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MBP 8897 – MANOR LODGE, RICKMANSWORTH ROAD NORTHWOOD, HA6 2QT

SUDS REPORT

MARCH 2023

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CONTENTS

APPENDICES

1. PREAMBLE

This report has been prepared by Michael Barclay Partnership LLP (MBP) on the instructions of, and for the sole use and benefit of, the Client (Merchant Land Investments Ltd).

MBP shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared and provided. If the Client wishes to pass copies of the report to other parties for information, the whole of the report should be copied. No professional liability or warranty is extended to other parties by MBP as a result of permitting the report to be copied or by any other cause without the express written agreement of MBP.

2. TERMS OF REFERENCE

MBP has been engaged by the Client for Manor Lodge, Rickmansworth Road, Northwood, HA6 2QT to undertake an appraisal of the sustainable drainage (SuDS) requirements for the demolition of the existing structures and creation of six residential units together with alterations to existing access points, associated parking and landscaping.

3. INTRODUCTION

The aim of this report is to identify the SuDS requirements for the design of the drainage system, as set out for developments within The London Borough of Hillingdon's SuDS policies. This appraisal includes a review of the net change in permeable surfaces following the proposed development using the drawings produced by the Architect (Appendix A).

4. SITE LOCATION

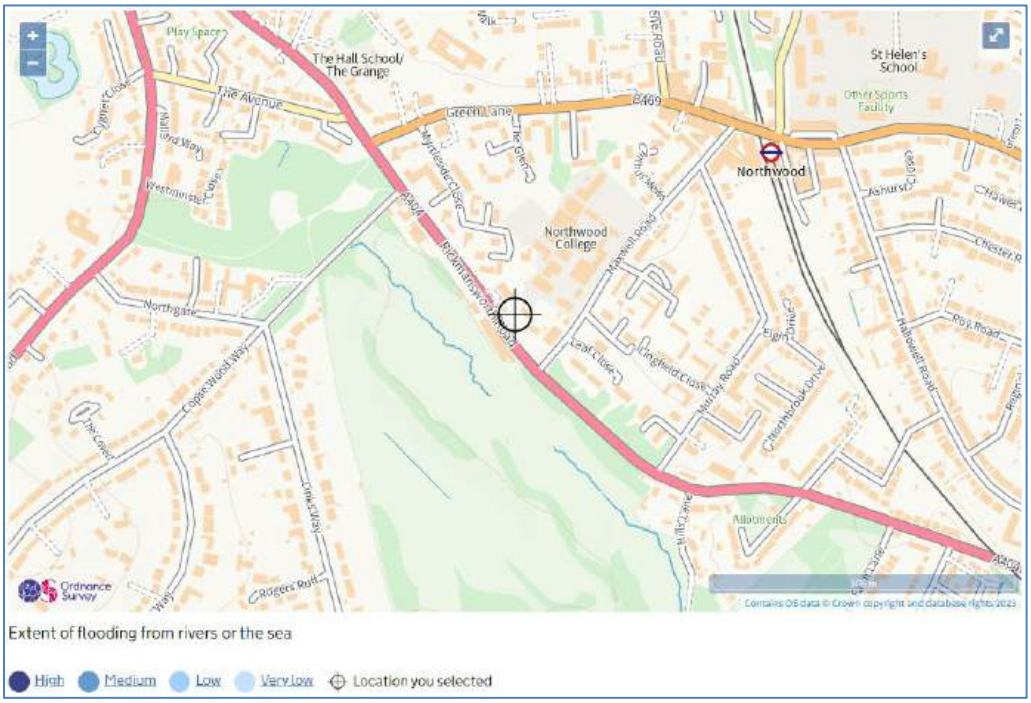
The site is located within the London Borough of Hillingdon, on the eastern side of Rickmansworth Road. The site is not located within a Critical Drainage area. The Lead Local Flood Authority is Hillingdon Council.

Aerial photograph

A topographic survey has been undertaken and is attached in Appendix B.

5. FLOOD RISK

The Environment Agency's (EA's) Flood Zone Mapping (below) shows that the site is located entirely within Flood Zone 1 which is land assessed as having a very low risk (<0.1%) of flooding in any year.



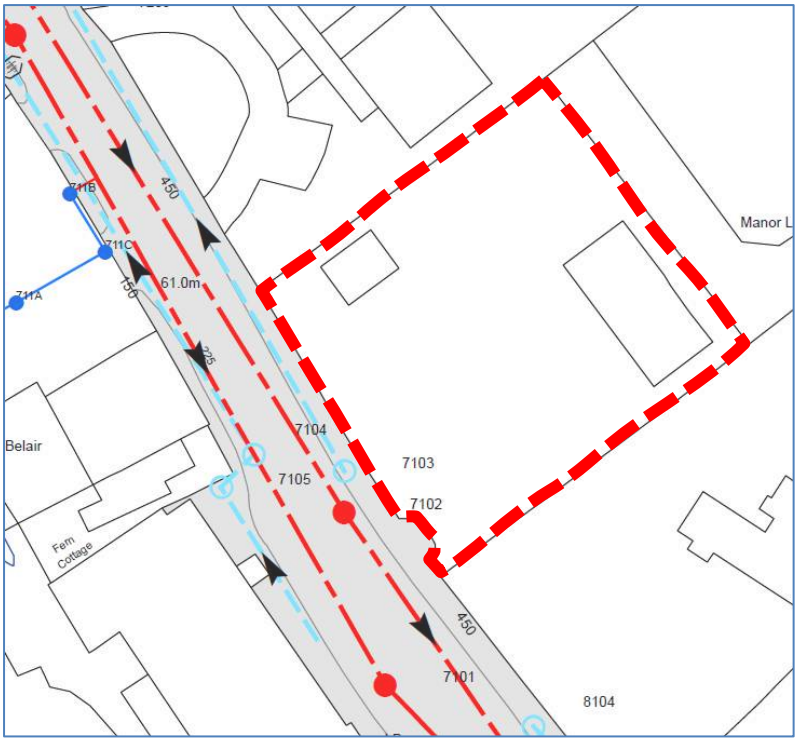
The EA's flooding from surface water mapping (below) shows that the site is classified as being at very low risk from this source of flooding.

6. EXISTING DRAINAGE

A CCTV survey of the existing drainage has not yet been undertaken.

The topographic survey shows an existing manhole located approximately 8m within the site boundary. It is assumed that this is the final manhole connection to the public foul water sewer in Rickmansworth Road downstream of MH 7102. There doesn't appear to be a separate surface water drainage system.

A sewer asset plan has been obtained from Thames Water (extract below & Appendix C) and shows both foul and surface water sewers in Rickmansworth Road. A 450mm diameter foul water sewer runs from north to south and is approximately 2.5m deep. The (unknown diameter) surface water sewer runs south to north in the northern footpath and is approximately 1m deep.



A pre-planning enquiry was submitted to Thames Water, the response (attached as Appendix I) confirms there is sufficient capacity in both the foul and surface water sewers to accommodate the new development.

7. INFILTRATION FEASIBILITY

A ground investigation has not yet been undertaken. However, an infiltration SuDS GeoReport has been obtained from the British Geological Survey. The underlying bedrock geology of the site is shown to be Lambeth Group (clay, silt and sand) with no superficial or artificial deposits.

Artificial deposits

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Superficial deposits

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Bedrock

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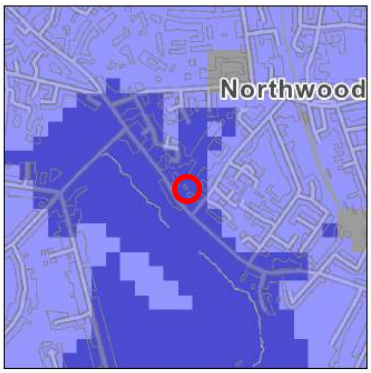
Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	LC-XCZS	LONDON CLAY FORMATION	CLAY, SILT AND SAND
	LMBE-XCZS	LAMBETH GROUP	CLAY, SILT AND SAND

According to the Part 1 of the GeoReport, the site is within an area that has "*Opportunities for bespoke infiltration SuDS*".

In terms of the drainage potential, is the ground suitable for infiltration SuDS?



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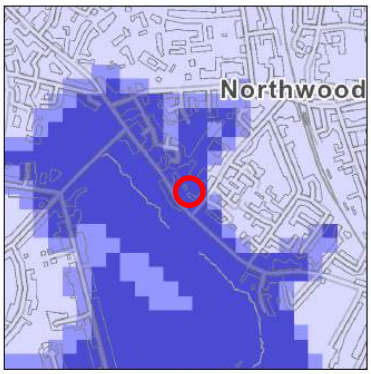
- Highly compatible for infiltration SuDS. The subsurface is likely to be suitable for free-draining infiltration SuDS.
- Probably compatible for infiltration SuDS. The subsurface is probably suitable although the design may be influenced by the ground conditions.
- Opportunities for bespoke infiltration SuDS. The subsurface is potentially suitable although the design will be influenced by the ground conditions.
- Very significant constraints are indicated. There is a very significant potential for one or more hazards associated with infiltration.

Section 2 of the report indicates that the depth to the groundwater table *"is likely to be less than 3m below ground level"*.

Depth to groundwater table



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- Groundwater is likely to be **more than 5 m** below the ground surface throughout the year.
- Groundwater is likely to be between **3 and 5 m** below the ground surface for at least part of the year.
- Groundwater is likely to be **less than 3 m** below the ground surface for at least part of the year.

Infiltration testing to BRE365 will be undertaken at the detailed design stage to confirm whether or not infiltration systems are viable at this site.

The full Infiltration SuDS GeoReport is attached as Appendix D.

8. LOCAL POLICY

This report sets out the methods that this development will comply with the requirements of LB Hillingdon's Sustainable drainage requirements for minor developments.

9. SUDS HIERARCY

The following hierarchy has been followed when assessing SuDS for this site…

	Technique	Used	Comments
1	Store water for later use	**Y**	A water butt will be located at the rainwater down pipes to the rear of the dwellings. These can be used for irrigation purposes, however these will be ignored within the hydraulic calculations.
2	Use infiltration techniques, such as porous paving surfaces in non-clay areas	**Y**	Permeable paving will be utilised for the driveway and parking spaces. Green roofs added to rear flat roofs.
3	Attenuate rainwater in ponds or open water features for gradual release	**N**	Due to site constraints, open water features are not a viable option.
4	Attenuate rainwater by storing in tanks or sealed water features for gradual release	**Y**	Run-off from the house roofs and that falling on the car park/parking spaces will be stored within the stone blanket under the driveway. The stored water will be discharged into the surface water sewer at a reduced rate of 1.0 l/s though the use of a Controflow flow control device.
5	Discharge rainwater direct to a watercourse	**N**	There is no suitable watercourse within the vicinity of the site.
6	Discharge rainwater to a surface water sewer/drain	**Y**	All run-off generated from the site will be discharged into the public surface water sewer at a restricted rate of 1.0 l/s.
7	Discharge rainwater to the combined sewer	**N**	Not applicable.

Table 1

10. EXISTING RUN-OFF

The existing site has a total area of 1839m^2 of which 739m^2 is impermeable. The drawing in Appendix E shows the change in impermeable areas.

The greenfield run-off rates have been calculated using the ICP SuDS method and are shown in the table below (Appendix F).

Return Period (Years)	Greenfield run-off (l/s)
Q_{bar}	0.3
1	0.3
30	0.7
100	1.1

Table 2

Calculation have been undertaken to determine the existing surface water run-off from the site. These have been undertaken using the Modified Rational Method utilising the FSR rainfall model to determine the rainfall intensities for a 15-minute duration based on an existing impermeable area of 739m^2.

Return Period (years)	Rainfall intensity (mm/hr)	Run-off (l/s)
1	31.042	6.95
30	76.163	17.04
100	98.853	22.12

Table 3

11. SURFACE WATER DRAINAGE STRATEGY

Bearing in mind the low infiltration potential for this site, it is proposed to provide water butts to the rear of all the dwellings. The water butts will be assumed to be full of water and as such will be ignored in the hydraulic calculations. The driveway and car parking spaces will be surfaced with permeable paving (Type to be decided) with a tanked stone storage blanket below. All roof drainage will be discharged into the stone blanket and gradually released into the public surface water sewer.

The discharge rates for the 1, 30 and 100 year (plus climate change) storm events will be restricted to 1.0 l/s, this represents a reduction of 86%, 94% and 95% respectively. It is generally accepted that restricting discharges from a site to less than 1.0 l/s would require a very small control and would introduce unacceptable risks of flooding from blockages.

In order to achieve the restricted discharge of 1.0 l/s, a flow control device (Controflow chamber) will be used in conjunction with permeable paving. Flows above this discharge rate will be stored within the stone blanket beneath the permeable paving and released gradually into the existing surface water sewer in Rickmansworth Road via a new connection to MH 7103, subject to approval from Thames Water.

Hydraulic calculations have been undertaken and are presented in Appendix G.

Based on the restricted discharge of 1.0 l/s, the storage blanket would need to be able to store 73.7m^3 of rainwater. This equates to a blanket with a depth of 0.6m.

A plan showing the proposed SuDS strategy is included in Appendix H.

12. MAINTENANCE PLAN

Maintenance of the SuDS drainage elements will be undertaken by an approved management company in accordance with the SuDS Manual (CIRIA C753) extracts below…

Permeable Paving

Maintenance Schedule	Required Action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weed.	As required.
	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.
Remedial actions	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required.
	Rehabilitation of surface and upper sub-structure.	As required (if infiltration performance is reduced as a result of significant clogging).
	Initial inspection.	Monthly for 3 months after installation
Monitoring	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action.	3-monthly, 48 h after large storms.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.

Silt traps/Flow control chamber

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.	Annually (in Autumn after leaf fall)
Remedial Actions	Repair physical damage if necessary	As required

CONCLUSION

We have assessed the impact of the proposed works on the drainage of Manor Lodge; permeable paving will be utilised on the driveway/car parking to provide storage within the sub-base stone blanket. A Controflow chamber will be utilised to restrict the discharge from the site to 1.0 l/s for all storms up to and including the critical 100 year return period plus 40% climate change allowance. The blanket will provide a storage volume of 78.4m^3. The rear flat roofs will be green roofs and water butts will be positioned to the rear of the dwellings for irrigation purposes. However, these have not been included in the storage/hydraulic calculations.

Report Prepared by:	Report Approved by:
	
Name: Peter White	Name: Malcolm Brady (Principal)
For Michael Barclay Partnership LLP	Date: 09 March 2023
Issue: 1	Issued on: 09 March 2023

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Appendix A: Proposed Development Plans

EXISTING SITE PLAN

PROPOSED SITE PLAN

0 Scale 1:200 10m 20m

Amendments/Notes

Rev.	Detail	By	Date
D	Amendments in correlation with landscape scheme	AW	27/01/25
E	Updated with Landscape scheme	AW	19/03/25
F	Minor Amendments	AW	20/03/25

Total GIA : 63 m2

Project

MANOR LODGE
RICKMANSWORTH
ROAD
NORTHWOOD
HA6 2QT

Drawing

EXISTING AND
PROPOSED SITE
BLOCK PLAN

SEABROOK
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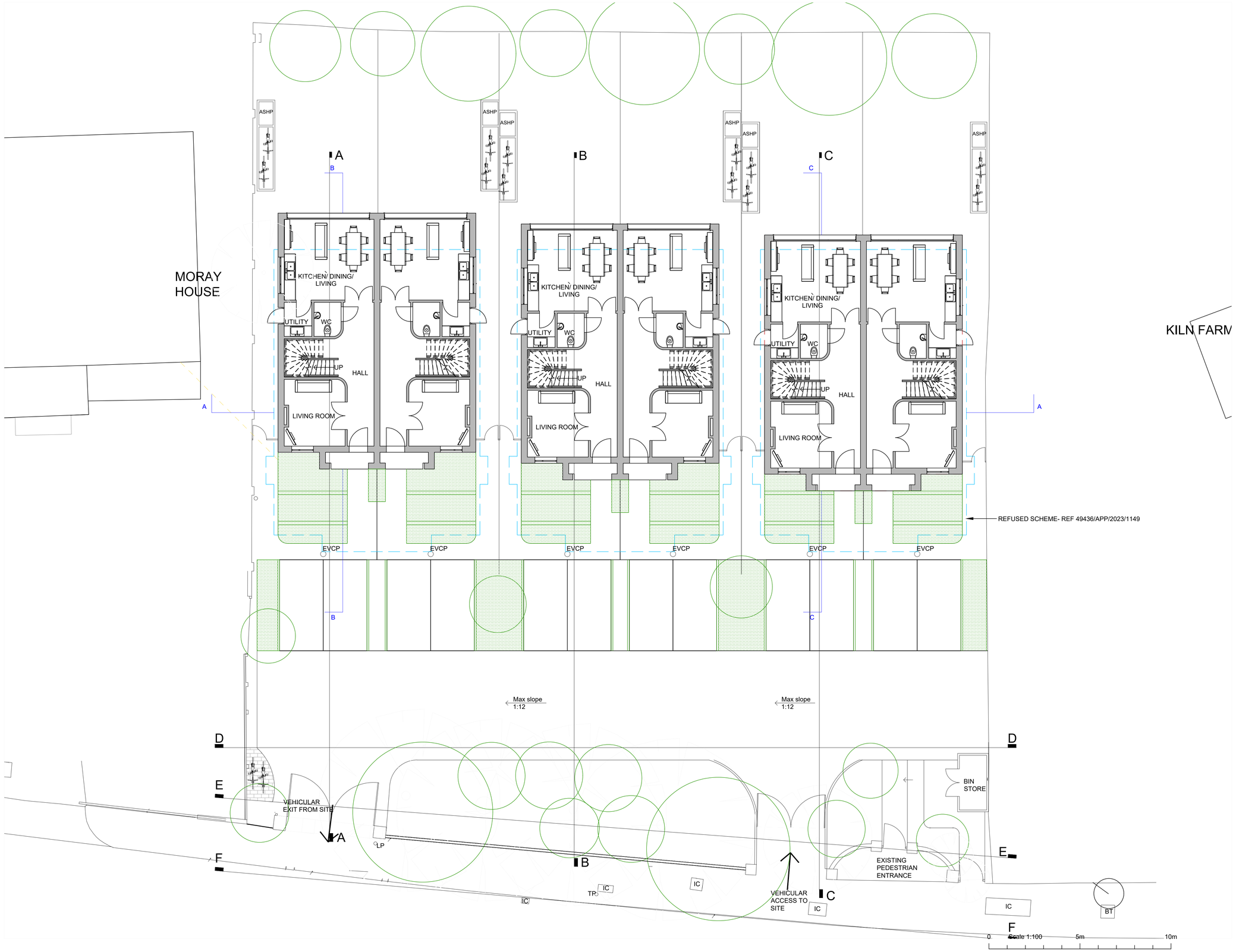
e-mail: info@seabrookarchitects.co.uk

Drawn By	Date 01/03/2023
Checked By	Date 16/08/2024
Approved By	Scale 1:200@A1
Drawing No. 5819A(PP)018	Rev. F



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Rev.	Detail	By	Date
D	Amendments in correlation with landscape scheme	AW	27/01/25
E	Updated with Landscape scheme	AW	19/03/25
F	Minor Amendments	AW	20/03/25

Total GIA : 63 m2

Project

MANOR LODGE
RICKMANSWORTH
ROAD
NORTHWOOD
HA6 2QT

Drawing

PROPOSED
GROUND FLOOR
PLANS

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Checked By	Date 16/08/2024
Approved By	Scale 1:100@A1
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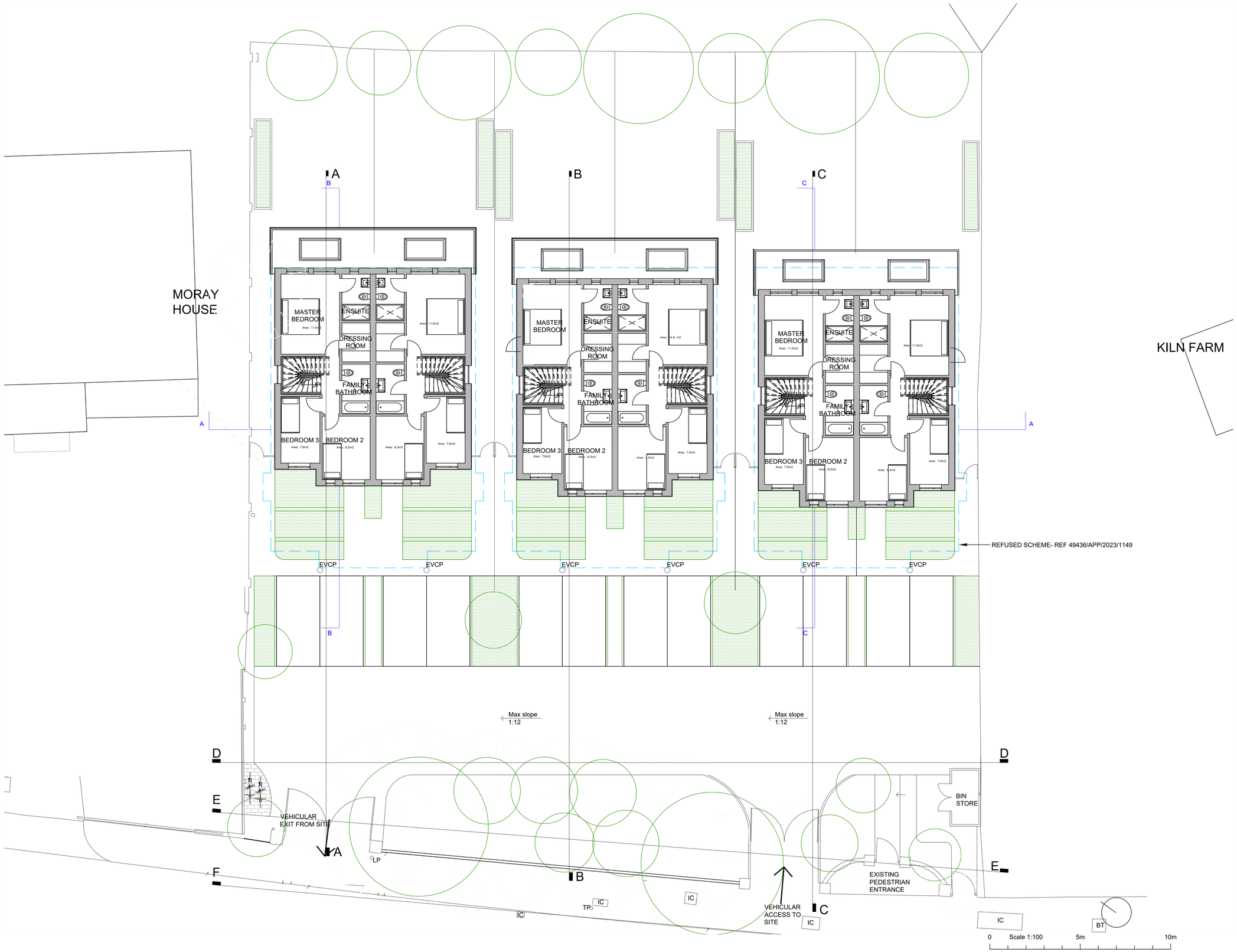

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Rev.	Detail	By	Date
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E	Updated with Landscape scheme	AW	19/03/25
F	Minor Amendments	AW	20/03/25

Total GIA : 54 m2

Project

MANOR LODGE
RICKMANSWORTH
ROAD
NORTHWOOD
HA6 2QT

Drawing

PROPOSED FIRST FLOOR PLANS

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Checked By	Date 16/08/2024
Approved By	Scale 1:100@A1
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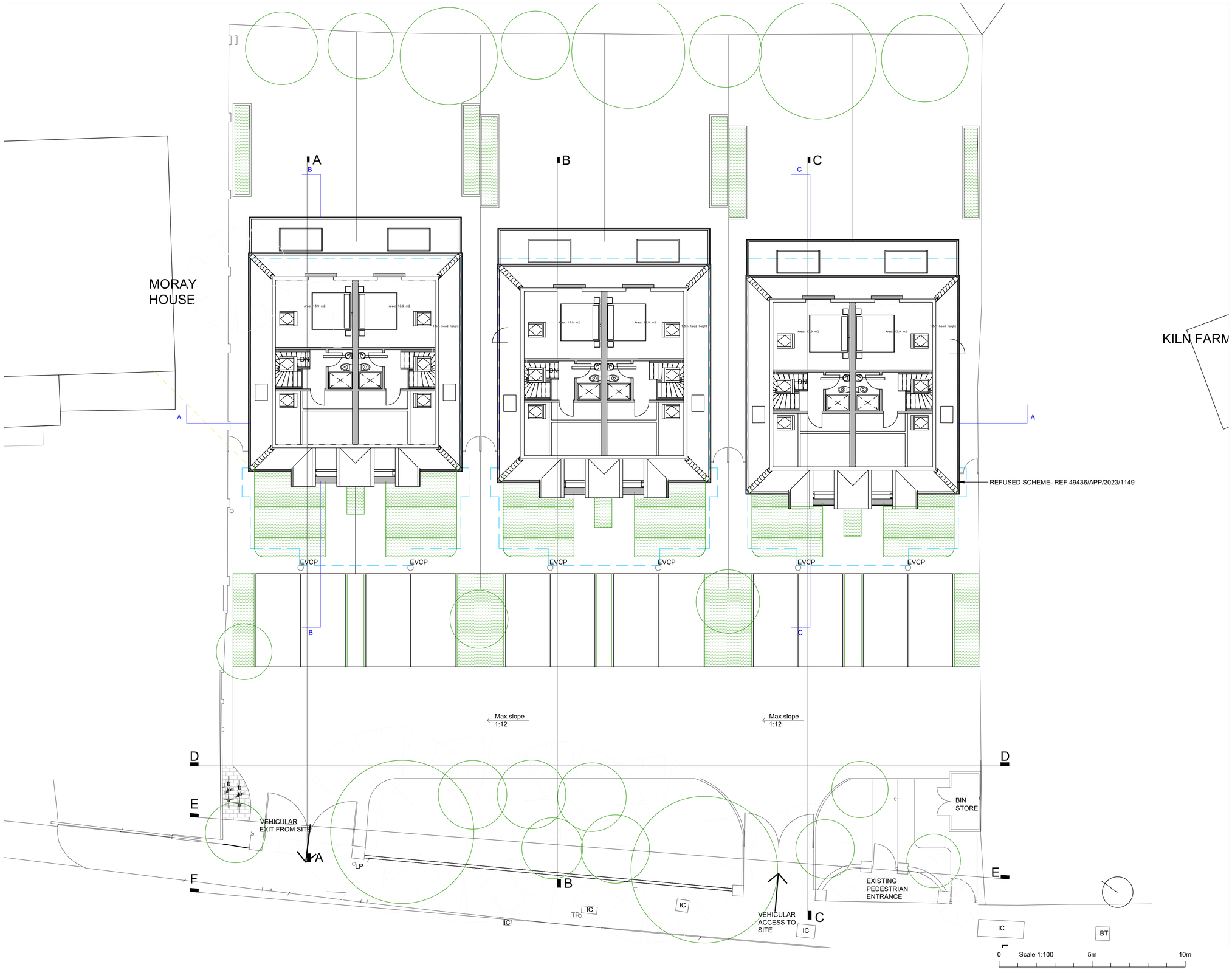

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Rev.	Detail	By	Date
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E	Updated with Landscape scheme	AW	19/03/25
F	Minor Amendments	AW	20/03/25

Total GIA : 36 m2 (plan taken at 1.2m)

Project

MANOR LODGE
RICKMANSWORTH
ROAD
NORTHWOOD
HA6 2QT

Drawing

PROPOSED
LOFT/SECOND FLOR
PLANS

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Checked By		Date	16/08/2024
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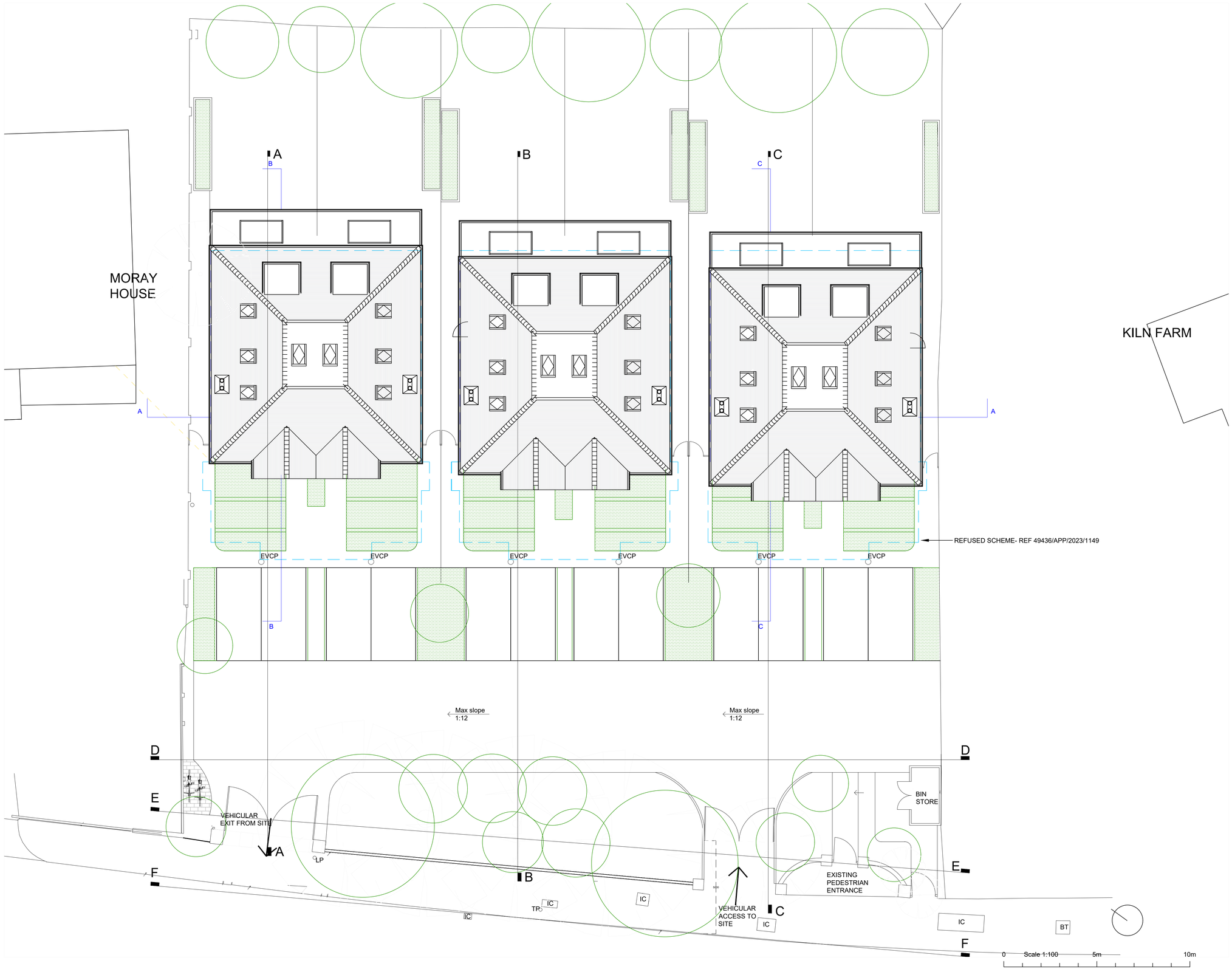

Amendments/Notes

Rev.	Detail	By	Date
D	Amendments in correlation with landscape scheme	AW	27/01/25
E	Updated with Landscape scheme	AW	19/03/25
F	Minor Amendments	AW	20/03/25

Total GIA : 63 m2

Project

MANOR LODGE
RICKMANSWORTH
ROAD
NORTHWOOD
HA6 2QT

Drawing

PROPOSED ROOF
PLANS

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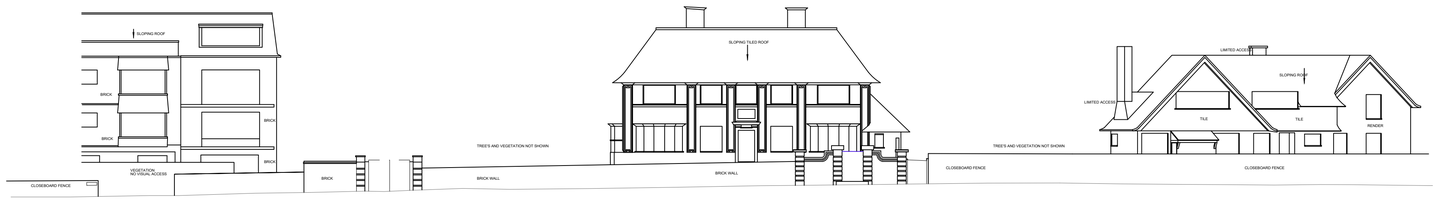
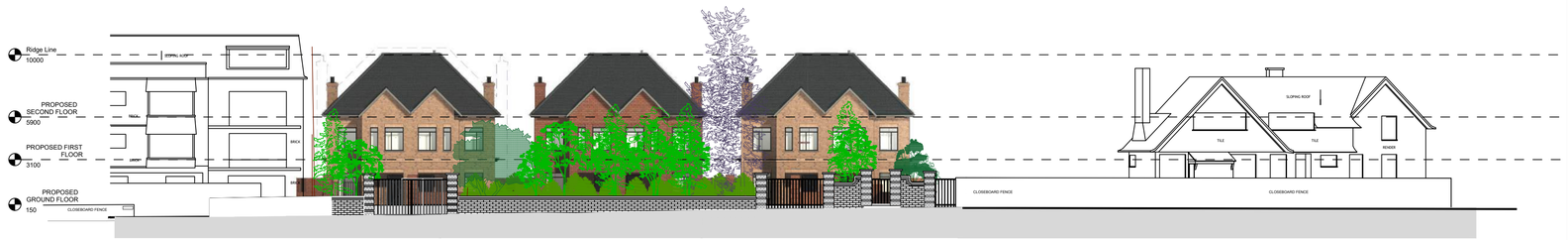


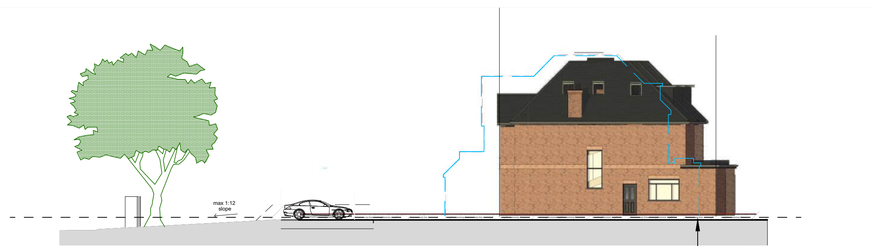
EXISTING FRONT ELEVATION

PROPOSED FRONT ELEVATION



PROPOSED FRONT ELEVATION WITH WALL AND VEGETATION

PROPOSED REAR ELEVATION



PROPOSED EAST ELEVATION

PROPOSED WEST ELEVATION

0 Scale 1:200 10m 20m

Amendments/Notes

Rev.	Detail	By	Date
D	Amendments in correlation with landscape scheme	AW	27/01/25
E	Updated with Landscape scheme	AW	19/03/25
F	Minor Amendments	AW	20/03/25

Project

MANOR LODGE
RICKMANSWORTH
ROAD
NORTHWOOD
HA6 2QT

Drawing

PROPOSED
ELEVATIONS

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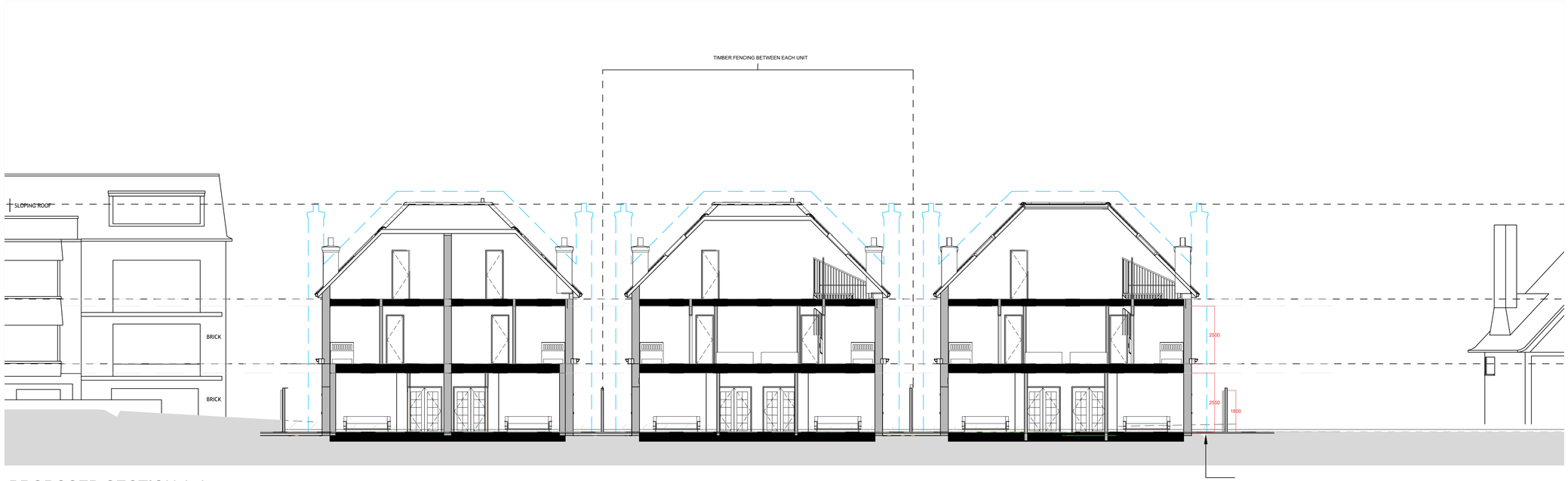
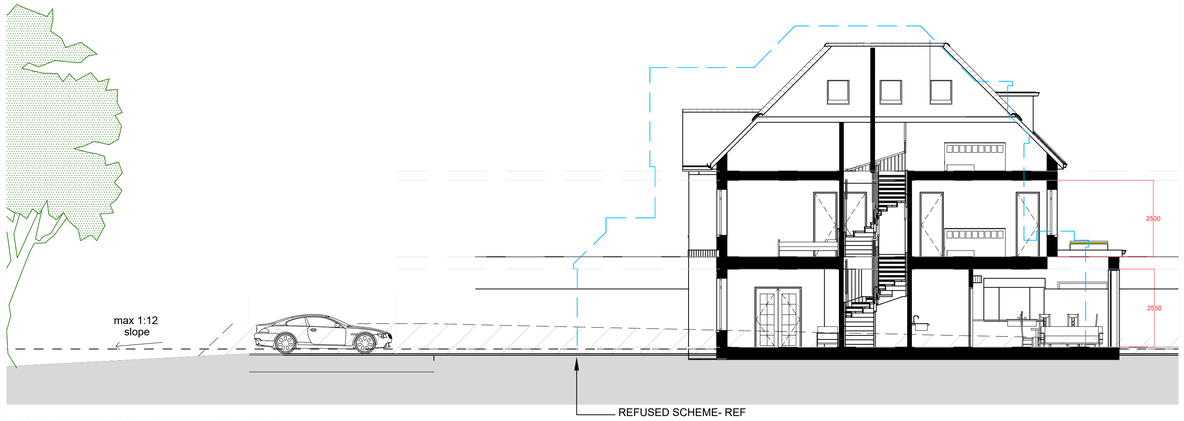
Checked By	Date 16/08/2024
Approved By	Scale 1:200@A1
Drawing No. 5819A(PP)017	Rev. F



PROPOSED SECTION A-A



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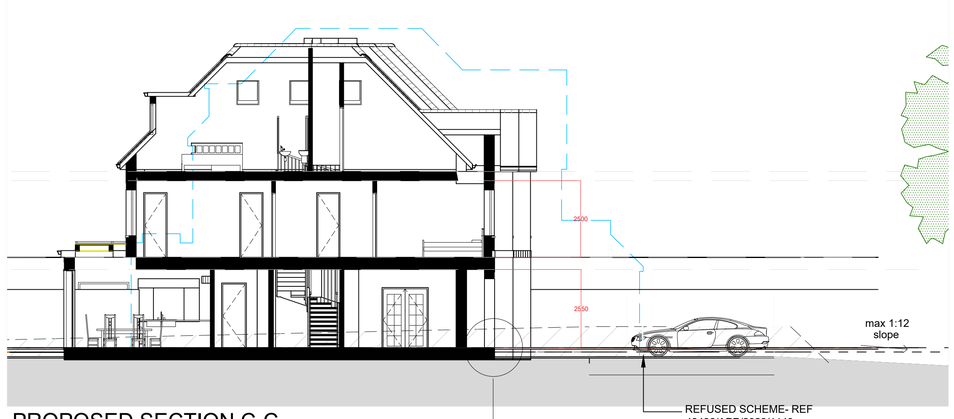

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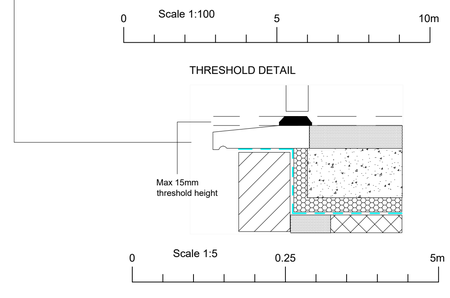

Amendments/Notes

Rev.	Detail	By	Date
D	Amendments in correlation with landscape scheme	AW	27/01/25
E	Updated with Landscape scheme	AW	19/03/25

Project

MANOR LODGE
RICKMANSWORTH
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Drawing

PROPOSED
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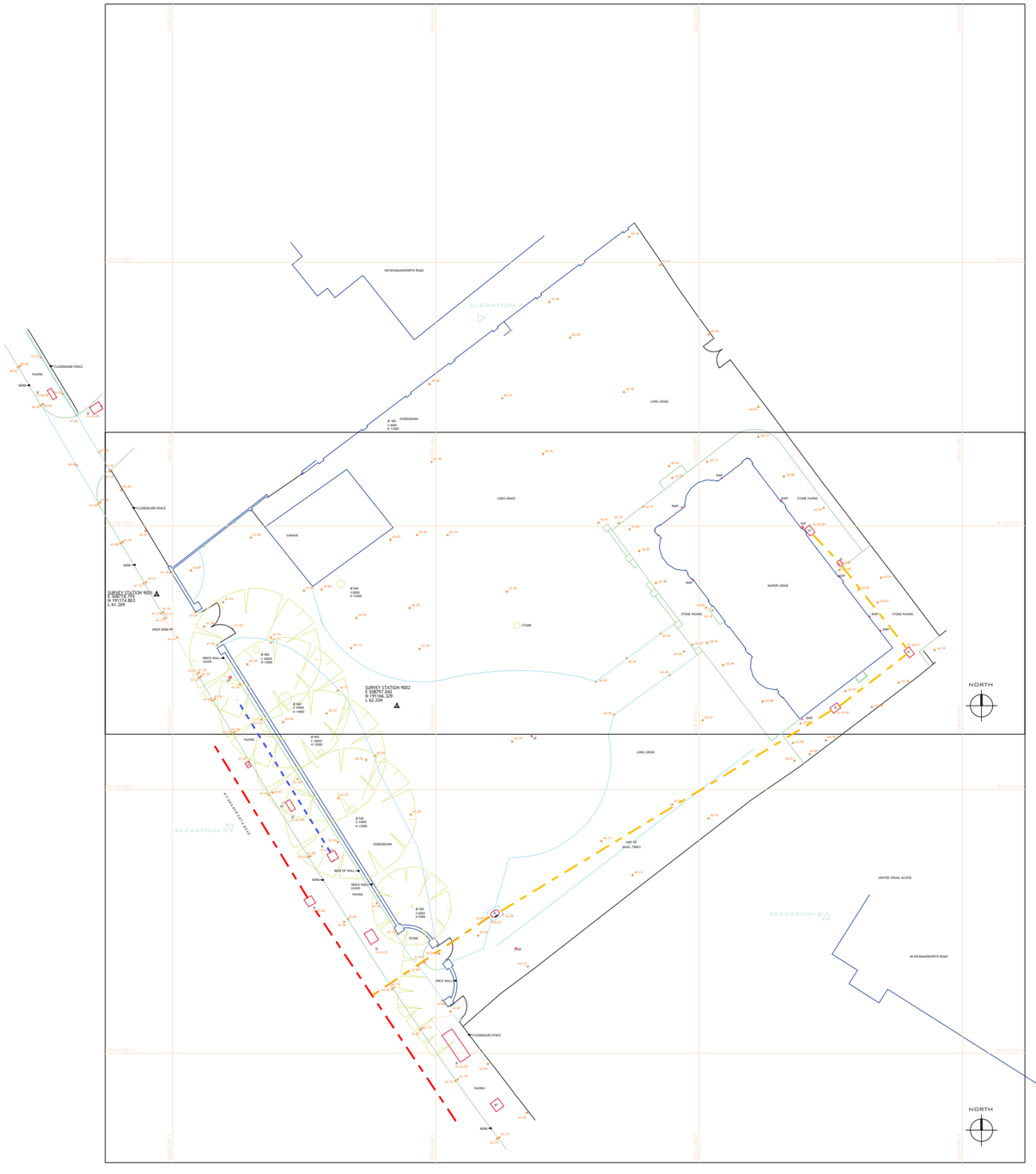
Drawn By	Date 01/03/2023
Checked By	Date 16/08/2024
Approved By	Scale AS.STATED@A1
Drawing No. 5819A(PP)022	Rev. E

MBP

Appendix B: Topographic Survey



Rev	Date	By	Amendment
A	MAR 2022	RT	INFORMATION ADDED & DRAWING MOVED TO OS COORDS

LEGEND

ABBREVIATIONS

B	BOLLARD	MH	MANHOLE
BOE	BRICK ON EDGE	O/H	OVER HEAD
BOX.	BOXING	P	POST
BT	BRITISH TELECOM	P/L	PAVEMENT LIGHT
B/W	BRICK WALL	RAD	RADIATOR
CATV	CABLE TELEVISION	RE	RODDING EYE
CF	CEILING FALL	RS	ROAD SIGN
CL	COVER LEVEL	RSJ	ROLLED STEEL JOIST
CONC	CONCRETE FINISH	RSS	ROLLED STEEL STANCHION
COU	COVER ORIGIN UNKNOWN	RWP	RAIN WATER PIPE
CPD	CUPBOARD	SC	STOP COCK
DK	DROP KERB	SP	SIGN POST
DL	DERIVED LEVEL	SVP	SOIL VENT PIPE
ELEC.	ELECTRICAL	TL	TRAFFIC LIGHT
ER	EARTHING ROD	TR	TOWEL RAIL
F/B	FLOWER BED	TP	TELEPHONE POLE
FAR	FLAT ASPHALT ROOF	UTL	UNABLE TO LIFT
G	GULLY	VP	VENT PIPE
GV	GAS VALVE	VTF	VINYL TILED FLOOR
HLW	HIGH LEVEL WINDOW	WC	WATER CLOSET
IC	INSPECTION COVER	WHB	WASH HAND BASIN
L/L	LOW LEVEL	WV	WATER VALVE
LP	LAMP POST	Ø	DIAMETER

OVERHEAD DETAIL

BARRIER OR FENCE

CHANGE IN SURFACE

GATE

SURVEY STATION

HEIGHTS

C	HEIGHT FROM FLOOR TO CILL
H	HEIGHT FROM CILL TO HEAD
SP	HEIGHT FROM FLOOR TO SPRING OF ARCH
AH	HEIGHT FROM FLOOR TO HEAD OF ARCH
(2000)	HEIGHT TO CEILING, BEAM OR DOOR
S/C	STRUCTURAL CEILING HEIGHT
F/C	FALSE CEILING HEIGHT
DL	DEDUCED LEVEL DERIVED FROM PLUS MEASUREMENTS

TREES

Ø DIAMETER(mm)
S SPREAD(mm) diameter
H HEIGHT(mm)
ALL TREE HEIGHTS SHOWN IN (mm)

LEVELS ARE RELATED TO ORDNANCE SURVEY DATUM BY MEANS OF GPS OBSERVATIONS TO CONTROL POINTS WHERE A MEAN VALUE HAS BEEN OBTAINED

3sixty measurement
LAND & MEASURED BUILDING SURVEYORS

LONDON
CHINA WORKS,
BLACK PRINCE ROAD
LONDON SE1 7SJ
Tel: 020 7637 2930
Fax: 020 7637 2931
E-mail: info@3sixtymeasurement.co.uk
Website:www.3sixtymeasurement.co.uk

Client: MERCHANT LAND

Project: MANOR LODGE
NORTHWOOD HA6 2QT

Drawing: SITE PLAN - SHEET 1 OF 2

Date	Scale	Drawn by	Checked by
JULY 2021	A1@1:200	DO	RJT

Project No	Drawing No	Revision
21378	-01	A

MBP

Appendix C: Thames Water sewer asset plan

Asset location search

Property Searches

The Infrastructure Design Consultancy Ltd
48West End
WESTBURY
BA13 3JG

Search address supplied Manor Lodge
Rickmansworth Road
Northwood
HA6 2QT

Your reference P22068

Our reference ALS/ALS Standard/2023_4769138

Search date 5 January 2023

Knowledge of features below the surface is essential for every development

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

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

Contact us to find out more.

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

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

0800 009 4540

Asset location search

Property Searches

Search address supplied: Manor Lodge, Rickmansworth Road, Northwood, HA6 2QT

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This searchprovides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0800 009 4540, or use the address below:

Thames Water Utilities Ltd
Property Searches
PO Box 3189
Slough
SL1 4WW

Email: searches@thameswater.co.uk
Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

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

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

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

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

For your guidance:

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

Clean Water Services

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

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd
Tamblin Way
Hatfield
AL10 9EZ
Tel: 0345 3572401

For your guidance:

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

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

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

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

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

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

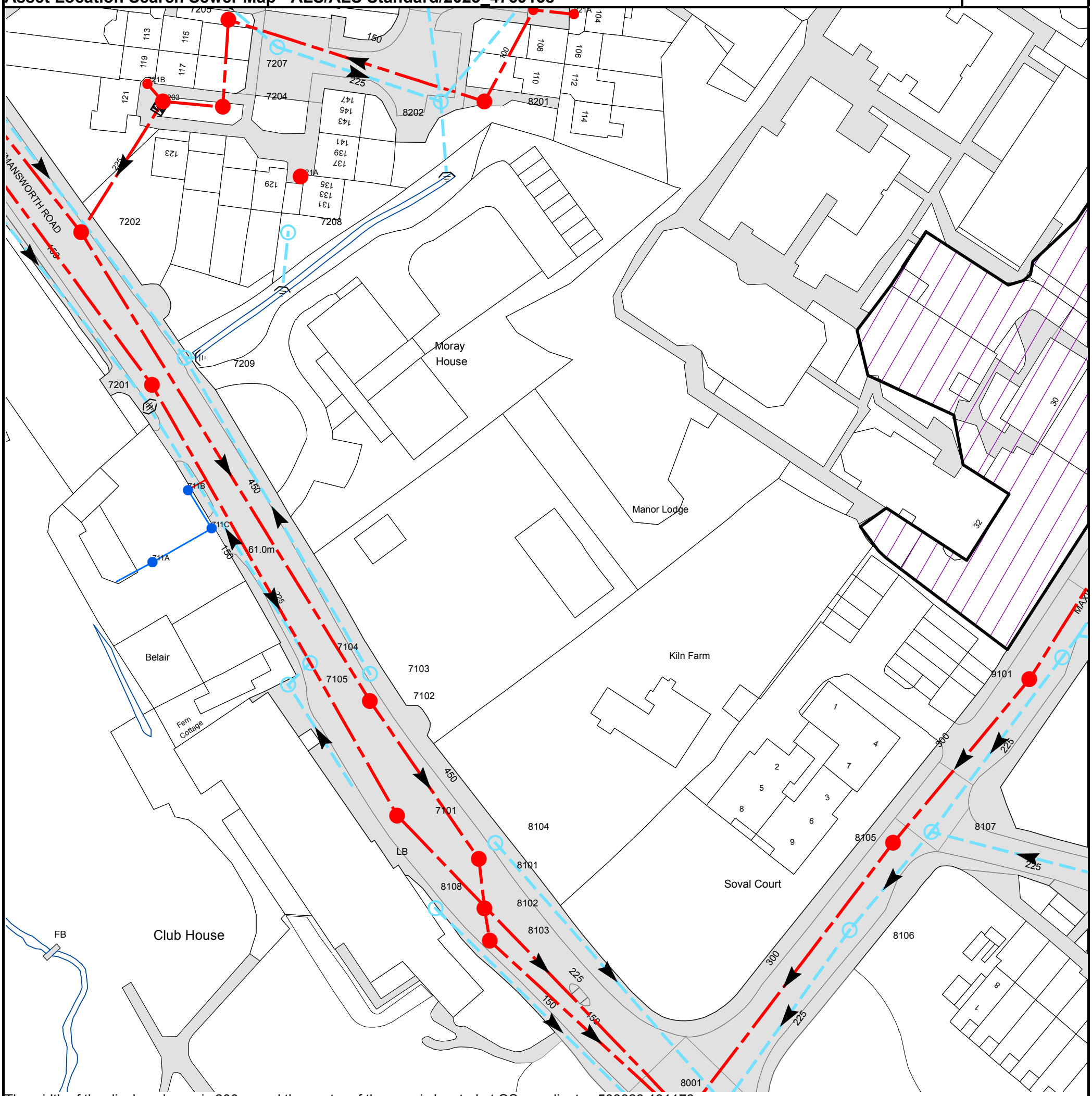
Clean Water queries

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

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

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

Asset Location Search Sewer Map - ALS/ALS Standard/2023_4769138



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 508823,191178

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
7208	n/a	n/a
721A	n/a	n/a
8202	n/a	n/a
8201	n/a	n/a
7207	n/a	n/a
821A	n/a	n/a
821B	n/a	n/a
7202	61.69	59.17
721B	n/a	n/a
7201	60.81	59.39
711A	n/a	n/a
7203	n/a	n/a
7209	60.78	59.6
711B	n/a	n/a
711C	n/a	n/a
7204	n/a	n/a
7205	n/a	n/a
8106	62.73	61.27
8108	61.71	60.54
8102	61.74	58.93
8101	61.7	58.95
8104	61.71	60.5
8105	63.53	61.65
8107	63.78	62.13
7101	n/a	n/a
7102	61.53	59.02
7105	n/a	n/a
9101	65.46	63.18
7103	61.56	60.43
7104	61.39	60.72
9106	65.61	64.29
8103	61.61	58.93

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

Sewer Fittings

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

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

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- Weir

End Items

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

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement
- Conduit Bridge
- Subway
- Tunnel

Ducts may contain high voltage cables. Please check with Thames Water.

Notes:

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

If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.

Terms and Conditions

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

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

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

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

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

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

Ways to pay your bill

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

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

MBP

Appendix D: Infiltration SuDS GeoReport

GeoReports

British Geological Survey

Peter White
tIDC Ltd
48 West End
Westbury
BA13 3JG

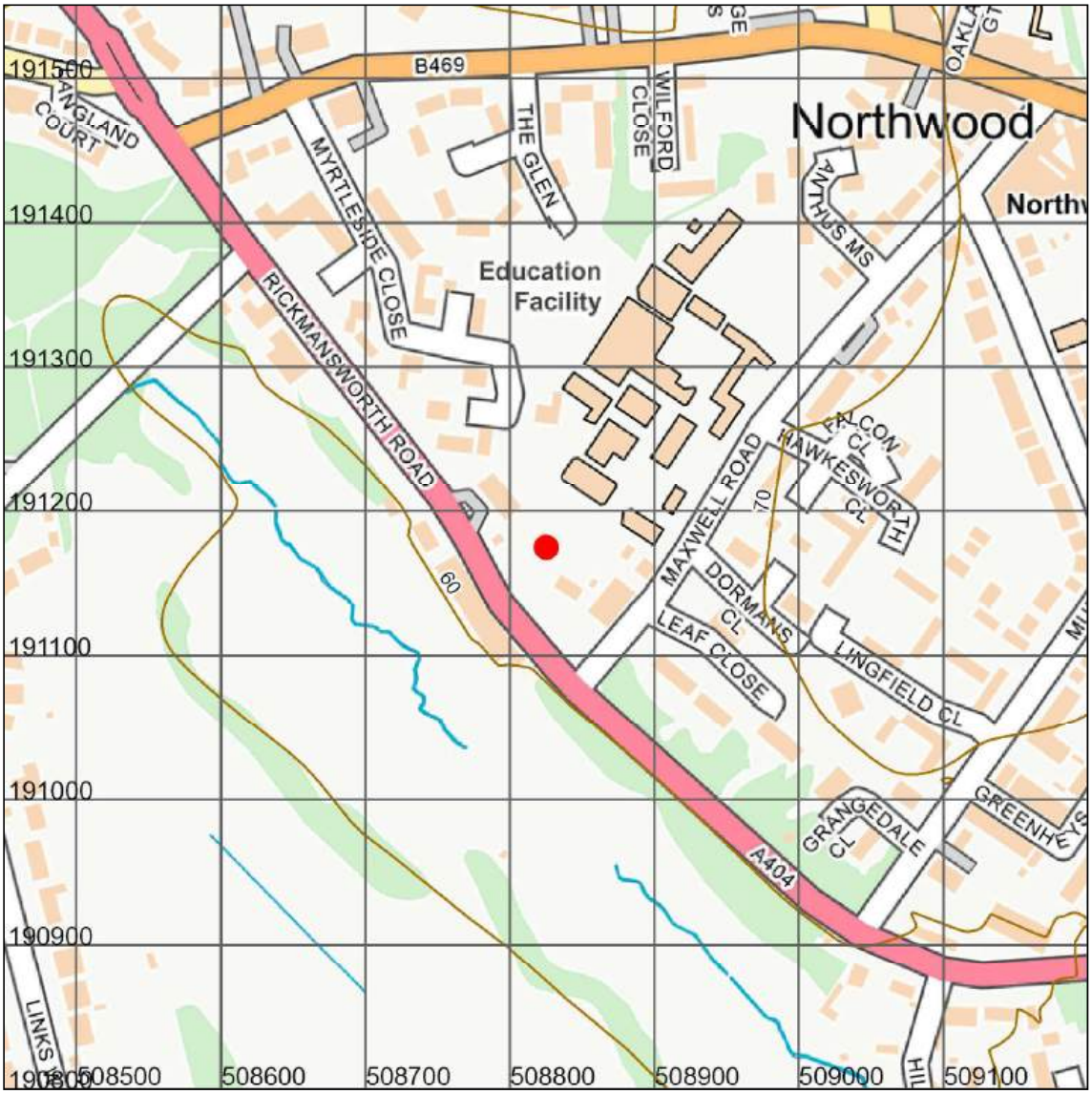
Infiltration SuDS GeoReport:

This report provides information on the suitability of the subsurface for the installation of infiltration sustainable drainage systems (SuDS). It provides information on the properties of the subsurface with respect to significant constraints, drainage, ground stability and groundwater quality protection.

Report Id: ***BGS_330043/40781***

Client reference: P22068

Search location



Contains OS data © Crown Copyright and database right 2023. OS OpenMap Local: Scale: 1:5 000 (1cm = 50 m)
Search location indicated in red

Site Address:
MANOR LODGE
RICKMANSWORTH ROAD
NORTHWOOD
HA6 2QT

Point centred at: grid reference obtained from Ordnance Survey AddressPoint

Assessment for an infiltration sustainable drainage system

Introduction

Sustainable drainage systems (SuDS) are drainage solutions that manage the volume and quality of surface water close to where it falls as rain. They aim to reduce flow rates to rivers, increase local water storage capacity and reduce the transport of pollutants to the water environment. There are four main types of SuDS, which are often designed to be used in sequence. They comprise:

- **source control:** systems that control the rate of runoff
- **pre-treatment:** systems that remove sediments and pollutants
- **retention:** systems that delay the discharge of water by providing surface storage
- **infiltration:** systems that mimic natural recharge to the ground.

This report focuses on infiltration SuDS. It provides subsurface information on the properties of the ground with respect to drainage, ground stability and groundwater quality protection. It is intended principally for those involved in the preliminary assessment of the suitability of the ground for infiltration SuDS, and those involved in assessing proposals from others for sustainable drainage, but it may also be useful to help house-holders judge whether or not further professional advice should be sought. If in doubt, users should consult a suitably-qualified professional about the results in this report before making any decisions based upon it.

This GeoReport is structured in two parts:

- **Part 1. Summary data**.

  Comprises three maps that summarise the data contained within Part 2.

- **Part 2. Detailed data**.

  Comprises a further 24 maps in four thematic sections:

  - **Very significant constraints.** Maps highlight areas where infiltration may result in adverse impacts due to factors including: ground instability (soluble rocks, non-coal shallow mining and landslide hazards); persistent shallow groundwater, or the presence of made ground, which may represent a ground stability or contamination hazard.
  - **Drainage potential**. Maps indicate the drainage potential of the ground, by considering subsurface permeability, depth to groundwater and the presence of floodplain deposits.
  - **Ground stability**. Maps indicate the presence of hazards that have the potential to cause ground instability resulting in damage to some buildings and structures, if water is infiltrated to the ground.
  - **Groundwater protection**. Maps provide key indicators to help determine whether the groundwater may be susceptible to deterioration in quality as a result of infiltration.

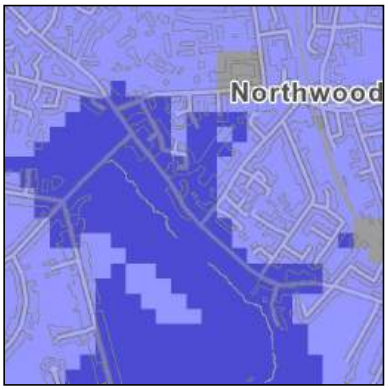
This report considers the suitability of the subsurface for the installation of infiltration SuDS, such as soakaways, infiltration basins or permeable pavements. It provides subsurface data to indicate whether, and which type of infiltration system may be appropriate. It does not state that infiltration SuDS are, or are not, appropriate as this is highly dependent on the design of the individual system. This report therefore describes the subsurface conditions at the site, allowing the reader to determine the suitability of the site for infiltration SuDS.

The map and text data in this report is similar to that provided in the '*Infiltration SuDS Map: Detailed'* national map product. For further information about the data, consult the '*User Guide for the Infiltration SuDS Map: Detailed'*, available from http://nora.nerc.ac.uk/16618/.

PART 1: SUMMARY DATA

This section provides a summary of the data.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?



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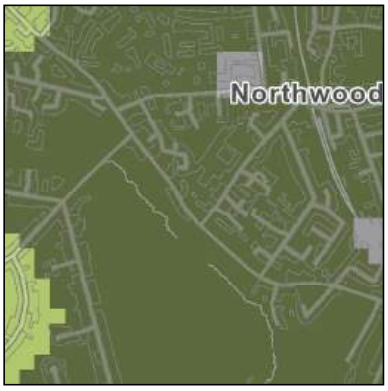
- Highly compatible for infiltration SuDS. The subsurface is likely to be suitable for free-draining infiltration SuDS.
- Probably compatible for infiltration SuDS. The subsurface is probably suitable although the design may be influenced by the ground conditions.
- Opportunities for bespoke infiltration SuDS. The subsurface is potentially suitable although the design will be influenced by the ground conditions.
- Very significant constraints are indicated. There is a very significant potential for one or more hazards associated with infiltration.

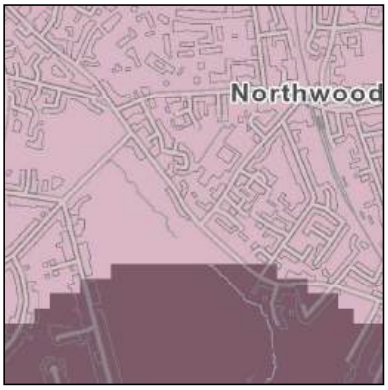
Is ground instability likely to be a problem?



Contains OS data © Crown Copyright and database right **2023**

- Increased infiltration is very unlikely to result in ground instability.
- Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability.
- Ground instability problems are probably present. Increased infiltration may result in ground instability.
- There is a very significant potential for one or more geohazards associated with infiltration.

Is the groundwater susceptible to deterioration in quality?



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- The groundwater is not expected to be especially vulnerable to contamination.
- The groundwater may be vulnerable to contamination.
- The groundwater is likely to be vulnerable to contaminants.
- Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

PART 2: DETAILED DATA

This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

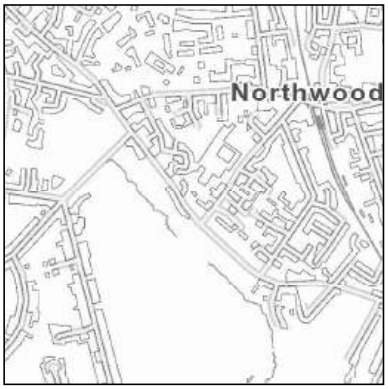
Section 1. Very significant constraints

Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining (not including coal)
- shallow groundwater
- made ground

For more information read 'Explanation of terms' at the end of this report.

Soluble rock hazard



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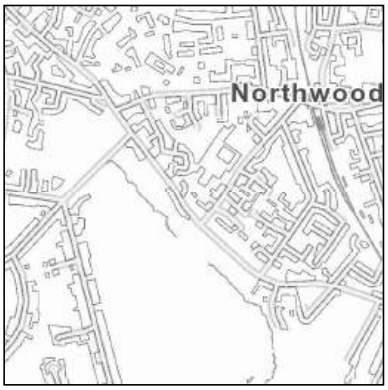
■ Very significant soluble rock hazard.

Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant.

☐ Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.

Landslide hazard



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■ Very significant landslide hazard.

Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant.

☐ Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.

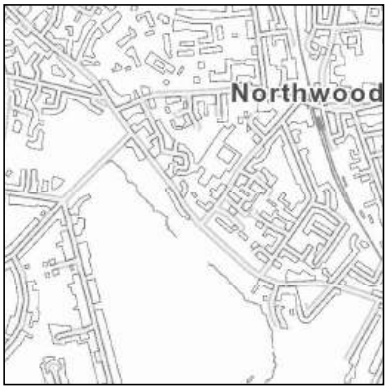
Shallow mining hazard (not including coal)

■ Very significant mining hazard.

Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant.

☐ Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.

Persistent shallow groundwater

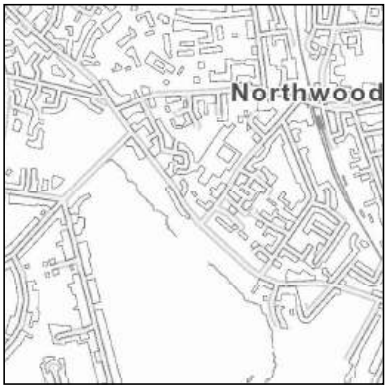


■ Very high likelihood of persistent or seasonally shallow groundwater.

Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant.

☐ See Part 2 for the likely depth to water table.

Made ground



■ Made ground present.

Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant.

☐ None recorded

Section 2. Drainage potential

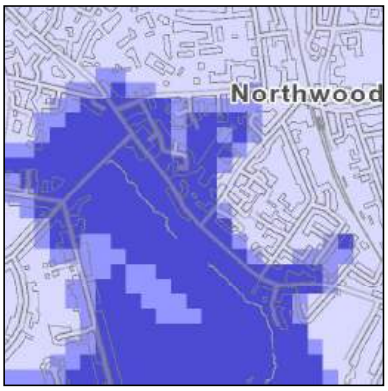
The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.

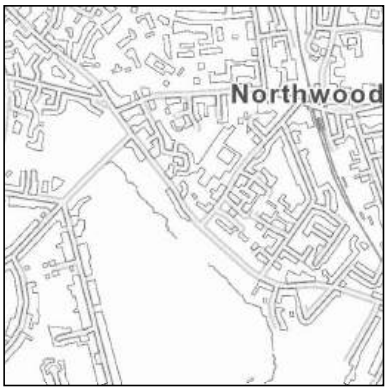
For more information read 'Explanation of terms' at the end of this report.

Depth to groundwater table



	Groundwater is likely to be **more than 5 m** below the ground surface throughout the year.
	Groundwater is likely to be between **3 and 5 m** below the ground surface for at least part of the year.
	Groundwater is likely to be **less than 3 m** below the ground surface for at least part of the year.

Superficial deposit permeability



Superficial deposits are likely to be **free-draining**.

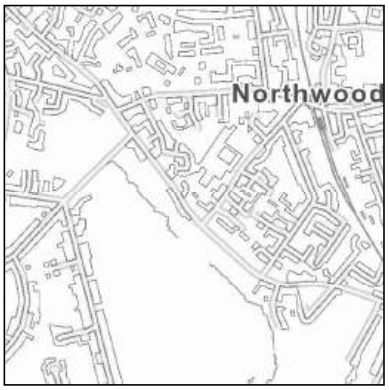
The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.

Superficial deposits are likely to be **poorly draining**.

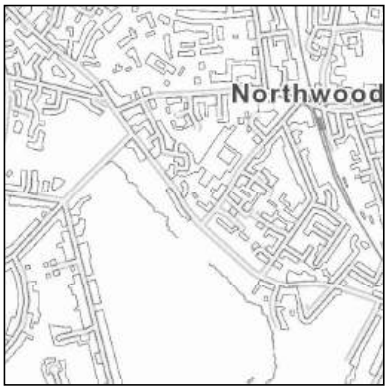
These maps show the permeability range that is summarised above.

- Very Low
- Low
- Moderate
- High
- Very High

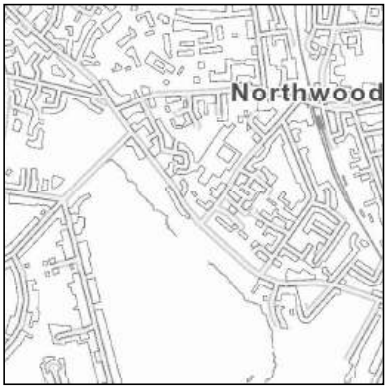
Minimum



Maximum



Superficial deposit thickness



The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).

The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

Bedrock permeability

Bedrock deposits are likely to be **free-draining**.

The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.

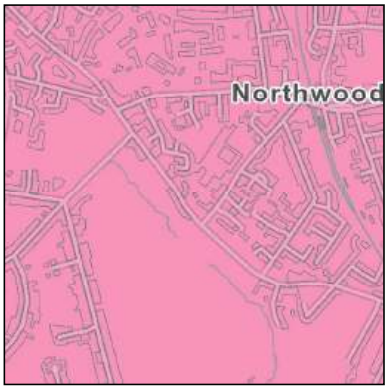
Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

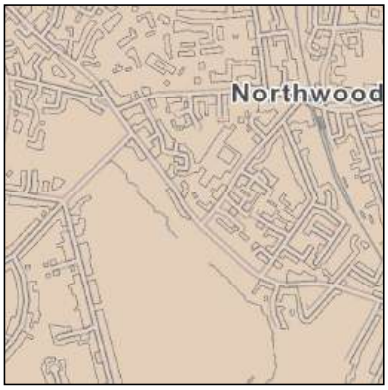
Key

- Very Low
- Low
- Moderate
- High
- Very High

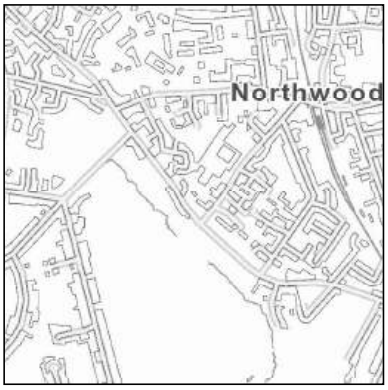
Minimum



Maximum



Geological indicators of flooding



Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

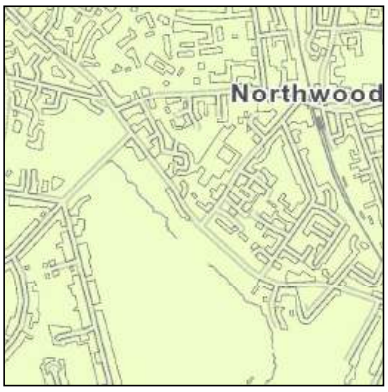
Section 3. Ground stability

The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground

In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design. For more information read 'Explanation of terms' at the end of this report.

Soluble rocks



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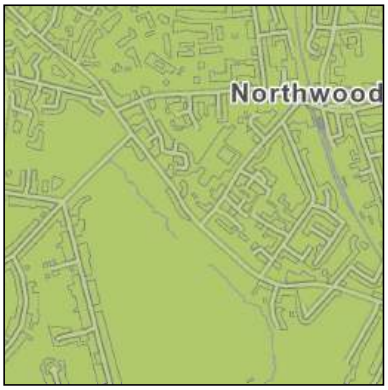
	Increased infiltration is unlikely to result in subsidence.
	Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.
	Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.
	Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.

Landslides

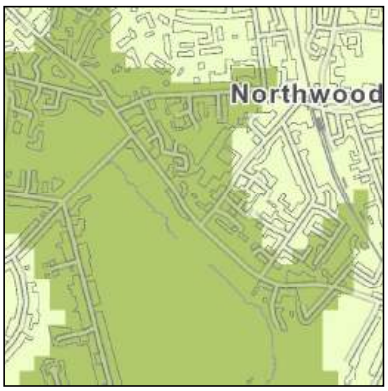


- Increased infiltration is unlikely to lead to slope instability.
- Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
- Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
- Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.

Shallow mining

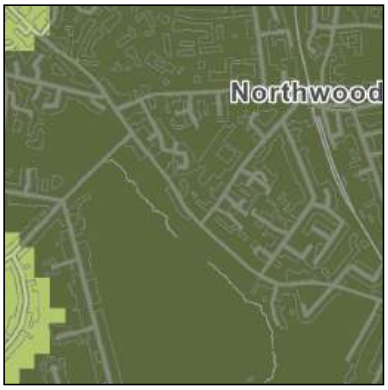
- Increased infiltration is unlikely to lead to subsidence.
- Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
- Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.

Running sand



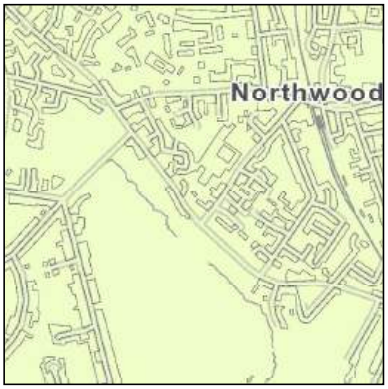
- Increased infiltration is unlikely to cause ground collapse associated with running sands.
- Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

Swelling clays



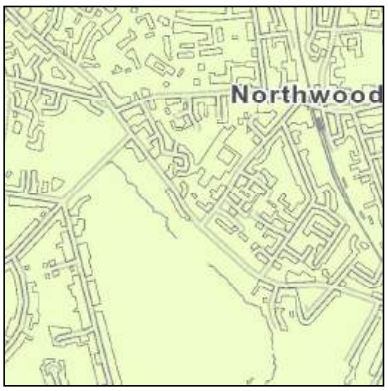
- Increased infiltration is unlikely to cause shrink-swell ground movement.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.

Compressible ground



- Increased infiltration is unlikely to lead to ground compression.
- Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.

Collapsible ground



- Increased infiltration is unlikely to result in subsidence.
- Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
- Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground

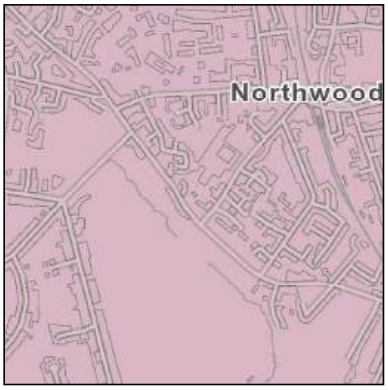
For more information read ‘Explanation of terms’ at the end of this report.

Groundwater source protection zones

Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2023.

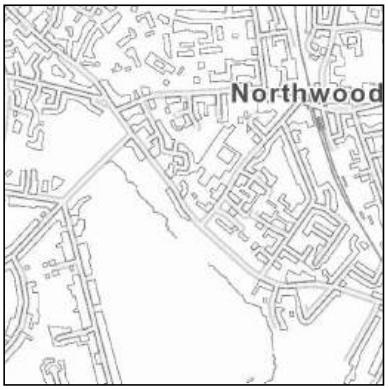
- Groundwater is not within a source protection zone.
- Source protection zone IV
- Source protection zone III
- Source protection zone II
- Source protection zone I

Predominant flow mechanism



- Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
- Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.

Made ground

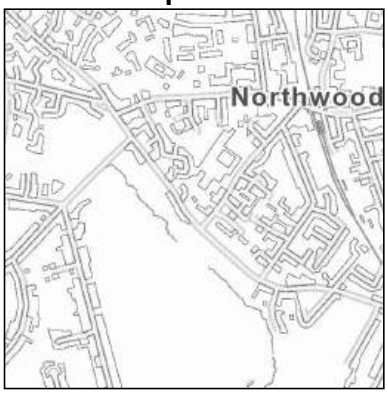


Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

Section 5. Geological Maps

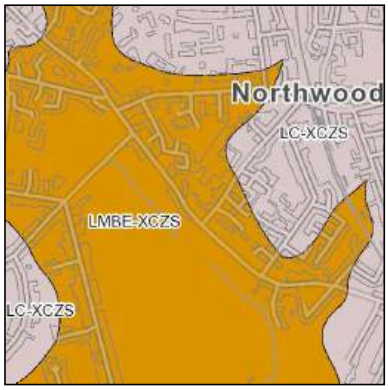
The following maps show the artificial, superficial and bedrock geology within the area of interest.

Artificial deposits



Superficial deposits

Bedrock



Fault

Coal, ironstone or mineral vein

Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:
No deposits recorded by BGS in the search area

Key to Superficial deposits:
No deposits recorded by BGS in the search area

Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	LC-XCZS	LONDON CLAY FORMATION	CLAY, SILT AND SAND
	LMBE-XCZS	LAMBETH GROUP	CLAY, SILT AND SAND

Limitations of this report:

- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
    - previous land use,
    - potential for, or presence of contaminated land
    - presence of perched water tables
    - shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
    - made ground, where not recorded
    - proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
    - zones around private water supply boreholes that are susceptible to groundwater contamination.
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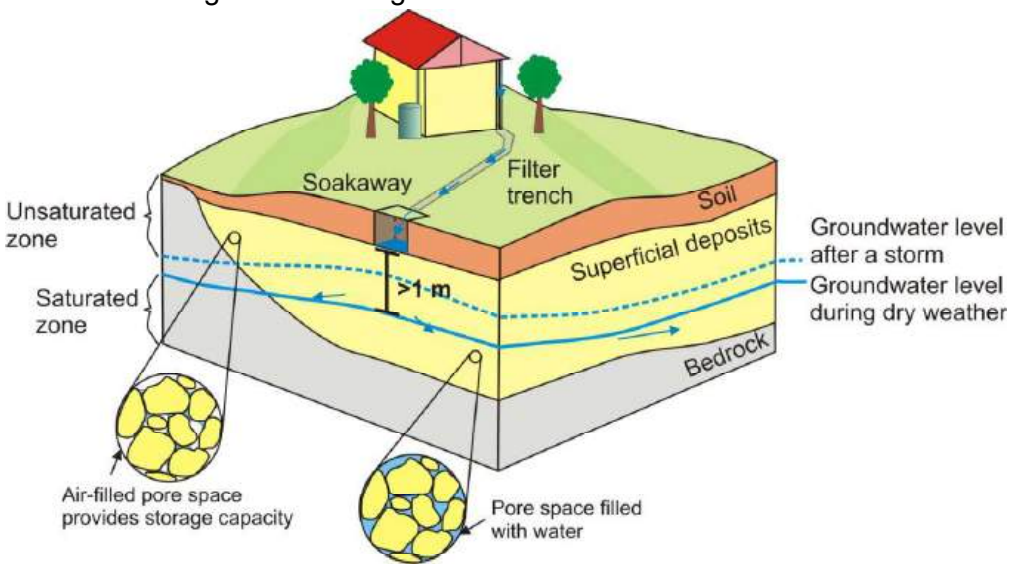
Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

Geological indicators of flooding

In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground

Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability

Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability

Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

Natural ground instability

Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell

A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)

A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)

Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

Compressible ground
Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits
Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand
Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.

Shallow mining hazards (non coal)
Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.

For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk**.** For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)

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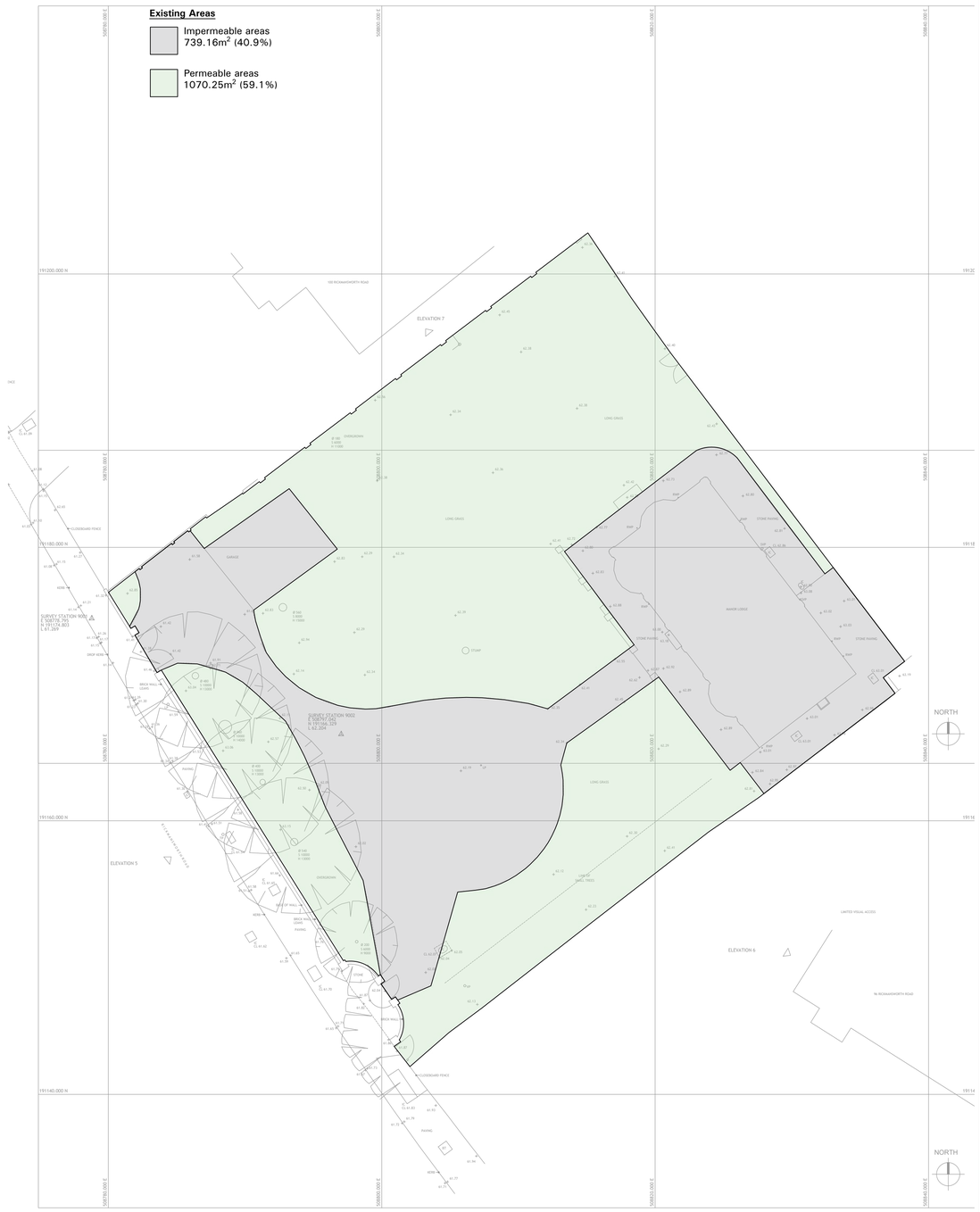
Important notes about this Report

- The data, information and related records supplied in this Report by BGS can only be indicative and should not be taken as a substitute for specialist interpretations, professional advice and/or detailed site investigations. You must seek professional advice before making technical interpretations on the basis of the materials provided.
- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
- Data may be compiled from the disparate sources of information at BGS's disposal, including material donated to BGS by third parties, and may not originally have been subject to any verification or other quality control process.
- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report issued by
BGS Enquiry Service

Appendix E: Impermeable area plans



NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. All drainage works to be carried out in accordance with the requirements of the Local Authority, the Environment Agency and in conjunction with all relevant British Standards, Codes of Practice and any addendums as appropriate.
3. Invert levels and positions of existing drains / chambers / sewers where new connections are to be made must be checked and confirmed to the Engineer prior to the commencement of any works.
4. All drainage shall comply with the typical details and the requirements of BS EN 752 and Part H of the Building Regulations.
5. Any part of the existing drainage system to be retained as part of the new scheme shall be cleaned and inspected. Any structural defects shall be repaired using appropriate and approved means.
6. For setting-out dimensions of SVPs, RWPs etc, refer to the Architect's or Mechanical Engineer's drawings. Positions shown are indicative only.
7. All pipework shall be 100mm diameter unless otherwise noted.
8. All precast concrete units used in the drainage works shall be manufactured using sulphate resisting cement.
9. Manhole covers and frames shall be to BS EN 124 and shall be Kitemarked. Covers and frames shall be heavy duty (D400) in carriageways and vehicular areas and medium duty (B125) in footways and soft landscaping. In blocked / concrete paved areas, covers shall be recessed fabricated steel. All recessed covers shall be in accordance with the FACTA association gradings.
10. Cover levels shown are approximate only and are to be adjusted to suit finished ground levels.
11. At least one soil pipe at the head of each foul run shall vent to the atmosphere.
12. Existing drainage to be removed is to be broken out to bed level and void backfilled with granular material, compacted in layers not exceeding 225mm.
13. All drain runs from SVPs, stub stacks, or FW gullies to be laid at 1:40 gradient unless otherwise noted. All RWPs to be laid at minimum 1:60 gradient unless otherwise stated.
14. Access panels are to be provided to all rainwater pipes, max 600mm above finished ground level.
15. All manholes / inspection chambers in block paved areas to have recessed covers. MH covers in paved areas to have cover and frame orientated 'square' with paving to minimise cut slabs or blocks.
16. All gradients on drainage runs are indicative. Runs to be laid soffit to soffit.
17. Generally pipes to have granular bed and surround in accordance with the manufactureres recommendations, ensuring adequte protection with respect to depth and location.
18. All private drainage to be laid to levels shown using flexibly jointed pipes, either uPVC to BS 4660 and BS 5481 or vitrified clayware to BS EN 295.
19. Rodding eyes are to be laid to manufacturers minimum cover and depth to allow adequate fall from adjoining unit.
20. Where new sewers are to be constructed within 5m of a new or existing tree, the sewer shall be encased in concrete against root intrusion.
21. All new drainage to be jetted and CCTV surveyed on completion. Contractor to ensure that the drainage is fully operational.
22. All runs connecting into public drainage network to be extra strength clayware to BS EN 295 or BS65 with plain sleeved or socketed flexible joints.
23. Before commencing any sewer or drainage works, the groundworker is to satisfy himself, the Client and the Local Authority of actual levels and conditions of existing sewers/drains.
24. HEALTH AND SAFETY: The works shall be carried out by specialist competent and experienced contractors who are members of a recognised national organisation. Operatives shall have received full and appropriate training for the operations they are to undertake. All work shall be carried out in accordance with all pertinent Health and Safety Regulations.

Rev	Date	Description	By
I2	31/03/25	Updated site layout	MB
I1	16/01/23	Issued for INFORMATION	MB

Drawing Status

INFORMATION

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Title

AREA COMPARISON PLAN

Scale @ A1	Date	By	Checked
1:200	JAN '23	PTW	MB

Drawing Number: MBP / 8897 / 550

Revision: I2

Appendix F: Greenfield Run-off rates

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 700 Urban 0.000
Area (ha) 0.181 Soil 0.300 Region Number Region 6

Results l/s

QBAR Rural 0.3
QBAR Urban 0.3

Q1 year 0.3

Q1 year 0.3
Q30 years 0.7
Q100 years 1.1

MBP

Appendix G: Hydraulic Calculations

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

Half Drain Time : 745 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	61.697	0.227	0.0	0.6	0.6	28.9	O K
30 min Summer	61.768	0.298	0.0	0.7	0.7	38.2	O K
60 min Summer	61.838	0.368	0.0	0.8	0.8	47.4	O K
120 min Summer	61.902	0.432	0.0	0.8	0.8	55.8	O K
180 min Summer	61.933	0.463	0.0	0.9	0.9	59.8	O K
240 min Summer	61.950	0.480	0.0	0.9	0.9	62.0	O K
360 min Summer	61.965	0.495	0.0	0.9	0.9	64.0	O K
480 min Summer	61.969	0.499	0.0	0.9	0.9	64.5	O K
600 min Summer	61.968	0.498	0.0	0.9	0.9	64.3	O K
720 min Summer	61.966	0.496	0.0	0.9	0.9	64.1	O K
960 min Summer	61.961	0.491	0.0	0.9	0.9	63.5	O K
1440 min Summer	61.946	0.476	0.0	0.9	0.9	61.4	O K
2160 min Summer	61.916	0.446	0.0	0.9	0.9	57.6	O K
2880 min Summer	61.886	0.416	0.0	0.8	0.8	53.6	O K
4320 min Summer	61.831	0.361	0.0	0.8	0.8	46.5	O K
5760 min Summer	61.786	0.316	0.0	0.7	0.7	40.6	O K
7200 min Summer	61.750	0.280	0.0	0.7	0.7	35.8	O K
8640 min Summer	61.719	0.249	0.0	0.6	0.6	31.9	O K
10080 min Summer	61.694	0.224	0.0	0.6	0.6	28.5	O K
15 min Winter	61.726	0.256	0.0	0.6	0.6	32.7	O K
30 min Winter	61.805	0.335	0.0	0.7	0.7	43.1	O K
60 min Winter	61.884	0.414	0.0	0.8	0.8	53.4	O K
120 min Winter	61.957	0.487	0.0	0.9	0.9	63.0	O K
180 min Winter	61.993	0.523	0.0	0.9	0.9	67.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.994	0.0	27.9	19
30 min Summer	91.555	0.0	36.3	34
60 min Summer	57.005	0.0	48.9	64
120 min Summer	34.282	0.0	59.2	122
180 min Summer	25.123	0.0	65.1	182
240 min Summer	20.031	0.0	69.3	242
360 min Summer	14.520	0.0	75.3	360
480 min Summer	11.555	0.0	79.7	480
600 min Summer	9.672	0.0	83.2	526
720 min Summer	8.360	0.0	86.0	588
960 min Summer	6.637	0.0	90.2	712
1440 min Summer	4.787	0.0	94.0	980
2160 min Summer	3.447	0.0	107.5	1388
2880 min Summer	2.728	0.0	113.0	1792
4320 min Summer	1.959	0.0	120.5	2596
5760 min Summer	1.548	0.0	126.3	3352
7200 min Summer	1.288	0.0	130.4	4112
8640 min Summer	1.109	0.0	133.7	4848
10080 min Summer	0.976	0.0	136.2	5552
15 min Winter	139.994	0.0	31.3	19
30 min Winter	91.555	0.0	40.2	33
60 min Winter	57.005	0.0	55.0	62
120 min Winter	34.282	0.0	66.5	120
180 min Winter	25.123	0.0	73.1	180

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	62.013	0.543	0.0	0.9	0.9	70.2	O K
360 min Winter	62.033	0.563	0.0	1.0	1.0	72.8	O K
480 min Winter	62.040	0.570	0.0	1.0	1.0	73.8	O K
600 min Winter	62.040	0.570	0.0	1.0	1.0	73.7	O K
720 min Winter	62.035	0.565	0.0	1.0	1.0	73.2	O K
960 min Winter	62.027	0.557	0.0	1.0	1.0	72.0	O K
1440 min Winter	62.003	0.533	0.0	0.9	0.9	69.0	O K
2160 min Winter	61.960	0.490	0.0	0.9	0.9	63.3	O K
2880 min Winter	61.916	0.446	0.0	0.9	0.9	57.6	O K
4320 min Winter	61.839	0.369	0.0	0.8	0.8	47.6	O K
5760 min Winter	61.779	0.309	0.0	0.7	0.7	39.6	O K
7200 min Winter	61.731	0.261	0.0	0.7	0.7	33.4	O K
8640 min Winter	61.693	0.223	0.0	0.6	0.6	28.4	O K
10080 min Winter	61.662	0.192	0.0	0.6	0.6	24.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	20.031	0.0	77.7	238
360 min Winter	14.520	0.0	84.4	352
480 min Winter	11.555	0.0	89.3	462
600 min Winter	9.672	0.0	93.1	568
720 min Winter	8.360	0.0	96.1	664
960 min Winter	6.637	0.0	100.3	750
1440 min Winter	4.787	0.0	103.6	1054
2160 min Winter	3.447	0.0	120.9	1512
2880 min Winter	2.728	0.0	127.2	1932
4320 min Winter	1.959	0.0	135.6	2764
5760 min Winter	1.548	0.0	142.4	3568
7200 min Winter	1.288	0.0	147.2	4320
8640 min Winter	1.109	0.0	151.0	5024
10080 min Winter	0.976	0.0	154.0	5752

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.100	Shortest Storm (mins)	15
Ratio R	0.409	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.120

Time (mins) From:	To:	Area (ha)
0	4	0.120

Model Details

Storage is Online Cover Level (m) 62.200

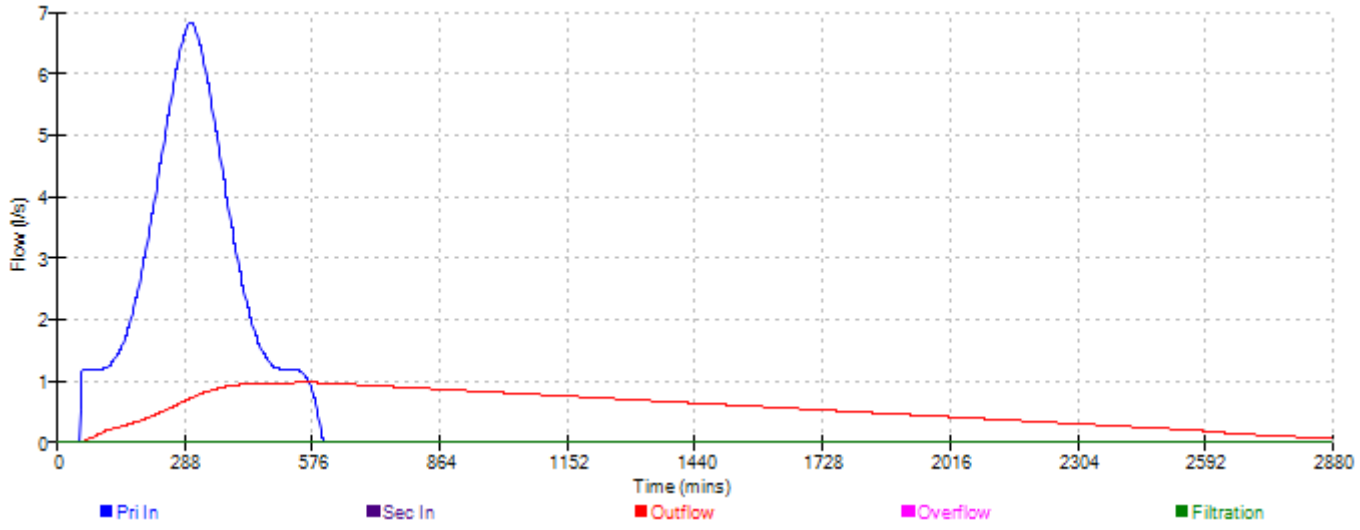
Porous Car Park Structure

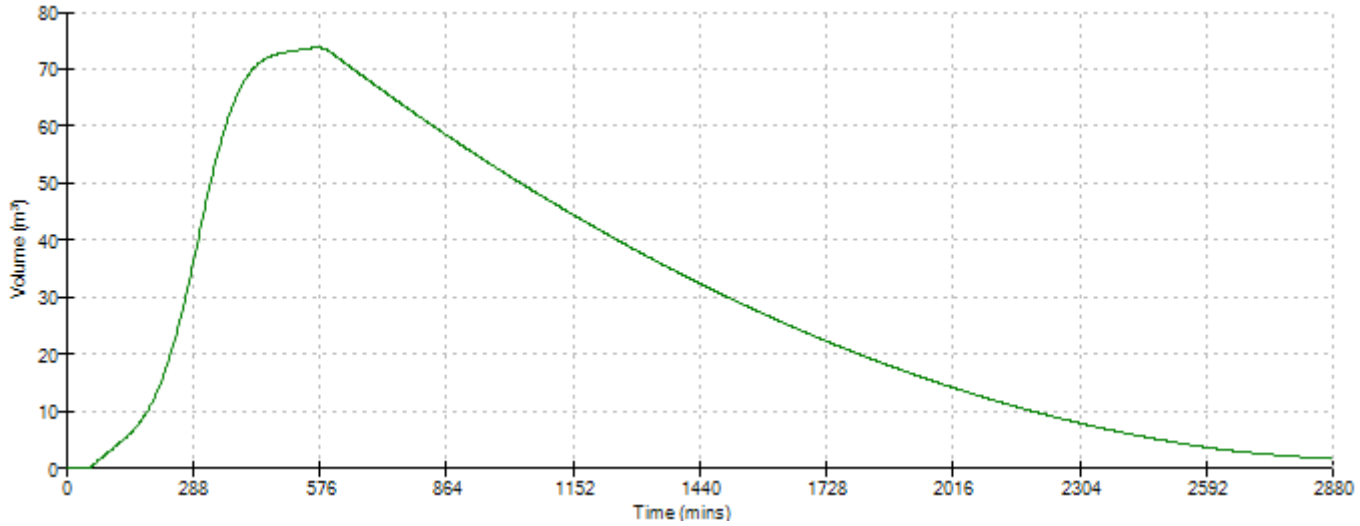
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	39.6
Membrane Percolation (mm/hr)	1000	Length (m)	11.0
Max Percolation (l/s)	121.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	61.470	Cap Volume Depth (m)	0.600

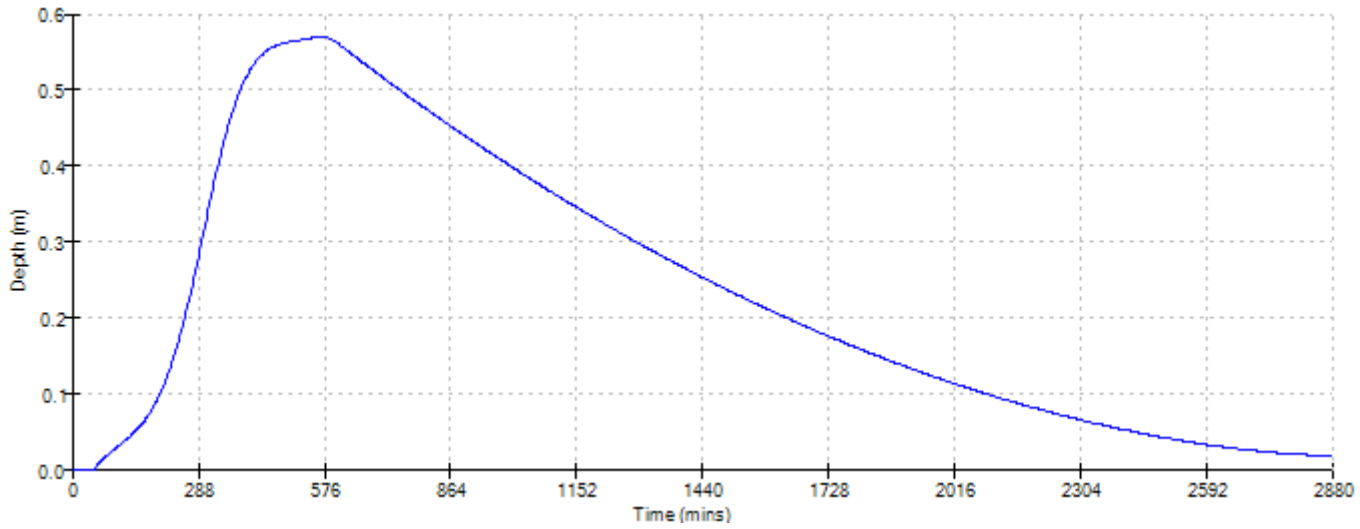
Orifice Outflow Control

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 61.470

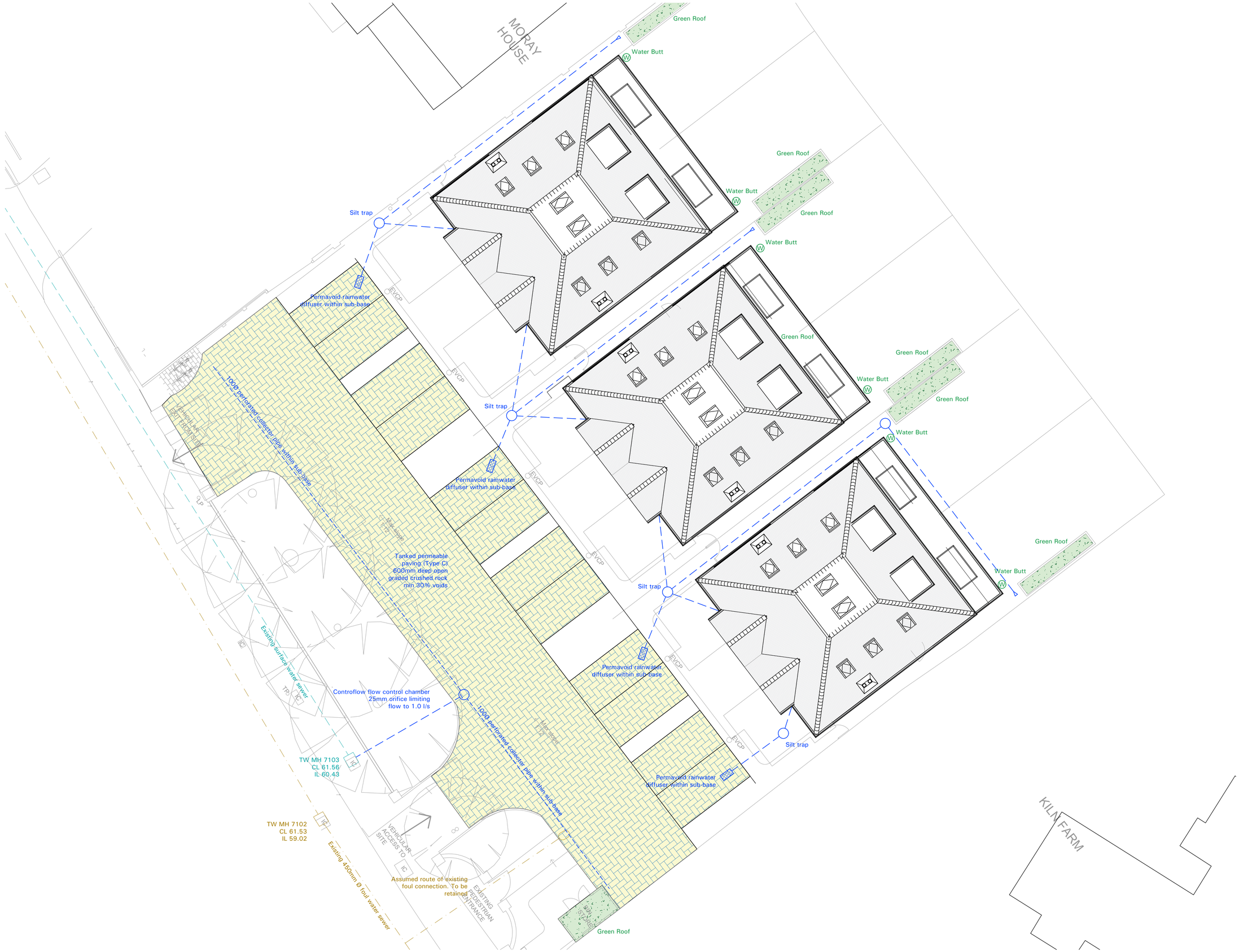
Event: 600 min Winter







Appendix H: SuDS/Drainage strategy Drawing



NOTES:

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. All drainage works to be carried out in accordance with the requirements of the Local Authority, the Environment Agency and in conjunction with all relevant British Standards, Codes of Practice and any addendums as appropriate.
3. Invert levels and positions of existing drains / chambers / sewers where new connections are to be made must be checked and confirmed to the Engineer prior to the commencement of any works.
4. All drainage shall comply with the typical details and the requirements of BS EN 752 and Part H of the Building Regulations.
5. Any part of the existing drainage system to be retained as part of the new scheme shall be cleaned and inspected. Any structural defects shall be repaired using appropriate and approved means.
6. For setting-out dimensions of SVPs, RWPs etc, refer to the Architect's or Mechanical Engineer's drawings. Positions shown are indicative only.
7. All pipework shall be 100mm diameter unless otherwise noted.
8. All precast concrete units used in the drainage works shall be manufactured using sulphate resisting cement.
9. Manhole covers and frames shall be to BS EN 124 and shall be Kitemarked. Covers and frames shall be heavy duty (D400) in carriageways and vehicular areas and medium duty (B125) in footways and soft landscaping. In blocked / concrete paved areas, covers shall be recessed fabricated steel. All recessed covers shall be in accordance with the FACTA association gradings.
10. Cover levels shown are approximate only and are to be adjusted to suit finished ground levels.
11. At least one soil pipe at the head of each foul run shall vent to the atmosphere.
12. Existing drainage to be removed is to be broken out to bed level and void backfilled with granular material, compacted in layers not exceeding 225mm.
13. All drain runs from SVPs, stub stacks, or FW gullies to be laid at 1:40 gradient unless otherwise noted. All RWPs to be laid at minimum 1:60 gradient unless otherwise stated.
14. Access panels are to be provided to all rainwater pipes, max 600mm above finished ground level.
15. All manholes / inspection chambers in block paved areas to have recessed covers. MH covers in paved areas to have cover and frame orientated 'square' with paving to minimise cut slabs or blocks.
16. All gradients on drainage runs are indicative. Runs to be laid soffit to soffit.
17. Generally pipes to have granular bed and surround in accordance with the manufactureres recommendations, ensuring adequte protection with respect to depth and location.
18. All private drainage to be laid to levels shown using flexibly jointed pipes, either uPVC to BS 4660 and BS 5481 or vitrified clayware to BS EN 295.
19. Rodding eyes are to be laid to manufacturers minimum cover and depth to allow adequate fall from adjoining unit.
20. Where new sewers are to be constructed within 5m of a new or existing tree, the sewer shall be encased in concrete against root intrusion.
21. All new drainage to be jetted and CCTV surveyed on completion. Contractor to ensure that the drainage is fully operational.
22. All runs connecting into public drainage network to be extra strength clayware to BS EN 295 or BS65 with plain sleeved or socketed flexible joints.
23. Before commencing any sewer or drainage works, the groundworker is to satisfy himself, the Client and the Local Authority of actual levels and conditions of existing sewers/drains.
24. HEALTH AND SAFETY: The works shall be carried out by specialist competent and experienced contractors who are members of a recognised national organisation. Operatives shall have received full and appropriate training for the operations they are to undertake. All work shall be carried out in accordance with all pertinent Health and Safety Regulations.

Rev	Date	Description	By
I4	26/03/25	Layout updated	MB
I3	14/04/23	Layout updated	MB
I2	09/03/23	Layout updated; green roofs added	MB
I1	16/01/23	Issued for INFORMATION	MB

Drawing Status

INFORMATION

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Job

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Title

SuDS Strategy

Scale @ A1	Date	By	Checked
1:100	JAN '23	PTW	MB

Drawing Number: MBP / 8897 / 555 — Revision: I4

MBP

Appendix I: Thames Water pre-planning enquiry response

Peter White

Michael Barclay Partnership LLP
1 Lancaster Place
London

WC2E 7ED

Wastewater pre-planning
Our ref DS6101734

17 January 2023

Pre-planning enquiry: Confirmation of sufficient capacity

Site Address: Manor Lodge, Rickmansworth Road, Northwood, HA6 2QT

Dear Peter,

Thank you for providing information on your development.

Proposed site: Existing site with 1 residential unit to be redeveloped to provide 6 residential units. Proposed foul water connection by gravity into existing 450mm in dia foul water sewer in Rickmansworth Road via existing foul water drainage on site. Proposed surface water connection into a surface water sewer in Rickmansworth Road restricted at 1l/s for all storms up to and including the 100 year return period plus 40% climate change allowance.

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

When developing a site, policy 5.13 of the London Plan and Policy 3.4 of the Supplementary Planning Guidance (Sustainable Design And Construction) states that every attempt should be made to use flow attenuation and SuDS/Storage to reduce the surface water discharge from the site as much as possible.

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal

methods have been examined and proven to be impracticable. Before we can consider your surface water needs, you'll need written approval from the lead local flood authority that you have followed the sequential approach to the disposal of surface water and considered all practical means.

The disposal hierarchy being:

1) rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
2) rainwater infiltration to ground at or close to source
3) rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
4) rainwater discharge direct to a watercourse (unless not appropriate)
5) controlled rainwater discharge to a surface water sewer or drain
6) controlled rainwater discharge to a combined sewer.

Where connection to the public sewerage network is required to manage surface water flows we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

If the above surface water hierarchy has been followed and if the flows are restricted to a total of 1.0 l/s then Thames Water would not have any objections to the proposal.

Please see the attached 'Planning your wastewater' leaflet for additional information.

What happens next?

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you've any further questions, please contact me on 07747 641932

Yours sincerely

Natalya Bacon
Developer Services – Adoptions Engineer
Mobile: 07747 641 932
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk
Get advice on making your sewer connection correctly at connectright.org.uk