface water flooding issues should be investigated further. The risk categories are classified as follows:

- Very low probability of flooding – This zone is assessed as having less than a 1 in 1000 annual probability of surface water flooding.
- Low probability of flooding – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of surface water flooding.
- Medium probability of flooding - This zone comprises land assessed as having between a 1 in 30 and 1 in 100 annual probability of surface water flooding.
- High probability of flooding – This zone is assessed as having greater than a 1 in 30 annual probability of surface water flooding.

10.9.5 A review of the EA mapping indicates there is no risk of surface water flooding to the site. However, there may be some risk to the adjacent road and land.

10.9.6 An assessment of the "medium" risk scenario (up to 1 in 100 year event) indicates that the risk of surface water flooding is minimal and localised to the roads, so there should not be a hazard to occupants of the site.

11.0 Maintenance

11.1.1 Maintenance of SuDS drainage should be in accordance with the guidance presented in CIRIA Factsheet “Maintenance of SuDS” May 2017. A detailed maintenance plan for the scheme will be generated by the appointed owner/maintainer of the site or a selected maintenance company and this section is for guidance only.

11.1.2 Maintenance operations can be divided into the following categories:

- Regular (or routine frequent) - this covers items that are carried out typically with a frequency from monthly to annually. It includes item such as inspection and monitoring, litter removal, grass cutting or other vegetation management, sweeping permeable pavements.
- Infrequent (or routine infrequent) - this covers items that are required typically with a frequency from annually up to 25 years (or possibly greater). It includes items such as wetland vegetation management, silt removal from swales, ponds or wetlands, scarifying and spiking infiltration basins and gravel replacement to filter drains.
- Remedial (or reactive) - this covers maintenance that is not usually required, but may be necessary as a result of vandalism, accidental damage, rainfall that exceeds the design capacity or similar events. Examples include repair of erosion in a swale or repair of permeable surfaces blocked for example by mixing concrete on them.

11.2 Riparian Responsibility

11.2.1 If a resident owns land adjoining, above or with a portion of the drainage system running through it, they have certain rights and responsibilities. In legal terms they are a ‘riparian owner’. If they rent the land, they should agree with the owner who will manage these rights and responsibilities.

11.2.2 It is recommended that the owner’s appointed Management Company handle the maintenance of all underground drainage and all SuDS devices, with the following exceptions:

- Inspecting and cleaning out any surface mounted hard drainage systems (such as channel drains);
- Inspecting and cleaning out (or reporting) SuDS systems on a small scale (such as garden ditches and swales).

11.3 Allowing for Replacement

11.3.1 The design life of some SuDS elements and drainage elements of the proposed system is shorter than the predicted design life of the development. Therefore, the design and maintenance regime consider any potential replacement works (such as replacing permeable paving).

11.3.2 Regular inspection of the drainage system should be as per the tables below.

Operation and maintenance requirements for Surface Water Systems		
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular Maintenance	Inspect for sediment and debris in catchpit manholes and gullies. Clean out as required	Twice Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional Maintenance	Remove sediment and debris from catchpits, gullies, attenuation devices and inside of concrete manhole rings	As required, based on inspections
Remedial Actions	Reconstruct and/or replace components, if performance deteriorates or failure/blockage occurs	As required
	Replacement of clogged components (flow restriction)	As required
Monitoring	Inspect silt traps/gullies/catchpits and note rate of sediment accumulation	Monthly in the first year and then annually
	Check flow control chamber and attenuation devices	Annually

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

12.0 Summary and Conclusions

12.1.1 B&M Investments Limited is planning a proposed development on the site at 1-6 Station Parade, Ickenham Rd, Ruislip HA4 7DL.

12.1.2 Patrick Parsons has been instructed by B&M Investments Limited, to produce a Drainage Strategy to support the Planning Application.

12.1.3 No documentary or anecdotal evidence has been found to show previous flooding events for this site.

12.1.4 The surface water system will discharge into the public surface water sewer at a restricted rate.

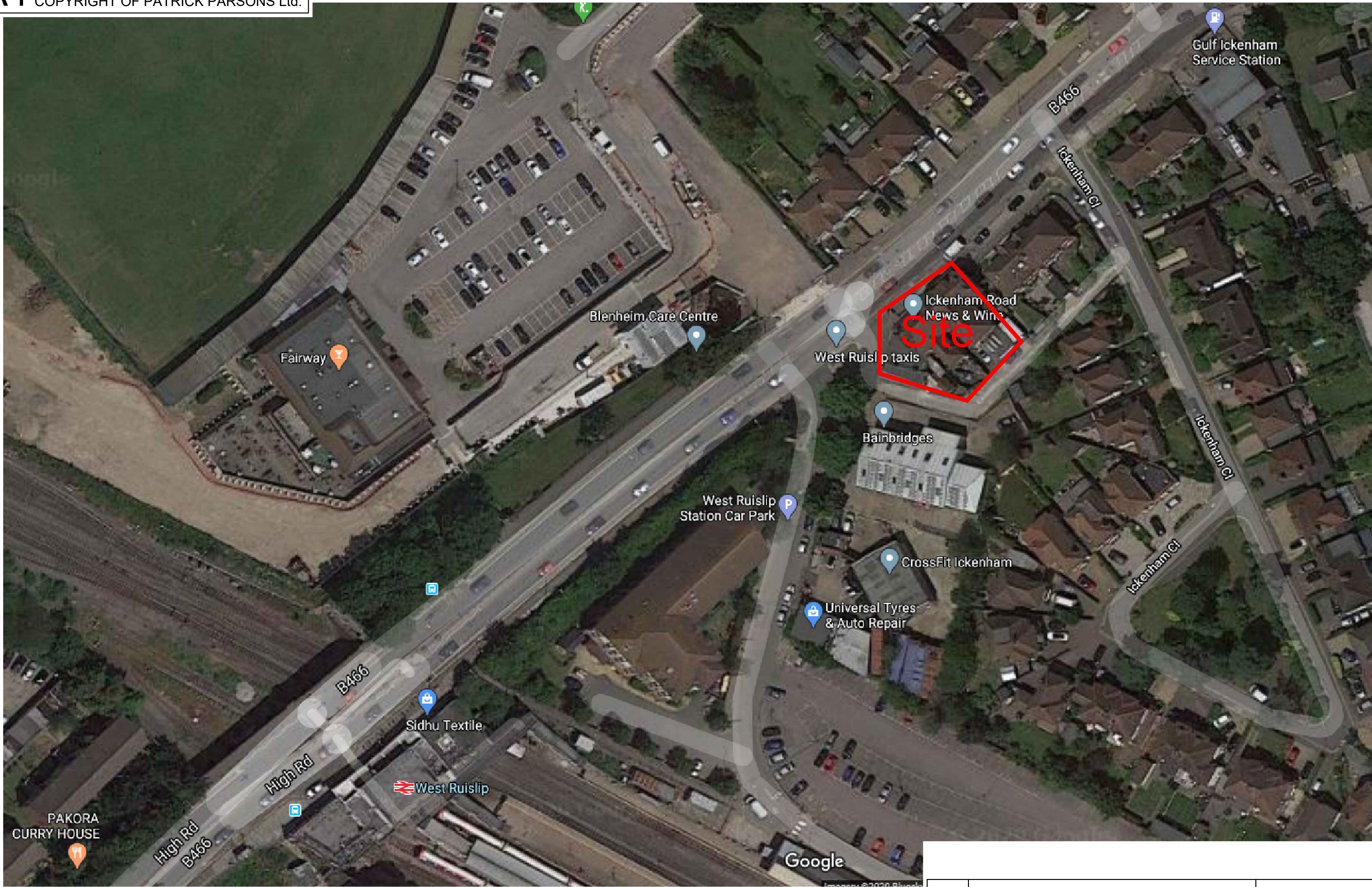
12.1.5 The foul water will discharge into the existing public sewer.

12.1.6 The report has demonstrated that the proposed drainage measures ensure that no property will be at risk of flooding if the development proceeds and that suitable means of surface water and foul drainage can be achieved for the proposed development.

Appendix A

Location Plan

A4 ORIGINAL SIZE - DO NOT SCALE.



P1	INITIAL ISSUE	07.02.20	JBr	CV

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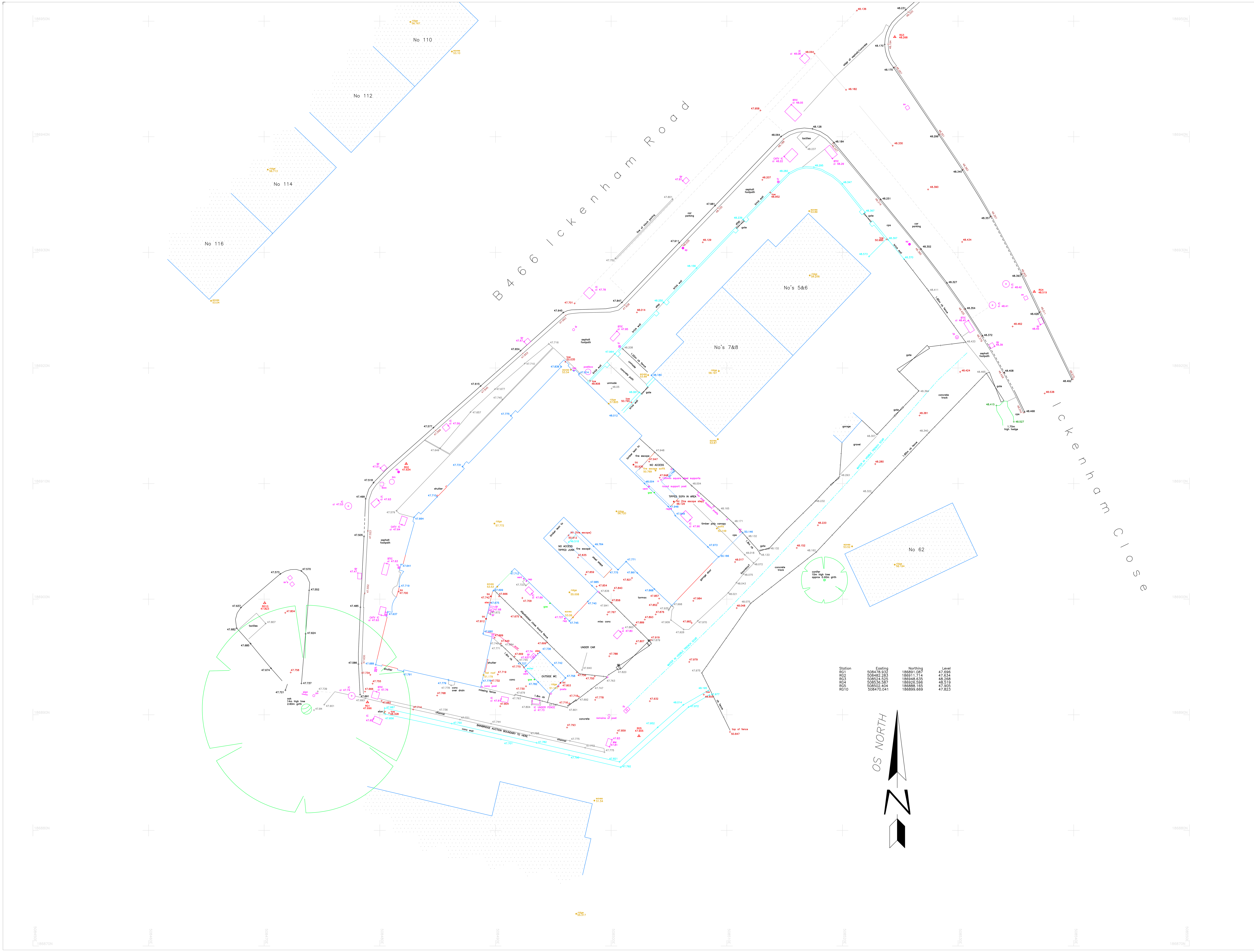
Client	B & M Investements
Project	1-6 Station Parade
Drawing	Site Location Plan
Scales	NTS
Date	Feb 20
Drawn	JBr
Checked by	CV
Drawing No.	A20032-201
Rev.	P1

Appendix B

Topographical Survey



Station	Easting	Northing	Level
RG1	508478.932	186891.087	47.696
RG2	508482.283	186911.714	47.634
RG3	508524.525	186948.635	48.268
RG4	508536.587	186926.596	48.519
RG5	508502.404	186888.165	47.905
RG10	508470.041	186899.669	47.823

Topographic Legend

Building (footprint)
Building canopy (overhead) /foundations/ruins
Kerb / hard surface (levels at channel)
Verge/ change of surface / ditch
Bank
Fence: cb Closed board; cp Conc. panel; hr Hand rail; bw Barbed wire; pc Post & chain; pr Post & rail; sec Security Fence; ob Open board; clf Chain link; pw Post & wire; ir Iron railings
Armco Safety barrier
Overhead cable
Gate
Hedge
foliage/tree canopy
Bench Mark
BT IC
TV IC
Tree Gn.n =girth
52.47 level
bh Borehole

bol	Bollard	mp	Mile post
bin	Litter bin	Mic	Mercury Telecom IC
bp	Block Paving	rnp	Road Name plate
bs	Bus stop	pm	Parking meter
BT	British Telecom IC	po	Post
cab	Cabinet	re	Rodding eye
cps	Concrete Paving Slabs	rs	Road sign (electrical)
tv	Cable Television cover	rwp	Rain water pipe
dl	Data Logger	sp	Sign Post
dp	Down Pipe	st	Stop tap
ejb	electric junction box	sv	Stop valve
ep	Elec. pole	stay	Cable stay
fl	Floodlight	tcb	Telephone call box
fm	Flow Meter	tl	Traffic light
fp	Flagpole	tp	Telegraph pole
gp	Gate post	vp	Vent pipe
gy	Gully	wm	Water meter
gv	Gas valve	wo	Water outlet
fh	Hydrant	utl	Unable to Lift
ht	Height	uts	Unable to Survey
IC	Inspection Cover		
jb	Junction box		**Level prefix descriptions**
ko	Kerb outlet	ah	Arch level
lb	Letter box	bl	Bed level
lp	Lamp post	cl	Cover level
mkr	Utility marker	el	Eaves level
mb	Multi-bole tree trunk	ffl	Finished Floor level
	Drainage abbreviations	il	Invert level
bd	Back drop	pl	Parapet level
lh	Lamp hole	rl	Roof/Ridge level
re	Rodding eye	sfl	Soffit level
of	Overflow	tow	Top of wall level
ww	Wash water	twl	Top water level
		wl	Water level

Please note surveyed boundaries may not represent the extent of legal ownership of the land.

Contractor should check crucial dimensions on site before commencement of any work.

Grid Orientation and Level Datum:

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN15 and OSGM15 transformation models. The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation. No scale factor applied.

Services Survey verified with Utility Record Plans
CHECK MUST BE MADE BY ANOTHER SURVEYOR

Utility Type	Company	Checked	Verified
Electricity			
Water			
Drainage			
Gas			
Cable TV			
Telecoms			
Oil Pipelines			
Other			

NOT APPLICABLE

Services Survey Key

HV ELECTRIC CABLES
LV ELECTRIC CABLES
TELEPHONE
CABLE TV
DATA CABLES
GAS MAINS
WATER MAINS
UNIDENTIFIED
FOUL WATER SEWERS (FWS)
COMBINED WATER SEWERS (CWS)
STORM WATER SEWERS (SWS)
RISING MAIN
ABANDONED SERVICE
OVERHEAD SERVICE
OTHER SERVICES
END OF TRACE (EOT)

av	air valve	lp	lamp post
AG	Abandoned Gas	mkr	marker
AW	Abandoned Water	NL	not located
bd	back drop	o/f	overflow
BT	British Telecom IC	PE	polyethylene
cab	cabinet	prv	pressure reducing valve
cl	cover level	re	rodding eye
dp	down pipe	rs	road sign
ejb	electricity junction box	rts	rodded to stop
EML	electromagnetic location	rwp	rain water pipe
EOR	end of rodding	sc	stop cock
EOT	end of trace	sv	stop valve
ep	electricity pole	tp	telegraph pole
fl	flood light	tv	cable tv ic
fh	fire hydrant	UTL	unable to lift
GPR	ground probing radar	UTS	unable to survey
gs	gas syphon	vp	vent pipe
gv	gas valve	wl	water level
ic	inspection chamber	wm	water meter
il	invert level	wo	washout
lh	lamp hole		

Services Survey Notes

Services detection including electromagnetic location (EML) and ground probing radar (GPR) have been used to locate underground services. RGI Surveys have successfully used these methods since our establishment in 1989. identification of services is only possible through confirmation with record drawings & with surveyor's experience in the field. please be aware that results are not flawless and where critical we advise confirmation of services by trial excavations.
The services survey should be read in conjunction with utility record drawings. single cable lines may represent multiple cables and ducts.
Statutory utility records can be obtained through Linesearch.org. although all efforts are made to provide a complete & comprehensive survey as possible, Rugby Ground Information LTD cannot guarantee the completeness of the survey.
Only BT contractors are allowed to access BT covers therefore our survey for BT cables may be restricted. we advise contacting Openreach to arrange telecoms location by openreach engineers prior to any excavation.
Additional services may exist within the survey area.
depths to services (eg 1.00d) are provided as a guidance only and are not infallible. Where critical we advice confirmation by trial excavations to determine location, depth and identity.
Drainage depths are inverts from cover level.
drainage surveys have been carried out by non–man entry means, unless otherwise stated. pipe sizes & depths are as accurate as possible when surveyed from the surface.
Where survey includes services and anomalies determined utilising GPR on a realtime basis with a single frequency system. Please note GPR results are open to interpretation and dependant upon ground conditions. Results are to the best of our abilities.
Services not electronically located are annotated as follows:
GPR GROUND PROBING RADAR
NL–A NOT LOCATED – plotted in an assumed position
NL–I NOT LOCATED – plotted from on site information
NL–R NOT LOCATED – taken from records
NL–TS NOT LOCATED – plotted from visible trench scars

Rev Details

Client
GAA – Aitor Carreton

Project Title
Topographic Survey

1–6 Station Parade
Ickenham Road Ickenham HA4 7DL

drawing no. 9063 Station Parade
date 19th Feb 2020

surveyed	drawn	chkd	scale	plot
RGI	RGI	RGI	1:100	A0

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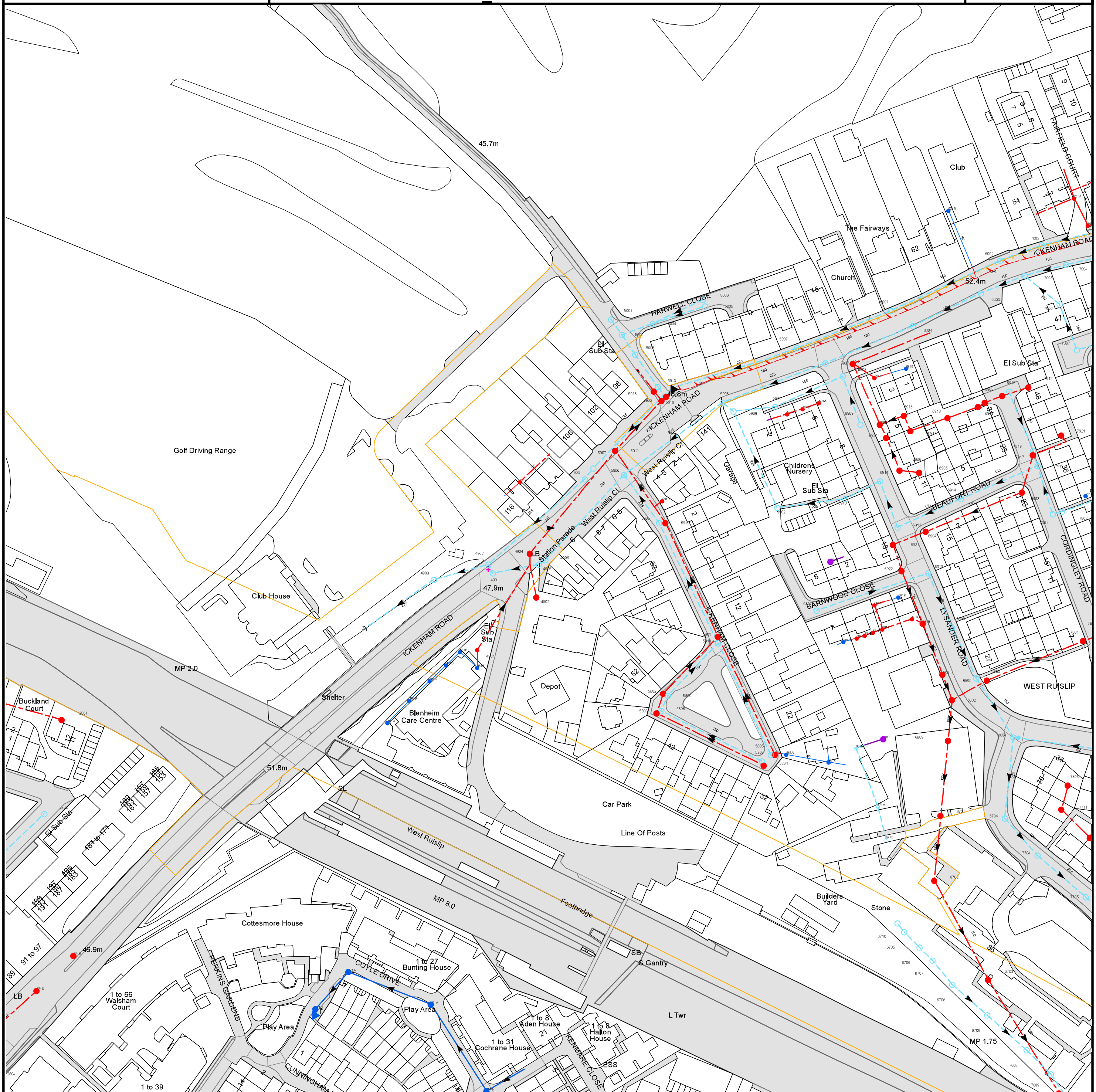
Cert No.GB2002292

Appendix C

Thames Water Sewer Records

Asset Location Search Sewer Map - ALS/ALS Standard/2020_4148449



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 508484,186915

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
2702	46.84	45.76
2801	n/a	n/a
271D	n/a	n/a
271E	n/a	n/a
7711	n/a	n/a
7803	n/a	n/a
7801	n/a	n/a
7705	49.12	47.25
7713	n/a	n/a
7615	n/a	n/a
7901	n/a	n/a
7006	n/a	n/a
7921	n/a	n/a
7902	n/a	n/a
7004	n/a	n/a
701A	n/a	n/a
7007	n/a	n/a
791A	n/a	n/a
701E	n/a	n/a
7903	n/a	n/a
691C	n/a	n/a
6925	n/a	n/a
6911	50.55	49.29
6924	n/a	n/a
6001	51.47	50.13
6906	n/a	n/a
6916	n/a	n/a
691B	n/a	n/a
6917	n/a	n/a
6004	51.7	50.59
6905	n/a	n/a
6918	n/a	n/a
601B	n/a	n/a
6914	51.21	49.79
6919	n/a	n/a
6003	52.49	51.23
6901	n/a	n/a
6002	53.11	51.62
6902	n/a	n/a
6915	52.43	50.84
6903	n/a	n/a
7003	n/a	n/a
7912	n/a	n/a
7917	n/a	n/a
7918	52.53	50.69
7919	52.54	50.6
7002	53.8	52.12
681C	n/a	n/a
681D	n/a	n/a
681M	n/a	n/a
681E	n/a	n/a
671A	n/a	n/a
681L	n/a	n/a
671B	n/a	n/a
6710	n/a	n/a
6705	n/a	n/a
6706	n/a	n/a
6707	n/a	n/a
6702	n/a	n/a
6701	n/a	n/a
6801	n/a	n/a
6809	n/a	n/a
6802	n/a	n/a
6708	n/a	n/a
6805	50.26	48
6709	n/a	n/a
6803	n/a	n/a
6703	n/a	n/a
6704	49.68	47.6
6804	50.34	47.81
7608	n/a	n/a
7704	49.55	47.47
7609	n/a	n/a
5801	48.61	46.46
681I	n/a	n/a
681F	n/a	n/a
681J	n/a	n/a
6806	50.46	48.36
681B	n/a	n/a
681G	n/a	n/a
6807	49.77	48.98
681H	n/a	n/a
4802	47.58	45.34
681K	n/a	n/a
4909	n/a	n/a
4901	47.39	46
6913	50.52	48.52
6922	n/a	n/a
4902	47.57	46.15
4905	47.48	46.28
691D	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
4906	47.58	46.54
4904	47.42	45.27
6921	n/a	n/a
6904	n/a	n/a
6912	50.41	49.36
5912	48.4	46.02
5905	48.38	46.69
5902	50.17	48.8
591C	n/a	n/a
6910	50.34	49.11
491A	n/a	n/a
4903	48.1	46.7
5906	n/a	n/a
5907	48.12	46.71
5911	48.28	44.93
6909	n/a	n/a
591A	n/a	n/a
5909	49.95	48.04
591B	n/a	n/a
5901	50.22	48.37
691A	n/a	n/a
5908	49.11	47.66
5903	48.66	44.73
5919	48.66	44.07
5918	48.57	46.27
5913	n/a	n/a
6908	50.37	48.81
601A	n/a	n/a
6907	50.15	48.95
5003	n/a	n/a
5007	50.09	48.55
5002	n/a	n/a
5004	n/a	n/a
5001	n/a	n/a
5005	n/a	n/a
5006	n/a	n/a
371B	n/a	n/a
371A	n/a	n/a
481A	n/a	n/a
481B	n/a	n/a
481C	n/a	n/a
471A	n/a	n/a
481D	n/a	n/a
481E	n/a	n/a
481F	n/a	n/a
4801	n/a	n/a
461A	n/a	n/a
5803	48.05	46.7
5808	48.11	47.03
5802	48.16	46.69
5809	48.15	46.95
5810	48.63	46.82
5807	48.09	47.12
5804	48.01	46.88
5806	48.11	47.11
5805	48.08	46.76
581A	n/a	n/a

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

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

- Trunk Surface Water
- Trunk Foul
- Storm Relief
- Trunk Combined
- Vent Pipe
- Bio-solids (Sludge)
- Proposed Thames Surface Water Sewer
- Proposed Thames Water Foul Sewer
- Gallery
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Sludge Rising Main
- Proposed Thames Water Rising Main
- Vacuum

Sewer Fittings

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

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

Operational Controls

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

- Control Valve
- Drop Pipe
- Ancillary
- Weir

End Items

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

- Outfall
- Undefined End
- Inlet

Other Symbols

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

- Public/Private Pumping Station
- Change of characteristic indicator (C.O.C.I.)
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Operational Site
- Chamber
- Tunnel
- Conduit Bridge

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

- Foul Sewer
- Surface Water Sewer
- Combined Sewer
- Gulley
- Culverted Watercourse
- Proposed
- Abandoned Sewer

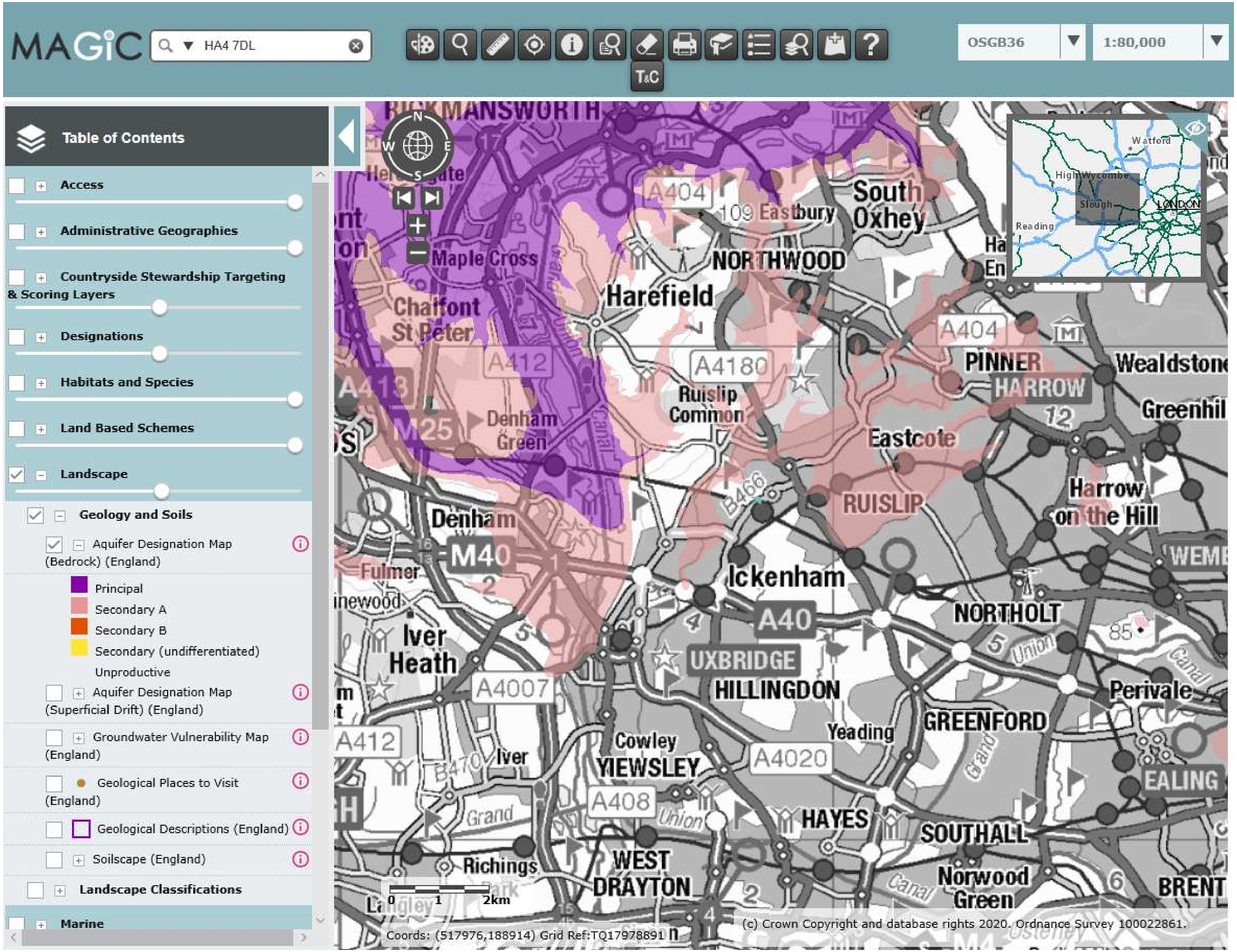
Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Thames Water Utilities Ltd, Property Searches, PO Box 3189, Slough SL1 4W, DX 151280 Slough 13
T 0845 070 9148 E searches@thameswater.co.uk I www.thameswater-propertysearches.co.uk

Appendix D

Magic Map Geology Information


MAGIC
HA4 7DL
T&C
OSGB36
1:80,000
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Habitats and Species
Land Based Schemes
Landscape
Geology and Soils
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Principal
Secondary A
Secondary B
Secondary (undifferentiated)
Unproductive
Aquifer Designation Map (Superficial Drift) (England)
Groundwater Vulnerability Map (England)
Geological Places to Visit (England)
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Denham
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Harrow on the Hill
Ickenham
NORTHOLT
Iver Heath
UXBRIDGE
HILLINGDON
Perivale
GREENFORD
Yeading
Cowley
YIEWSLEY
HAYES
SOUTHALL
EALING
WEST DRAYTON
Richings Park
Norwood Green
BRENT
Iver
Fulmer
Watford
High Wycombe
Slough
LONDON
Reading
A404
A4180
A412
A40
A4007
A4020
A408
M40
M25
0 1 2km
(c) Crown Copyright and database rights 2020. Ordnance Survey 100022861.
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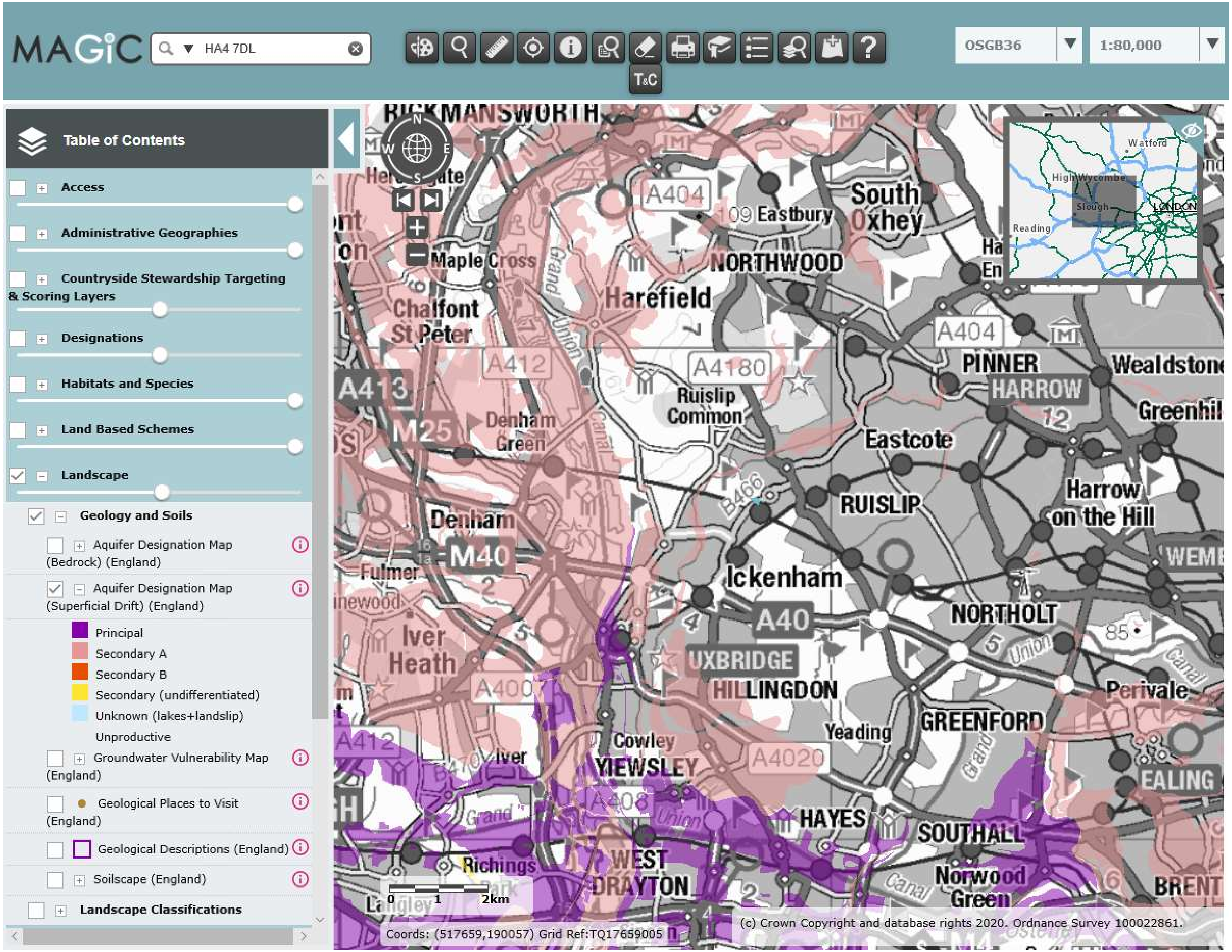
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HA4 7DL
T&C
OSGB36
1:80,000
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Geology and Soils
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Aquifer Designation Map (Superficial Drift) (England)
Principal
Secondary A
Secondary B
Secondary (undifferentiated)
Unknown (lakes+landslip)
Unproductive
Groundwater Vulnerability Map (England)
Geological Places to Visit (England)
Geological Descriptions (England)
Soilscape (England)
Landscape Classifications
RICKMANSWORTH
South Oxhey
Eastbury
NORTHWOOD
Maple Cross
Harefield
Chalfont St Peter
PINNER
HARROW
Wealdstone
Ruislip Common
Denham Green
Eastcote
RUISLIP
Harrow on the Hill
Denham
Fulmer
Ickenham
NORTHOLT
Iver Heath
UXBRIDGE
HILLINGDON
Perivale
GREENFORD
Yeading
Cowley
YIEWSLEY
EALING
HAYES
SOUTHALL
Richings
WEST DRAYTON
Norwood Green
BRENT
A404
A4180
A412
A413
M25
M40
A40
A4020
A4008
Watford
High Wycombe
Slough
Reading
LONDON
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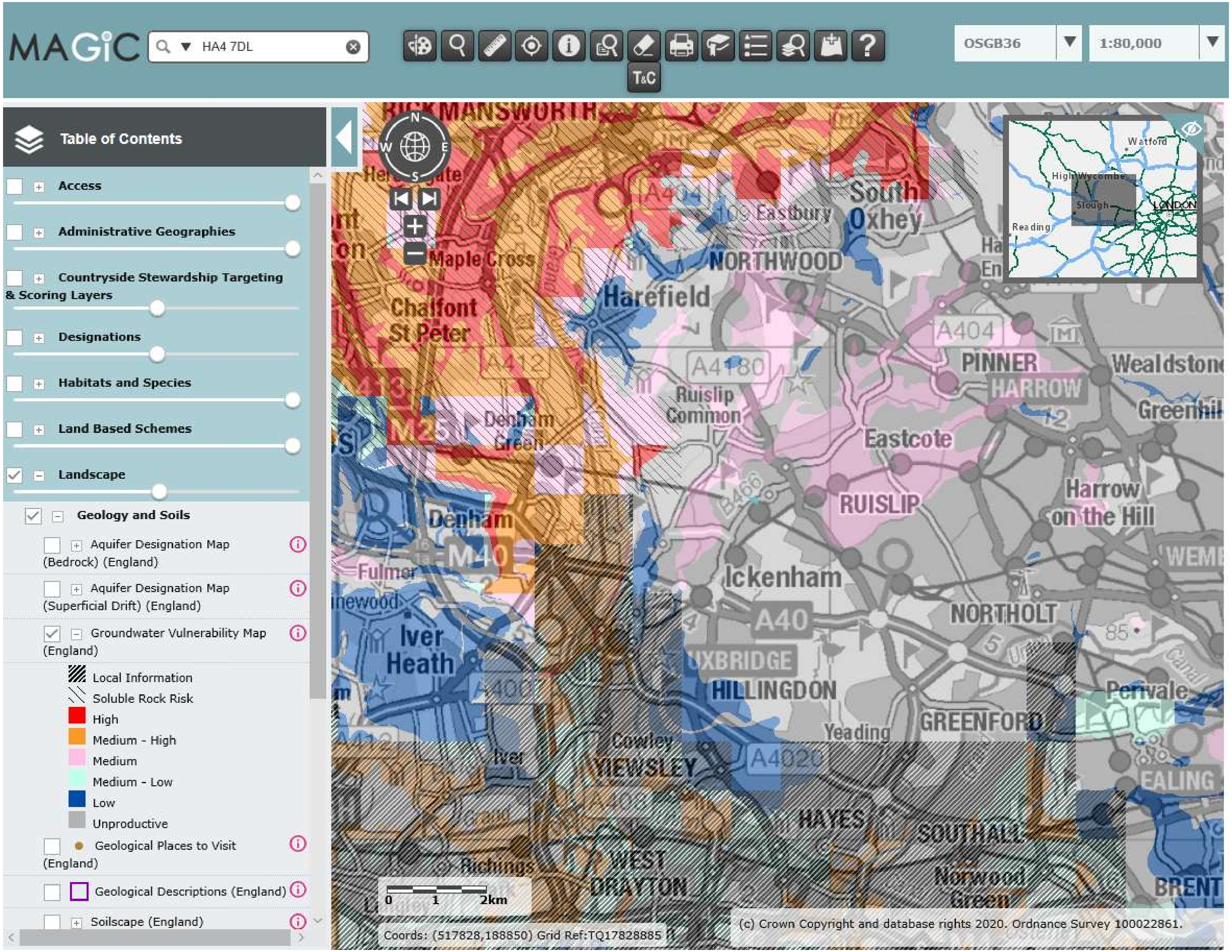

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HA4 7DL
T&C
OSGB36
1:80,000
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Aquifer Designation Map (Superficial Drift) (England)
Groundwater Vulnerability Map (England)
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High
Medium - High
Medium
Medium - Low
Low
Unproductive
Geological Places to Visit (England)
Geological Descriptions (England)
Soilscape (England)
RICKMANSWORTH
Maple Cross
Chalfont St Peter
Harefield
NORTHWOOD
South Oxhey
Eastbury
PINNER
HARROW
Wealdstone
Ruislip Common
Eastcote
RUISLIP
Harrow on the Hill
Denham Green
Denham
Fulmer
Ickenham
NORTHOLT
Iver Heath
UXBRIDGE
HILLINGDON
Yeading
GREENFORD
Perivale
Cowley
YIEWSLEY
Iver
HAYES
SOUTHALL
EALING
Richings
WEST DRAYTON
Norwood Green
BRENT
A404
A4180
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A412
A4020
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M40
Watford
High Wycombe
Slough
Reading
LONDON
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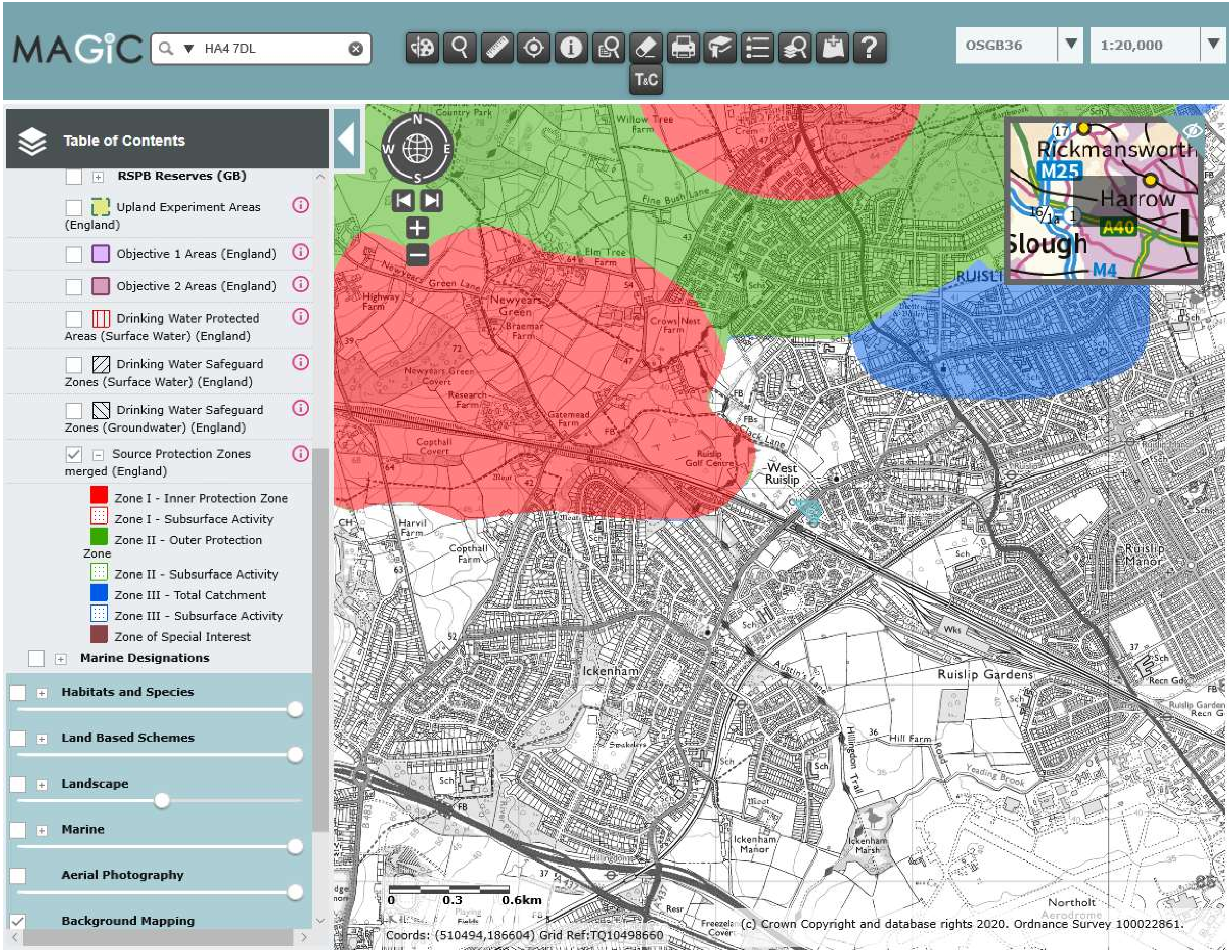

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HA4 7DL
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OSGB36
1:20,000
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RSPB Reserves (GB)
Upland Experiment Areas (England)
Objective 1 Areas (England)
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Zone II - Subsurface Activity
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M25
Harrow
A40
Slough
M4
West Ruislip
Ickenham
Ruislip Gardens
Ruislip Manor
Newyears Green
Northolt
0 0.3 0.6km
Coords: (510494,186604) Grid Ref:TQ10498660
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Appendix E

Greenfield Run-Off

ICP SUDS Mean Annual Flood

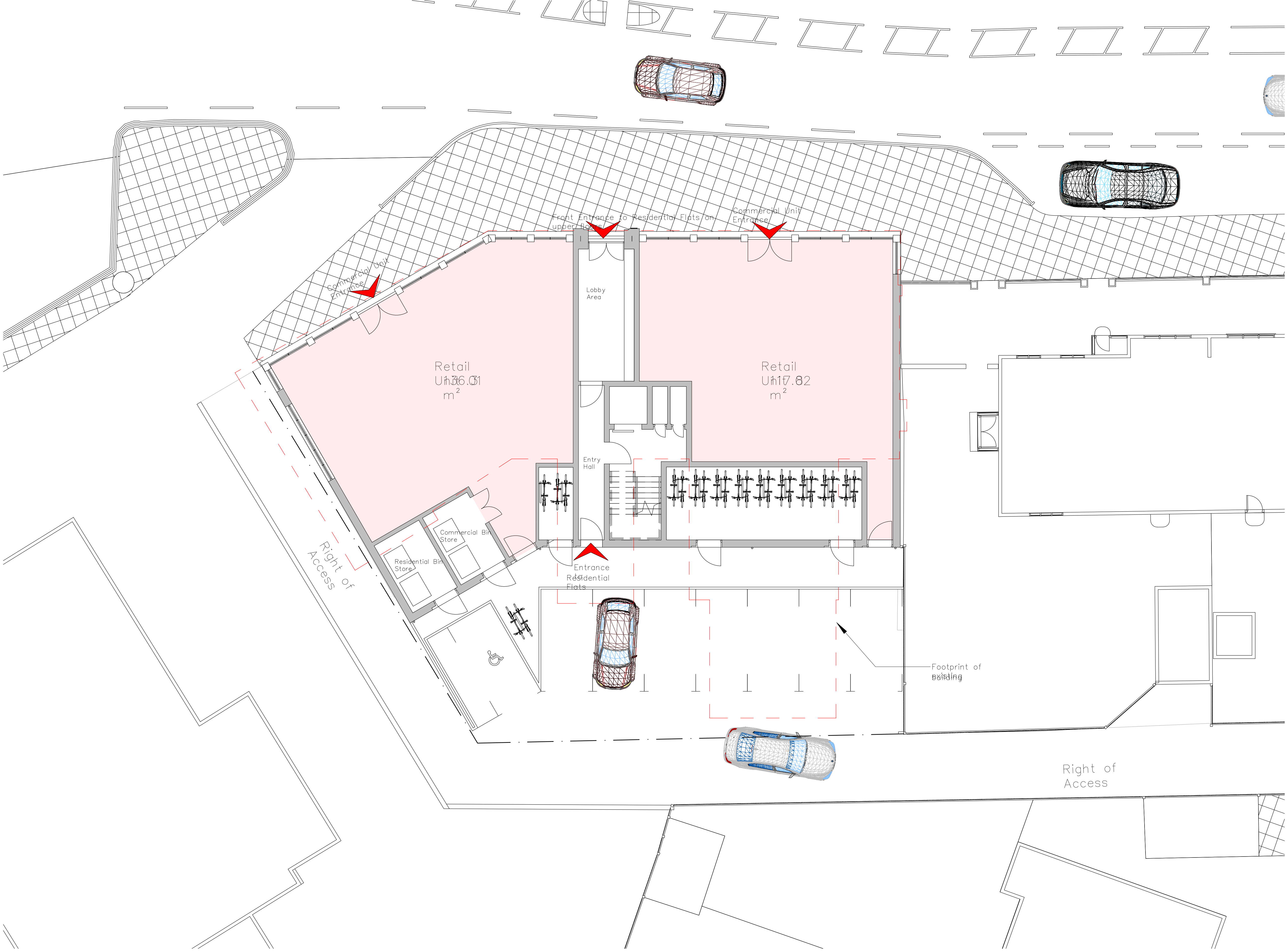
Input

Return Period (years)	1	Soil	0.450
Area (ha)	0.077	Urban	0.700
SAAR (mm)	800	Region Number	Region 6

Results	**l/s**
QBAR Rural	0.4
QBAR Urban	1.0
Q1 year	0.8
Q1 year	0.8
Q30 years	1.7
Q100 years	2.0

Appendix F

Proposed Site Plan



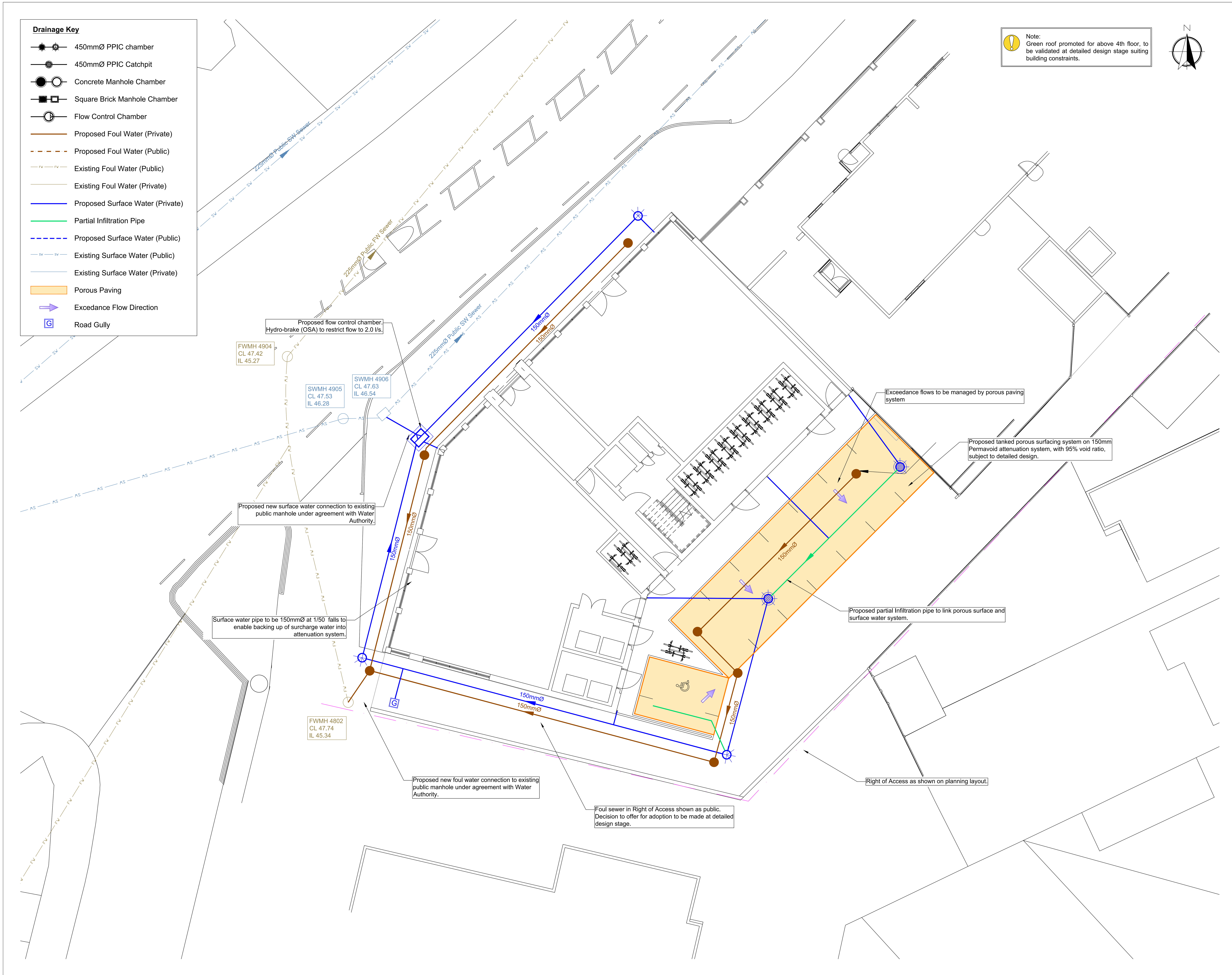
1 Site Plan 200

0m 2m 4m 6m 8m 10m
SCALE 1:200 @ A3

0m 2m 4m 6m 8m 10m
SCALE 1:200 @ A3

Appendix G

Schematic Drainage Layout



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1.4. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT PATRICK PARSONS DRAWINGS & SPECIFICATIONS.

Drainage Construction Notes

1. All materials and workmanship related to private sewers shall be in accordance with Part H of the Building Regulations and BS EN752 and best practice
2. All materials and workmanship related to adoptable sewers shall be in accordance with the Sewers For Adoption 7th Edition as published by the Water Services Association and any subsequent revisions shown by the water authority
3. All sustainable drainage systems to be designed and maintained in accordance with CIRIA C753 The SuDS Manual and best practice guidance.
4. If the contractor finds any discrepancies in the information provided then he must notify the engineer immediately before any materials are ordered or works undertaken

Rev.	Amendments	Date	Drg	Chk
P4	Site Plan Updated	25.02.21	AJ	DB
P3	Site Plan Updated	09.04.20	AJ	DB
P2	Minor Updates	25.02.20	GM	DB
P1	INITIAL ISSUE	21.02.20	GM	DB

Revisions

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Client
B&M Investments

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Ickenham Road
Ickenham HA4 7DL

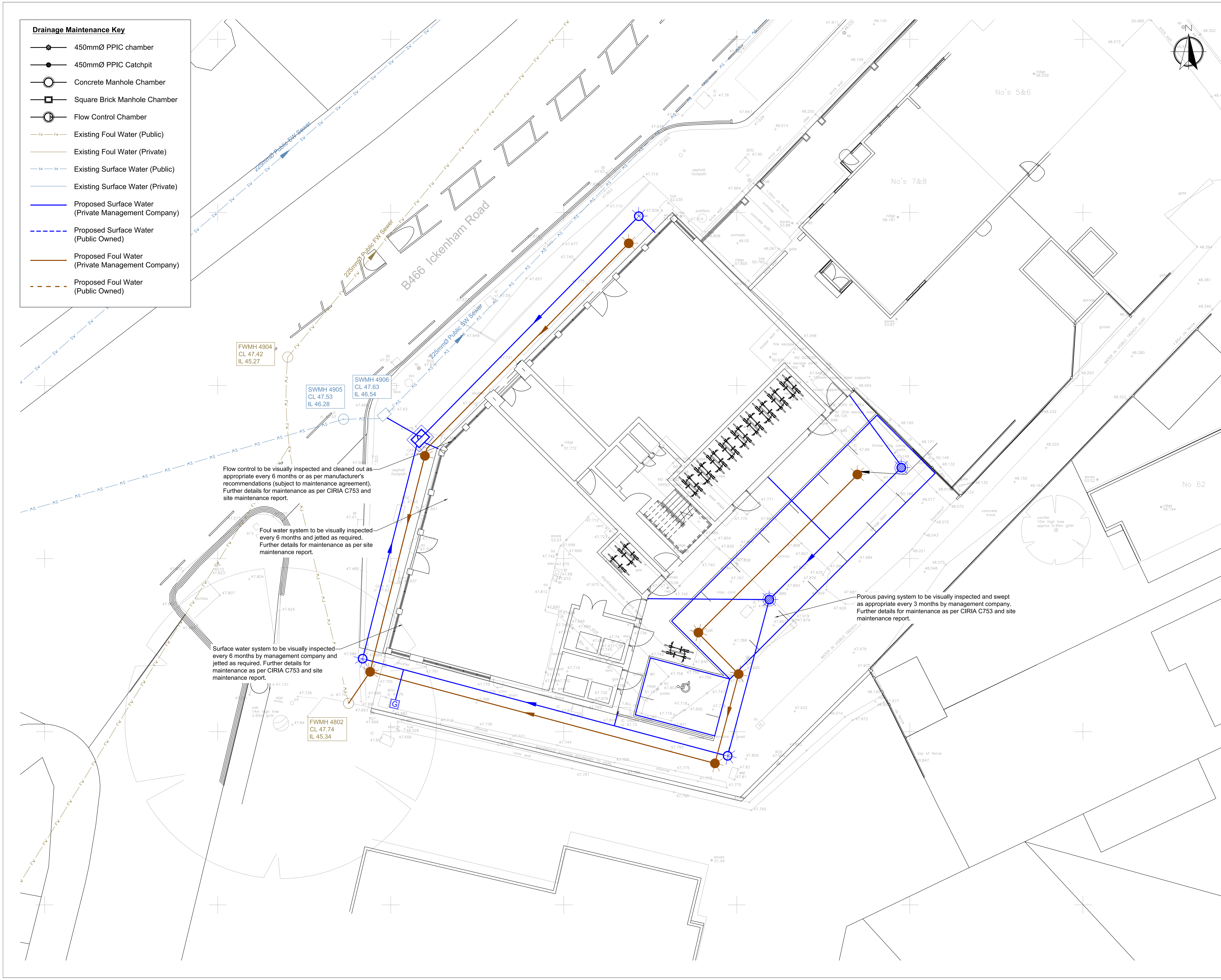
Drawing
Schematic Drainage Layout

Scales 1:100 At original size A1

Date Feb 2020 Drawn by GM Checked by DB

Status PRELIMINARY

Drawing No. A20032/0202 Rev. P4



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Rev.	Amendments	Date	Drg	Chk
P2	Site Plan Updated	25.02.21	GM	DB
P1	INITIAL ISSUE	21.02.20	GM	DB

Revisions

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Ickenham HA4 7DL

Drawing
Maintenance Plan

Scales 1:100 At original size A1

Date Feb 2020 Drawn by GM Checked by DB

Status PRELIMINARY

Drawing No. A20032/0204 Rev. P2

Appendix H

MicroDrainage Calculations

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

Half Drain Time : 91 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.880	0.160	0.0	1.9	1.9	11.4	Flood Risk
30 min Summer	9.922	0.202	0.0	1.9	1.9	14.6	Flood Risk
60 min Summer	9.946	0.226	0.0	1.9	1.9	16.4	Flood Risk
120 min Summer	9.941	0.221	0.0	1.9	1.9	16.0	Flood Risk
180 min Summer	9.929	0.209	0.0	1.9	1.9	15.1	Flood Risk
240 min Summer	9.916	0.196	0.0	1.9	1.9	14.1	Flood Risk
360 min Summer	9.890	0.170	0.0	1.9	1.9	12.2	Flood Risk
480 min Summer	9.867	0.147	0.0	1.9	1.9	10.4	Flood Risk
600 min Summer	9.845	0.125	0.0	1.8	1.8	8.7	Flood Risk
720 min Summer	9.825	0.105	0.0	1.8	1.8	7.2	Flood Risk
960 min Summer	9.790	0.070	0.0	1.8	1.8	4.6	Flood Risk
1440 min Summer	9.747	0.027	0.0	1.7	1.7	1.3	Flood Risk
2160 min Summer	9.720	0.000	0.0	1.6	1.6	0.0	Flood Risk
2880 min Summer	9.720	0.000	0.0	1.3	1.3	0.0	Flood Risk
4320 min Summer	9.720	0.000	0.0	0.9	0.9	0.0	Flood Risk
5760 min Summer	9.720	0.000	0.0	0.7	0.7	0.0	Flood Risk
7200 min Summer	9.720	0.000	0.0	0.6	0.6	0.0	Flood Risk
8640 min Summer	9.720	0.000	0.0	0.5	0.5	0.0	Flood Risk
10080 min Summer	9.720	0.000	0.0	0.5	0.5	0.0	Flood Risk
15 min Winter	9.902	0.182	0.0	1.9	1.9	13.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	13.9	25
30 min Summer	90.705	0.0	18.3	38
60 min Summer	56.713	0.0	23.1	64
120 min Summer	34.246	0.0	27.9	102
180 min Summer	25.149	0.0	30.7	134
240 min Summer	20.078	0.0	32.8	168
360 min Summer	14.585	0.0	35.7	236
480 min Summer	11.622	0.0	37.9	302
600 min Summer	9.738	0.0	39.7	366
720 min Summer	8.424	0.0	41.2	428
960 min Summer	6.697	0.0	43.7	548
1440 min Summer	4.839	0.0	47.3	768
2160 min Summer	3.490	0.0	51.1	0
2880 min Summer	2.766	0.0	53.9	0
4320 min Summer	1.989	0.0	58.0	0
5760 min Summer	1.573	0.0	60.9	0
7200 min Summer	1.311	0.0	63.3	0
8640 min Summer	1.129	0.0	65.2	0
10080 min Summer	0.994	0.0	66.8	0
15 min Winter	138.153	0.0	15.5	25

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	9.951	0.231	0.0	2.0	2.0	16.8	Flood Risk
60 min Winter	9.983	0.263	0.0	2.0	2.0	19.2	Flood Risk
120 min Winter	9.980	0.260	0.0	2.0	2.0	19.0	Flood Risk
180 min Winter	9.963	0.243	0.0	2.0	2.0	17.7	Flood Risk
240 min Winter	9.944	0.224	0.0	1.9	1.9	16.3	Flood Risk
360 min Winter	9.905	0.185	0.0	1.9	1.9	13.3	Flood Risk
480 min Winter	9.869	0.149	0.0	1.9	1.9	10.6	Flood Risk
600 min Winter	9.836	0.116	0.0	1.8	1.8	8.1	Flood Risk
720 min Winter	9.807	0.087	0.0	1.8	1.8	5.8	Flood Risk
960 min Winter	9.761	0.041	0.0	1.8	1.8	2.3	Flood Risk
1440 min Winter	9.720	0.000	0.0	1.6	1.6	0.0	Flood Risk
2160 min Winter	9.720	0.000	0.0	1.2	1.2	0.0	Flood Risk
2880 min Winter	9.720	0.000	0.0	0.9	0.9	0.0	Flood Risk
4320 min Winter	9.720	0.000	0.0	0.6	0.6	0.0	Flood Risk
5760 min Winter	9.720	0.000	0.0	0.5	0.5	0.0	Flood Risk
7200 min Winter	9.720	0.000	0.0	0.4	0.4	0.0	Flood Risk
8640 min Winter	9.720	0.000	0.0	0.4	0.4	0.0	Flood Risk
10080 min Winter	9.720	0.000	0.0	0.3	0.3	0.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	90.705	0.0	20.6	38
60 min Winter	56.713	0.0	25.7	64
120 min Winter	34.246	0.0	31.2	112
180 min Winter	25.149	0.0	34.4	144
240 min Winter	20.078	0.0	36.7	182
360 min Winter	14.585	0.0	40.0	256
480 min Winter	11.622	0.0	42.6	324
600 min Winter	9.738	0.0	44.5	390
720 min Winter	8.424	0.0	46.1	450
960 min Winter	6.697	0.0	48.9	562
1440 min Winter	4.839	0.0	53.0	0
2160 min Winter	3.490	0.0	57.3	0
2880 min Winter	2.766	0.0	60.5	0
4320 min Winter	1.989	0.0	65.1	0
5760 min Winter	1.573	0.0	68.4	0
7200 min Winter	1.311	0.0	71.1	0
8640 min Winter	1.129	0.0	73.2	0
10080 min Winter	0.994	0.0	75.1	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Pipe Network

Volume in Pipe Network (m^3)	3	Dia of Outfall Pipe (m)	0.2
Slope of Outfall Pipe (1:X)	80	Roughness of Outfall Pipe (mm)	0.600

Time Area Diagram

Total Area (ha) 0.055

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.018	4	8	0.018	8	12	0.018

Model Details

Storage is Online Cover Level (m) 10.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	22.2	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	3
Invert Level (m)	9.720	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	9.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

Appendix J

Environment Agency Flood Map

Environment Agency

Flood map for planning

Your reference	Location (easting/northing)	Created
A20037	**508484/186899**	**4 Feb 2020 14:04**

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Environment Agency

Flood map for planning

Your reference
A20037

Location (easting/northing)
508484/186899

Scale
1:2500

Created
4 Feb 2020 14:04

Selected point

Flood zone 3

Flood zone 3: areas benefitting from flood defences

Flood zone 2

Flood zone 1

Flood defence

Main river

Flood storage area

0 20 40 60m

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