PATRICK PARSONS

# Drainage Strategy

Manor Court

High Street, Harmondsworth, UB7 0AQ

for

Heathrow 1 Limited

A21138

September 2021

# Drainage Strategy

# Manor Court

# for

# Heathrow 1 Limited

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## Executive Summary

| | |
|---|---|
| **Description** | |
| Patrick Parsons has been instructed by Heathrow 1 Limited, to produce a Drainage Strategy to support the Planning Application for the site at Manor Court, High Street, Harmondsworth, UB7 0AQ. | |
| **Site Parameters** | |
| Total Area:<br>Greenfield:<br>Brownfield:<br>Mixed Green and Brownfield:<br>Existing Runoff Location:<br>Ground Conditions:<br>Method of Study:<br>Ground Infiltration Potential: | 1.1 Ha<br>NO<br>NO<br>YES<br>Ground<br>Gravel/Sand over Clay<br>Site Investigation<br>High |
| **Drainage Strategy / SuDS** | |
| Infiltration Viable:<br>Discharge Point (SW):<br>Flow Control:<br>Storage Provided:<br>Discharge Point (FW): | YES<br>Ground<br>N/A<br>1 in 100 Year + 40% Climate Change<br>Sewer |
| SuDS Elements:<br>Water Quality Measures:<br>Exceedance flows: | Porous Surfacing, Soakaways<br>Catchpits, Geotextiles<br>Managed within site |
| **Conclusions** | |
| Infiltration has been shown to be suitable on site so discharge of surface water will be via existing soakaways and a new porous paving system, with additional benefit from retrofitted rainwater harvesting devices. | |

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## Contents



## Appendices

# 1.0 Introduction

1.1.1 Heathrow 1 Limited is planning a proposed development on the site at Manor Court, High Street, Harmondsworth, UB7 0AQ.

1.1.2 Patrick Parsons has been instructed by Heathrow 1 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.

1.1.5 This report is based on, but supersedes, the approved Planning Submission and subsequent technical notes by Lanmor Consulting. This report should be read in conjunction with that information, which has been included in this report by extract where appropriate.

# 2.0 Location of Site

2.1.1 The site is located off High Street in Harmondsworth. A site 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 Manor Court. A topographical survey has been commissioned for the site and can be found in **Appendix B**.

## 3.2 Existing Drainage System

3.2.1 Sewer records were obtained from Thames Water for the original Planning Submission and can be found at **Appendix C**. There are public foul water and surface water sewers located within High Street.

3.2.2 The approved drainage strategy indicates the re-use of existing drainage systems on site, including existing soakaways.

3.2.3 A site visit was undertaken by Patrick Parsons on 18th August 2021 to inspect and do a visual trace of the system. His information has been included on the proposed drainage plan as appropriate.

## 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."*

3.3.3 The strata of the site (superficial drift) comprises Langley Silt, described as follows:

*"Langley Silt Member - Clay and Silt. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by wind blown deposits (U). These sedimentary deposits are aeolian in origin. They are detrital, comprising medium- to fine- grained materials, forming lenses, beds (and locally) dunes."*

## 3.4 Geological Assessment

3.4.1 Boreholes in the local area indicate gravel and sand with clay at depth.

3.4.2 A geotechnical survey including infiltration testing was undertaken by Fastrack Limited to support the Planning Application. The findings of the report can be found at **Appendix E**.

Based on the geotechnical information and the findings of the Lanmor report, a proposed infiltration rate of 3.128 x $10^{-5}$ m/s will be used for the design.

### 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 F**, provide the following information for the site:

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

### 3.6 Hydrology

3.6.1 The nearest strategic watercourse is the Duke of Northumberland's River located 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 1.1 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 G**.

4.1.3 The Qbar (rural) value for the site is 4.8 litres per second. A conservative value of 50% hardstanding has been used to calculate the urban run-off from site. The Qbar (urban) value for the site is 9.9 litres per second.

## 4.2 Greenfield Run-Off Assessment

4.2.1 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.

4.2.2 Infiltration has been selected, based on the geotechnical information provided within this report.

# 5.0 Proposed Development

5.1.1 The proposal is for alterations and conversion of the Manor Lodge into 2 No. 4-bedroom houses; conversion of the Stable Building into 6 No. 1-bedroom and 2 No. 2-bedroom cottages; conversion of the Office Barn into 1 No. studio flat, 1 No. 1- bedroom flat, 2 No. 2-bedroom houses and 1 No. 3-bedroom house; retention of the Granary Building and conversion to garden store; upgrade of boundary treatments; reinstatement of yard pond, together with associated parking and landscaping. A site layout can be found at **Appendix H**.

## 5.2 Infiltration Potential

5.2.1 The geotechnical information provided in this report indicates that standard infiltration methods will be suitable on site.

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.<br>**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.<br>**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. | **NO** |
| **Moderate infiltration potential:** There is a moderate potential for infiltration SuDS in parts of the Site.<br>**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.<br>**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.<br>**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.<br>**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. | **YES** |

# 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 | Selected Option |
|---|---|
| **Discharge to Watercourse** | **N/A** |
| **Discharge to Surface Water Sewer** | **N/A** |
| **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 | ✓ | ✓ | None | Yes |
| **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 | Yes |
| **Green roofs** | ✓ | ✓ | ✓ | X | ✓ | N/A | No |
| **Rain Garden (external)** | ✓ | ✓ | ✓ | X | X | Site Constraints | No |
| **Rain Garden (planter)** | ✓ | ✓ | ✓ | X | X | Site Constraints | No |

## 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 scope for blue or green roofs on the scheme | ↓ |
| 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 should be viable on site. | ↓ |
| Permeable Surfaces and Filter Drains | Porous surfaces will be viable on site with discharge to the ground. | ↓ |
| 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.

### 6.3 Rainwater Harvesting

6.3.1 Rainwater harvesting will be promoted on the site and will be retrofitted to the existing drainage system upstream of the existing soakaways.

6.3.2 Further details and performance specification of the units will be coordinated at the next design stage with an assessment of yield and demand by a specialist supplier.

# 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 ground via infiltration. A Drainage Plan can be found at **Appendix J**.

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, the Design and Construction Guidance 2020 and Sewers for Adoption recommend that the 1 in 30 year storm event is managed below ground with exceedance flows managed above ground.

## 7.2 Design Approach

7.2.1 As the existing buildings are being retained, the existing surface water systems will be retained, and the existing soakaways will be re-used for the scheme.

7.2.2 Any external hardstanding areas will be formed in porous surfacing with discharge to the ground. These have all been designed to accommodate any potential exceedance flows arising from the existing system (as the historical drainage may not have been suitable for a 1 in 100 year event).

7.2.3 MicroDrainage calculations have been undertaken for the porous surfacing areas, which can be found at **Appendix H**.

### 7.3 Rainwater Harvesting

7.3.1 To provide additional surface water control on site, two locations have been selected to install rainwater harvesting on the site. These have been selected as the most appropriate places to undertake excavation works and provide sustainable systems with minimal disruption.

7.3.2 The rainwater harvesting tanks have been sized initially in accordance with best practice guidance. A specialist supplier will need to be engaged to determine the size relating to the client requirements for rainwater re-use.

### 7.4 Designing for Exceedance Events

7.4.1 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.

7.4.2 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.

7.4.3 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.

### 7.5 Designing for System Failure

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

7.5.2 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 | Not applicable for site as infiltration is used. |
| Failure | Potential blockage of outfall from flow control failure or build-up of debris | Not applicable for site as infiltration is used. |
| Surcharge | Potential back-up of system due to surcharging or poorly maintained public surface water infrastructure or watercourse | Not applicable for site as infiltration is used. |
| 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 | It is assumed that surface mounted SuDS will have minimal infiltration due to the potential clay cap on site. Therefore, ground consolidation should not have a major impact. However, ground should be suitably perforated to ensure that any infiltration into the natural soil is not impeded. |
| Failure | Poor planting and maintenance of green areas could reduce the hydraulic properties of SuDS devices (and amenity/biodiversity benefits) | Not applicable |

### 7.6 Foul Water Drainage

7.6.1 The foul water for the development will discharge into the existing foul water system. Foul water flows are anticipated to be 0.694 litres per second based on 4000 litres per dwelling per day in accordance with Sewers for Adoption 7th Edition and the Design and Construction Guidance 2020.

7.6.2 The existing foul drainage system was surveyed and deemed not fit for purpose for the new scheme. So, a new system has been recommended, connecting to the existing outfall from site.

# 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<br>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.

## 8.4 Treatment with Discharge to Ground

8.4.1 As the site is discharging to ground, Table 26.4 of the CIRIA C753 manual is used to evaluate the water quality mitigation measures offered by the proposed drainage system.

8.4.2 The identified hazard remediation levels are as follows:

**TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater**

| Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1] | TSS | Metals | Hydrocarbons |
|---|---|---|---|
| A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3] | 0.6[4] | 0.5 | 0.6 |
| A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3] | 0.4[4] | 0.3 | 0.3 |
| Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3] | 0.4[4] | 0.4 | 0.4 |
| Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3] | 0.7 | 0.6 | 0.7 |
| Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3] | 0.8[4] | 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 inflow concentrations relevant to the contributing drainage area. | | |

**Notes**

1 All designs must include a minimum of 1 m unsaturated depth of aquifer material between the infiltration surface and the maximum likely groundwater level (as required in infiltration design – Chapter 25).

2 For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance.

3 Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater – see note 1.

4 If significant volumes of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure.

5 See Chapter 14 for approaches to demonstrate product performance. Note: 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: **www.britishwater.co.uk/Publications/codes-of-practise.aspx**

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. WAT-RM-08 (SEPA, 2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

| | Hazard | Treatment | Result |
|---|---|---|---|
| – Total Suspended Solids (TSS) | 0.70 | 1.1 | 0 |
| – Metals | 0.60 | 0.9 | 0 |
| – Hydrocarbons | 0.45 | 1.0 | 0 |

# 9.0 Summary and Conclusions

9.1.1 Heathrow 1 Limited is planning a proposed development on the site at Manor Court, High Street, Harmondsworth, UB7 0AQ.

9.1.2 Patrick Parsons has been instructed by Heathrow 1 Limited, to produce a Drainage Strategy to support the Planning Application.

9.1.3 The surface water system will discharge into the existing soakaways via infiltration.

9.1.4 The foul water will discharge into the existing sewer system.

9.1.5 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


Rev. | Date | Details

Project:
Manor Court
High Street
Harmondsworth

Content:
E X I S T I N G
Site Plan
Topographical Provided by MK
Surveys

North:

Drawn By: TH Date: APR15

Scale: 1:500@A3 Rev: -

Notes:
Figured dimensions to be used in preference to scaled.
The Contractor is to check all site dimensions and setting-out and obtain the Architect's instructions in respect of any discrepancy revealed before work is put in hand.
Description or illustration of proprietary systems or products is not to be taken as licence in respect of patents or copyright involved or royalties due.
All rights in drawing and design are reserved to the Architect.
Copyright; not to be reproduced without the Architect's permission.
Subject to survey

The Old School House Bridge Road Hunton Bridge
Kings Langley Hertfordshire WD4 8RQ
T 0 1 9 2 3 2 6 7 4 8 8
w a k e l i n - a d m i n @ w a k e l i n . c o . u k
w w w . w a k e l i n . c o . u k



Wakelin Associates Architects

MC/17/EX01

PATRICK PARSONS

# Appendix B
# Topographical Survey

505600 E

505650 E

177850 N

177800 N

177750 N

Notes :

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GPS NETWORK.
2. DRAINAGE INFORMATION HAS BEEN DETERMINED WITHOUT MAN ENTRY INTO CHAMBERS AND WHILST EVERY EFFORT HAS BEEN MADE TO CORRECTLY IDENTIFY THIS INFORMATION, IT SHOULD ALWAYS BE CHECKED IN AREAS THAT ARE CRITICAL TO THE FUTURE PROPOSAL.
3. ALL SEWERS ARE PRESUMED TO BE STRAIGHT BETWEEN CHAMBERS.
4. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.

## Coordinate Table

| Station | Description | Easting | Northing | Level |
|---|---|---|---|---|
| T1 | ROAD NAIL | 505661.250 | 177775.195 | 25.327 |
| T2 | ROAD NAIL | 505664.603 | 177832.263 | 25.141 |
| T3 | ROAD NAIL | 505673.607 | 177877.051 | 26.196 |
| T4 | PEG | 505629.756 | 177877.816 | 27.282 |
| T5 | ROAD NAIL | 505610.559 | 177816.358 | 26.262 |
| T6 | ROAD NAIL | 505599.472 | 177780.446 | 25.806 |
| T7 | PEG | 505636.510 | 177749.342 | 25.665 |
| T8 | ROAD NAIL | 505652.886 | 177805.093 | 24.993 |
| T9 | ROAD NAIL | 505649.469 | 177846.766 | 25.418 |

## TOPOGRAPHICAL KEY

SURVEY STATION 5

BANKING (TOP / BOTTOM)

HEDGE SPREADS

WOODLAND CANOPY

MARSH / WATERLOGGED

TREES (SPREAD & GIRTH SHOWN TO SCALE)

GATE

KERB CHANNEL

ROAD UNKERBED

FOOTPATH

CHANGE IN SURFACE

FENCE

WALL

OVERHEAD ELECTRIC

OVERHEAD TELECOM

FOUL SEWER

SURFACE SEWER

BUILDING

OPEN SIDED BUILDING

GLASSHOUSE

CONTOUR 25.50

SPOT LEVEL + 127.13

BORE HOLE BH

TRIAL HOLE TH

### GENERAL ABBREVIATIONS

| | |
|---|---|
| AIR CONDITIONING UNIT | ACU |
| AIR VALVE | AV |
| BACK DROP | BD |
| BRICK | BK |
| BOLLARD | BO |
| BUS STOP | BS |
| BT INSPECTION COVER | BT |
| CABLE TV COVER | CATV |
| CONTROL BOX | CB |
| COVER LEVEL | CL |
| CATCH PIT | C/PIT |
| DRAINAGE CHANNEL | DCH |
| ELECTRICITY CONTROL BOX | EB |
| ELECTRICITY POLE | EP |
| EARTH ROD | ER |
| FIRE HYDRANT | FH |
| FLOOR LEVEL | FL |
| FOOTPATH | FP |
| FOUL WATER SEWER | FWS |
| GAS VALVE | GV |
| GATE POST | GP |
| GULLY | GY |
| INSPECTION COVER | IC |
| INVERT LEVEL | IL |
| KERB OUTRET | KO |
| LAMP POST | LP |
| LETTER BOX | LB |
| LITTER BIN | BIN |
| MANHOLE | MH |
| MARKER POST | MK |
| METER | MT |
| ORDNANCE SURVEY BENCH MARK | OSBM |
| RODDING EYE | RE |
| ROAD SIGN | RS |
| RAIN WATER PIPE | RWP |
| RETAINING WALL | RW |
| STOP COCK | SC |
| STREET NAME PLATE | SNP |
| STAY CABLES | ST |
| SURFACE WATER SEWER | SWS |
| STOP VALVE | SV |
| SOIL VENT PIPE | SVP |
| TACTILE PAVING | TAC |
| TELEPHONE CALL BOX | TCB |
| TRAFFIC LIGHT | TL |
| TELECOM POLE | TP |
| UNABLE TO RAISE | UTR |
| VENT PIPE | VP |
| WATER LEVEL | WL |
| WATER METER | WM |
| WASH OUT | WO |

### FENCE ABBREVIATIONS

| | |
|---|---|
| BARBED WIRE FENCE | B/W |
| CLOSE BOARDED FENCE | C/B |
| CONCRETE PANEL FENCE | CPL |
| CORRUGATED IRON FENCE | C/I |
| CHAIN LINK FENCE | C/L |
| CHESTNUT PALING | CNP |
| IRON RAILINGS | I/R |
| POST AND RAIL FENCE | P/R |
| POST AND WIRE FENCE | P/W |
| WIRE MESH FENCE | W/M |

| Revision | Description | Surv. by | Appr. by | Date |
|---|---|---|---|---|

0m 2 4 6 8 10 12 14 16 18 20 22


mksurveys

Tel 01908 565561 (Milton Keynes) enquiries@mksurveys.co.uk
Tel 01865 594979 (Oxford) oxford@mksurveys.co.uk
Tel 0116 2849127 (East Midlands) eastmidlands@mksurveys.co.uk
Tel 01384 404203 (West Midlands) westmidlands@mksurveys.co.uk
Tel 01403 243162 (Horsham) horsham@mksurveys.co.uk
www.mksurveys.com www.surveys4bim.co.uk


# Heathrow 1 Ltd.

## Manor Court
## Harmondsworth

Topographical Survey

| Scale | Sheet Size: | Sheet Number: | Date: |
|---|---|---|---|
| 1:200 | A1 | 1 | March 2015 |
| Project Number: | Rev: | Surveyed By: | Approved By: |
| 20738 | - | DJ | JS |

# Appendix C
# Thames Water Sewer Records

## Asset Location Search Sewer Map - ALS/ALS Standard/2016_3272984


The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 505704,177796

**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 |
|---|---|---|
| 8603 | -23.13 | n/a |
| 8605 | 25.97 | 24.42 |
| 8604 | 25.95 | 22.62 |
| 8602 | 26 | 24.17 |
| 761E | n/a | n/a |
| 7601 | 25.36 | 24.3 |
| 8601 | 23.88 | n/a |
| 7602 | n/a | n/a |
| 8705 | n/a | n/a |
| 771B | n/a | n/a |
| 7704 | n/a | n/a |
| 771A | n/a | n/a |
| 7703 | 24.62 | 23.53 |
| 7708 | 24.8 | 22.68 |
| 7707 | 24.76 | 22.88 |
| 871A | n/a | n/a |
| 8704 | 25.55 | 24.58 |
| 7706 | 24.74 | 23.57 |
| 871C | n/a | n/a |
| 7705 | 24.69 | 21.64 |
| 871B | n/a | n/a |
| 8701 | 25.04 | 21.75 |
| 8706 | -24.11 | n/a |
| 8707 | 25.18 | 24.11 |
| 8703 | 24.48 | 23.14 |
| 8702 | 25.6 | 22 |
| 871D | n/a | n/a |
| 8502 | 26.45 | 23.62 |
| 8504 | 25.92 | 24.85 |
| 7501 | n/a | n/a |
| 8503 | 26.05 | 24.34 |
| 8501 | 26.1 | 24.88 |
| 7607 | n/a | n/a |
| 861A | n/a | n/a |
| 7606 | n/a | n/a |
| 761C | n/a | n/a |
| 7605 | 26.26 | 23.43 |
| 7604 | 25.75 | 24.47 |
| 7603 | 25.75 | 23.88 |
| 761D | n/a | n/a |
| 8606 | 25.99 | 23.74 |
| 6502 | 26.24 | 23.77 |
| 6501 | 26.03 | 23.59 |
| 661C | n/a | n/a |
| 661D | n/a | n/a |
| 761B | n/a | n/a |
| 761A | n/a | n/a |
| 661A | n/a | n/a |
| 661B | n/a | n/a |
| 6601 | 24.3 | 21.25 |
| 6602 | 23.45 | 21.36 |
| 6701 | 24.55 | 23.46 |
| 7701 | 24.78 | 21.59 |
| 7702 | 24.89 | 23.8 |
| 671A | n/a | n/a |
| 671B | n/a | n/a |
| 671C | n/a | n/a |
| 9701 | 25.58 | 22.12 |
| 8801 | n/a | n/a |
| 9804 | n/a | n/a |
| 9803 | n/a | n/a |
| 981A | n/a | n/a |
| 9805 | n/a | n/a |
| 981B | n/a | n/a |
| 4801 | 23.19 | 19.26 |
| 4001 | 23.23 | 19.42 |
| 4601 | 23.8 | 19.09 |
| 4602 | 23.81 | 20.78 |
| 461A | n/a | n/a |
| 5501 | 25.97 | 25.07 |
| 5603 | 25.77 | 24.72 |
| 5602 | 24.6 | 23.47 |
| 5502 | 25.99 | 24.9 |
| 5601 | 24.18 | 21.1 |
| 561A | n/a | n/a |
| 5606 | 26.33 | 23.22 |
| 6603 | 26.28 | 23.31 |

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.

# Appendix D
NOT USED

12.0

# Appendix E
# Approved Geotechnical Information

FASTRACK

# Geotechnical Survey Report

| | |
|---|---|
| FSI Ref: | 10952 |
| Issue Date: | August 2017 |
| Risk Address: | Manor Court<br>High Street<br>Harmondsworth<br>West Drayton<br>UB7 0AQ |
| Engineer: | Mo Khan |
| Company: | Lanmor Consulting |


| | |
|---|---|
| Director: | Martin Rush MSc FGS |
| Office Manager: | Louise Hiscock BSc (Hons) |
| CAD Technician: | Perry Martin AMCIHT |

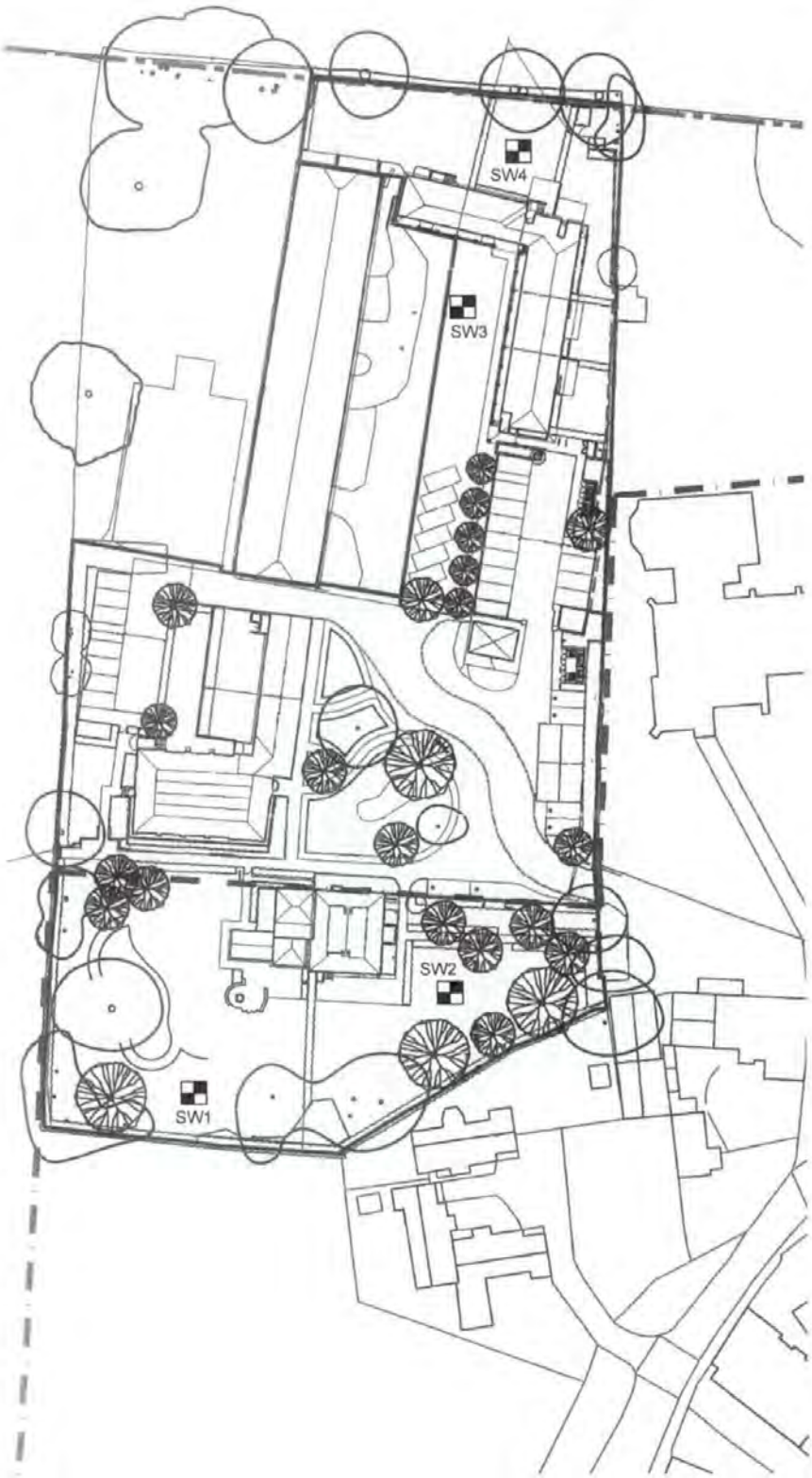
FASTRACK
Tyndales Farm, Southend Road, Woodham Mortimer, Maldon, Essex, CM9 6TQ
Telephone: 0844 3358908
Fax: 0844 3358907
Email:enquiries@fastrackgroup.co.uk
Web: www.fastrackgroup.co.uk

**Appendix No:** 1
**FSI Ref:** 10952

# SITE PLAN

**Property Address:** Manor Court, High Street, Harmondsworth, West Drayton UB7 0AQ

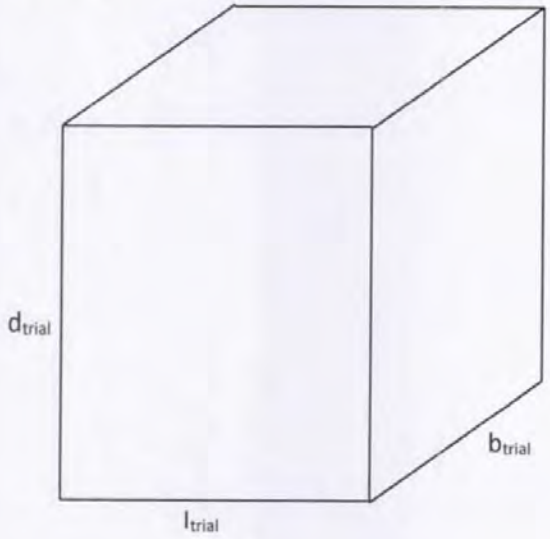
**Survey date:** 25/08/2017 **Operative:** SE2




| Scale: | Drawn by: | Key: |
|---|---|---|
| NTS | GB | Trial Pit, Borehole, Manholes, Rain Water Pipe, Soil & Vent Pipe, Surface Water Gully, Foul Water Gully, Shrub, Tree (Conifer), Tree (Deciduous) |

FASTRACK

**Soil Infiltration Rate (BRE Digest 365)**




**SOAK AWAY TEST NO: 1**

Length of Trial Pit $l_{trial}$ = **0.30m**
Width of Trial Pit $b_{trial}$ = **0.30m**
Depth of Trial Pit $d_{trial}$ = **1.00m**
Free Volume (if fill used) $V_{trial}$ = 35%

75% depth of pit: $d_{75}$: ($d_{trial}$ x 0.75) = **0.75m**
50% depth of pit: $d_{50}$: ($d_{trial}$ x 0.50) = **0.50m**
25% depth of pit: $d_{25}$: ($d_{trial}$ x 0.25) = **0.25m**

Test 1 – time to fall from 75% depth to 25% depth = T1 = **1188 Seconds**

Longest time to fall from 75% depth to 25% depth = $T_{lg}$ = Max(T1, T2, T3) = **1188 Seconds**

Storage Volume from 75% depth to 25% depth = $V_{p75\_25}$ = ($l_{trial}$ x $b_{trial}$ x ($d_{75}$ – $d_{25}$)) x $V_{trial}$ = **0.045m³**

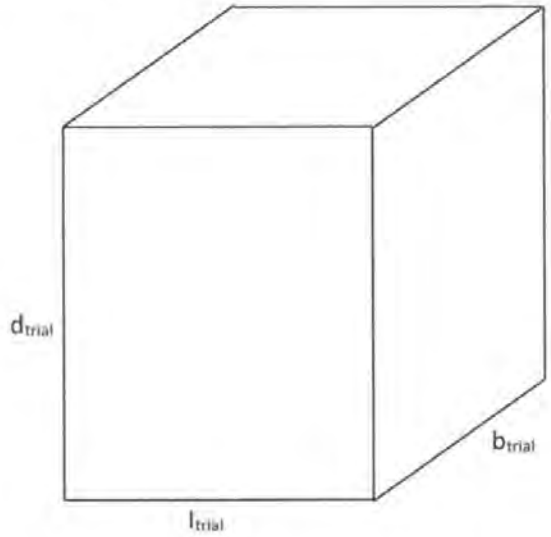
Internal surface area to 50% depth = $A_{p50}$ = (($l_{trial}$ x $b_{trial}$) + ($l_{trial}$ + $b_{trial}$) x 2 x $d_{50}$) = **0.69m²**

Surface area of soakaway to 50% storage depth $A_{s50}$ = 2 x ($l_{trial}$ + $b_{trial}$) x $d_{trial}$ / 2 = **0.60m²**

Soil infiltration rate = F = $V_{p75\_25}$ / ($A_{p50}$ x $T_{lg}$) = **$54.90 \times 10^{-6}$ m/s**

FASTRACK

**Soil Infiltration Rate (BRE Digest 365)**




**SOAK AWAY TEST NO: 2**

Length of Trial Pit $l_{trial}$ = **0.30m**
Width of Trial Pit $b_{trial}$ = **0.30m**
Depth of Trial Pit $d_{trial}$ = **1.00m**
Free Volume (if fill used) $V_{trial}$ = 35%

75% depth of pit: $d_{75}$: ($d_{trial}$ x 0.75) = **0.75m**
50% depth of pit: $d_{50}$: ($d_{trial}$ x 0.50) = **0.50m**
25% depth of pit: $d_{25}$: ($d_{trial}$ x 0.25) = **0.25m**

Test 1 – time to fall from 75% depth to 25% depth = T1 = **2085 Seconds**

Longest time to fall from 75% depth to 25% depth = $T_{lg}$ = Max(T1, T2, T3) = **2085 Seconds**

Storage Volume from 75% depth to 25% depth = $V_{p75\_25}$ = ($l_{trial}$ x $b_{trial}$ x ($d_{75}$ – $d_{25}$)) x $V_{trial}$ = **0.045m³**

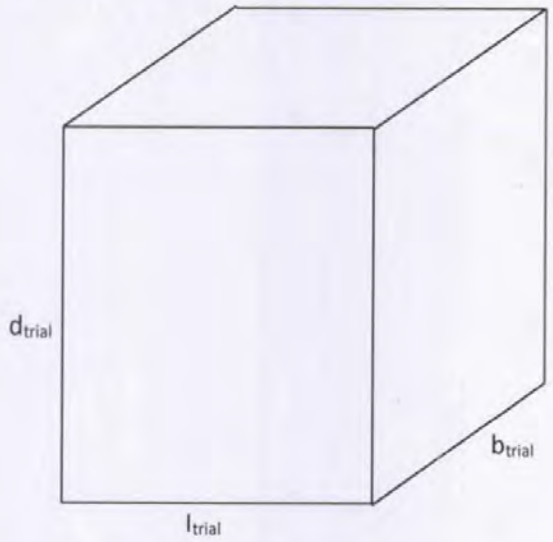
Internal surface area to 50% depth = $A_{p50}$ = (($l_{trial}$ x $b_{trial}$) + ($l_{trial}$ + $b_{trial}$) x 2 x $d_{50}$) = **0.69m²**

Surface area of soakaway to 50% storage depth $A_{s50}$ = 2 x ($l_{trial}$ + $b_{trial}$) x $d_{trial}$ / 2 = **0.60m²**

Soil infiltration rate = F = $V_{p75\_25}$ / ($A_{p50}$ x $T_{lg}$) = **$31.28 \times 10^{-6}$ m/s**

FASTRACK

**Soil Infiltration Rate (BRE Digest 365)**




**SOAK AWAY TEST NO: 3**

Length of Trial Pit $l_{trial}$ = **0.30m**
Width of Trial Pit $b_{trial}$ = **0.30m**
Depth of Trial Pit $d_{trial}$ = **1.00m**
Free Volume (if fill used) $V_{trial}$ = 35%

75% depth of pit: $d_{75}$: ($d_{trial}$ x 0.75) = **0.75m**
50% depth of pit: $d_{50}$: ($d_{trial}$ x 0.50) = **0.50m**
25% depth of pit: $d_{25}$: ($d_{trial}$ x 0.25) = **0.25m**

Test 1 – T1 = **11mm drop in water level after 3600 seconds**

Longest time to fall from 75% depth to 25% depth = $T_{lg}$ = Max(T1, T2, T3) = **N/A**

Storage Volume from 75% depth to 25% depth = $V_{p75\_25}$ = ($l_{trial}$ x $b_{trial}$ x ($d_{75} - d_{25}$)) x $V_{trial}$ = **0.045m³**

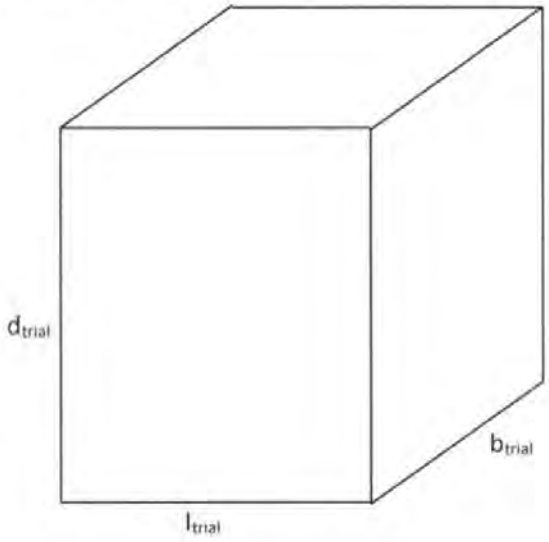
Internal surface area to 50% depth = $A_{p50}$ = (($l_{trial}$ x $b_{trial}$) + ($l_{trial}$ + $b_{trial}$) x 2 x $d_{50}$) = **0.69m²**

Surface area of soakaway to 50% storage depth $A_{s50}$ = 2 x ($l_{trial}$ + $b_{trial}$) x $d_{trial}$ / 2 = **0.60m²**

Soil infiltration rate = F = $V_{p75\_25}$ / ($A_{p50}$ x $T_{lg}$) = **Unable to Calculate**

FASTRACK

**Soil Infiltration Rate (BRE Digest 365)**




**SOAK AWAY TEST NO: 4**

Length of Trial Pit $l_{trial}$ = **0.30m**
Width of Trial Pit $b_{trial}$ = **0.30m**
Depth of Trial Pit $d_{trial}$ = **1.00m**
Free Volume (if fill used) $V_{trial}$ = 35%

75% depth of pit: $d_{75}$: ($d_{trial}$ x 0.75) = **0.75m**
50% depth of pit: $d_{50}$: ($d_{trial}$ x 0.50) = **0.50m**
25% depth of pit: $d_{25}$: ($d_{trial}$ x 0.25) = **0.25m**

Test 1 – T1 = **13mm drop in water level after 3600 Seconds**

Longest time to fall from 75% depth to 25% depth = $T_{lg}$ = Max(T1, T2, T3) = **N/A**

Storage Volume from 75% depth to 25% depth = $V_{p75\_25}$ = ($l_{trial}$ x $b_{trial}$ x ($d_{75} - d_{25}$)) x $V_{trial}$ = **0.045m³**

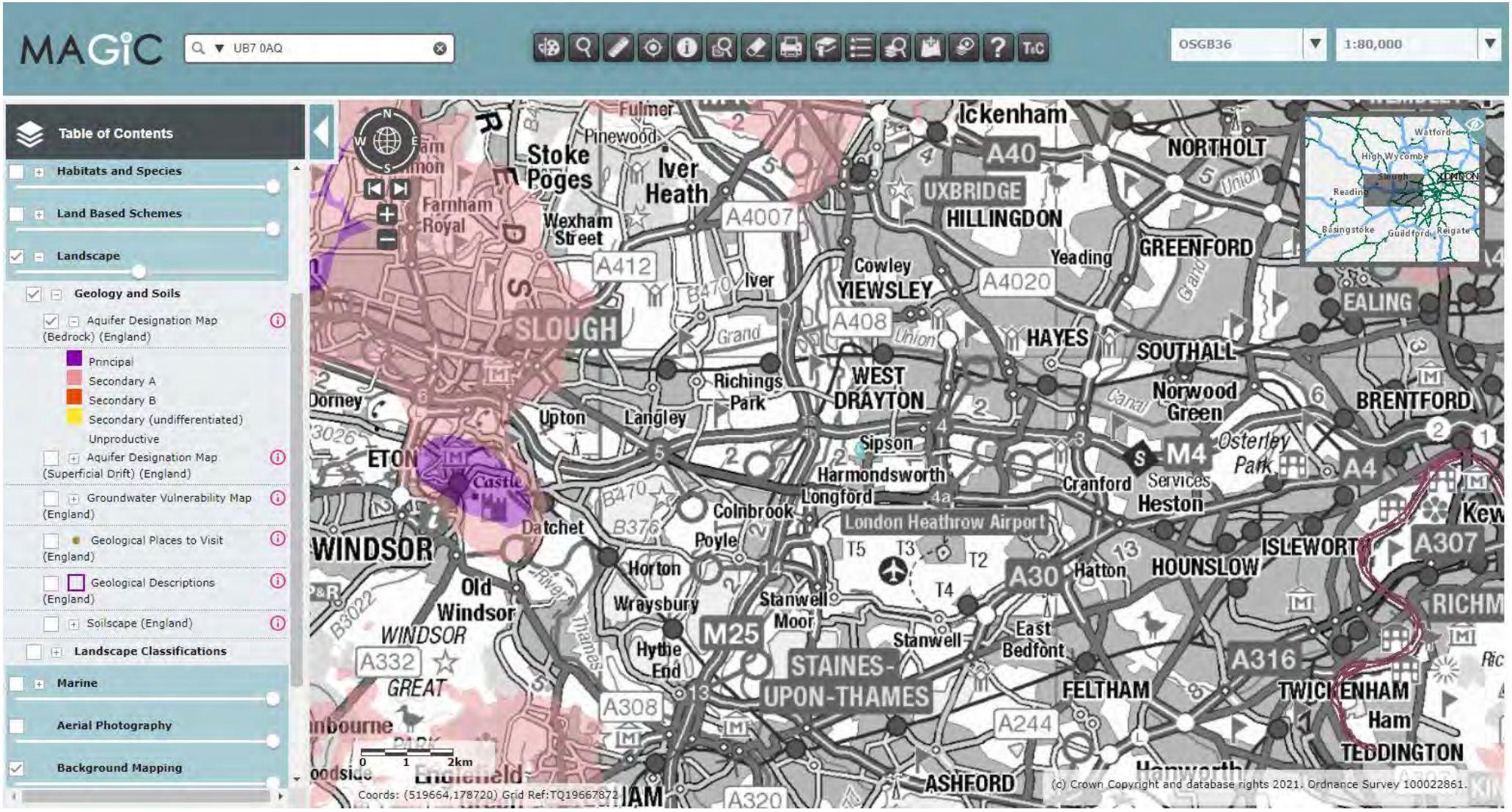
Internal surface area to 50% depth = $A_{p50}$ = (($l_{trial}$ x $b_{trial}$) + ($l_{trial}$ + $b_{trial}$) x 2 x $d_{50}$) = **0.69m²**

Surface area of soakaway to 50% storage depth $A_{s50}$ = 2 x ($l_{trial}$ + $b_{trial}$) x $d_{trial}$ / 2 = **0.60m²**

Soil infiltration rate = F = $V_{p75\_25}$ / ($A_{p50}$ x $T_{lg}$) = **Unable to Calculate**

PATRICK PARSONS

# Appendix F
# Magic Map Geology Information


MAGiC
UB7 0AQ
OSGB36
1:80,000
Table of Contents
Habitats and Species
Land Based Schemes
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Geology and Soils
Aquifer Designation Map (Bedrock) (England)
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Secondary B
Secondary (undifferentiated)
Unproductive
Aquifer Designation Map (Superficial Drift) (England)
Groundwater Vulnerability Map (England)
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Iver Heath
Farnham Royal
Wexham Street
Iver
Cowley
YIEWSLEY
SLOUGH
Richings Park
WEST DRAYTON
Upton
Langley
Sipson
Harmondsworth
Longford
Colnbrook
Poyle
Datchet
ETON
WINDSOR
Old Windsor
Horton
Wraysbury
Stanwell Moor
Hythe End
STAINES-UPON-THAMES
Stanwell
East Bedfont
FELTHAM
ASHFORD
London Heathrow Airport
T5
T3
T2
T4
Hatton
HOUNSLOW
Cranford
Heston
Services
Osterley Park
Norwood Green
SOUTHALL
HAYES
Yeading
GREENFORD
EALING
BRENTFORD
ISLEWORTH
Kew
RICHM
TWICKENHAM
Ham
TEDDINGTON
UXBRIDGE
HILLINGDON
NORTHOLT
Ickenham
A40
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A316
A307
A308
A332
A244
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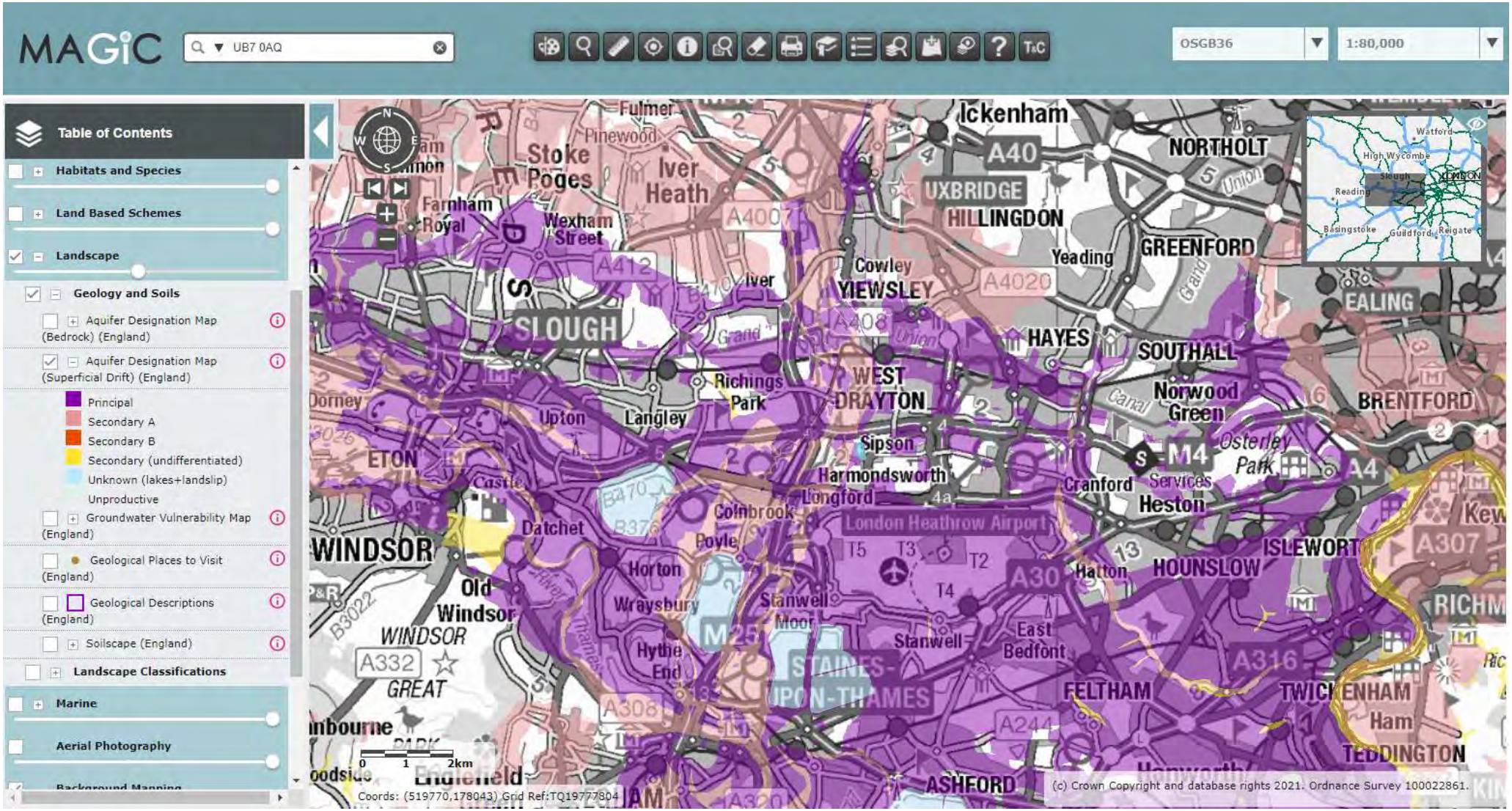
M4
Grand Union Canal
River Thames
Watford
High Wycombe
Slough
Reading
Basingstoke
Guildford
Reigate
0 1 2km
Coords: (519664,178720) Grid Ref:TQ19667872
(c) Crown Copyright and database rights 2021. Ordnance Survey 100022861.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HAYES
SOUTHALL
EALING
BRENTFORD
HOUNSLOW
ISLEWORTH
FELTHAM
TWICKENHAM
TEDDINGTON
ASHFORD
London Heathrow Airport
Coordinates: (519770,178043) Grid Ref:TQ19778043
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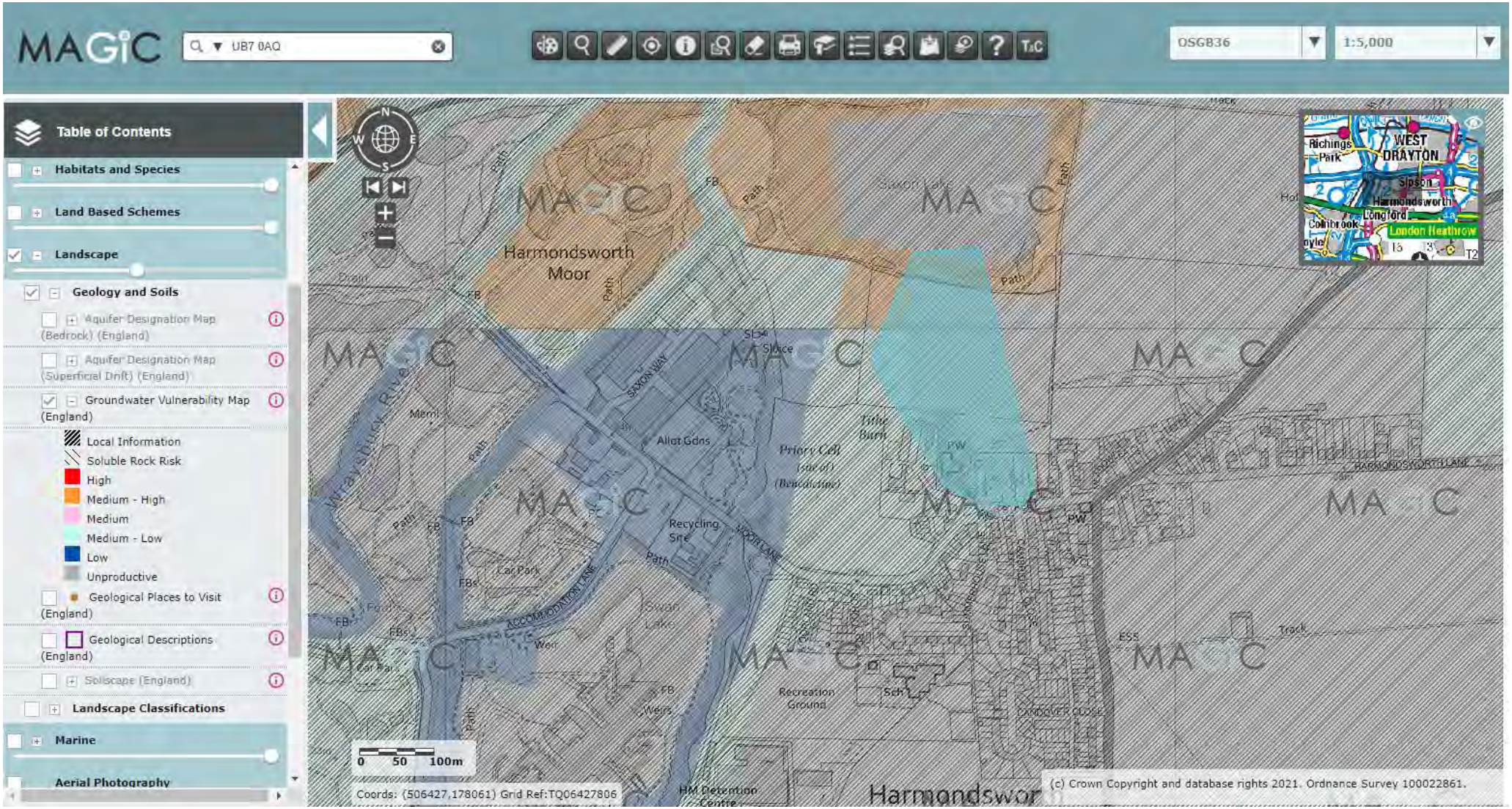
MAGIC
UB7 0AQ
OSGB36
1:5,000
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Landscape
Geology and Soils
Aquifer Designation Map (Bedrock) (England)
Aquifer Designation Map (Superficial Drift) (England)
Groundwater Vulnerability Map (England)
Local Information
Soluble Rock Risk
High
Medium - High
Medium
Medium - Low
Low
Unproductive
Geological Places to Visit (England)
Geological Descriptions (England)
Soilscape (England)
Landscape Classifications
Marine
Aerial Photography
Harmondsworth Moor
Recycling Site
Recreation Ground
HM Detention Centre
Harmondsworth
WEST DRAYTON
Richings Park
Sipson
Longford
Colnbrook
London Heathrow
0 50 100m
Coords: (506427,178061) Grid Ref:TQ06427806
(c) Crown Copyright and database rights 2021. Ordnance Survey 100022861.

# Appendix G
# Greenfield Run-Off

## ICP SUDS Mean Annual Flood

Input

| | | | |
|---|---|---|---|
| Return Period (years) | 1 | Soil | 0.450 |
| Area (ha) | 1.100 | Urban | 0.500 |
| SAAR (mm) | 700 | Region Number | Region 6 |

**Results l/s**

| | |
|---|---|
| QBAR Rural | 4.8 |
| QBAR Urban | 9.9 |
| Q1 year | 8.4 |
| Q1 year | 8.4 |
| Q30 years | 18.6 |
| Q100 years | 22.6 |

# Appendix H
# Site Plan


# KEY

## Soft Works

- Existing retained trees
- Proposed trees
- Existing retained hedges
- Proposed Hedges
- Proposed planting-Shrub & herbaceous
- Proposed grass-Managed meadow
- Proposed grass
- Proposed gravel over geotextile

## Hard Works

- Retained + New brick paviors to rear gardens. Improved where damaged. New paviors to match
- Proposed resin bonded gravel laid over existing tarmac.
- Retained yorkstone paving paths + New yorkstone to rear patios. New reclaimed yorkstone provided to new areas. All to match existing.
- Proposed post and rail fence at 1.2m high with mesh guard to improve security.
- Existing retained outside boundary - Closeboard at 2m high approx
- Proposed BS kerb. All to engineers details
- Retained granite setts in grey. New granite setts to match all to engineers details
- Retained walls

EXISTING SURVEY SURVEY UNDERNEATH AS GREY LINE

DRAFT

# LANDSCAPE PLAN

**NOTES**

FOR DETAILS ON RETAINING STRUCTURES AND ALL HARD SURFACING - PLEASE REFER TO ENGINEERS/ARCHITECTS DETAILS.
LEVELS TO BE PROVIDED BY ENGINEERS/ARCHITECTS
ALL HARD SURFACING LAID TO FALLS.
SURFACE DRAINAGE - TO BE PROVIDED BY ENGINEERS
FOR RED LINE PLEASE REFER TO ARCHITECTS DRAWING

**FIGURED DIMENSIONS ONLY TO BE USED**

1. This drawing is to be read in conjunction with all other drawings.
2. Do not scale off this drawing for construction purposes. Written dimensions to be taken only. All dimensions are in millimeters and must be checked on site against Engineers setting out drawings for construction.
3. Any discrepancies found in this drawing or other drawings and specifications in the construction document must be referred to the Designer prior to work commencing.
4. This drawing must not be copied in whole or in part without prior consent of LDC Design Ltd.


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The Charcoal House
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Scale @A1
Drawn by AF
Status
DRAFT

Project Title
MANOR COURT
Client
Heathrow 1 Limited

Drawing Number
10216-GA-01
Revision
P1

PATRICK PARSONS

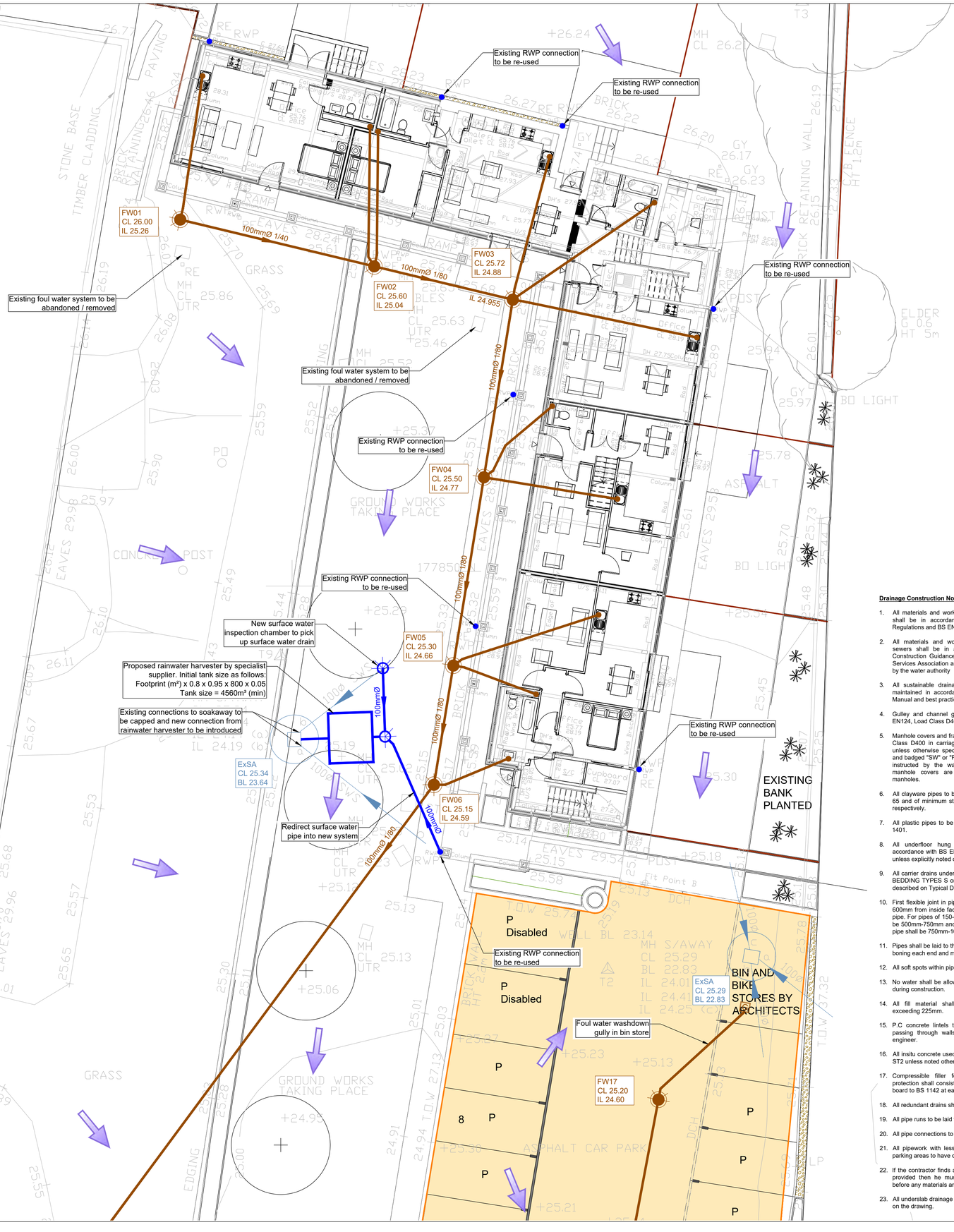
# Appendix J
# Drainage Layout

**All PPIC chambers to be:**

- Wavin OSMA Universal 450mm PPIC (depth up to 1.2m)
- Wavin Deep Inspection Chamber (1.2m to to 3.0m or larger pipes). 450mmØ for 100/150 pipes. 600mmØ for 225/300 pipes.

**Drainage Key**

- 450mmØ PPIC chamber
- Proposed Foul Water (Private)
- Existing Foul Water (Public)
- Proposed Surface Water (Private)
- Existing Surface Water (Public)
- Porous Surfacing
- Excedance Flow Direction
- Foul Water Gully




Note:
Existing sewers mapped from topographical survey informaiton and site inspection only. Full GPR/CCTV survey of existing services strongly recommended prior to commencement of works on site to verify connections, potential services clashes and suitability of existing network.

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N
W E
S

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12. All soft spots within pipe trenches shall be removed.
13. No water shall be allowed to accumulate in pipe trenches during construction.
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22. 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
23. All underslab drainage at minimum 1 in 40 fall unless noted on the drawing.

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|---|---|---|---|---|---|---|
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| | AJ | 09.08.21 | DB | 09.08.21 | DB | 09.08.21 |

Revisions


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Client
Heathrow 1 Limited

Project
Manor Court, High Street, Harmondsworth

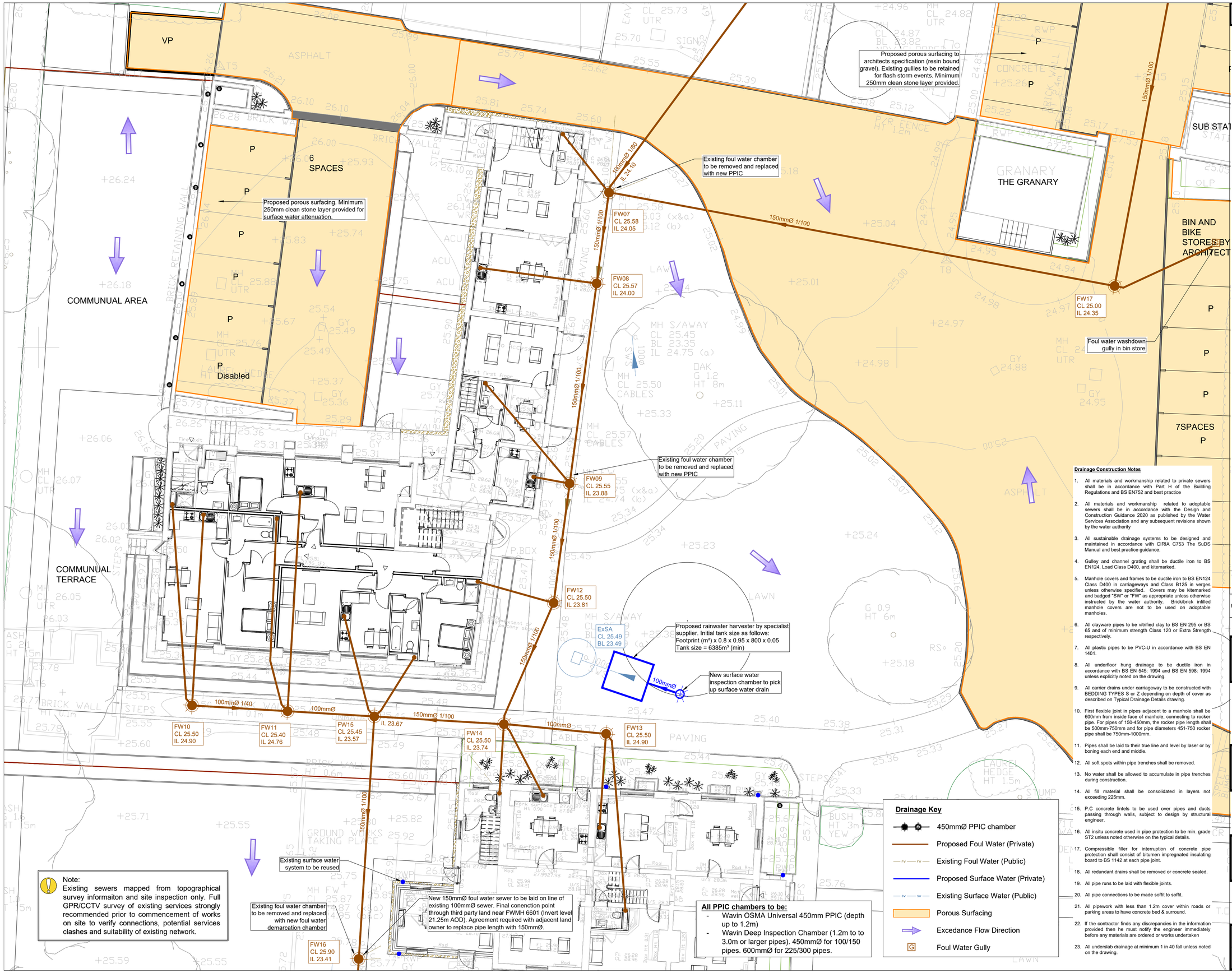
Drawing
Drainage Layout
Sheet 1 of 2

Scales 1:100 At original size A1

Drawn AJ Checked DB
Date Aug 2021

Status TENDER

Drawing No. A21138/0300 Rev. T1

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Sheet 2 of 2

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Drawn AJ Checked DB
Date Aug 2021

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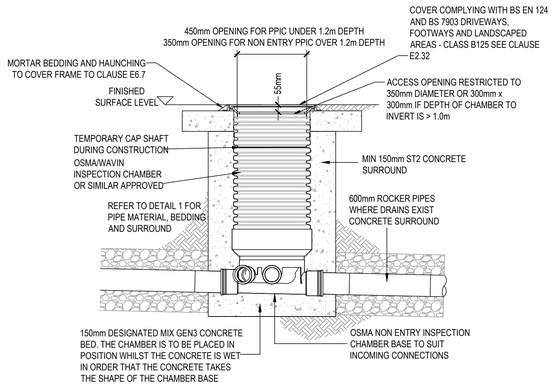
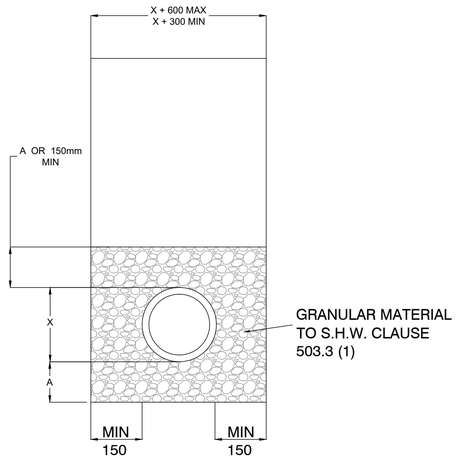



POLYPROPYLENE INSPECTION CHAMBER (PPIC & NEIC) IN NON TRAFFICKED AREAS

450ø/600ø PPIC MAXIMUM DEPTH TO INVERT OF CHAMBER TO BE 600mm TO 1200mm – CUT TO INTERMEDIATE SIZES
450ø/600ø NON ENTRY PPIC DEPTH TO INVERT OF CHAMBER TO BE 1200mm TO 3000mm – CUT TO INTERMEDIATE SIZES

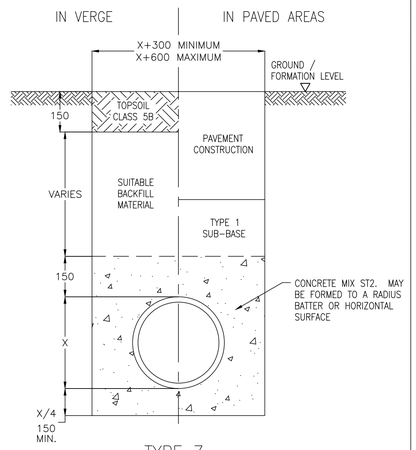



TYPE S

PIPE BEDDING WHEN COVER IS GREATER THAN (1.2m COVER IN HIGHWAYS OR 0.9m VERGES) BEDDING FACTOR 2.2

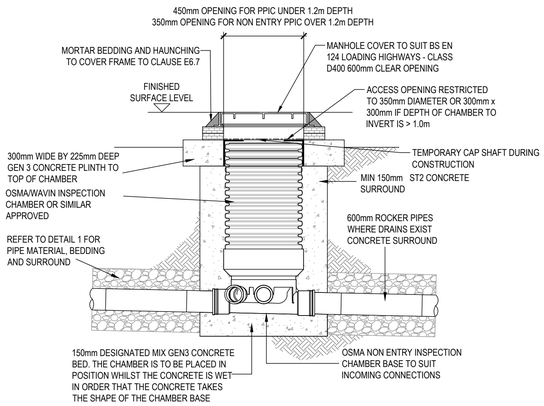
## TRENCH WIDTHS

| INTERNAL PIPE DIAMETER (mm) | MAXIMUM TRENCH WIDTH (mm) |
|---|---|
| 100 | 600 |
| 150 | 600 |
| 225 | 700 |
| 300 | 850 |
| 375 | 1050 |
| 450 | 1150 |
| 525 | 1200 |
| 600 | 1350 |
| 675 | 1450 |
| 750 | 1500 |
| 825 | 1600 |
| 900 | 1900 |
| 975 | 2000 |
| 1050 | 2100 |
| 1200 | 2300 |




TYPE Z

PIPE BEDDING WHEN COVER IS LESS THAN (1.2m COVER IN HIGHWAYS OR 0.9m VERGES)

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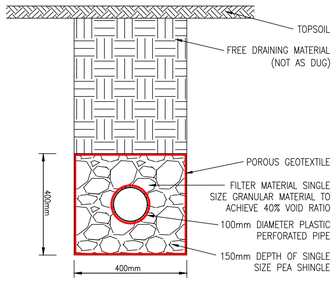
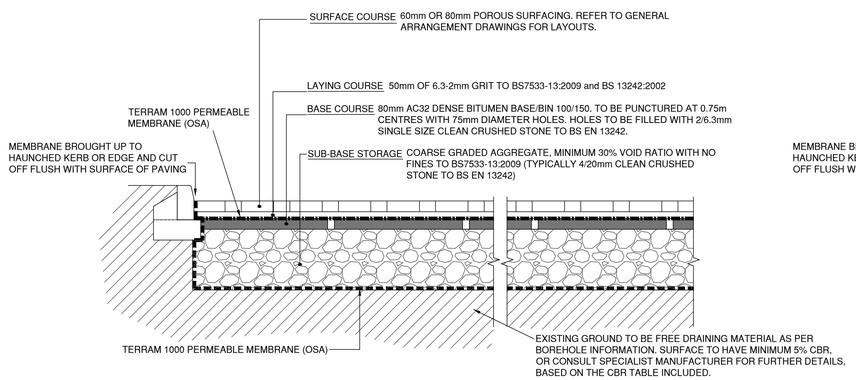
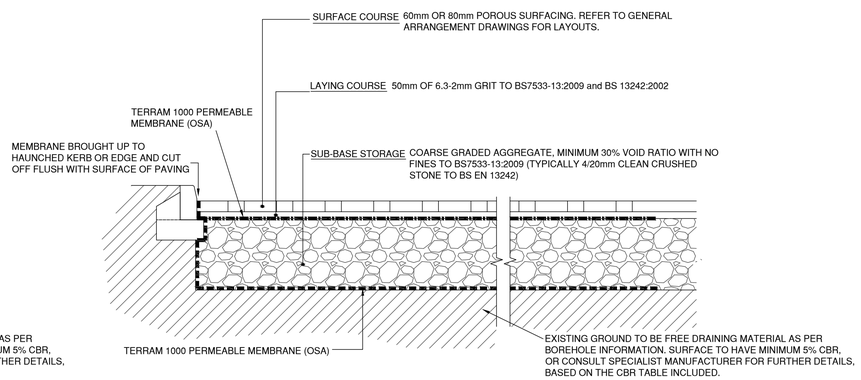



LAND DRAIN DETAIL
100mmø PIPE




POROUS PAVEMENT DETAIL
(FULL INFILTRATION, WITH TEMPORARY BITUMEN LAYER)

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| REV. | REVISION NOTE/COMMENT | | | | | | |
| | DRW BY | DATE | CCK BY | DATE | APP BY | DATE | |

Revisions

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Client
Heathrow 1 Limited

Project
Manor Court, High Street, Harmondsworth

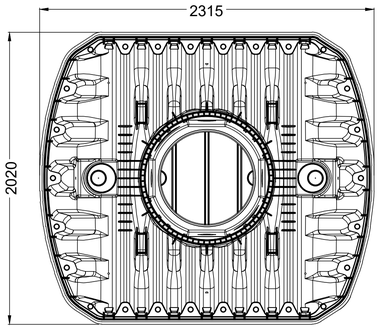
Drawing
Typical Details

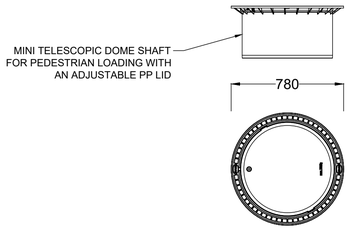
Scales NTS At original size A1

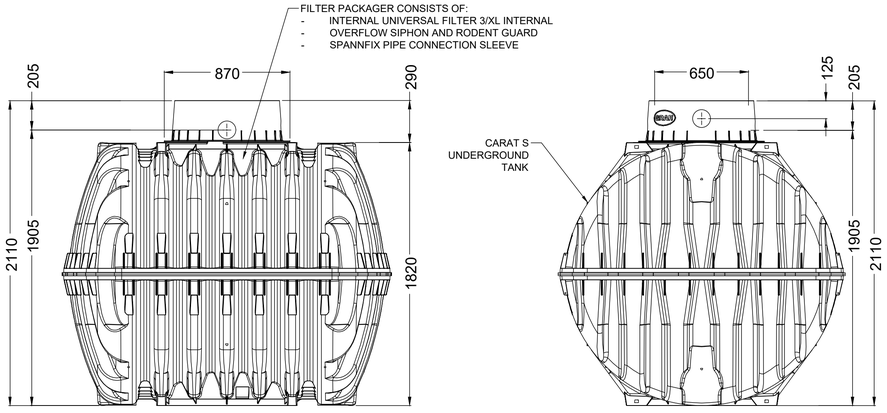
Drawn HS
Date Aug 2021
Checked DB

Status TENDER

Drawing No. A21138/0302 Rev. T1



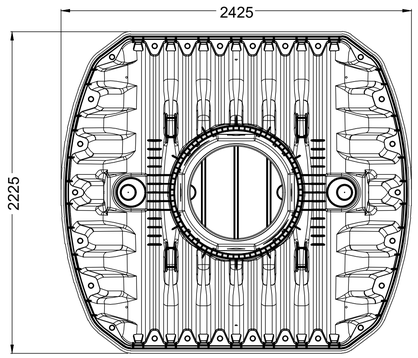



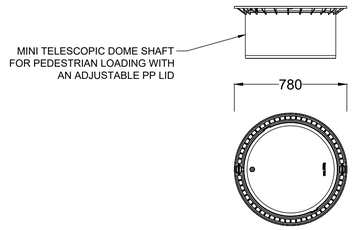



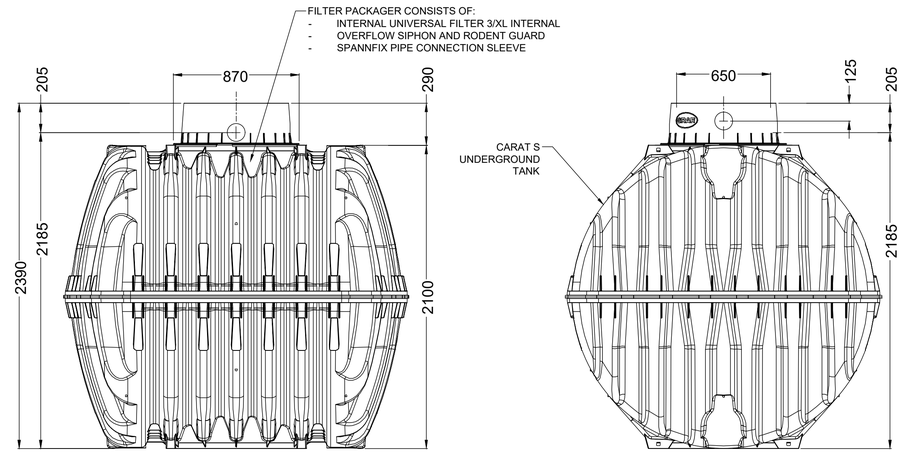




Carat S underground tank 4800L with Mini-Dome 185kg







Carat S underground tank 6500L with Mini-Dome 220kg

Tank details indicative only subject to specialist supplier specification

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Client
Heathrow 1 Limited

Project
Manor Court, High Street, Harmondsworth

Drawing
Rainwater Harvester Details

Scales NTS At original size A1

Drawn HS
Date Aug 2021
Checked DB

Status TENDER

Drawing No. A21138/0305 Rev. T1

# Appendix K
# MicroDrainage Calculations

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

Half Drain Time : 49 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 0.193 | 0.193 | 2.0 | 7.2 | O K |
| 30 min Summer | 0.216 | 0.216 | 2.2 | 9.1 | O K |
| 60 min Summer | 0.228 | 0.228 | 2.4 | 10.2 | O K |
| 120 min Summer | 0.230 | 0.230 | 2.4 | 10.3 | O K |
| 180 min Summer | 0.225 | 0.225 | 2.3 | 9.8 | O K |
| 240 min Summer | 0.217 | 0.217 | 2.3 | 9.2 | O K |
| 360 min Summer | 0.201 | 0.201 | 2.1 | 7.9 | O K |
| 480 min Summer | 0.187 | 0.187 | 1.9 | 6.8 | O K |
| 600 min Summer | 0.174 | 0.174 | 1.8 | 5.9 | O K |
| 720 min Summer | 0.164 | 0.164 | 1.7 | 5.2 | O K |
| 960 min Summer | 0.146 | 0.146 | 1.5 | 4.1 | O K |
| 1440 min Summer | 0.119 | 0.119 | 1.2 | 2.8 | O K |
| 2160 min Summer | 0.094 | 0.094 | 1.0 | 1.7 | O K |
| 2880 min Summer | 0.078 | 0.078 | 0.8 | 1.2 | O K |
| 4320 min Summer | 0.058 | 0.058 | 0.6 | 0.6 | O K |
| 5760 min Summer | 0.048 | 0.048 | 0.5 | 0.4 | O K |
| 7200 min Summer | 0.044 | 0.044 | 0.4 | 0.4 | O K |
| 8640 min Summer | 0.041 | 0.041 | 0.3 | 0.3 | O K |
| 10080 min Summer | 0.038 | 0.038 | 0.3 | 0.3 | O K |
| 15 min Winter | 0.193 | 0.193 | 2.0 | 7.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 138.153 | 0.0 | 17 |
| 30 min Summer | 90.705 | 0.0 | 30 |
| 60 min Summer | 56.713 | 0.0 | 48 |
| 120 min Summer | 34.246 | 0.0 | 82 |
| 180 min Summer | 25.149 | 0.0 | 116 |
| 240 min Summer | 20.078 | 0.0 | 148 |
| 360 min Summer | 14.585 | 0.0 | 214 |
| 480 min Summer | 11.622 | 0.0 | 276 |
| 600 min Summer | 9.738 | 0.0 | 338 |
| 720 min Summer | 8.424 | 0.0 | 398 |
| 960 min Summer | 6.697 | 0.0 | 520 |
| 1440 min Summer | 4.839 | 0.0 | 762 |
| 2160 min Summer | 3.490 | 0.0 | 1120 |
| 2880 min Summer | 2.766 | 0.0 | 1472 |
| 4320 min Summer | 1.989 | 0.0 | 2204 |
| 5760 min Summer | 1.573 | 0.0 | 2928 |
| 7200 min Summer | 1.311 | 0.0 | 3648 |
| 8640 min Summer | 1.129 | 0.0 | 4392 |
| 10080 min Summer | 0.994 | 0.0 | 5040 |
| 15 min Winter | 138.153 | 0.0 | 17 |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 30 min Winter | 0.217 | 0.217 | 2.3 | 9.2 | O K |
| 60 min Winter | 0.227 | 0.227 | 2.4 | 10.1 | O K |
| 120 min Winter | 0.226 | 0.226 | 2.4 | 10.0 | O K |
| 180 min Winter | 0.216 | 0.216 | 2.2 | 9.1 | O K |
| 240 min Winter | 0.205 | 0.205 | 2.1 | 8.2 | O K |
| 360 min Winter | 0.183 | 0.183 | 1.9 | 6.6 | O K |
| 480 min Winter | 0.165 | 0.165 | 1.7 | 5.3 | O K |
| 600 min Winter | 0.150 | 0.150 | 1.6 | 4.4 | O K |
| 720 min Winter | 0.136 | 0.136 | 1.4 | 3.6 | O K |
| 960 min Winter | 0.116 | 0.116 | 1.2 | 2.6 | O K |
| 1440 min Winter | 0.088 | 0.088 | 0.9 | 1.5 | O K |
| 2160 min Winter | 0.065 | 0.065 | 0.7 | 0.8 | O K |
| 2880 min Winter | 0.052 | 0.052 | 0.5 | 0.5 | O K |
| 4320 min Winter | 0.043 | 0.043 | 0.4 | 0.4 | O K |
| 5760 min Winter | 0.038 | 0.038 | 0.3 | 0.3 | O K |
| 7200 min Winter | 0.035 | 0.035 | 0.3 | 0.2 | O K |
| 8640 min Winter | 0.032 | 0.032 | 0.2 | 0.2 | O K |
| 10080 min Winter | 0.030 | 0.030 | 0.2 | 0.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 30 min Winter | 90.705 | 0.0 | 30 |
| 60 min Winter | 56.713 | 0.0 | 50 |
| 120 min Winter | 34.246 | 0.0 | 86 |
| 180 min Winter | 25.149 | 0.0 | 124 |
| 240 min Winter | 20.078 | 0.0 | 158 |
| 360 min Winter | 14.585 | 0.0 | 224 |
| 480 min Winter | 11.622 | 0.0 | 288 |
| 600 min Winter | 9.738 | 0.0 | 350 |
| 720 min Winter | 8.424 | 0.0 | 412 |
| 960 min Winter | 6.697 | 0.0 | 530 |
| 1440 min Winter | 4.839 | 0.0 | 764 |
| 2160 min Winter | 3.490 | 0.0 | 1120 |
| 2880 min Winter | 2.766 | 0.0 | 1464 |
| 4320 min Winter | 1.989 | 0.0 | 2140 |
| 5760 min Winter | 1.573 | 0.0 | 2936 |
| 7200 min Winter | 1.311 | 0.0 | 3664 |
| 8640 min Winter | 1.129 | 0.0 | 4256 |
| 10080 min Winter | 0.994 | 0.0 | 5008 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.950 |
| Region | England and Wales | Cv (Winter) | 0.950 |
| M5-60 (mm) | 20.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.030

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.030 |

## Model Details

Storage is Online Cover Level (m) 25.200

## Porous Car Park Structure

| | | | |
|---|---|---|---|
| Infiltration Coefficient Base (m/hr) | 0.05760 | Width (m) | 13.0 |
| Membrane Percolation (mm/hr) | 1000 | Length (m) | 23.0 |
| Max Percolation (l/s) | 83.1 | Slope (1:X) | 100.0 |
| Safety Factor | 2.0 | Depression Storage (mm) | 5 |
| Porosity | 0.30 | Evaporation (mm/day) | 3 |
| Invert Level (m) | 0.000 | Cap Volume Depth (m) | 0.250 |

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

Half Drain Time : 95 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 0.352 | 0.352 | 6.0 | 41.6 | O K |
| 30 min Summer | 0.460 | 0.460 | 6.0 | 53.5 | O K |
| 60 min Summer | 6.204 | 6.204 | 6.0 | 62.2 | O K |
| 120 min Summer | 9.212 | 9.212 | 6.0 | 65.2 | O K |
| 180 min Summer | 8.324 | 8.324 | 6.0 | 64.3 | O K |
| 240 min Summer | 6.121 | 6.121 | 6.0 | 62.1 | O K |
| 360 min Summer | 0.796 | 0.796 | 6.0 | 56.8 | O K |
| 480 min Summer | 0.435 | 0.435 | 6.0 | 51.4 | O K |
| 600 min Summer | 0.387 | 0.387 | 6.0 | 46.4 | O K |
| 720 min Summer | 0.353 | 0.353 | 6.0 | 41.8 | O K |
| 960 min Summer | 0.308 | 0.308 | 6.0 | 34.3 | O K |
| 1440 min Summer | 0.261 | 0.261 | 5.2 | 25.6 | O K |
| 2160 min Summer | 0.217 | 0.217 | 4.3 | 17.6 | O K |
| 2880 min Summer | 0.185 | 0.185 | 3.7 | 12.8 | O K |
| 4320 min Summer | 0.143 | 0.143 | 2.9 | 7.7 | O K |
| 5760 min Summer | 0.117 | 0.117 | 2.3 | 5.2 | O K |
| 7200 min Summer | 0.099 | 0.099 | 2.0 | 3.7 | O K |
| 8640 min Summer | 0.086 | 0.086 | 1.7 | 2.8 | O K |
| 10080 min Summer | 0.076 | 0.076 | 1.5 | 2.1 | O K |
| 15 min Winter | 0.352 | 0.352 | 6.0 | 41.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 138.153 | 0.0 | 18 |
| 30 min Summer | 90.705 | 0.0 | 32 |
| 60 min Summer | 56.713 | 0.0 | 60 |
| 120 min Summer | 34.246 | 0.0 | 100 |
| 180 min Summer | 25.149 | 0.0 | 130 |
| 240 min Summer | 20.078 | 0.0 | 164 |
| 360 min Summer | 14.585 | 0.0 | 232 |
| 480 min Summer | 11.622 | 0.0 | 300 |
| 600 min Summer | 9.738 | 0.0 | 364 |
| 720 min Summer | 8.424 | 0.0 | 426 |
| 960 min Summer | 6.697 | 0.0 | 546 |
| 1440 min Summer | 4.839 | 0.0 | 782 |
| 2160 min Summer | 3.490 | 0.0 | 1148 |
| 2880 min Summer | 2.766 | 0.0 | 1500 |
| 4320 min Summer | 1.989 | 0.0 | 2208 |
| 5760 min Summer | 1.573 | 0.0 | 2936 |
| 7200 min Summer | 1.311 | 0.0 | 3672 |
| 8640 min Summer | 1.129 | 0.0 | 4400 |
| 10080 min Summer | 0.994 | 0.0 | 5136 |
| 15 min Winter | 138.153 | 0.0 | 18 |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 30 min Winter | 0.461 | 0.461 | 6.0 | 53.5 | O K |
| 60 min Winter | 6.357 | 6.357 | 6.0 | 62.4 | O K |
| 120 min Winter | 8.751 | 8.751 | 6.0 | 64.8 | O K |
| 180 min Winter | 7.088 | 7.088 | 6.0 | 63.1 | O K |
| 240 min Winter | 3.760 | 3.760 | 6.0 | 59.8 | O K |
| 360 min Winter | 0.441 | 0.441 | 6.0 | 52.0 | O K |
| 480 min Winter | 0.372 | 0.372 | 6.0 | 44.5 | O K |
| 600 min Winter | 0.328 | 0.328 | 6.0 | 37.9 | O K |
| 720 min Winter | 0.299 | 0.299 | 6.0 | 32.7 | O K |
| 960 min Winter | 0.263 | 0.263 | 5.3 | 25.8 | O K |
| 1440 min Winter | 0.212 | 0.212 | 4.2 | 16.9 | O K |
| 2160 min Winter | 0.164 | 0.164 | 3.3 | 10.1 | O K |
| 2880 min Winter | 0.133 | 0.133 | 2.7 | 6.7 | O K |
| 4320 min Winter | 0.097 | 0.097 | 1.9 | 3.6 | O K |
| 5760 min Winter | 0.077 | 0.077 | 1.5 | 2.2 | O K |
| 7200 min Winter | 0.064 | 0.064 | 1.3 | 1.5 | O K |
| 8640 min Winter | 0.055 | 0.055 | 1.1 | 1.1 | O K |
| 10080 min Winter | 0.049 | 0.049 | 1.0 | 0.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 30 min Winter | 90.705 | 0.0 | 32 |
| 60 min Winter | 56.713 | 0.0 | 60 |
| 120 min Winter | 34.246 | 0.0 | 108 |
| 180 min Winter | 25.149 | 0.0 | 138 |
| 240 min Winter | 20.078 | 0.0 | 176 |
| 360 min Winter | 14.585 | 0.0 | 248 |
| 480 min Winter | 11.622 | 0.0 | 316 |
| 600 min Winter | 9.738 | 0.0 | 378 |
| 720 min Winter | 8.424 | 0.0 | 436 |
| 960 min Winter | 6.697 | 0.0 | 560 |
| 1440 min Winter | 4.839 | 0.0 | 806 |
| 2160 min Winter | 3.490 | 0.0 | 1152 |
| 2880 min Winter | 2.766 | 0.0 | 1500 |
| 4320 min Winter | 1.989 | 0.0 | 2208 |
| 5760 min Winter | 1.573 | 0.0 | 2936 |
| 7200 min Winter | 1.311 | 0.0 | 3672 |
| 8640 min Winter | 1.129 | 0.0 | 4304 |
| 10080 min Winter | 0.994 | 0.0 | 4968 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.950 |
| Region | England and Wales | Cv (Winter) | 0.950 |
| M5-60 (mm) | 20.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.075

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.075 |

## Time Area Diagram

Total Area (ha) 0.075

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.075 |

## Model Details

Storage is Online Cover Level (m) 25.000

## Porous Car Park Structure

| | | | |
|---|---|---|---|
| Infiltration Coefficient Base (m/hr) | 0.05760 | Width (m) | 25.0 |
| Membrane Percolation (mm/hr) | 1000 | Length (m) | 30.0 |
| Max Percolation (l/s) | 208.3 | Slope (1:X) | 100.0 |
| Safety Factor | 2.0 | Depression Storage (mm) | 5 |
| Porosity | 0.30 | Evaporation (mm/day) | 3 |
| Invert Level (m) | 0.000 | Cap Volume Depth (m) | 0.250 |

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

Half Drain Time : 42 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 0.127 | 0.127 | 2.0 | 5.8 | O K |
| 30 min Summer | 0.147 | 0.147 | 2.0 | 7.3 | O K |
| 60 min Summer | 0.157 | 0.157 | 2.0 | 8.1 | O K |
| 120 min Summer | 0.155 | 0.155 | 2.0 | 7.9 | O K |
| 180 min Summer | 0.146 | 0.146 | 2.0 | 7.2 | O K |
| 240 min Summer | 0.135 | 0.135 | 2.0 | 6.3 | O K |
| 360 min Summer | 0.115 | 0.115 | 2.0 | 4.9 | O K |
| 480 min Summer | 0.101 | 0.101 | 2.0 | 3.8 | O K |
| 600 min Summer | 0.092 | 0.092 | 1.8 | 3.2 | O K |
| 720 min Summer | 0.085 | 0.085 | 1.7 | 2.7 | O K |
| 960 min Summer | 0.073 | 0.073 | 1.5 | 2.0 | O K |
| 1440 min Summer | 0.058 | 0.058 | 1.2 | 1.3 | O K |
| 2160 min Summer | 0.047 | 0.047 | 0.9 | 0.8 | O K |
| 2880 min Summer | 0.042 | 0.042 | 0.7 | 0.7 | O K |
| 4320 min Summer | 0.036 | 0.036 | 0.5 | 0.5 | O K |
| 5760 min Summer | 0.032 | 0.032 | 0.4 | 0.4 | O K |
| 7200 min Summer | 0.029 | 0.029 | 0.3 | 0.3 | O K |
| 8640 min Summer | 0.027 | 0.027 | 0.3 | 0.3 | O K |
| 10080 min Summer | 0.025 | 0.025 | 0.3 | 0.2 | O K |
| 15 min Winter | 0.127 | 0.127 | 2.0 | 5.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 138.153 | 0.0 | 17 |
| 30 min Summer | 90.705 | 0.0 | 30 |
| 60 min Summer | 56.713 | 0.0 | 48 |
| 120 min Summer | 34.246 | 0.0 | 82 |
| 180 min Summer | 25.149 | 0.0 | 114 |
| 240 min Summer | 20.078 | 0.0 | 148 |
| 360 min Summer | 14.585 | 0.0 | 208 |
| 480 min Summer | 11.622 | 0.0 | 266 |
| 600 min Summer | 9.738 | 0.0 | 326 |
| 720 min Summer | 8.424 | 0.0 | 384 |
| 960 min Summer | 6.697 | 0.0 | 502 |
| 1440 min Summer | 4.839 | 0.0 | 738 |
| 2160 min Summer | 3.490 | 0.0 | 1100 |
| 2880 min Summer | 2.766 | 0.0 | 1464 |
| 4320 min Summer | 1.989 | 0.0 | 2164 |
| 5760 min Summer | 1.573 | 0.0 | 2872 |
| 7200 min Summer | 1.311 | 0.0 | 3568 |
| 8640 min Summer | 1.129 | 0.0 | 4280 |
| 10080 min Summer | 0.994 | 0.0 | 5136 |
| 15 min Winter | 138.153 | 0.0 | 17 |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 30 min Winter | 0.147 | 0.147 | 2.0 | 7.3 | O K |
| 60 min Winter | 0.155 | 0.155 | 2.0 | 7.9 | O K |
| 120 min Winter | 0.149 | 0.149 | 2.0 | 7.4 | O K |
| 180 min Winter | 0.133 | 0.133 | 2.0 | 6.3 | O K |
| 240 min Winter | 0.118 | 0.118 | 2.0 | 5.1 | O K |
| 360 min Winter | 0.096 | 0.096 | 1.9 | 3.5 | O K |
| 480 min Winter | 0.083 | 0.083 | 1.7 | 2.6 | O K |
| 600 min Winter | 0.073 | 0.073 | 1.5 | 2.0 | O K |
| 720 min Winter | 0.065 | 0.065 | 1.3 | 1.6 | O K |
| 960 min Winter | 0.054 | 0.054 | 1.1 | 1.1 | O K |
| 1440 min Winter | 0.045 | 0.045 | 0.8 | 0.7 | O K |
| 2160 min Winter | 0.038 | 0.038 | 0.6 | 0.5 | O K |
| 2880 min Winter | 0.034 | 0.034 | 0.5 | 0.4 | O K |
| 4320 min Winter | 0.029 | 0.029 | 0.3 | 0.3 | O K |
| 5760 min Winter | 0.025 | 0.025 | 0.3 | 0.2 | O K |
| 7200 min Winter | 0.023 | 0.023 | 0.2 | 0.2 | O K |
| 8640 min Winter | 0.021 | 0.021 | 0.2 | 0.2 | O K |
| 10080 min Winter | 0.020 | 0.020 | 0.2 | 0.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 30 min Winter | 90.705 | 0.0 | 30 |
| 60 min Winter | 56.713 | 0.0 | 48 |
| 120 min Winter | 34.246 | 0.0 | 86 |
| 180 min Winter | 25.149 | 0.0 | 122 |
| 240 min Winter | 20.078 | 0.0 | 154 |
| 360 min Winter | 14.585 | 0.0 | 212 |
| 480 min Winter | 11.622 | 0.0 | 272 |
| 600 min Winter | 9.738 | 0.0 | 332 |
| 720 min Winter | 8.424 | 0.0 | 390 |
| 960 min Winter | 6.697 | 0.0 | 504 |
| 1440 min Winter | 4.839 | 0.0 | 732 |
| 2160 min Winter | 3.490 | 0.0 | 1104 |
| 2880 min Winter | 2.766 | 0.0 | 1428 |
| 4320 min Winter | 1.989 | 0.0 | 2160 |
| 5760 min Winter | 1.573 | 0.0 | 2896 |
| 7200 min Winter | 1.311 | 0.0 | 3680 |
| 8640 min Winter | 1.129 | 0.0 | 4376 |
| 10080 min Winter | 0.994 | 0.0 | 5104 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.950 |
| Region | England and Wales | Cv (Winter) | 0.950 |
| M5-60 (mm) | 20.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.025

| Time (mins) From: | To: | Area (ha) |
|---|---|---|
| 0 | 4 | 0.025 |

## Model Details

Storage is Online Cover Level (m) 26.200

## Porous Car Park Structure

| | | | |
|---|---|---|---|
| Infiltration Coefficient Base (m/hr) | 0.05760 | Width (m) | 25.0 |
| Membrane Percolation (mm/hr) | 1000 | Length (m) | 10.0 |
| Max Percolation (l/s) | 69.4 | Slope (1:X) | 100.0 |
| Safety Factor | 2.0 | Depression Storage (mm) | 5 |
| Porosity | 0.30 | Evaporation (mm/day) | 3 |
| Invert Level (m) | 0.000 | Cap Volume Depth (m) | 0.250 |

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