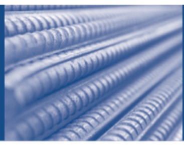
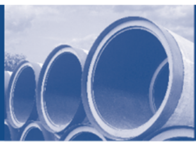
PROPOSED RESIDENTIAL DEVELOPMENT
LAND TO THE SOUTH OF SOUTHSIDE
STEEPLE ASTON
BICESTER
OX25 4RX

FLOOD RISK ASSESSMENT & DEVELOPMENT DRAINAGE STRATEGY

RECTORY HOMES

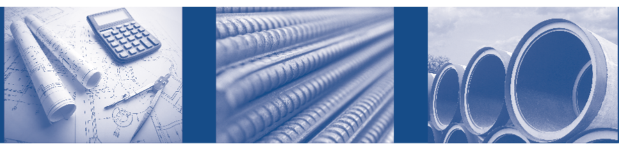
REV B
DECEMBER 2017
REF: SS/17/0321/5634

DOCUMENT CONTROL RECORD

Document Issue:

Rev	Date	Issue Status	Prepared by	Checked by
-	06.10.17	First Issue for comment	S.Smith	C.Pendle
A	20.11.17	Updates to FRA and Strategy following BRE365 infiltration testing	S.Smith	C.Pendle
B	18.12.17	Site Layout (Appendix A) amended, Drainage Strategy (Appendix D) updated to suit.	C.Pendle	C.Pendle



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APPENDICES

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Appendix B - Topographical Survey
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Appendix D - Foul & Surface Drainage Strategy Layout
Appendix E - SuDS Compatibility Matrix

REFERENCES

Environment Agency Flood Map Information © and database right www.environment-agency.gov.uk

Technical Guidance to the National Planning Policy Framework - NPPF (2012)
Department for Communities and Local Government ISBN: 978-1-4098-3410-6

Contains British Geological Survey materials © NERC (2014)

Cherwell & West Oxfordshire District Council, Strategic Flood Risk Assessment (SFRA) (April 2009)

Oxfordshire County Council, Preliminary Flood Risk Assessment (June 2011).

1 Executive Summary

SITE INFORMATION	CLIENT	Rectory Homes
	SITE NAME	Land to the South of South Side
	SITE LOCATION	SP 46967 25852 Land to the South of South Side Steeple Aston Bicester, OX25 4RX
	SITE AREA CURRENT LAND USE PROPOSED LAND USE	0.810 ha Greenfield – Arable / agricultural grassland 6No. Residential Dwellings (Class C3A)
	SITE GEOLOGY – Superficial SITE GEOLOGY - Bedrock	None Recorded East: Chipping Norton Limestone Formation – Limestone, ooidal. West: Horsehay Sand Formation – Sandstone.
	SOIL INFILTRATION RATE	Variable. North east of the site: 8.2x10-6 m/s
	GROUNDWATER LEVELS	Level not confirmed by tests. Anticipated at large depths (>3m).
	GROUNDWATER SPZ / AQUIFER	Not in an SPZ / Principle and Secondary A
	GROUND CONTAMINATION	TBC – None anticipated
FLOOD RISK	ENVIRONMENT AGENCY FLOOD ZONE	Flood Zone 1 - Lowest Risk < 0.1% (<1:1000)
	FLUVIAL (RIVERS & WATERCOURSES)	Not a risk
	PLUVIAL (SURFACE WATER)	Not a risk
	GROUNDWATER	Not a risk
	EXISTING/PROPOSED SEWERS & MAINS	Not a risk
	ARTIFICIAL	Not a risk
	TIDAL	Not a risk
FOUL & SURFACE	PROPOSED SURFACE WATER STRATEGY	Onsite Infiltration
	PROPOSED SUDS TYPE	Permeable block paving
	EXISTING SW PEAK FLOW RATE PROPOSED SW PEAK FLOW RATE	Greenfield QBar : 1.4 l/s NA
	FOUL WATER STRATEGY	Gravity to Thames Water Foul Sewer
	EXISTING FW PEAK FLOW RATE PROPOSED FW PEAK FLOW RATE	N/A 0.3 l/s (SFA 4000 l/unit/d) for 6 Units
MISC	FURTHER INVESTIGATIONS	NA

2 Introduction

2.1 Scope

Rectory Homes is seeking planning permission for the construction of 6No. residential dwellings with associated infrastructure including development access road, SuDS, vehicle parking, domestic gardens and areas of public open space.
The 8104 m² (0.810 ha) site is located in Steeple Aston, Bicester.
Refer to Appendix A for site layout.

2.2 MJA Consulting has been appointed to undertake a Flood Risk Assessment and Development Drainage Strategy to determine the potential flood risks associated with the site and to provide a suitable strategy for the disposal of surface and foul water from the proposed development.

2.3 Report Structure

The National Planning Policy Framework (NPPF) and the Flood Risk and Coastal Planning Practice Guidance (PPG) is the current guidance on development and flood risk in England and Wales.
The Flood Risk technical guidance for the National Planning Policy Framework requires a Flood Risk Assessment (FRA) to be carried out on sites over 1ha to consider all potential forms of flooding including that from river, sea, estuarial, land drainage, groundwater, overland flow, surface water run-off, sewer systems, and artificial water bodies (lakes, reservoirs, canals etc.) to both the development site and to offsite parties and land.

2.4 This report will take the structure of a 'Flood Risk Assessment' in accordance with the National Planning Policy Framework, the Flood Risk and Coastal Planning Practice Guidance, Environment Agency's Flood Risk Assessment Guidance and CIRIA Report 624 'Development and Flood Risk.

2.5 The objective of this report is:

- To confirm whether the proposed development site is affected by current or anticipated future flooding from all sources for the lifetime of the site.
- To confirm that this development will not increase the risk of flooding to any offsite properties and land or increase the population within a floodplain.
- To undertake calculations to establish the foul and surface water runoff rates from the existing site and to assess the potential foul and surface water runoff from the proposed development.
- To detail a suitable strategy for the management of foul and surface water generated from the proposed development allowing for future climate change.
- To satisfy the approving planning authority that the most sustainable foul and surface water drainage solutions have been considered, in line with Environment Agency guidance, The Building Regulations (Document H 2002) and government legislation such as the Flood and Water Management Act 2010 (Defra) and The National Planning Policy Framework (NPPF & PPG).

3 The Development Site

3.1 Site Location and Description

The application site is located to the south of South Side Road on the western edge of the village of Steeple Aston, Bicester.

The 0.810 ha parcel of land comprises of grass/scrub land.

The site is centred on National Grid Reference SP 46967 25852.

3.2 Topography

A topographical survey of the site was undertaken by RGL Surveys Ltd in June 2017 which indicates the site generally falls from west to east with levels ranging from 130.27mAOD to 126.39mAOD (metres above Ordnance Datum).

Refer to Appendix B for a Topographical Survey of the existing site.

3.3 Geology

Information published by the British Geological Society (BGS) indicates that the site is anticipated to be directly underlain by two bedrock formations. Split in half, the west of the site is situated on the Chipping Norton Limestone Formation (Limestone, ooidal) and the east of the site is situated on the Horsehay Sand Formation (Sandstone).

3.4 Information from the infiltration tests found the superficial deposits to be that of the Oolite Group. This generally comprised of an upper unit of 'brash' comprising gravel & cobble of limestone with variable quantities of sand and silt. This in turn was underlain by a soft and firm clay with variable quantities of sand and silt.

3.5 Groundwater

Groundwater monitoring has not been carried out at the site to date. However, infiltration tests have given an indication.

3.6 Groundwater was not encountered to a depth of 3m during infiltration testing. Groundwater is anticipated at greater depths.

3.7 The consideration of encountering groundwater during the construction of the development and the vulnerability of the site and proposed SuDS to high groundwater levels is to be considered during detailed design.

The base of any infiltrating SuDS structures are to be at least 1m above the maximum groundwater level.

3.8 Hydrogeology

The Environment Agency's mapping website (www.maps.environment-agency.gov.uk) has classified the site as not being located within a Groundwater Source Protection Zone for both the surface soils and the bedrock strata below the site.

3.9 The bedrock to the west, the Chipping Norton Limestone Formation is classified as a 'Principle' aquifer. These are water storing layers of rock that usually support water supply and/or river base flows on a strategic scale.

The bedrock to the east, the Horsehay Sand Formation is classified as a 'Secondary A' aquifer. These are permeable layers capable of supporting water supplies at a local scale and in some cases, form an important source of base flow to rivers.

3.10 It would be expected that the hydraulic flow of groundwater beneath the site be consistent with the local surface topography, with flows being generally in a west-easterly direction.

3.11 Hydrology and Site Drainage Characteristics

The existing site is largely undeveloped grassland, as such rainfall that lands on this site firstly infiltrates directly at source and into the underlying soils. It is likely the site has relatively good surface water drainage with little overland flow.

3.12 During intense or prolonged storm events soils can become saturated and no longer accept further rainfall, in this event water will runoff following the natural ground contours and drain towards the low spot on the far east of the site.

3.13 The part of South Side road adjacent to the site contains no artificial drainage system and any surface water drains to the road-side ditch and infiltrates there.

3.14 The nearest surface water feature to the development is a shallow land drainage ditch north of the site which runs through the middle of the village. This ditch feature flows west to east and contains a series of several shallow ponds. These features do not pose a flood risk to the site.

3.15 The nearest 'ordinary' watercourse to the development is located 440m north of the site. Ordinary watercourses are those that are not defined as a 'Main River' by the Water Resources Act (1991) and not shown on the Environment Agency's Main River map.

3.16 The nearest 'main river' watercourse to the site is the River Cherwell approximately 2.5km to the east.

3.17 There are no artificial sources of flooding within a 500m radius of the site including that from canals, reservoirs or sewerage works.

3.18 Soil Permeability

Soakaway testing in accordance with BRE Digest 365 has been carried out by The Brownfield Consultancy. Variable infiltration rates were observed across the site; with the best rates in the north east corner. Soils drain at a rate of 8.2×10^{-6} m/s in this area. In sample areas across the rest of the test pits failed to achieve a 75% reduction in effective depth (which is a requirement under BRE 365).

3.19 Ground Contamination

The available environment data does not indicate the presence of any significant sources of contamination risk on site and no visual or olfactory evidence of soil contamination was identified during a site walkover.

Figure 1: Site Location

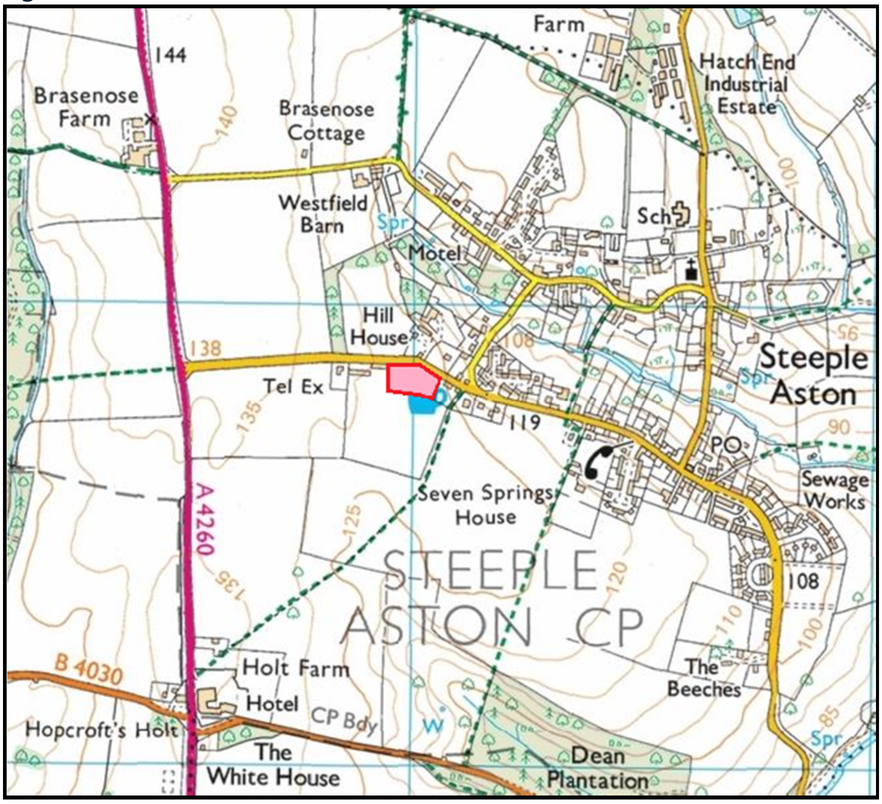


Image courtesy of: @2017 Microsoft Corporation Image courtesy of Ordnance Survey

Figure 2: Development site boundary

Image courtesy of: Imagery @ 2017 Digital Globe, Getmapping plc, Infoterra Ltd & Bluesky, Map data @2017 Google

4 Flood Risk Assessment

4.1 A Flood Risk Assessment requires that an evaluation of all potential forms of flood risk to the site are considered.
In accordance with the Environment Agency's Flood Risk Assessment Guidance, NPPF, PPG and CIRIA Report 624, sources of flooding to be assessed include tidal, fluvial (rivers, streams and watercourses), pluvial (overland rainfall runoff), groundwater, artificial sources (canals and reservoirs) and existing / proposed sewerage and water mains infrastructure.

4.2 History of Flooding

During the data collection process it is important to consider the information which already exists for the site location with respect to flood risk.

4.3 The main source of data for flood risk and recorded incidents of flooding for the site has been the *Cherwell & West Oxfordshire District Council – Strategic Flood Risk Assessment (SFRA) (April 2009)* and the *Oxfordshire County Council – Preliminary Flood Risk Assessment (June 2011).*
Within these studies, consultation was carried out with all relevant authorities and organisations including the Environment Agency, Thames Water, Oxfordshire County Council, Cherwell & West Oxfordshire District Council, Steeple Aston Parish Council and local community stakeholders to identify known or perceived problem areas with respect to flooding in the area.

4.4 Within the context of the proposed development, there has been no recorded issues of flooding from potential sources including:

- Tidal.
- Fluvial (Main rivers and Ordinary watercourses).
- Pluvial (Surface Water).
- Groundwater.
- Existing foul and storm sewers and potable water main infrastructure.
- Artificial infrastructure (ponds, sewerage treatment plants etc.)

4.5 Although the site has not previously flooded, it should be acknowledged that the wider village of Steeple Aston is seen to be at risk of groundwater flooding attributed to emerging groundwater and springs.

4.6 Surface Water

The Environment Agency's 'uFMfSW' (updated Flood Map for Surface Water) (Figure 3) is a theoretical assessment of potential overland flow paths, ground levels and drainage systems using information from the LLFA to highlight areas that may be susceptible to surface water flooding. This map indicates that the whole of the existing site has a 'very low' (less than a 1:1000 or 0.1%) risk of flooding from surface water runoff.

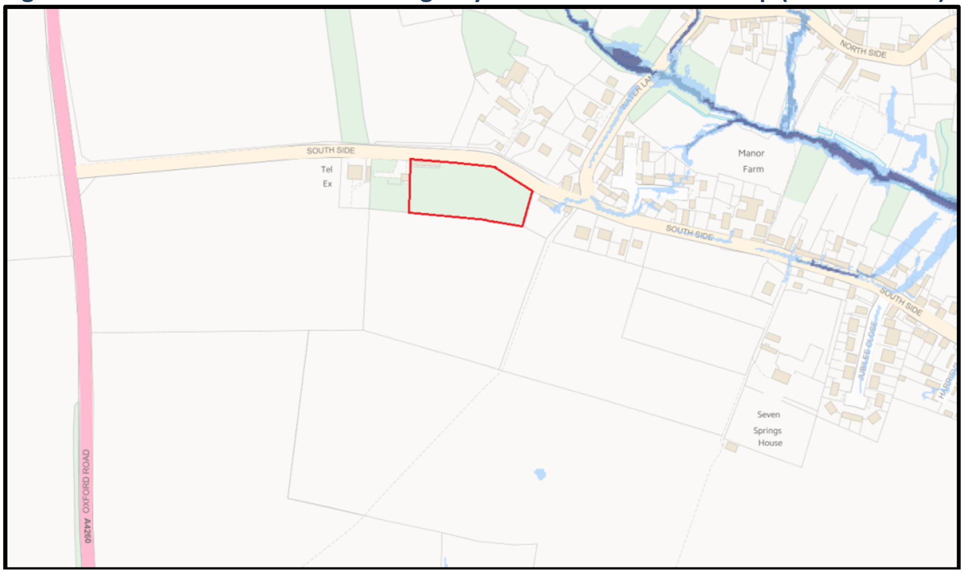
4.7 The piped surface water sewer network will be designed in accordance with 'Sewer for Adoption' requirements of no surcharging during the 1 in 1 year event and no flooding up to the 1 in 30 year event.
During exceedance events storm water may surcharge the surface water drainage system at limited locations across the site.

4.8 To mitigate the risk of overland flooding to properties the design levels of hard paved and landscaped areas as part of the proposed design of the development will contain and safely direct any exceedance flood flows to areas of the site as to cause minimum flood risk and disruption to properties and residents.

4.9 This development will provide a safe dry access and egress route for all residents during an exceptional flood event.
Dry exit routes will be provided for each property and safe egress from the site is provided with the provision of raised ground floor slab levels a minimum of 150mm above surrounding ground level and raised pavement levels.
Beyond the site boundary, safe exit is afforded to onto South Side Road onwards to local public amenities.

4.10 The 'FMfSWF' (Flood Map for Surface Water Flooding) presented within the SFRA confirms that no incidents of flooding from surface water runoff have been recorded within the site boundary.

Figure 3: Extract from Environment Agency Surface Water Flood Map (October 2017)



Contains Environment Agency information © Environment Agency 2017

Key:

- High (Greater than 1:30(3.3%) chance of flooding)
- Medium (Between 1:100(1%) and 1:30(3.3%) chance of flooding)
- Low (Between 1:1000 (0.1%) and 1:100 (1%) chance of flooding)
- Very Low (Less than 1:1000 (0.1%) chance of flooding)

4.11 It is proposed that the development of this site and the implementation of a positive surface water drainage system incorporating the use of SuDS to manage the rainfall that lands on this site, will provide a level of betterment or match the greenfield conditions and the level of surface water flood risk that currently exists for the site.
This is achieved by capturing and infiltrating all runoff from impermeable areas at the proposed development.

4.12 The source of any surface water flooding at the existing site is generated from the site itself when the volume of rainfall exceeds the capacity of the underlying soils to store further water.
The development of this site would fundamentally alter the existing greenfield site runoff regime of this site, by capturing and attenuating all runoff from impermeable areas within SuDS that are sized to manage much larger volumes of runoff than the greenfield site.
This would mitigate the current greenfield runoff scenario of uncontrolled overland flows and overwhelmingly reduce the potential for ponding across the site, thereby mitigating the existing risk of surface water flooding.

4.13 The consideration of peak discharge rates and overland exceedance flow routes to safely direct and contain runoff to low risk areas of the site during an extreme rainfall event or failure of the drainage system, will also prevent an increase in surface water flood risk to offsite properties and land.

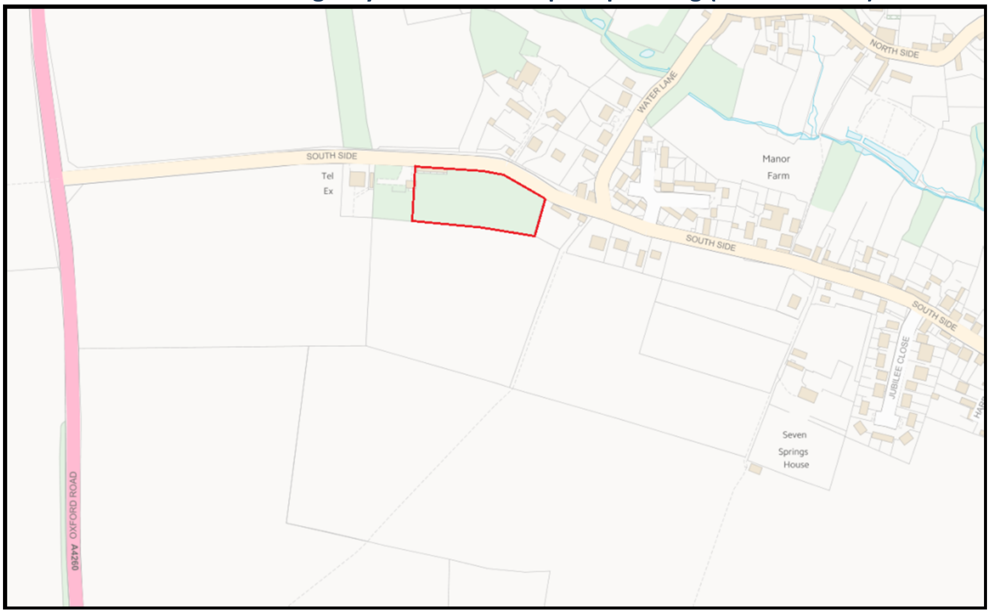
4.14 Fluvial

The SFRA studies have indicated that there are no historic, current or potential issues of fluvial flooding from ordinary, main watercourses or rivers at or in the vicinity of the site. This includes the River Cherwell and its local tributaries.

4.15 The Environment Agency is the principal flood risk management operating authority in England. The EA have carried out a national flood risk assessment (NaFRA) which assesses the probability of flooding to land from all main rivers in England.
The results of this modelling are combined and calibrated against data from recorded flood events to produce the Environment Agency's Flood Zone Map (Figure 4).

4.16 As indicated by the latest Environment Agency 'Flood Zone Map' (October 2017), the whole site is located within the lowest risk category - Flood Zone 1.
'Flood Zone 1' is land assessed as having a less than 1 in 1000 (<0.1%) annual probability of flooding from a main river in each year and is not within an area of recorded river flooding.

Figure 4: Fluvial Flood Zone Map
Extract from Environment Agency Flood Zone Map for planning (October 2017)



Main Rivers

Dark Blue : (Flood Zone 3)
Shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded: from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

Light Blue : (Flood Zone 2)
Shows the additional extent of an extreme flood from rivers or the sea.
These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year.
These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

Clear : (Flood Zone 1)
Shows the area where flooding from rivers and the sea is very unlikely.
There is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

4.17 The SFRA does make an assessment of the likely effects of increase in river flows due to the effects climate change; however these do not affect the site.

4.18 It is demonstrated that safe and dry access and egress at the site is achievable to a publicly accessible location outside the 1:100 year (plus climate change) flood event extent, in accordance with DEFRA Report FD2320/TR2 - 'Flood Risk Assessment Guidance for New Developments'.

4.19 Tidal

Oxfordshire and its local river networks do not encounter a risk from tidal flooding as confirmed by the SFRA and the Environment Agency.

4.20 Groundwater

Various springs are present within the village of Steeple Aston which according to the SFRA reports could cause groundwater to flood areas of the village.
With reference to the SFRA reports, no incidents of groundwater flooding have been recorded at the site and no springs have been identified within the site boundary.

4.21 The distinction between flooding from groundwater and surface water is often difficult to differentiate and can be inextricably linked.
Therefore, it is considered that the risk of flooding from any 'perched pockets' can be defined under the risk of flooding from surface water runoff and the proposed mitigation methods for this development are relevant to both flood risk sources.

4.22 The influence of groundwater and the bearing capacity of the soils will be taken into consideration during the detailed design of all new foundations.
To mitigate the effect of groundwater within excavations during the site construction phase, a dewatering system will remove unwanted groundwater to ensure construction is carried out in dry and stable conditions.
Prior to any dewatering, the ground worker will prepare and submit a method statement for the local authority / Environment Agency sign off prior to the operation of any pumping.

4.23 The proposed development is unlikely to have any significant impact upon natural groundwater flows beneath the site either during or after completion of the proposed works and therefore is unlikely to create an increased risk of flooding on or off the site.

If groundwater levels were to rise above the base of proposed foundations during winter months, groundwater would be able to flow laterally around these obstructions without any major increase in local groundwater levels and consequently will have a negligible effect on the site wide and offsite groundwater flow regime and overall flood risk from groundwater.

4.24 To mitigate the effects of any residual groundwater flooding, the proposed development will not include basement levels and finished floor levels will be set a minimum of 150mm above finished ground levels.

4.25 Existing Sewers & Water Mains

There are no existing foul, surface or potable water mains within the boundary of the site. With reference to the SFRA reports no incidents of flooding from surcharging of existing sewers or burst water mains have been recorded within the vicinity of the site that pose a flood risk to the development.

4.26 Thames Water have no recorded incidents of sewer flooding and water main flooding effecting the site.

4.27 To avoid the risk of flooding and to allow unrestricted access for any future maintenance and repairs, the required easements will be afforded to all existing sewers and water infrastructure within the vicinity of the site by the layout of the development.
All existing sewers and infrastructure will be suitably protected during all construction activities on site.

4.28 Artificial Sources

With reference to the SFRA there have been no recorded incidents of flooding to the site or surrounding areas from artificial sources.

4.39 The Environment Agency has assessed that the site is not at risk from reservoir flooding.

4.30 There are no additional artificial sources of flooding within a 500m radius of the site.

4.31 Proposed Site Drainage

A Flood Risk Assessment requires that an evaluation of all proposed artificial drainage systems and infrastructure within, or in close proximity to the site is carried out.
In the context of this development, the following systems are to be installed which need to be assessed in terms of potential flooding through the capacity of the systems being exceeded or the structural, hydraulic, mechanical or operational failure of the system occurring during the lifetime of the development:

- Piped foul and surface water sewers, manholes and potable water mains.
- SuDS for the conveyance and infiltration of surface water.

4.32 Any adoptable foul and surface water drains, sewers and manholes will be designed and constructed to the Sewers for Adoption *7th edition* with all private drainage constructed in accordance with *The Building Regulations Part H, BS EN 752 or BS EN 12056-2* as appropriate, ensuring adequate design capacity and robust structural integrity for the lifetime of the development.

This will not only prevent the risk of flooding to both the development and offsite parties, but will avoid the potential contamination of groundwater by preventing the ingress of groundwater into the pipework and egress of sewerage into the underlying soils.

4.33 Surface water sewers will be designed to the Sewers for Adoption requirement of 'no surcharge of pipes up to the 1 year event' and 'no flooding up to the 30 year event'.

4.34 All SuDS within the drainage system will be sized to manage the runoff from the exceptionally rare 1 in 100 storm event (1% AEP), plus an additional 40% allowance for predicted future climate change effects (in accordance with EA recommendations up to the year 2115).

4.35 Thames Water will be consulted with to confirm that there is capacity within the existing foul water network to accommodate the proposed development flows.
This will ensure that the proposed development has a 'no detriment' impact on the existing foul and surface sewer system within Steeple Aston and does not create an increase in flood risk.

4.36 The new development as a whole must not create or exacerbate existing flood risk elsewhere and in particular to properties, land and highways downstream of the site.
During the design of the proposed development careful consideration has been given to the most sustainable method of surface water disposal and strict controls have been imposed to limit the peak rate and volume of runoff generated from the developed site.

4.37 Sequential Test

The flood risk technical guidance to the National Planning Policy Framework (NNPF) categorises residential developments as 'More Vulnerable' within the risk classification.
'More vulnerable' developments located within Flood Zone 1 are considered appropriate under the NPPF.

4.38 The NPPF guidance states that planning authorities should complete a risk based 'Sequential Test' at all stages of the planning process, to steer new development to areas with the lowest probability of flooding.
Under the requirements of the 'Sequential Test' and as the proposed development is already located within Flood Zone 1 (lowest risk), there are no more suitable, developable and deliverable alternative sites, better located from a flood risk perspective which could accommodate the proposed development.

5 Existing and Proposed Site Runoff

5.1 This section aims to calculate the estimated the peak rate and volume of surface water runoff from the existing greenfield site.
These greenfield discharge figures are then used to establish the post-development constraints to inform the preliminary design of the surface water drainage strategy.

5.2 Catchment Areas

The existing and proposed permeable and impermeable areas are listed in the table below. Of the total 0.810 ha site, 0.315 ha is to be developed with the remaining areas consigned as domestic gardens and open space which will continue to discharge at current greenfield runoff rates.
Therefore, for the purpose of determining the allowable post-development discharge rate, the existing greenfield runoff rate will be calculated on the proposed developed area of 0.315 ha.

	Permeable	Impermeable	Total
Existing Site Area	8104 m²	0 m²	8104 m²
Proposed Site Area	4954 m²	3150 m²	8104 m²

5.3 This development represents an overall approximate increase of 3150 m² in impermeable area post development

5.4 Existing Surface Water Runoff Peak Runoff Rate & Volume (Greenfield)

An assessment of the estimated current greenfield runoff rate has been carried out using the Institute of Hydrology Report 124 (QBar) methodology.
Refer to Appendix C for a summary of WinDes results.

FSR (0.315ha catchment)

1 Year	0.1 l/s
QBar	**0.1 l/s**
30 Year	0.3 l/s
100 Year	0.4 l/s
Volume 100y 6hr	17.49 m³

5.5 Post Development Surface Water Runoff Peak Runoff Rate & Volume

The procedure for surface water management in accordance within 'Rainfall runoff management for developments' (DEFRA/EA Report – SC030219 E, 2013) states;
For the range of annual flow rate probabilities up to and including the 1% (1 in 100 year) annual exceedance probability event including an appropriate allowance for climate change, the post-developed rate of run-off into a watercourse, sewer, or other receiving water body, should be no greater than the existing pre-developed rate of run-off for the same event or 2 l/s/ha, whichever is the greater.

5.6 The additional volume of runoff generated from a site should also be limited to the existing greenfield runoff volume where possible.
Where infiltration cannot be utilised to dispose of all the additional volume;
The limiting discharge for any return period up to the 1% AEP (1 in 100 year) event including climate change, shall not be greater than the mean annual peak rate of runoff for the greenfield site (QBar) or 2 l/s/ha, whichever is the greater.

5.7 The National Planning Policy Framework requires that consideration is given to the effect of climate change on the surface water flows generated by any new development.
Table 2 of *the NPPF - Flood Risk Assessments: Climate Change Allowances – Detailed Guidance (Feb 2016)*, specifies that an assessment of a 40% increase in rainfall intensity allowance is made when calculating post development runoff rates for residential developments with a design lifespan of approximately 100 years.

5.8 As a result of this development and the increase in impermeable areas, the peak rate and volume of surface water that could potentially runoff the proposed site if not effectively managed, will be greater than in its current greenfield state.
To mitigate this increase, it is proposed that all surface water runoff from impermeable areas at the proposed development for up to the 1:100year +40%cc rainfall event will be infiltrated on site via the use of sustainable drainage systems (SuDS).

5.9 This will ensure that the peak rate of surface water runoff from the site post development will be no greater than the existing greenfield runoff rate for the site for all equivalent rainfall events up to the 1:100year+40% standard.

6 Surface Water Drainage Strategy

6.1 The National Planning Policy Framework (NPPF) requires that developments do not exacerbate flood risks both to the development site and to offsite parties and land, which means there is a need to control surface water drainage and overland runoff to ensure there are no increases in peak rates and volumes of runoff as a result of the development.

6.2 Environment Agency guidance and government legislation such as the Flood and Water Management Act (Defra 2010) requires surface water drainage strategies for new developments to be in accordance with the ideals of 'sustainable development' via the provision of Sustainable Drainage Systems (SuDS).

6.3 SuDS are more sustainable than conventional drainage methods because they can mitigate many of the adverse effects of urban stormwater runoff on the environment.
This can be achieved through reducing runoff rates and volumes to sewer networks and watercourses, reducing the risk of downstream flooding.
Where appropriate SuDS can reduce pollutant concentrations in stormwater, protecting the quality of the receiving water body.

6.4 The Building Regulations Document H (2015) and The SuDS Manual CIRIA 753 (2015) details the appropriate hierarchy of potential methods for disposing of surface water from a development:

1. A soakaway or some other adequate infiltration system, or where that is not practicable;
2. A watercourse, or where that is not practicable;
3. A sewer.

6.5 Following a desktop review of the site geology, as well as evidence from infiltration tests, infiltration as a method of disposing the surface water runoff generated from the proposed development is considered to be feasible.

6.6 Infiltration is a sustainable drainage technique (SuDS) that enables storm water to be managed within the site rather than discharging offsite into a watercourse or sewer network.
This method of disposal improves the quality of the storm water runoff whilst maintaining the existing natural drainage regime and the pre-development rates of runoff and volumes.
Infiltration is also an important process of maintaining groundwater recharge to aquifers.

6.7 It is proposed that all surface water runoff from roofs and hardstanding areas including driveways and the site access road is discharged via permeable block paving. To maximise storage, the permeable block paving is split into sections with 0.02m orifices as flow controls. This creates a conveyance system to provide maximum infiltration at the east of the site. (See appendix D).

6.8 All infiltration SUDS will be sized to manage the 1 in 100year (1% AEP) storm event, plus an extra allowance of 40% for the predicted potential increase in peak rainfall up to 2115.

6.9 The hydraulic performance of the permeable block paving during periods of high groundwater level will be considered and designed to ensure adequate infiltration, as such the base of the SUDS features will be 1m above peak groundwater level.

6.10 The proposed surface water drainage strategy offers a sustainable, safe and robust system which will afford complete flood risk protection to residents within the new site and to existing properties and land within Steeple Aston.

6.11 Pollution Prevention

In terms of water quality, the proposed surface system offers a suitable level of mitigation in accordance with the Environment Agency pollution prevention guidance GP3, CIRIA C697 and DEFRA guidance.

6.12 The process of sedimentation is the principle pollution removal mechanism in SuDS as pollution in surface water runoff is generally attached to sediment particles.
By reducing flow velocities and capturing sediments, a significant reduction in pollutant loads can be achieved.

6.13 For 'low risk' residential developments where the receiving waterbody is considered non-sensitive, the minimum treatment process is achieved via the permeable block paving within the private access roads, parking areas and driveways.
The permeable paving will provide a high level of treatment through capture of silts, filtration of hydrocarbons and other pollutants through the pavers, filter membrane and media sub-base prior to discharging through the infiltration tanks.

6.14 SuDS Management and Maintenance

It is envisaged that the residents will be given ownership of the shared areas of permeable paving with private areas of permeable paving to be owned and maintained by individual property owners.
Residents will be entrusted with a robust inspection, de-silting and maintenance programme to ensure the optimum operation of the surface water drainage system is continually maintained in perpetuity.

6.15 Overland Flood Flow / Exceedance

The proposed SuDS features within the development are designed to manage the 1 in 100 year return storm (1% chance of occurrence each year) plus an extra allowance of 40% for the potential increase in peak rainfall predicted up to 2115.
An 'exceedance' or 'extreme' event refers to a storm in excess of this design level.

6.16 The occurrence of an extreme rainfall event exceeding the design storm of the drainage network or failure / blockages of the infiltration basin has been considered.
Any flood water that occurs as a result of surcharging of manholes within the upstream piped system will be contained within the road limits by raised kerb edges and driveway entrance levels, where it will be temporarily stored until capacity returns within the drainage system.
To mitigate the residual risk of overland flooding the design levels of hard paved and landscaped areas as part of the proposed design of the development will aim to contain and safely direct any flood flows to areas of the site as to cause minimum flood risk and disruption to properties and residents.

6.17 Any residual risk of overland flooding to properties is to be mitigated by the provision of raised property slab levels a minimum of 150mm above surrounding ground level.

6.18 The described protection measures ensure that properties both within the proposed development and any offsite parties and land will not be affected by overland runoff in the event of a reasonably extreme rainfall event exceeding the design storm or a failure or a blockage of the SuDS structures within the system.

7 Foul water drainage strategy

7.1 The foul water discharge from each property will drain via gravity to an existing public sewer system located beyond the north west of the site boundary, within South Side Road.

7.2 The development foul drainage network will be offered to Thames Water for adoption under a Section 104 agreement of the Water Industry Act 1991.

7.3 Thames Water will be consulted with to ensure adequate capacity and determine a suitable point of connection with the existing foul sewer. If required, upgrading works will be carried out to the existing network to enable the proposed connection.

7.4 This will ensure that the proposed development has a 'no detriment' impact on the foul sewer system within the village of Steeple Aston and does not create a flood risk.

7.5 The predicted peak foul sewer discharge from the site to the existing foul sewer based on the Sewers for Adoption 7th figure (4000 l/dwelling/day) for 6 units will be 0.3 l/s

APPENDIX A
SITE LAYOUT

PROJECT: South Side, Steeple Aston

DRAWING: Proposed Site Plan

DEPARTMENT: Planning

DRAWN BY: GL

CHECKED BY:

DRAWING No: P.224.SP.01

SCALE: 1:500

PAPER: A3

REV: D

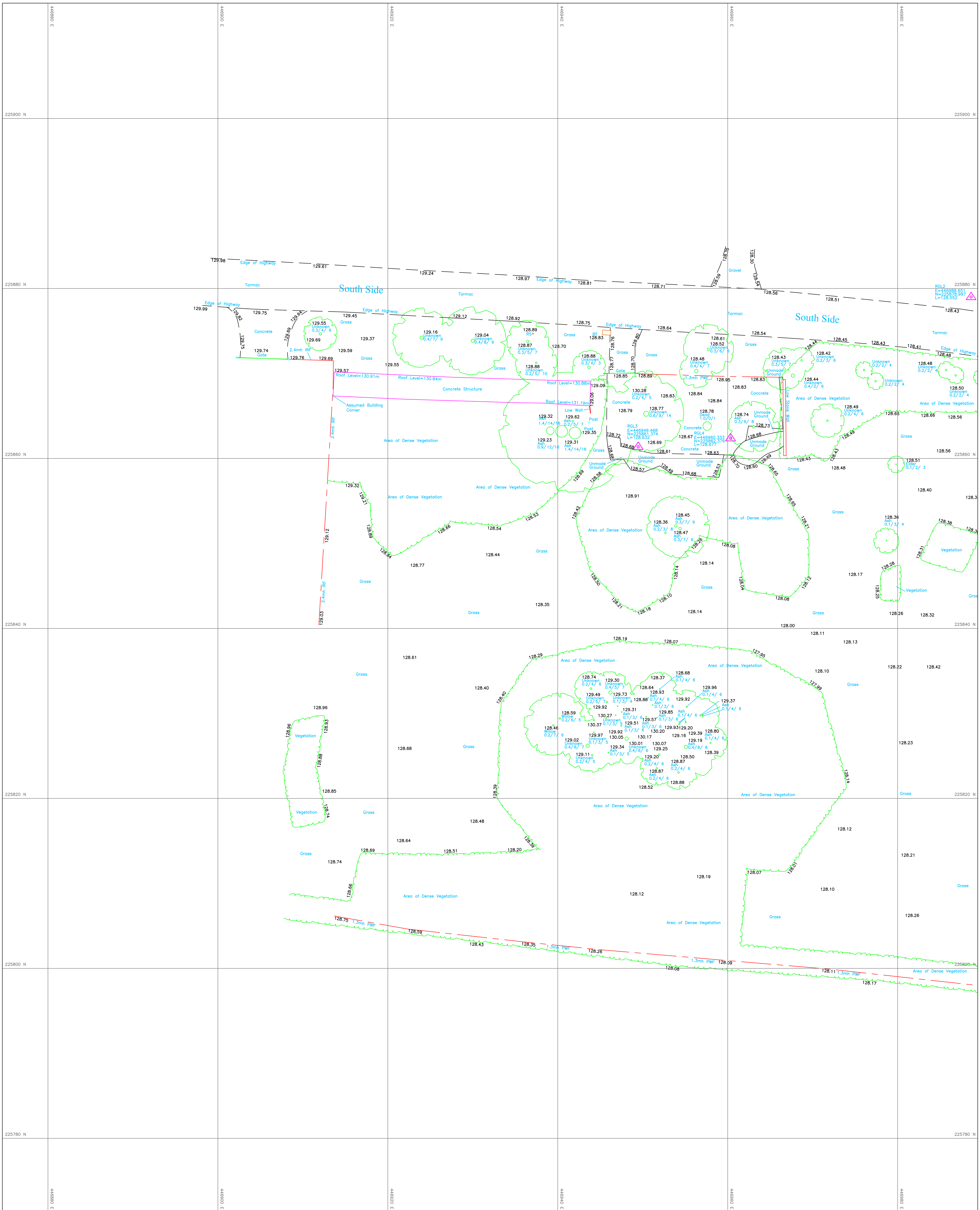
STATUS: PROPOSED

DATE: 28.07.17

rectory

RECTORY LTD RECTORY HOUSE THAME ROAD
HADDENHAM, AYLESBURY, BUCKINGHAMSHIRE, HP17 8DA
T: 01844 295100 F: 01844 295350 www.rectory.co.uk

APPENDIX B
SITE TOPOGRAPHICAL SURVEY



RGL Surveys Ltd

Land & Measured Building Surveyors

Building S8
Westcott Venture Park
Westcott
Bucks HP18 0XB

Tel: 01296 651833
Email: mail@rglsurveys.co.uk

www.rglsurveys.co.uk

Drawn: OS
Checked: AL
Scale: 1:200 @A1

Levelling: All levels relate to OS Active GPS Network.

Date of Survey: June 2017

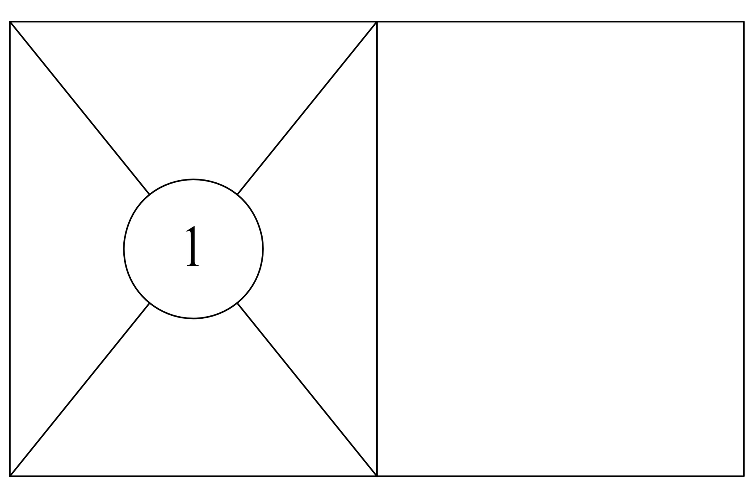
Drawing Number: RGL-17-2679-01

Notes

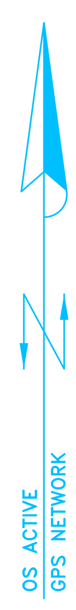
Client:
Rectory Homes
Rectory House
Thame Road
Haddenham
HP17 8DA

Job Title:
Land to South of Southside
Steeple Aston

Site Survey

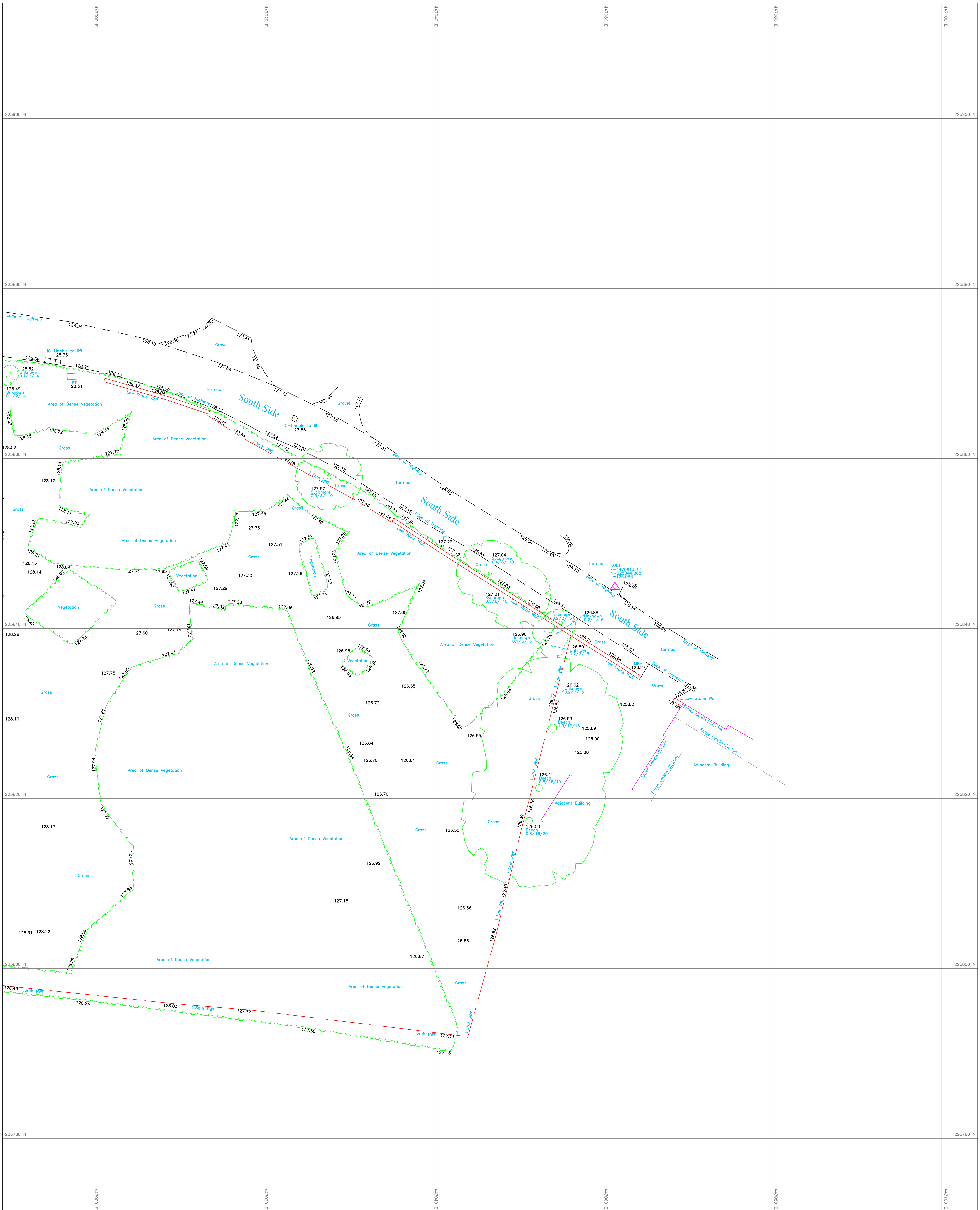


Sheet 1 of 2



Legend

B	Bollard	MH	Manhole
BT	British Telecom	MKR	Marker Post
CATV	Cable Television	PRF	Post & Rail Fence
CB	Control Box	PS	Pipe Size
CBF	Closed Board Fence	PWF	Post & Wire Fence
CBP	Concrete Block Paving	RE	Rodding Eye
CL	Cover Level	RN	Road Name
CLF	Chain Link Fence	RS	Road Sign
CPS	Concrete Paving Slabs	SY	Stay Wire
DC	Drainage Channel	Sycamore MB	Species Multi Bowl
DK	Drop Kerb	0.3/4/8	Trunk(Dia)/Spread(Rad)/Height(Approx)
DP	Down Pipe	TL	Traffic Light
ER	Earth Rod	TOB	Top of Bank
FB	Flowerbed	TP	Tactile Paving
FH	Fire Hydrant	UTL	Unable To Lift
FP	Flag Pole	VP	Vent Pipe
G	Gully	WV	Water Valve
GV	Gas Valve	WL	Water Level
IC	Inspection Cover	2.70	Ceiling Height/Level (metres)
IRF	Iron Railing Fence	2.70f	False Ceiling Height/Level (metres)
2.70	Ceiling Height (metres)	2.42	Beam Height/Level (metres)
2.70f	False Ceiling Height (metres)	f–s=1.50	Floor to Sill Height/Level (metres)
2.42	Beam Height (metres)	s–h=0.67	Sill to Head Height/Level (metres)
f–s=1.50	Floor to Sill Height (metres)	+ 50.00	Finished Floor Level (metres)
s–h=0.67	Sill to Head Height (metres)	+ 52.00	Ceiling/Beam Level (metres)
+50.00m	Finished Floor Level (metres)	→	All Arrows Indicate Direction Up
△ UP	All Arrows Indicate Direction Up	50.00 (2.50) ▽	Floor Level (Ceiling Height)
IL	Invert Level	△0.00	Soffit Level
KW	Kerb Weir	CHT 110.83	Sill Level
LP	Lamp Post	LHT 112.98	Lintel Level
		1.50 / 2.02	Door Width / Door Height



RGL Surveys Ltd

Land & Measured Building Surveyors

Building S8
Westcott Venture Park
Westcott
Bucks HP18 0XB

Tel: 01296 651833
Email: mail@rglsurveys.co.uk
www.rglsurveys.co.uk

Drawn: OS | Checked: AL

Levelling: All levels relate to OS Active GPS Network.

Scale: 1:200 @A1

Date of Survey: June 2017

Drawing Number: RGL-17-2679-01

Notes

Client:
Rectory Homes
Rectory House
Thame Road
Haddenham
HP17 8DA

Job Title:
Land to South of Southside
Steeple Aston

Site Survey

OS ACTIVE GPS NETWORK

2

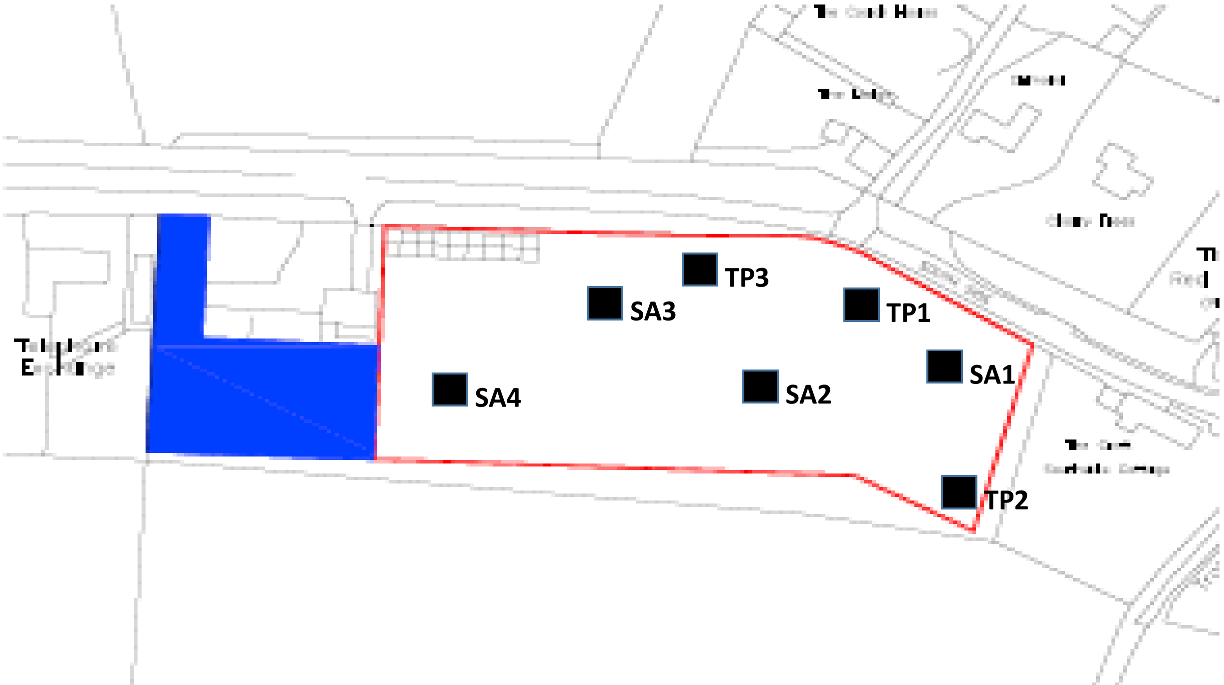
Sheet 2 of 2

Legend

B	Bollard	MH	Manhole
BT	British Telecom	MKR	Marker Post
CATV	Cable Television	PRF	Post & Rail Fence
CB	Control Box	PS	Pipe Size
CBF	Closed Board Fence	PWF	Post & Wire Fence
CBP	Concrete Block Paving	RE	Rodding Eye
CL	Cover Level	RN	Road Name
CLF	Chain Link Fence	RS	Road Sign
CPS	Concrete Paving Slabs	SY	Stay Wire
DC	Drainage Channel	Sycamore MB	Species Multi Bowl
DK	Drop Kerb	0.3/4/8	Trunk(Dia)/Spread(Rad)/Height(Approx)
DP	Down Pipe	TL	Traffic Light
ER	Earth Rod	TOB	Top of Bank
FB	Flowerbed	TP	Tactile Paving
FH	Fire Hydrant	UTL	Unable To Lift
FP	Flag Pole	VP	Vent Pipe
G	Gully	WV	Water Valve
GV	Gas Valve	WL	Water Level
IC	Inspection Cover	2.70	Ceiling Height/Level (metres)
IRF	Iron Railing Fence	2.70f	False Ceiling Height/Level (metres)
2.70	Ceiling Height (metres)	2.42	Beam Height/Level (metres)
2.70f	False Ceiling Height (metres)	f-s=1.50	Floor to Sill Height/Level (metres)
2.42	Beam Height (metres)	s-h=0.67	Sill to Head Height/Level (metres)
f-s=1.50	Floor to Sill Height (metres)	+ 50.00	Finished Floor Level (metres)
s-h=0.67	Sill to Head Height (metres)	+ 52.00	Ceiling/Beam Level (metres)
+50.00m	Finished Floor Level (metres)	→	All Arrows Indicate Direction Up
△ UP	All Arrows Indicate Direction Up	50.00 (2.50) ▽	Floor Level (Ceiling Height)
IL	Invert Level	△0.00	Soffit Level
KW	Kerb Weir	CHT 110.83	Sill Level
LP	Lamp Post	LHT 112.98	Lintel Level
		1.50	Door Width
		2.02	Door Height

SOUTHSIDE, STEEPLE ASTON

EXPLOATORY HOLE LOCATION PLAN



Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

TRIAL PIT LOG

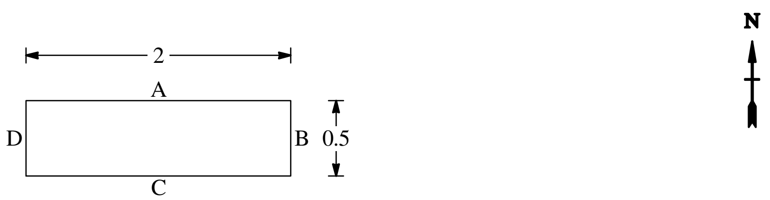
The Brownfield Consultancy

Project				TRIAL PIT No
Southside, Steeple Aston				SA1
Job No: BC340	Date: 15-11-17	Ground Level (m):	Co-Ordinates ():	
Contractor: Brownfield Consultancy Ltd				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	Legend	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.20			Grass over TOPSOIL. (MADE GROUND)			
0.20-1.30			Dark brown very clayey sandy GRAVEL & COBBLE of sbangular and subrounded occasionally tabular limestone. Some minor spalling in the sidewalls initially. Possibly Made Ground / Reworked ground. (MADE GROUND)			
1.30-2.15			Firm brown occasionally grey sandy locally very sandy CLAY with abundant shell fragments. (OOLITE GROUP)			
2.15			No further progress due to encountering bedrock.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway Test undertaken. Groundwater not encountered. Backfilled with arisings.

All dimensions in metres Scale 1:25	Client: Rectory Homes Ltd	Method/ Plant Used: JCB 3CX	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

TRIAL PIT LOG

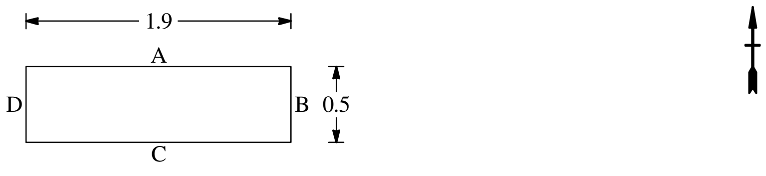
The Brownfield Consultancy

Project				TRIAL PIT No
Southside, Steeple Aston				SA2
Job No: BC340	Date: 15-11-17	Ground Level (m)	Co-Ordinates ()	
Contractor: Brownfield Consultancy Ltd				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	Legend	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.20			Grass over TOPSOIL. (TOPSOIL)			
0.20-0.50			Soft brown sandy CLAY. Rare gravel of limestone. (OOLITE GROUP)			
0.50-0.90			Brown slightly clayey sandy GRAVEL & COBBLE of subangular and subrounded occasionally tabular limestone. (OOLITE GROUP)			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway Test undertaken. Groundwater not encountered. Backfilled with arisings.

All dimensions in metres Scale 1:25	Client: Rectory Homes Ltd	Method/Plant Used: JCB 3CX	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

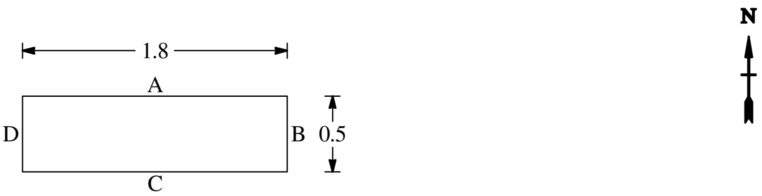
TRIAL PIT LOG

The Brownfield Consultancy

Project				TRIAL PIT No
Southside, Steeple Aston				SA3
Job No: BC340	Date: 15-11-17	Ground Level (m)	Co-Ordinates ()	
Contractor: Brownfield Consultancy Ltd				Sheet: 1 of 1

STRATA				SAMPLES & TESTS		
Depth	No	Legend	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.15			Grass over TOPSOIL. (TOPSOIL)			
0.15-1.20			Soft becoming firm below 0.70m brown sandy locally very sandy CLAY with shell fragments, abundant in places. (OOLITE GROUP)			
1.20			No further progress due to encountering bedrock.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway Test undertaken. Groundwater not encountered. Backfilled with arisings.

All dimensions in metres Scale 1:25	Client: Rectory Homes Ltd	Method/ Plant Used: JCB 3CX	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

TRIAL PIT LOG

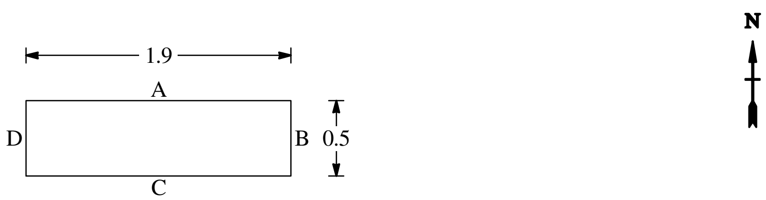
The Brownfield Consultancy

Project: Southside, Steeple Aston				TRIAL PIT No: **SA4**
Job No: BC340	Date: 15-11-17	Ground Level (m):	Co-Ordinates ()	
Contractor: Brownfield Consultancy Ltd				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	Legend	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.10			Grass over TOPSOIL. (TOPSOIL)			
0.10-0.30			Soft brown sandy CLAY. Rare gravel of limestone. (OOLITE GROUP)			
0.30-1.40			Soft becoming firm below 0.90m brown sandy locally very sandy CLAY with shell fragments, abundant in places. (OOLITE GROUP)			
1.40			No further progress due to encountering bedrock.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Soakaway Test undertaken. Groundwater not encountered. Backfilled with arisings.

All dimensions in metres Scale 1:25	Client: Rectory Homes Ltd	Method/Plant Used: JCB 3CX	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

TRIAL PIT LOG

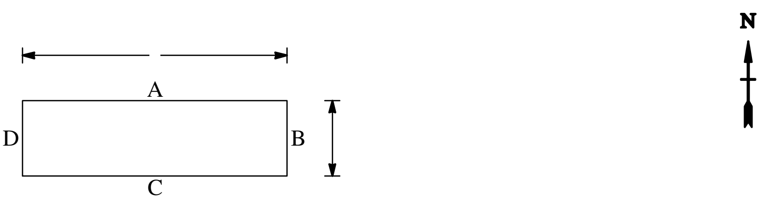
The Brownfield Consultancy

Project				TRIAL PIT No
Southside, Steeple Aston				TP1
Job No: BC340	Date: 15-11-17	Ground Level (m)	Co-Ordinates ()	
Contractor: Brownfield Consultancy Ltd				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.40		Grass over TOPSOIL. (TOPSOIL)			
0.40-2.20		Brown slightly clayey sandy GRAVEL & COBBLE of subangular and subrounded occasionally tabular limestone. Occasional boulder. (OOLITE GROUP) 1.00 Becoming very sandy below 1.00m.			
2.20-2.40		Firm brown sandy CLAY with abundant shell fragments. (OOLITE GROUP)			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Groundwater not encountered. Backfilled with arisings.

All dimensions in metres Scale 1:25	Client: Rectory Homes Ltd	Method/Plant Used: JCB 3CX	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

TRIAL PIT LOG

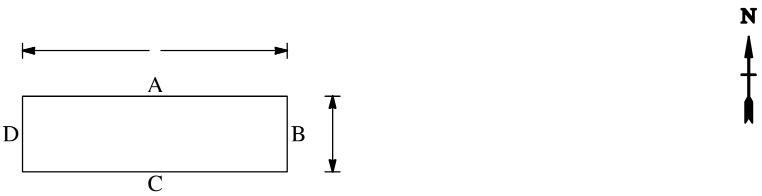
The Brownfield Consultancy

Project				TRIAL PIT No
Southside, Steeple Aston				**TP2**
Job No: BC340	Date: 15-11-17	Ground Level (m)	Co-Ordinates ()	
Contractor: Brownfield Consultancy Ltd				Sheet: 1 of 1

STRATA / SAMPLES & TESTS

Depth	No	Legend	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.20			Grass over TOPSOIL. (TOPSOIL)			
0.20-1.00			Buff brown slightly clayey very sandy GRAVEL of subangular and subrounded fine to coarse limestone. (OOLITE GROUP)			
1.00-1.90			Firm brown sandy CLAY with shell fragments. Shell fragments abundant in places. (OOLITE GROUP)			
1.90			No further progress due to encountering bedrock.			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Groundwater not encountered. Backfilled with arisings.

All dimensions in metres Scale 1:25	Client: Rectory Homes Ltd	Method/Plant Used: JCB 3CX	Logged By: JT

Brownfield Consultancy
The Cottage, Mill Lane
Fenny Compton, CV47 2YF
Phone: 07852881086

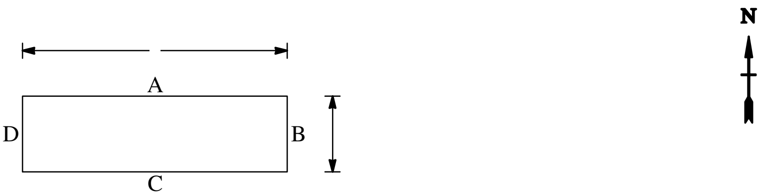
TRIAL PIT LOG

The Brownfield Consultancy

Project				TRIAL PIT No
Southside, Steeple Aston				TP3
Job No: BC340	Date: 15-11-17	Ground Level (m)	Co-Ordinates ()	
Contractor: Brownfield Consultancy Ltd				Sheet: 1 of 1

STRATA			SAMPLES & TESTS		
Depth	No	DESCRIPTION	Depth	No	Remarks/Tests
0.00-0.20		Black humic TOPSOIL with timber. (MADE GROUND)			
0.20-0.90		Soft brown sandy CLAY. Rare gravel of limestone. (OOLITE GROUP)			
0.90-1.50		Brown slightly clayey sandy GRAVEL & COBBLE of subangular and subrounded occasionally tabular limestone. (OOLITE GROUP)			
1.50-3.00		Firm brown sandy CLAY with abundant shell fragments. (OOLITE GROUP)			

Shoring/Support:
Stability: Sides stable.



GENERAL REMARKS

Groundwater not encountered. Backfilled with arisings.

All dimensions in metres Scale 1:25	Client: Rectory Homes Ltd	Method/Plant Used: JCB 3CX	Logged By: JT

The Brownfield Consultancy

Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

SOIL INFILTRATION TEST

Project:
Southside, Steeple Aston

Project No:
BC340

Test Location: SA1 | Test No: 1 | Date: 14.11.17

Water level during test

Time mins	Depth m bgl
0	1.270
9	1.360
15	1.380
26	1.410
50	1.470
65	1.520
98	1.600
130	1.680
145	1.700
196	1.800
245	1.900
287	1.980

Trial pit dimensions

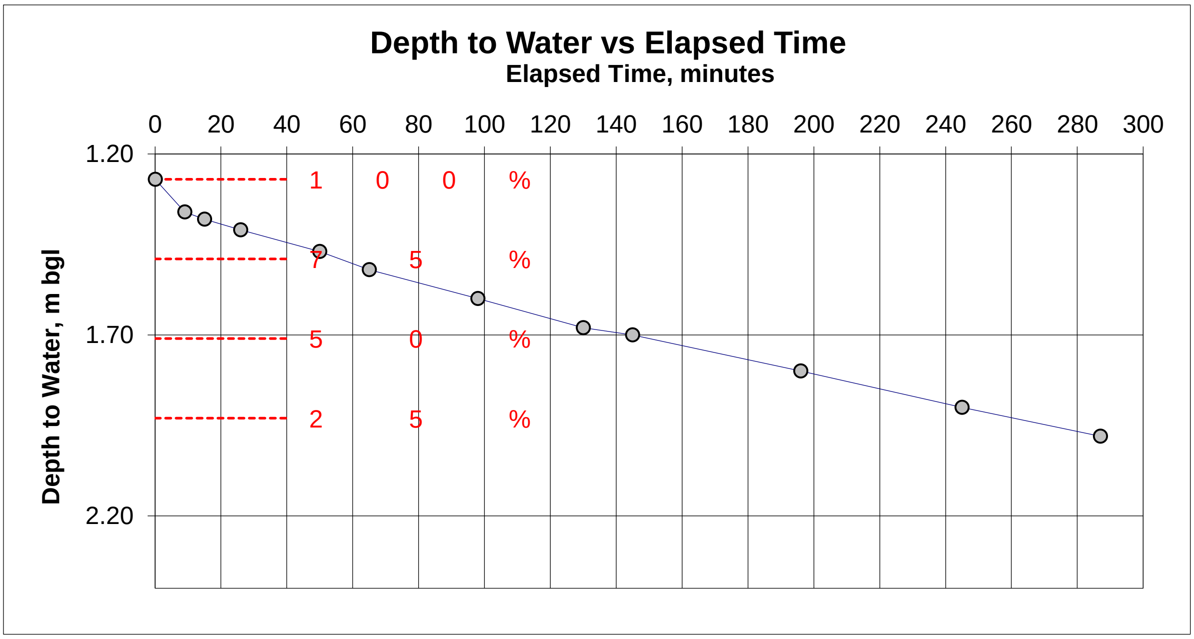
depth (m)	2.15
length (m)	2.00
width (m)	0.50

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	60
time at 25% effective depth (mins)	280
(from graph)	

Calculated Soil Infiltration Rate = 8.2E-06 m/sec



The Brownfield Consultancy

SOIL INFILTRATION TEST

Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

Project:
Southside, Steeple Aston

Project No:
BC340

Test Location: SA2

Test No: 1

Date: 14.11.17

Water level during test

Time mins	Depth m bgl
0	0.570
8	0.680
26	0.720
42	0.760
55	0.800
70	0.840

Trial pit dimensions

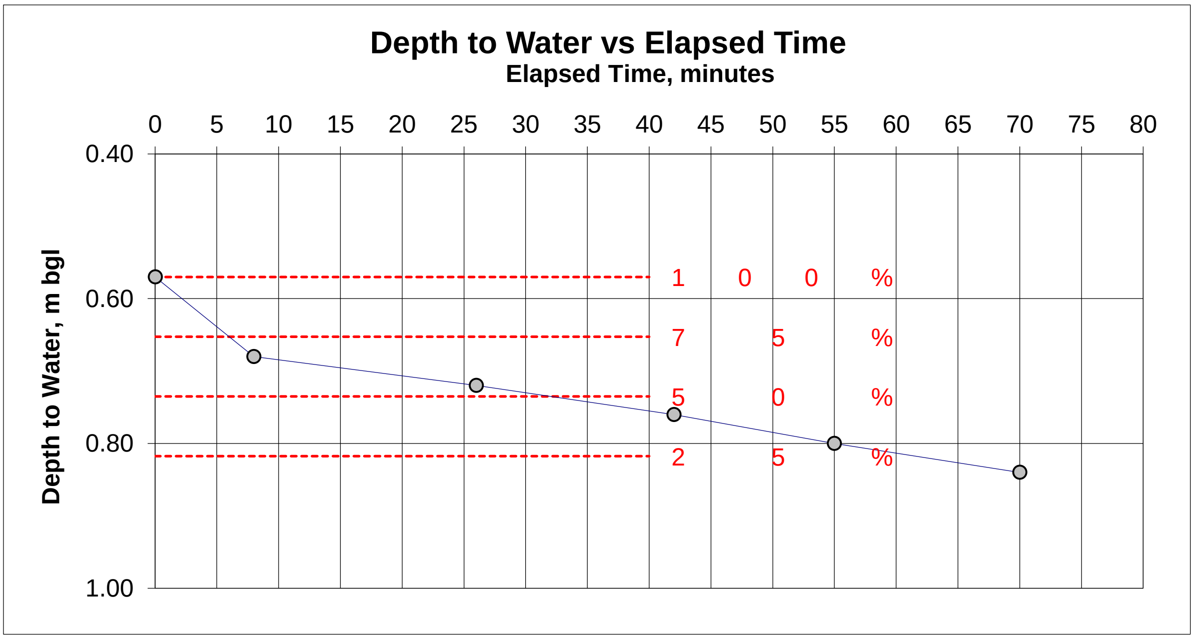
depth (m)	0.90
length (m)	1.90
width (m)	0.50

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate
Vp = volume of water from 75% to 25% effective depth
αp = Internal surface area at 50% effective depth
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins) 7
time at 25% effective depth (mins) 60
(from graph)

Calculated Soil Infiltration Rate = 2.4E-05 m/sec



The Brownfield Consultancy	SOIL INFILTRATION TEST
Woodstock **Memorial Road** **Fenny Compton** **CV47 2XU** **Tel: 07852881086**	**Project:** Southside, Steeple Aston
	Project No: BC340

Test Location: SA2   Test No: 2   Date: 14.11.17

Water level during test

Time mins	Depth m bgl
0	0.290
5	0.350
27	0.490
79	0.690
114	0.790
142	0.850

Trial pit dimensions

depth (m)	0.90
length (m)	1.90
width (m)	0.50

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

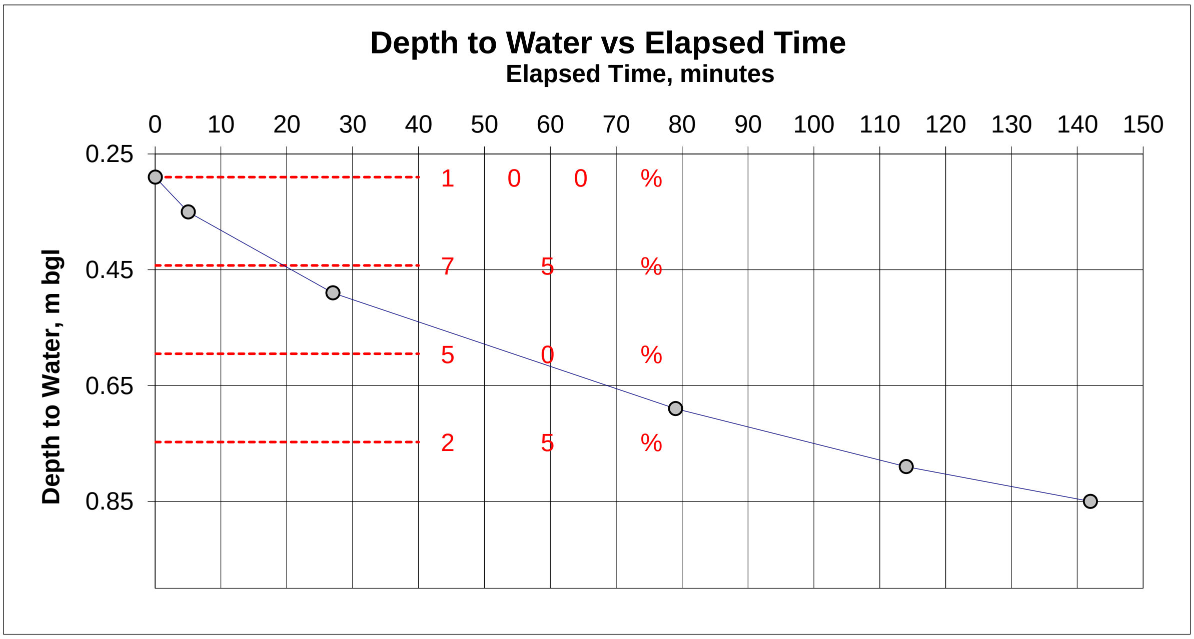
Vp = volume of water from 75% to 25% effective depth

αp = Internal surface area at 50% effective depth

tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)	20
time at 25% effective depth (mins)	102
(from graph)	

Calculated Soil Infiltration Rate = 2.2E-05 m/sec



The Brownfield Consultancy	SOIL INFILTRATION TEST
Woodstock **Memorial Road** **Fenny Compton** **CV47 2XU** **Tel: 07852881086**	**Project:** Southside, Steeple Aston **Project No:** BC340

Test Location: SA3 Test No: 1 Date: 14.11.17

Water level during test

Time mins	Depth m bgl
0	0.500
12	0.510
47	0.540
89	0.550
109	0.560
146	0.570

Trial pit dimensions

depth (m)	1.20
length (m)	1.80
width (m)	0.50

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

Vp = volume of water from 75% to 25% effective depth

αp = Internal surface area at 50% effective depth

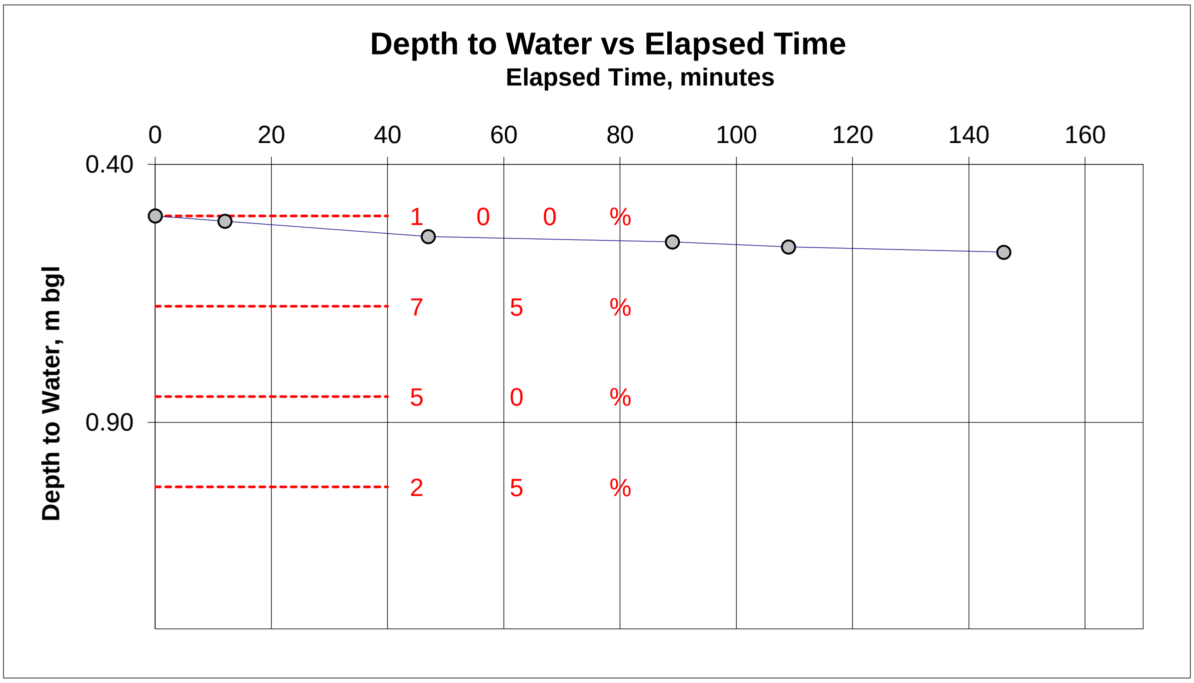
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)

time at 25% effective depth (mins)

(from graph)

Calculated Soil Infiltration Rate = - m/sec



The Brownfield Consultancy

SOIL INFILTRATION TEST

Woodstock
Memorial Road
Fenny Compton
CV47 2XU
Tel: 07852881086

Project:
Southside, Steeple Aston

Project No:
BC340

Test Location: SA4 Test No: 1 Date: 14.11.17

Water level during test

Time mins	Depth m bgl
0	0.450
10	0.490
52	0.540
71	0.560
110	0.570
144	0.580

Trial pit dimensions

depth (m)	1.20
length (m)	1.80
width (m)	0.50

$$f = \frac{V_p}{\alpha_p \times t_p}$$

f = soil infiltration rate

Vp = volume of water from 75% to 25% effective depth

αp = Internal surface area at 50% effective depth

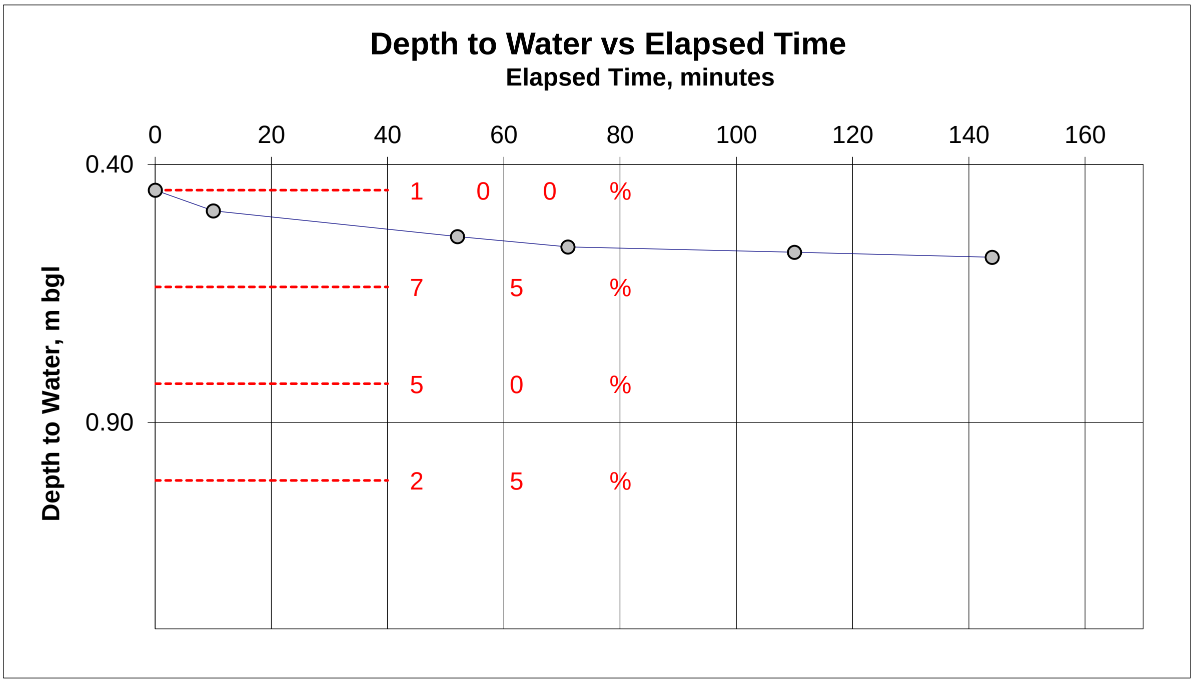
tp = time for the water level to fall from 75% to 25% effective depth

time at 75% effective depth (mins)

time at 25% effective depth (mins)

(from graph)

Calculated Soil Infiltration Rate = - m/sec



APPENDIX C

GREENFIELD / POST DEVELOPMENT RUNOFF CALCULATIONS

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.315	Urban	0.000
SAAR (mm)	699	Region Number	Region 6

Results	**l/s**
QBAR Rural	1.4
QBAR Urban	1.4
Q100 years	4.4
Q1 year	1.2
Q30 years	3.1
Q100 years	4.4

Greenfield Runoff Volume

FSR Data

Return Period (years)	100
Storm Duration (mins)	360
Region	England and Wales
M5-60 (mm)	20.000
Ratio R	0.406
Areal Reduction Factor	1.00
Area (ha)	0.315
SAAR (mm)	699
CWI	104.820
Urban	0.000
SPR	47.000

Results

Percentage Runoff (%)	45.89
Greenfield Runoff Volume (m^3)	89.828

Cascade Summary of Results for Area 1.srcx

Upstream Structures	Outflow To	Overflow To
(None)	Area 2.srcx	(None)

Half Drain Time : 280 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	128.651	0.401	0.0	0.5	0.5	8.9	O K
30 min Summer	128.710	0.460	0.0	0.6	0.6	11.7	Flood Risk
60 min Summer	128.757	0.507	0.0	0.6	0.6	14.2	Flood Risk
120 min Summer	128.790	0.540	0.0	0.6	0.6	16.0	Flood Risk
180 min Summer	128.797	0.547	0.0	0.6	0.6	16.4	Flood Risk
240 min Summer	128.796	0.546	0.0	0.6	0.6	16.3	Flood Risk
360 min Summer	128.789	0.539	0.0	0.6	0.6	15.9	Flood Risk
480 min Summer	128.781	0.531	0.0	0.6	0.6	15.5	Flood Risk
600 min Summer	128.771	0.521	0.0	0.6	0.6	14.9	Flood Risk
720 min Summer	128.761	0.511	0.0	0.6	0.6	14.4	Flood Risk
960 min Summer	128.741	0.491	0.0	0.6	0.6	13.3	Flood Risk
1440 min Summer	128.703	0.453	0.0	0.6	0.6	11.3	Flood Risk
2160 min Summer	128.653	0.403	0.0	0.5	0.5	8.9	O K
2880 min Summer	128.608	0.358	0.0	0.5	0.5	7.1	O K
4320 min Summer	128.536	0.286	0.0	0.4	0.4	4.5	O K
5760 min Summer	128.481	0.231	0.0	0.4	0.4	2.9	O K
7200 min Summer	128.439	0.189	0.0	0.4	0.4	2.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.874	0.0	9.2	18
30 min Summer	90.946	0.0	12.4	33
60 min Summer	56.713	0.0	15.6	62
120 min Summer	34.162	0.0	19.0	122
180 min Summer	25.057	0.0	21.0	180
240 min Summer	19.992	0.0	22.4	214
360 min Summer	14.500	0.0	24.4	274
480 min Summer	11.545	0.0	25.9	340
600 min Summer	9.667	0.0	27.1	408
720 min Summer	8.358	0.0	28.1	476
960 min Summer	6.638	0.0	29.8	614
1440 min Summer	4.791	0.0	32.2	880
2160 min Summer	3.452	0.0	34.6	1260
2880 min Summer	2.733	0.0	36.3	1640
4320 min Summer	1.964	0.0	38.8	2336
5760 min Summer	1.552	0.0	40.4	3056
7200 min Summer	1.292	0.0	41.7	3752

Cascade Summary of Results for Area 1.srcx

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
8640 min Summer	128.406	0.156	0.0	0.3	0.3	1.3	O K
10080 min Summer	128.381	0.131	0.0	0.3	0.3	1.0	O K
15 min Winter	128.677	0.427	0.0	0.5	0.5	10.1	O K
30 min Winter	128.740	0.490	0.0	0.6	0.6	13.2	Flood Risk
60 min Winter	128.792	0.542	0.0	0.6	0.6	16.1	Flood Risk
120 min Winter	128.832	0.582	0.0	0.6	0.6	18.3	Flood Risk
180 min Winter	128.843	0.593	0.0	0.6	0.6	18.9	Flood Risk
240 min Winter	128.843	0.593	0.0	0.6	0.6	18.9	Flood Risk
360 min Winter	128.833	0.583	0.0	0.6	0.6	18.4	Flood Risk
480 min Winter	128.822	0.572	0.0	0.6	0.6	17.8	Flood Risk
600 min Winter	128.809	0.559	0.0	0.6	0.6	17.0	Flood Risk
720 min Winter	128.795	0.545	0.0	0.6	0.6	16.2	Flood Risk
960 min Winter	128.766	0.516	0.0	0.6	0.6	14.7	Flood Risk
1440 min Winter	128.713	0.463	0.0	0.6	0.6	11.8	Flood Risk
2160 min Winter	128.641	0.391	0.0	0.5	0.5	8.4	O K
2880 min Winter	128.579	0.329	0.0	0.5	0.5	6.0	O K
4320 min Winter	128.484	0.234	0.0	0.4	0.4	3.0	O K
5760 min Winter	128.419	0.169	0.0	0.3	0.3	1.6	O K
7200 min Winter	128.376	0.126	0.0	0.3	0.3	0.9	O K
8640 min Winter	128.348	0.098	0.0	0.2	0.2	0.5	O K
10080 min Winter	128.329	0.079	0.0	0.2	0.2	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.112	0.0	42.6	4416
10080 min Summer	0.980	0.0	43.3	5144
15 min Winter	138.874	0.0	10.4	18
30 min Winter	90.946	0.0	14.0	33
60 min Winter	56.713	0.0	17.6	62
120 min Winter	34.162	0.0	21.4	118
180 min Winter	25.057	0.0	23.6	176
240 min Winter	19.992	0.0	25.2	230
360 min Winter	14.500	0.0	27.4	290
480 min Winter	11.545	0.0	29.1	364
600 min Winter	9.667	0.0	30.5	442
720 min Winter	8.358	0.0	31.7	518
960 min Winter	6.638	0.0	33.5	664
1440 min Winter	4.791	0.0	36.2	940
2160 min Winter	3.452	0.0	39.0	1340
2880 min Winter	2.733	0.0	40.9	1700
4320 min Winter	1.964	0.0	43.7	2380
5760 min Winter	1.552	0.0	45.7	3064
7200 min Winter	1.292	0.0	47.1	3744
8640 min Winter	1.112	0.0	48.3	4416
10080 min Winter	0.980	0.0	49.2	5136

Cascade Model Details for Area 1.srcx

Storage is Online Cover Level (m) 129.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	13.6
Membrane Percolation (mm/hr)	1000	Length (m)	13.6
Max Percolation (l/s)	51.4	Slope (1:X)	27.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	128.250	Membrane Depth (m)	0

Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 128.250

Cascade Summary of Results for Area 2.srcx

Upstream Structures	Outflow To	Overflow To
Area 1.srcx	Area 3.srcx	(None)

Half Drain Time : 1126 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	127.919	0.269	0.0	0.4	0.4	20.9	O K
30 min Summer	127.963	0.313	0.0	0.5	0.5	28.2	O K
60 min Summer	128.007	0.357	0.0	0.5	0.5	35.9	O K
120 min Summer	128.051	0.401	0.0	0.5	0.5	43.7	O K
180 min Summer	128.078	0.428	0.0	0.5	0.5	48.2	O K
240 min Summer	128.096	0.446	0.0	0.6	0.6	51.4	O K
360 min Summer	128.121	0.471	0.0	0.6	0.6	55.9	Flood Risk
480 min Summer	128.140	0.490	0.0	0.6	0.6	59.2	Flood Risk
600 min Summer	128.155	0.505	0.0	0.6	0.6	61.7	Flood Risk
720 min Summer	128.166	0.516	0.0	0.6	0.6	63.6	Flood Risk
960 min Summer	128.179	0.529	0.0	0.6	0.6	65.9	Flood Risk
1440 min Summer	128.184	0.534	0.0	0.6	0.6	66.8	Flood Risk
2160 min Summer	128.169	0.519	0.0	0.6	0.6	64.2	Flood Risk
2880 min Summer	128.153	0.503	0.0	0.6	0.6	61.5	Flood Risk
4320 min Summer	128.122	0.472	0.0	0.6	0.6	55.9	Flood Risk
5760 min Summer	128.090	0.440	0.0	0.5	0.5	50.4	O K
7200 min Summer	128.059	0.409	0.0	0.5	0.5	45.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.874	0.0	29.3	189
30 min Summer	90.946	0.0	34.9	237
60 min Summer	56.713	0.0	50.5	284
120 min Summer	34.162	0.0	61.6	332
180 min Summer	25.057	0.0	68.0	364
240 min Summer	19.992	0.0	72.5	394
360 min Summer	14.500	0.0	76.9	446
480 min Summer	11.545	0.0	79.2	496
600 min Summer	9.667	0.0	80.5	604
720 min Summer	8.358	0.0	81.3	724
960 min Summer	6.638	0.0	81.9	962
1440 min Summer	4.791	0.0	80.7	1440
2160 min Summer	3.452	0.0	112.0	1776
2880 min Summer	2.733	0.0	117.5	2116
4320 min Summer	1.964	0.0	124.9	2852
5760 min Summer	1.552	0.0	130.0	3600
7200 min Summer	1.292	0.0	133.6	4344

Cascade Summary of Results for Area 2.srcx

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
8640 min Summer	128.032	0.382	0.0	0.5	0.5	40.3	O K
10080 min Summer	128.007	0.357	0.0	0.5	0.5	36.0	O K
15 min Winter	127.936	0.286	0.0	0.4	0.4	23.7	O K
30 min Winter	127.984	0.334	0.0	0.5	0.5	32.0	O K
60 min Winter	128.033	0.383	0.0	0.5	0.5	40.5	O K
120 min Winter	128.083	0.433	0.0	0.5	0.5	49.2	O K
180 min Winter	128.112	0.462	0.0	0.6	0.6	54.3	Flood Risk
240 min Winter	128.133	0.483	0.0	0.6	0.6	57.9	Flood Risk
360 min Winter	128.162	0.512	0.0	0.6	0.6	63.0	Flood Risk
480 min Winter	128.184	0.534	0.0	0.6	0.6	66.7	Flood Risk
600 min Winter	128.200	0.550	0.0	0.6	0.6	69.6	Flood Risk
720 min Winter	128.213	0.563	0.0	0.6	0.6	71.8	Flood Risk
960 min Winter	128.230	0.580	0.0	0.6	0.6	74.8	Flood Risk
1440 min Winter	128.241	0.591	0.0	0.6	0.6	76.8	Flood Risk
2160 min Winter	128.225	0.575	0.0	0.6	0.6	74.0	Flood Risk
2880 min Winter	128.205	0.555	0.0	0.6	0.6	70.5	Flood Risk
4320 min Winter	128.156	0.506	0.0	0.6	0.6	62.0	Flood Risk
5760 min Winter	128.106	0.456	0.0	0.6	0.6	53.3	Flood Risk
7200 min Winter	128.062	0.412	0.0	0.5	0.5	45.5	O K
8640 min Winter	128.023	0.373	0.0	0.5	0.5	38.8	O K
10080 min Winter	127.990	0.340	0.0	0.5	0.5	33.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.112	0.0	136.2	5104
10080 min Summer	0.980	0.0	138.1	5856
15 min Winter	138.874	0.0	31.9	206
30 min Winter	90.946	0.0	36.9	255
60 min Winter	56.713	0.0	57.1	300
120 min Winter	34.162	0.0	69.4	346
180 min Winter	25.057	0.0	76.0	378
240 min Winter	19.992	0.0	79.1	404
360 min Winter	14.500	0.0	82.6	452
480 min Winter	11.545	0.0	84.6	500
600 min Winter	9.667	0.0	85.8	602
720 min Winter	8.358	0.0	86.6	718
960 min Winter	6.638	0.0	87.0	952
1440 min Winter	4.791	0.0	85.7	1400
2160 min Winter	3.452	0.0	126.4	1888
2880 min Winter	2.733	0.0	132.7	2216
4320 min Winter	1.964	0.0	137.7	3024
5760 min Winter	1.552	0.0	147.3	3816
7200 min Winter	1.292	0.0	151.6	4616
8640 min Winter	1.112	0.0	154.8	5400
10080 min Winter	0.980	0.0	157.3	6152

Cascade Model Details for Area 2.srcx

Storage is Online Cover Level (m) 128.400

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	24.1
Membrane Percolation (mm/hr)	1000	Length (m)	24.1
Max Percolation (l/s)	161.3	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	127.650	Membrane Depth (m)	0

Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 127.650

Cascade Summary of Results for Area 3.srcx

Upstream Structures	Outflow To	Overflow To
Area 2.srcx Area 1.srcx	Area 4.srcx	(None)

Half Drain Time : 438 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	127.506	0.256	0.0	0.4	0.4	8.2	O K
30 min Summer	127.553	0.303	0.0	0.5	0.5	10.8	O K
60 min Summer	127.602	0.352	0.0	0.5	0.5	13.6	O K
120 min Summer	127.652	0.402	0.0	0.5	0.5	16.4	O K
180 min Summer	127.683	0.433	0.0	0.5	0.5	18.2	O K
240 min Summer	127.704	0.454	0.0	0.6	0.6	19.3	Flood Risk
360 min Summer	127.735	0.485	0.0	0.6	0.6	21.1	Flood Risk
480 min Summer	127.758	0.508	0.0	0.6	0.6	22.4	Flood Risk
600 min Summer	127.776	0.526	0.0	0.6	0.6	23.4	Flood Risk
720 min Summer	127.790	0.540	0.0	0.6	0.6	24.2	Flood Risk
960 min Summer	127.812	0.562	0.0	0.6	0.6	25.4	Flood Risk
1440 min Summer	127.837	0.587	0.0	0.6	0.6	26.8	Flood Risk
2160 min Summer	127.844	0.594	0.0	0.6	0.6	27.2	Flood Risk
2880 min Summer	127.831	0.581	0.0	0.6	0.6	26.5	Flood Risk
4320 min Summer	127.805	0.555	0.0	0.6	0.6	25.0	Flood Risk
5760 min Summer	127.781	0.531	0.0	0.6	0.6	23.7	Flood Risk
7200 min Summer	127.758	0.508	0.0	0.6	0.6	22.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.874	0.0	34.0	423
30 min Summer	90.946	0.0	37.8	493
60 min Summer	56.713	0.0	64.0	488
120 min Summer	34.162	0.0	78.0	124
180 min Summer	25.057	0.0	83.5	184
240 min Summer	19.992	0.0	86.1	244
360 min Summer	14.500	0.0	88.8	364
480 min Summer	11.545	0.0	90.2	484
600 min Summer	9.667	0.0	91.0	604
720 min Summer	8.358	0.0	91.3	724
960 min Summer	6.638	0.0	91.1	964
1440 min Summer	4.791	0.0	88.7	1442
2160 min Summer	3.452	0.0	142.0	2160
2880 min Summer	2.733	0.0	148.9	2568
4320 min Summer	1.964	0.0	150.9	3244
5760 min Summer	1.552	0.0	164.9	3984
7200 min Summer	1.292	0.0	169.4	4752

Cascade Summary of Results for Area 3.srcx

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
8640 min Summer	127.735	0.485	0.0	0.6	0.6	21.1	Flood Risk
10080 min Summer	127.712	0.462	0.0	0.6	0.6	19.8	Flood Risk
15 min Winter	127.524	0.274	0.0	0.4	0.4	9.2	O K
30 min Winter	127.577	0.327	0.0	0.5	0.5	12.2	O K
60 min Winter	127.631	0.381	0.0	0.5	0.5	15.2	O K
120 min Winter	127.689	0.439	0.0	0.5	0.5	18.5	O K
180 min Winter	127.724	0.474	0.0	0.6	0.6	20.4	Flood Risk
240 min Winter	127.747	0.497	0.0	0.6	0.6	21.8	Flood Risk
360 min Winter	127.782	0.532	0.0	0.6	0.6	23.7	Flood Risk
480 min Winter	127.807	0.557	0.0	0.6	0.6	25.2	Flood Risk
600 min Winter	127.828	0.578	0.0	0.6	0.6	26.3	Flood Risk
720 min Winter	127.844	0.594	0.0	0.6	0.6	27.2	Flood Risk
960 min Winter	127.869	0.619	0.0	0.7	0.7	28.7	Flood Risk
1440 min Winter	127.900	0.650	0.0	0.7	0.7	30.4	Flood Risk
2160 min Winter	127.914	0.664	0.0	0.7	0.7	31.2	Flood Risk
2880 min Winter	127.905	0.655	0.0	0.7	0.7	30.7	Flood Risk
4320 min Winter	127.870	0.620	0.0	0.7	0.7	28.7	Flood Risk
5760 min Winter	127.833	0.583	0.0	0.6	0.6	26.6	Flood Risk
7200 min Winter	127.794	0.544	0.0	0.6	0.6	24.4	Flood Risk
8640 min Winter	127.757	0.507	0.0	0.6	0.6	22.3	Flood Risk
10080 min Winter	127.721	0.471	0.0	0.6	0.6	20.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.112	0.0	172.7	5528
10080 min Summer	0.980	0.0	175.2	6264
15 min Winter	138.874	0.0	35.7	454
30 min Winter	90.946	0.0	39.5	493
60 min Winter	56.713	0.0	72.3	430
120 min Winter	34.162	0.0	84.9	124
180 min Winter	25.057	0.0	89.0	184
240 min Winter	19.992	0.0	91.2	242
360 min Winter	14.500	0.0	93.9	362
480 min Winter	11.545	0.0	95.3	482
600 min Winter	9.667	0.0	96.1	600
720 min Winter	8.358	0.0	96.4	718
960 min Winter	6.638	0.0	96.2	954
1440 min Winter	4.791	0.0	93.7	1426
2160 min Winter	3.452	0.0	160.1	2100
2880 min Winter	2.733	0.0	168.1	2708
4320 min Winter	1.964	0.0	162.9	3368
5760 min Winter	1.552	0.0	186.7	4200
7200 min Winter	1.292	0.0	192.1	5040
8640 min Winter	1.112	0.0	196.3	5800
10080 min Winter	0.980	0.0	199.5	6600

Cascade Model Details for Area 3.srcx

Storage is Online Cover Level (m) 128.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	13.7
Membrane Percolation (mm/hr)	1000	Length (m)	13.7
Max Percolation (l/s)	52.1	Slope (1:X)	62.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	127.250	Membrane Depth (m)	0

Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 127.250

Cascade Summary of Results for Area 4.srcx

Upstream Structures	Outflow To	Overflow To
Area 3.srcx Area 2.srcx Area 1.srcx	(None)	(None)

Half Drain Time : 116 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	126.534	0.284	0.8	0.4	1.3	8.8	O K
30 min Summer	126.576	0.326	0.9	0.5	1.3	11.5	O K
60 min Summer	126.612	0.362	0.9	0.5	1.4	13.8	O K
120 min Summer	126.633	0.383	0.9	0.5	1.4	15.2	O K
180 min Summer	126.636	0.386	0.9	0.5	1.4	15.3	O K
240 min Summer	126.634	0.384	0.9	0.5	1.4	15.2	O K
360 min Summer	126.626	0.376	0.9	0.5	1.4	14.7	O K
480 min Summer	126.617	0.367	0.9	0.5	1.4	14.2	O K
600 min Summer	126.608	0.358	0.9	0.5	1.4	13.5	O K
720 min Summer	126.598	0.348	0.9	0.5	1.4	12.9	O K
960 min Summer	126.580	0.330	0.9	0.5	1.3	11.8	O K
1440 min Summer	126.549	0.299	0.9	0.4	1.3	9.8	O K
2160 min Summer	126.519	0.269	0.8	0.4	1.2	7.9	O K
2880 min Summer	126.496	0.246	0.7	0.4	1.1	6.6	O K
4320 min Summer	126.463	0.213	0.6	0.4	1.0	5.0	O K
5760 min Summer	126.441	0.191	0.6	0.4	0.9	4.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.874	0.0	43.0	18
30 min Summer	90.946	0.0	49.9	33
60 min Summer	56.713	0.0	79.9	62
120 min Summer	34.162	0.0	97.4	120
180 min Summer	25.057	0.0	104.7	154
240 min Summer	19.992	0.0	108.4	184
360 min Summer	14.500	0.0	113.0	250
480 min Summer	11.545	0.0	115.9	320
600 min Summer	9.667	0.0	117.9	388
720 min Summer	8.358	0.0	119.2	456
960 min Summer	6.638	0.0	120.5	588
1440 min Summer	4.791	0.0	120.3	838
2160 min Summer	3.452	0.0	177.2	1212
2880 min Summer	2.733	0.0	185.9	1588
4320 min Summer	1.964	0.0	189.8	2332
5760 min Summer	1.552	0.0	205.9	3056

Cascade Summary of Results for Area 4.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
7200 min Summer	126.424	0.174	0.5	0.3	0.9	3.3	O K
8640 min Summer	126.411	0.161	0.5	0.3	0.8	2.9	O K
10080 min Summer	126.402	0.152	0.5	0.3	0.8	2.5	O K
15 min Winter	126.553	0.303	0.9	0.5	1.3	10.0	O K
30 min Winter	126.601	0.351	0.9	0.5	1.4	13.1	O K
60 min Winter	126.643	0.393	0.9	0.5	1.4	15.8	O K
120 min Winter	126.671	0.421	0.9	0.5	1.4	17.6	O K
180 min Winter	126.674	0.424	0.9	0.5	1.4	17.8	O K
240 min Winter	126.669	0.419	0.9	0.5	1.4	17.5	O K
360 min Winter	126.658	0.408	0.9	0.5	1.4	16.8	O K
480 min Winter	126.645	0.395	0.9	0.5	1.4	15.9	O K
600 min Winter	126.630	0.380	0.9	0.5	1.4	15.0	O K
720 min Winter	126.616	0.366	0.9	0.5	1.4	14.1	O K
960 min Winter	126.589	0.339	0.9	0.5	1.4	12.3	O K
1440 min Winter	126.546	0.296	0.9	0.4	1.3	9.6	O K
2160 min Winter	126.510	0.260	0.8	0.4	1.2	7.4	O K
2880 min Winter	126.484	0.234	0.7	0.4	1.1	6.0	O K
4320 min Winter	126.450	0.200	0.6	0.4	1.0	4.4	O K
5760 min Winter	126.428	0.178	0.5	0.3	0.9	3.5	O K
7200 min Winter	126.413	0.163	0.5	0.3	0.8	2.9	O K
8640 min Winter	126.401	0.151	0.5	0.3	0.8	2.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.292	0.0	211.7	3816
8640 min Summer	1.112	0.0	215.9	4504
10080 min Summer	0.980	0.0	219.0	5248
15 min Winter	138.874	0.0	45.9	18
30 min Winter	90.946	0.0	53.1	32
60 min Winter	56.713	0.0	90.3	60
120 min Winter	34.162	0.0	106.4	118
180 min Winter	25.057	0.0	112.5	172
240 min Winter	19.992	0.0	116.3	200
360 min Winter	14.500	0.0	121.1	274
480 min Winter	11.545	0.0	124.2	350
600 min Winter	9.667	0.0	126.3	424
720 min Winter	8.358	0.0	127.7	498
960 min Winter	6.638	0.0	129.2	636
1440 min Winter	4.791	0.0	129.3	894
2160 min Winter	3.452	0.0	199.8	1296
2880 min Winter	2.733	0.0	209.8	1676
4320 min Winter	1.964	0.0	206.7	2464
5760 min Winter	1.552	0.0	233.1	3288
7200 min Winter	1.292	0.0	240.0	4104
8640 min Winter	1.112	0.0	245.2	4928

Cascade Summary of Results for Area 4.srcx

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
10080 min Winter	126.392	0.142	0.4	0.3	0.7	2.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.980	0.0	249.3	5744

Cascade Model Details for Area 4.srcx

Storage is Online Cover Level (m) 127.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.02952	Width (m)	14.6
Membrane Percolation (mm/hr)	1000	Length (m)	14.6
Max Percolation (l/s)	59.2	Slope (1:X)	50.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	126.250	Membrane Depth (m)	0

Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 126.250

APPENDIX D

PROPOSED FOUL & SURFACE WATER DRAINAGE STRATEGY

PRELIMINARY FOR PLANNING

REV. No.	DATE	DESCRIPTION	INITIALS
A	20.12.17	Site layout amended, drainage updated to suit.	CP

Client: Rectory Homes

Project: Land at South Side, Steeple Aston

Title: Drainage Strategy

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Scale	Date	Drawing No.	Rev
1:150@A0	Nov 17	5634:01	A
Checked: CP	Drawn: SS		

APPENDIX E
SUDS COMPATIBILITY MATRIX

SuDS Type	Description	Suitable for this site	Comments
Green Roofs	Green roofs comprise a multi-layered system that covers the roof of a building with vegetation cover over a drainage layer. They are designed to intercept and retain rainfall, reducing the volume of runoff and attenuating	✗	Living Roofs would not be technically feasible at this develoment due to factors such as loadings, steep roof pitch of proposed dwellings, visual impact and high maintenance burden to homeowners.
Rainwater Harvesting	Re-using rainwater for non-potable purposes such as irrigation and toilet flushing.	✗	Rainwater harvesting cannot be relied upon to guarantee a reduction in the volume of water leaving the site as it relies upon tanks having available capacity. During intense/prolonged periods of rainfall it is likely that the tanks will be full and will overflow into the system. These systems can also be a high maintenance burden for residential home owners. Cost benifit of system is not recoverd unitl 10-15years.
Soakaways	Soakaways provide stormwater attenuation, stormwater treatment and groundwater recharge.	✓	Initial site desk study shows that this site is likely suitabel for onsite infiltration via soakaways. This will be confirmed with infiltration testing to BRE265 and groundwater monitoring.
Filter Strip / Trenches / Swales	Filter strips are linear grassed or vegetated strips of land / channels designed to accept runoff as overland sheet flow from impermeable surfaces usually located adjacent road or parking areas and used to treat infiltrated or convey runoff.	✓	Potentially for conveyance only, may be insufficient open space to incorporate effectively on this development.
Permeable Paving	Pervious pavements provide a pavement suitable for pedestrian and vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltration to the ground, reuse, or discharge to a watercourse or other drainage system.	✓	Potentially on private drives / parking areas/ roads . This would improve water quality into the receiving waterbody.
Bio Retention	Bioretention areas are shallow landscaped depressions which are typically under-drained and rely on engineered soils and enhanced vegetation and filtration to remove pollution and reduce runoff downstream. They are aimed at managing and treating runoff from frequent rainfall events.	✓	A bio retention pond could be utilised at this development if the receiving waterbody is considered sensitive and additional treatment is required. May be insufficient open space to incorporate effectively on this development as POS is limited.
Ponds / Basins	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.	✓	A pond / basin can be utilised at this development to provide attenuation and improvements in water quality. May be insufficient open space to incorporate effectively on this development as POS is limited.
Underground Storage	Underground large diameter Concrete pipes or Geocellular Tanks to reduce and attenuate peak flows	✓	Underground storage tanks can be utilised at this development if required.

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