



Civil Engineers & Transport Planners

39 Brunswick
Hill, Reading

Drainage Strategy

October 2017

170965/DS/TS/RS/01



Civil Engineers & Transport Planners

LANMOR Consulting Ltd,
Thorogood House, 34 Tolworth Close
Surbiton, Surrey, KT6 7EW

Tel: 0208 339 7899 Fax: 0208 339 7898

E-mail: info@lanmor.co.uk

Internet: www.lanmor.co.uk

● LONDON ● BIRMINGHAM

DOCUMENT STATUS

Project: 39 Brunswick Hill, Reading

Title: Drainage Strategy

Client: EB Solutions Ltd

Reference: 170965/DS/TS/RS/01

Produced by: TS Date:

Checked by: RS Date:

Approved by: KBL Date:

<u>Issue/revision</u>	<u>Date</u>	<u>Status</u>	<u>Issued by</u>
-	27/10/2017	For Approval	TS

CONTENTS

1	INTRODUCTION.....	1
1.1	Scope.....	1
2	SITE LOCATION AND DESCRIPTION.....	2
2.1	Location	2
2.2	Proposed Development.....	3
2.3	Regional Geology.....	3
3	SOURCES OF FLOODING.....	5
3.1	Fluvial/Tidal Flooding	5
3.2	Surface Water Flooding.....	6
3.3	Groundwater Flooding.....	7
3.4	Other Sources of Flooding	8
4	ONSITE DRAIANGE.....	9
4.1	Existing Drainage	9
4.2	Proposed Foul Drainage	9
4.3	Proposed Surface Water Sewer	10
4.4	Surface Water/SUDS Maintenance	13
5	SUMMARY AND CONCLUSION	15

TABLES

TABLE 4.1 – BROWNFIELD RUNOFF RATES.....	11
--	----

FIGURES

FIGURE 2.1 – SITE LOCATION.....	2
FIGURE 2.2 – GROUNDWATER VULNERABILITY ZONES.....	4
FIGURE 3.1 – EA FLOOD MAP	6
FIGURE 3.2 – SURFACE WATER FLOOD MAP	7
FIGURE 4.1 – SUSTAINABLE DRAINAGE HIERARCHY	11

APPENDICES

APPENDIX A

6319/01 – Topographical Survey
16-P1333-01 – Proposed Site Plan

APPENDIX B

Thames Water Asset Location Search

APPENDIX C

Greenfield Runoff Rate Calculation
170965/DS/01 – Proposed Drainage Strategy
MicroDrainage Calculations

1 INTRODUCTION

1.1 Scope

1.1.1 Lanmor Consulting Ltd has been appointed by EB Solutions Ltd to prepare a Drainage Strategy for the proposed development of 10 new apartments at 39 Brunswick Hill, Reading, RG1 7YU. This report has been commissioned to advice on the feasibility of providing a solution for the surface water and foul drainage for the proposed development.

1.1.2 This report will consider the proposed drainage regime for the site and set out the drainage strategy for the development including discharge rates and any requirements for attenuation.

1.1.3 The information within this report will be refined, modified, and updated as the detailed design is progressed. The scope of the works for this drainage strategy report is outlined below:

- Review available data relation to on-site drainage and other drainage networks near the site.
- Review of the ground conditions for the suitability of Sustainable Urban Drainage Systems (SUDS).
- Consider the use of SUDS as an option for disposal of surface water runoff from the proposed development.
- Undertake drainage assessments to establish attenuation requirements to deal with any increase in surface water runoff from the development.

2 SITE LOCATION AND DESCRIPTION

2.1 Location

2.1.1 The application site is located within the Borough of Reading on Brunswick Hill, the area around the site consists of mostly residential dwellings, with a variety of other facilities located to the north along Oxford Road, approximately 300m away. Figure 2.1 below shows the location of the site.

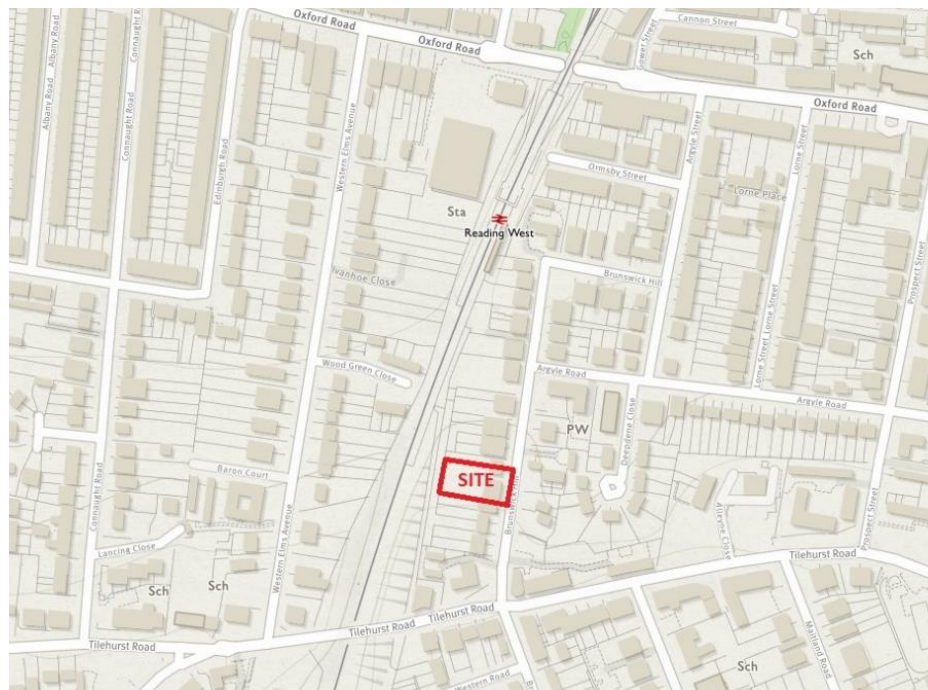


Figure 2.1 – Site Location

2.1.2 The site is currently occupied by a four storey detached dwelling, including basement level, with an associated garage. Levels on site fall from southeast to northwest, with highest levels of 56.15m AOD on the south-east boundary of the site, falling to 51.73m AOD towards the northwest boundary.

2.1.3 A topographical survey of the site was undertaken by Ground Surveys Ltd in June 2016, a copy is included in Appendix A as drawing 6319/01.

2.2 Proposed Development

- 2.2.1 The development proposals will see the demolition of the existing dwelling and garage to be replaced by a new residential block of flats. The block of flats will incorporate 10 new apartments spread over three storeys, comprising of 2x1 bedroom units, 6x2 bedroom units and 2x3 bedroom units. The development will also see the construction of a new access road to serve the development with associated parking facilities, landscaping and cycle/bin storage also to be provided.
- 2.2.2 Drawing 16-P1333-01 is included in Appendix A and shows the layout of the proposed development.

2.3 Regional Geology

- 2.3.1 The British Geological Survey (BGS) records indicate that the site sits on a sedimentary bedrock formation of Lambeth Group, a mixture of clay, silt and sand formed approximately 48 to 59 million years ago in the Palaeogene Period. This appears to be overlain with superficial deposits of Lynch Hill Gravel Member, a mixture of sand and gravel.
- 2.3.2 A number of boreholes were undertaken immediately to the east of the site, on the other side of Brunswick Hill. The borehole logs found that beneath a layer of topsoil, a number of layers of clay were present, with traces of silt and sand also encountered. Beneath the layers of clay, approximately 10 to 12m BGL, a layer of chalk was present.
- 2.3.3 All boreholes taken to the east of the site remained dry within the dig, the deepest of these was 14.45m BGL, this suggests that the water table around the local area is relatively low. Mapping provided by the Environment Agency shows the site to be located above a minor aquifer with a high groundwater vulnerability as shown in Figure 2.2 below.

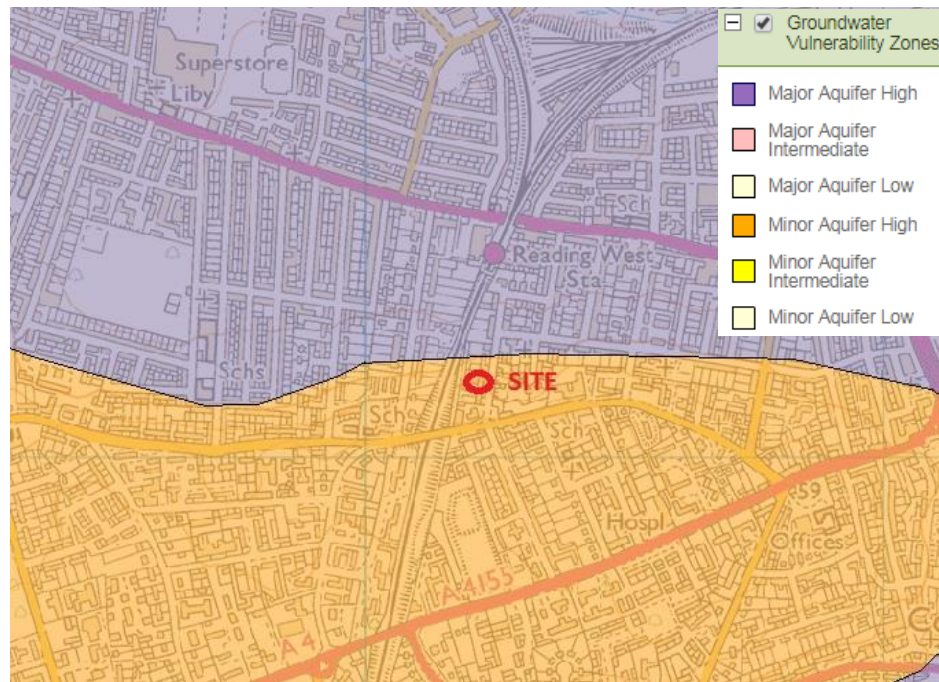


Figure 2.2 – Groundwater Vulnerability Zones

3 SOURCES OF FLOODING

3.1 Fluvial/Tidal Flooding

3.1.1 The National Planning Policy Framework (NPPF) defines the flood zones as follows:

- Zone 1: 'Low Probability' - This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding of less than 0.1%.
- Zone 2: 'Medium Probability' – This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year
- Zone 3a: 'High Probability' – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- Zone 3b: 'The Functional Floodplain' – This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.

3.1.2 The nearest sources of fluvial flooding to the site come from the River Thames, approximately 1.7km to the north of the site, the River Kennet, approximately 1.2km to the west and the Holy Brook river, approximately 1.3km to the south. Figure 3.1 below has been provided by The Environment Agency and shows the site in relation to the flood zones.

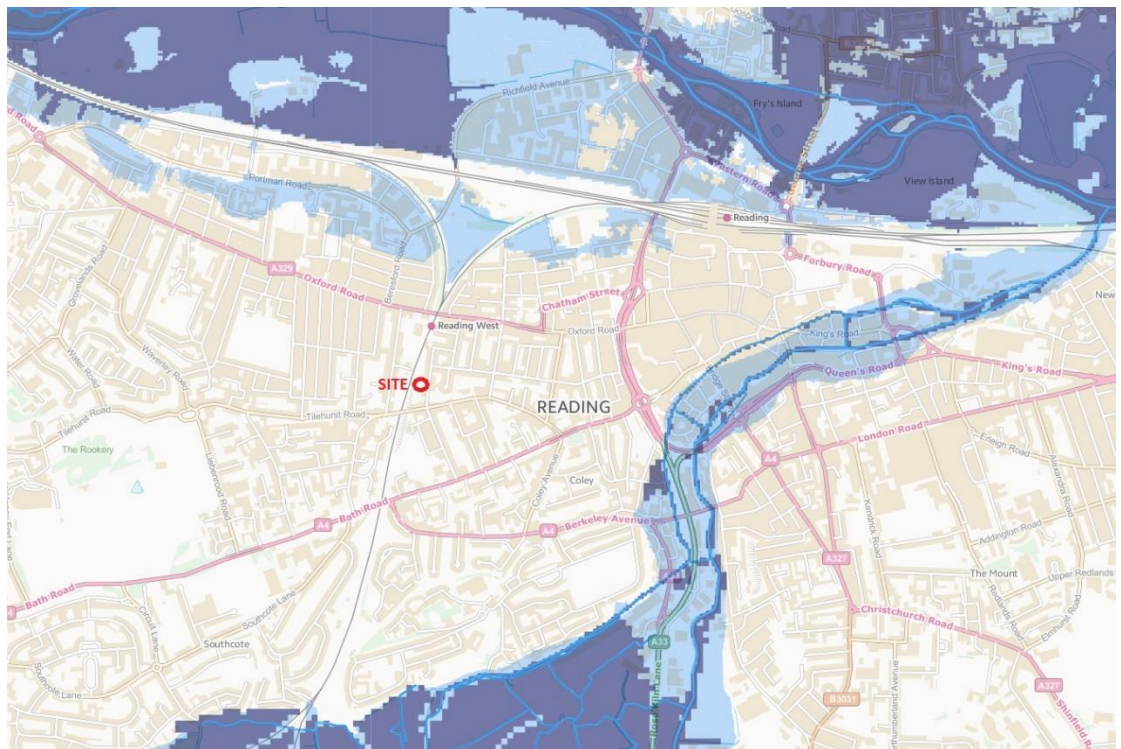


Figure 3.1 – EA Flood Map

- 3.1.3 The dark blue areas show the extents of Flood Zone 3, with the light blue areas indicating areas of Flood Zone 2. As can be seen the site is clearly located outside of these flood zones and is therefore located within Flood Zone 1, land assessed as having a less than 1 in 1000 annual probability of river flooding (0.1%), with the nearest areas of Flood Zone 2 located to the north, approximately 450m away.

3.2 Surface Water Flooding

- 3.2.1 Figure 3.2 below has been provided by The Environment Agency and shows the estimated depth of flooding that might occur in the event of a 1 in 100 year storm. Figure 3.2 shows the low-lying areas where surface water flooding may collect, as can be seen the entire site and the majority of the surrounding areas have been identified as having a “very low” risk of surface water flooding.

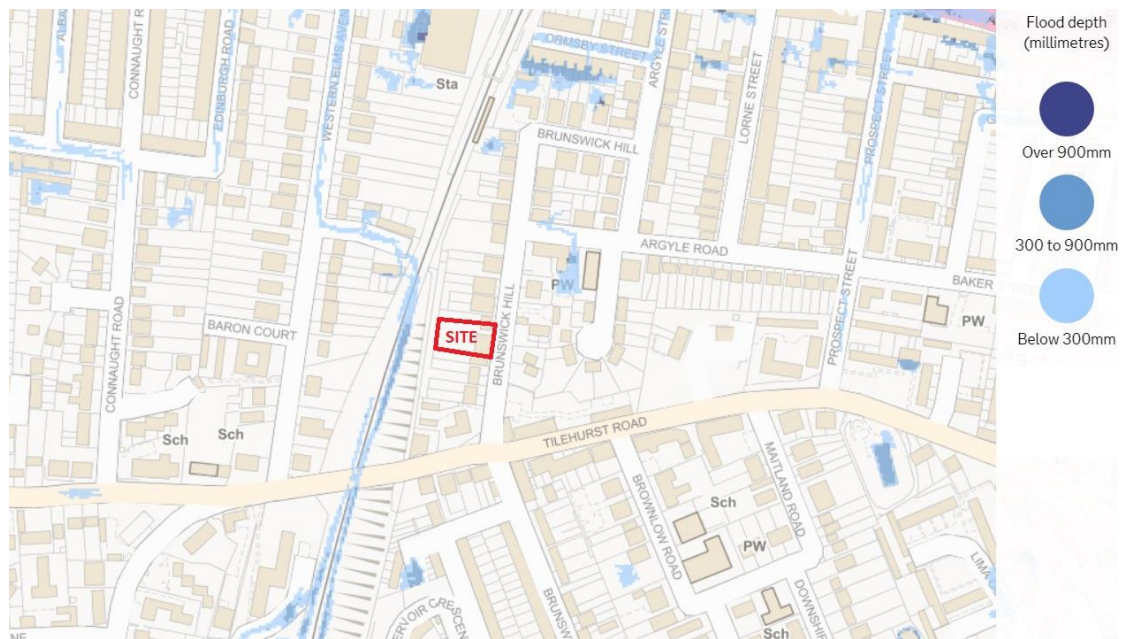


Figure 3.2 – Surface Water Flood Map

3.3 Groundwater Flooding

- 3.3.1 A Strategic Flood Risk Assessment (SFRA) was published by Peter Brett Associates in June 2017 on behalf of Reading Borough Council. This document was produced to assess potential flooding from a number of sources within the Borough. The SFRA states that *“The risk of groundwater flooding across the Reading area is typically considered to be low”*.
- 3.3.2 Within this document mapping has been produced showing areas that may be susceptible to groundwater flooding, the mapping shows that the site is located within an area of which 50% to 75% of the area is at risk of groundwater flooding. It is considered however that the site is unlikely to be subjected to groundwater emergence, due to the impermeable nature of the clay soil around the local area, the low water table and sloping nature of the surrounding ground.

3.4 Other Sources of Flooding

- 3.4.1 The SFRA states that *“Sewer flooding occurs when the drainage network becomes overwhelmed and surcharges or cannot manage the volume of water entering the system. This occurs during heavy rainfall or if the sewer is under capacity. Water then emerges from the sewer causing flooding. Sewer flooding can also occur due to blockages or failure to the system; or when outfalls are surcharged owing to the sea levels”*. Additionally, *“Sewer flooding can be aggravated by groundwater flooding which gets into the systems as either emerging as surface water that enters through gullies or through infiltration through damaged pipes”*.
- 3.4.2 Mapping has been provided within the SFRA showing the location of recorded sewer flooding within the Borough provided by Thames Water. The mapping shows that the postcode area RG1 7 has experienced between 51 to 100 recorded events of sewer flooding, it is unknown if any of these events have affected the site.
- 3.4.3 Given the ground level falls along Brunswick Road, any flood waters from off-site sewers are likely to flow past the site. There is also a significant fall across the site, so any flood waters from sewers within the site would flow down to the car park, away from the proposed building. Therefore, the risk of sewer flooding to the building is considered low.

4 ONSITE DRAIANGE

4.1 Existing Drainage

4.1.1 Thames Water serves the local area for the disposal of wastewater, an asset location plan has been obtained that identifies the location of existing Thames Water public sewers within the area of the site. A copy of the Thames Water asset location plan is included in Appendix C, as can be seen both foul and surface water 225mm dia sewers are located along Brunswick Hill, flowing from south to north.

4.1.2 The topographical survey included in Appendix A found two inspection chambers on site towards the western boundary approaching Brunswick Hill. One of the inspection chambers has been identified as being foul sewer, with the other listed as unable to lift. It is assumed that the foul inspection chamber drains to the chamber identified as unable to lift before flowing to the Thames Water foul sewer along Brunswick Hill.

4.1.3 Given that no other chambers were identified on site, it is assumed that the surface water run-off from the existing roof tops also drains to the Thames Water foul sewer at an unrestricted rate.

4.2 Proposed Foul Drainage

4.2.1 A new foul water drainage system comprising of pipes and manholes will be installed to serve the proposed development. Due to the levels on site and the invert of the existing Thames Water foul sewer along Brunswick Hill, the foul water will need to be pumped. Foul drainage will flow to a pumping station adjacent to the property before pumping via a 90mm MDPE rising main to the existing inspection chamber along the access road, where the existing connection to the existing Thames Water foul sewer is to be reutilised.

4.2.2 The proposed foul pumping station will discharge at a rate of 3.8 l/s, this is the minimum flow rate that will allow for self-cleansing velocity for foul

discharge, with pumped flow rates lower than this the 90mm dia rising main could be susceptible to blockages that may lead to maintenance issues.

4.3 Proposed Surface Water Sewer

4.3.1 Sustainable Urban Drainage systems (SUDs) were considered as part of this assessment for the disposal of surface water runoff from the proposed development. The proposed building will have a series of pitched roofs so it is not possible to employ green roofs, this method of surface water disposal has therefore been discounted.

4.3.2 Rainwater harvesting was also considered to re-use surface water run-off within the development. These systems require a separate network of pipework within the property, tanks and pumps to store the rainwater and distribute it throughout. Given the nature of the development it was considered impractical to use this within the building due to lack of space.

4.3.3 Furthermore, rainwater harvesting tanks should not be included in the assessment of attention required to store runoff from a development as there is no guarantee that the tank will be sufficiently empty to receive another storm.

4.3.4 Should the rainwater harvesting tank be full at the start of the storm, it will not be able to receive any more runoff, therefore additional storage would be required to cater for all storms and the rainwater harvesting tank will provide no benefit in terms of attenuation. For those reasons, and the excessive cost of providing the system, this method has been discounted.

4.3.5 Next on the Sustainable Drainage Hierarchy is the use of ground infiltration techniques such as soakaways and infiltration basins. The British Geological Survey records indicate the ground conditions to consist of clay, clay is not considered to be suitable for infiltration due to the small void ratio and chemical composition of the strata not allowing water to pass through. The use of infiltration techniques to dispose of surface water runoff generated on site has therefore been discounted.

4.3.6 Discharge to a watercourse is the next option on the Sustainable Drainage Hierarchy, as the proposed development is not situated near any suitable watercourse, discharging via this method would not be a viable option.

4.3.7 Last on the hierarchy is the discharge of surface water to public sewers and attenuating the flows. There are both foul and surface water sewers located adjacent to the site along Brunswick Hill, it is therefore proposed to attenuate surface water runoff on site before discharging at a restricted rate to the existing Thames Water surface water sewer.

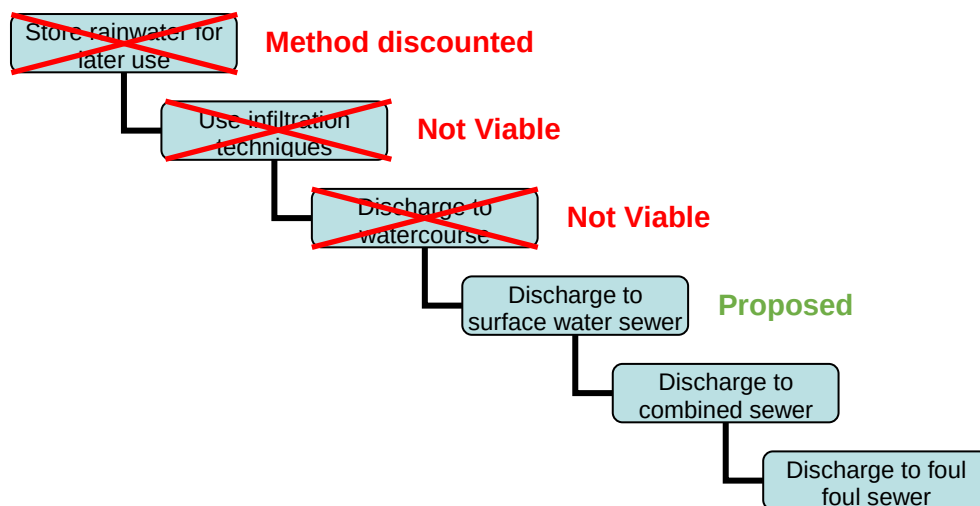


Figure 4.1 – Sustainable Drainage Hierarchy

4.3.8 The greenfield runoff rate has been calculated at 0.1l/s, a copy of the greenfield runoff rate calculation is included in Appendix C. The brownfield runoff rates for various return periods have been calculated and are tabulated below.

Return Period	Runoff Rate
1 year	3.2l/s
30 year	7.6l/s
100 year	10.0l/s

Table 4.1 – Brownfield Runoff Rates

- 4.3.9 As the Thames Water surface water sewer along Brunswick Hill is relatively shallow, the surface water runoff will need to be pumped to a new manhole, after which a gravity connection to the Thames Water surface water can be achieved. The surface water pump chamber will discharge at a rate of 2.0 l/s, this is considered to be the minimum flow rate a surface water pump chamber can function at efficiently without the 63mm dia rising main becoming prone to blockages that may lead to flooding on site.
- 4.3.10 The proposed peak discharge rate of 2l/s is an 80% reduction of the existing 1 in 100 brownfield rate, and therefore the proposals will reduce the risk of sewer flooding downstream of the site.
- 4.3.11 A new surface water drainage system comprising of pipes, manholes and gullies is to be installed that will collect surface water runoff from the roof, parking and access areas before draining to an underground storage tank located beneath parking area. Using the pumped discharge rate of 2 l/s, the tank has been sized to store a maximum volume of 32.4m³ (8m x 4.5m x 0.8m deep).
- 4.3.12 The access road and parking areas could be constructed using permeable paving, however as the soil on site is thought to be unsuitable for infiltration, the paving would need to be fitted with an impermeable geotextile membrane to create a tank structure, after which this could flow to the underground storage pipe. The falls on the access road would also limit the use permeable paving as there is 2 m level difference.
- 4.3.13 The entire surface water drainage system has been designed to cater for all events up to and including a 1 in 100 year storm event, including 40% allowances for climate change. Drawing 170965/DS/01 is included in Appendix C and shows an indicative layout of the proposed foul and surface water drainage. MicroDrainage software has been used to assist in the design of the storage tank, a copy of these calculations are included in Appendix C.

4.4 Surface Water/SUDS Maintenance

4.4.1 Regularly inspecting the surface water drainage network for blockages and clearing unwanted debris / silt from the system should improve the performance of the surface water network and decrease the need for future repairs. In the event that road gullies become blocked, high pressure water jets can be used to clear the gully and ensure they are functioning correctly, this should be undertaken by certified trained professionals.

4.4.2 Regular maintenance of the drainage and SUDs features will include, inspections, removal of litter / debris and sweeping of the surfaces. Occasional maintenance will include removal of sediment etc. and remedial maintenance may include structural repairs.

4.4.3 The drainage and SUDs elements after an initial inspection following construction should be inspected on a monthly basis for the first 12 months and after large storms, thereafter the following maintenance regime should be applied and adjusted if the 12 month monitoring process has identified any issues.

4.4.4 For the attenuation tank, the following maintenance is recommended.

Attenuation Tank Maintenance Schedule		
	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required take remedial action	Annually
	Remove debris from the catchment surface (where it may cause risk to performance).	Monthly

	For systems where rainfall infiltrates in the tank from above, check surface of filter for blockage by sediment, algae or other matter, remove and replace surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures.	Annually or as required
Remedial Actions	Repair/rehabilitate inlets/outlets, overflows and vents.	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually
	Survey inside of tanks for sediment build-up and remove if necessary	Every 5 years or as required

4.4.5 For specialist pieces of equipment such as the pumping chambers, maintenance brochures will be provided by the manufacturers. These will set out the frequency of inspections and correct methods of cleaning etc. that should be followed. It is recommended that once installed the facility should be inspected monthly for the first three months and thereafter at six monthly intervals or as advised in the maintenance brochure.

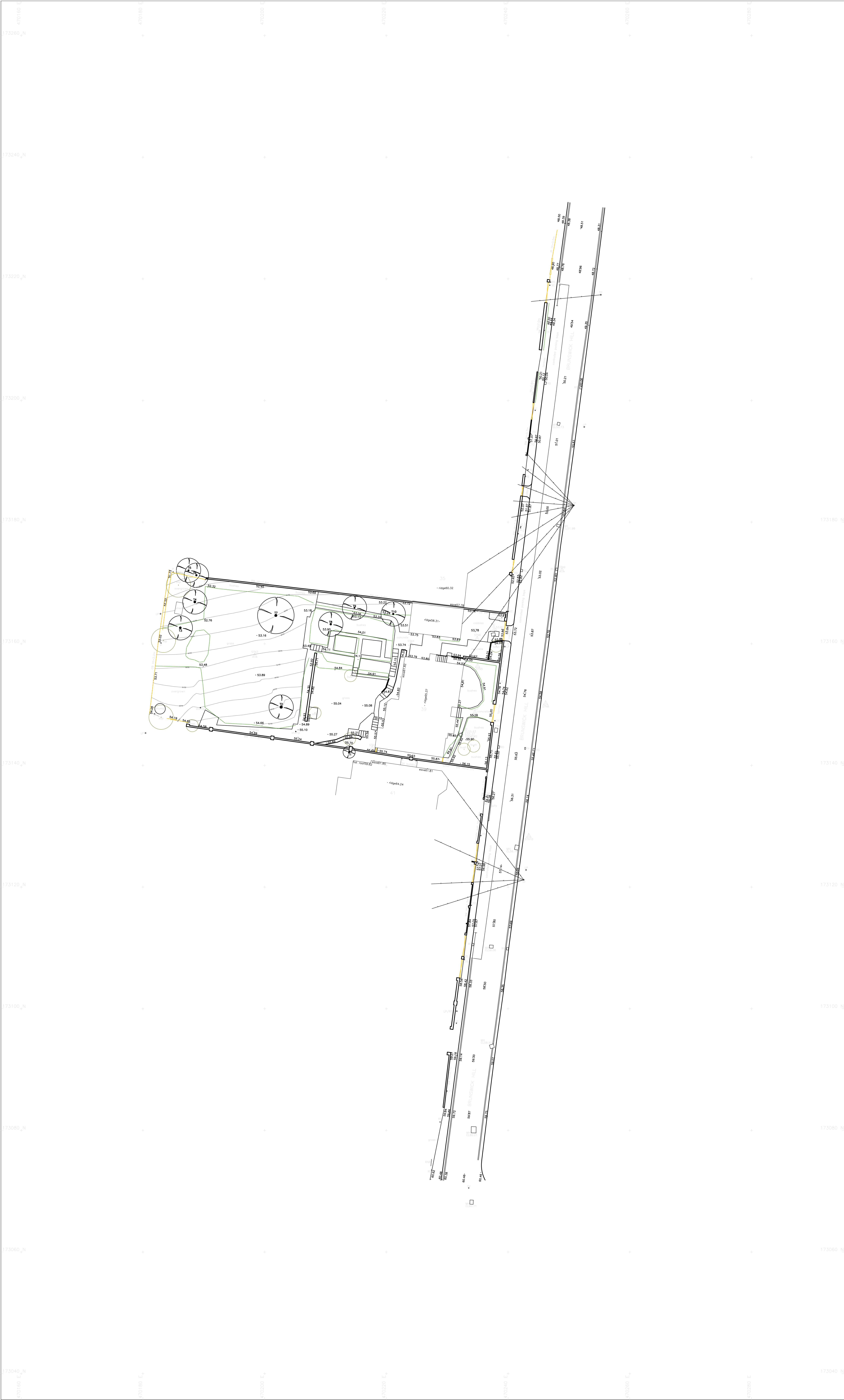
4.4.6 The above information is only intended as guidance in standard maintenance practise for surface water drainage and SUDs features. The above measures should be reviewed regularly and modified to suit the site conditions.

5 SUMMARY AND CONCLUSION

- 5.1.1 This Drainage Statement report has been prepared to support the planning application for the site and identify how the proposed development will be served in terms of the disposal of foul and surface water runoff.
- 5.1.2 The development proposals will see the removal of the existing dwelling to be replaced by a new residential block of flats that will incorporate 10 units, a mixture of 1, 2 and 3 bedrooms dwellings. The development will also provide a new access road, parking spaces, landscaping and cycle/bin storage units to serve the proposed dwellings.
- 5.1.3 The site is located within Flood Zone 1, land assessed as having a less than 1 in 1000 annual probability of river flooding with a “low probability of flooding. The risk of flooding from other sources, such as surface water and ground water flooding to the site is considered negligible.
- 5.1.4 A new foul drainage system will be installed to serve the development, this will need to be pumped to the existing manhole on the proposed access road, where the existing connection to the Thames Water foul sewer is to be reutilised.
- 5.1.5 Surface water generated on the roof, parking and access areas is to be attenuated in an underground storage tank before being pumped to a new manhole, after which the surface water runoff can flow under gravity to the existing Thames Water surface water sewer along Brunswick Hill. The discharge into the Thames Water sewer will be restricted to 2.0 l/s, this is considered to be the minimum flow rate at which surface water can be pumped without being susceptible to blockages.
- 5.1.6 This statement clearly demonstrates that both foul and surface water runoff from the development can be catered for and will not result in an increased risk of flooding in the area. Given the above we can see no reason to preclude development on this site on the grounds of there being insufficient capacity to cater for the runoff from the proposed development.

APPENDIX A

6319/01 – Topographical Survey



LEGEND

SURVEY CONTROL

FEATURE STYLES

FEATURE ABBREVIATIONS

DATUM

GRID – ORDNANCE SURVEY NATIONAL GRID (OSNG20)

LEVELS – ORDNANCE SURVEY (OSM02)

SURVEY CONTROL

STN

1 470217.899 173142.844 55.482

2 470218.042 173143.814 55.478

3 470198.377 173158.029 55.540

4 470214.441 173159.491 55.542

5 470214.487 173156.555 55.444

6 470214.438 173156.455 55.456

7 470214.553 173148.726 55.249

8 470214.148 173155.247 54.437

9 470248.858 173172.077 52.803

10 470248.455 173158.416 56.105

TREE SCHEDULE

TRN

1 0.8 6.0 1.0 APPLE

2 1.3 6.0 2.0 APPLE

3 MB 6.0 2.0 HAZEL

4 MB 6.0 2.0 HAZEL

5 0.7 9.0 2.0 CYPRESS

6 0.8 9.0 2.0 CYPRESS

7 1.2 9.0 2.0 APPLE

8 0.9 6.0 2.0 CYPRESS

9 0.6 5.0 2.0 APPLE

10 0.8 6.0 2.0 APPLE

NOTES

Surveyed boundaries are not necessarily the site legal boundaries.

Client should refer to the relevant Land Registry document for confirmation of title.

Drainage and service covers that were buried, obscured or not visible at the time of the survey cannot be shown. Other connections between manholes are assumed to be straight and only pipes visible from the cover are shown.

Tree canopy measurements are within a maximum of 10%.

Tree species and condition to be confirmed by an arboriculturist.

SURVEYED BY

grounds surveys ltd

land & engineering surveyors

units 9&10

woodlands farm

spring lane

cookham dean

berkshire

SL6 9PN

t: 01628 485200

f: 01628 485300

e:office@grounds surveys.com

www.ground surveys.com

CLIENT

NOVUS LAND SECURITIES LTD

SITE

39 BRUNSWICK HILL

READING

BERKSHIRE

RG1 7YU

TITLE

SITE SURVEY

AS EXISTING

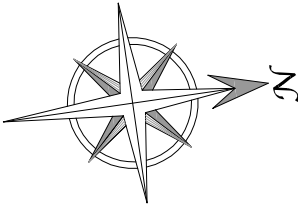
SCALE 1/200 (A0)

DATE JUNE 2016

DRAWING No. 01

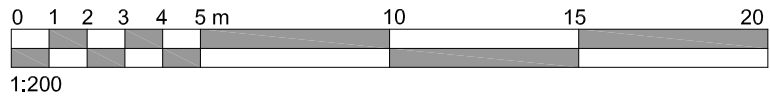
JOB No. 6319

16-P1333-01 – Proposed Site Plan



KEY

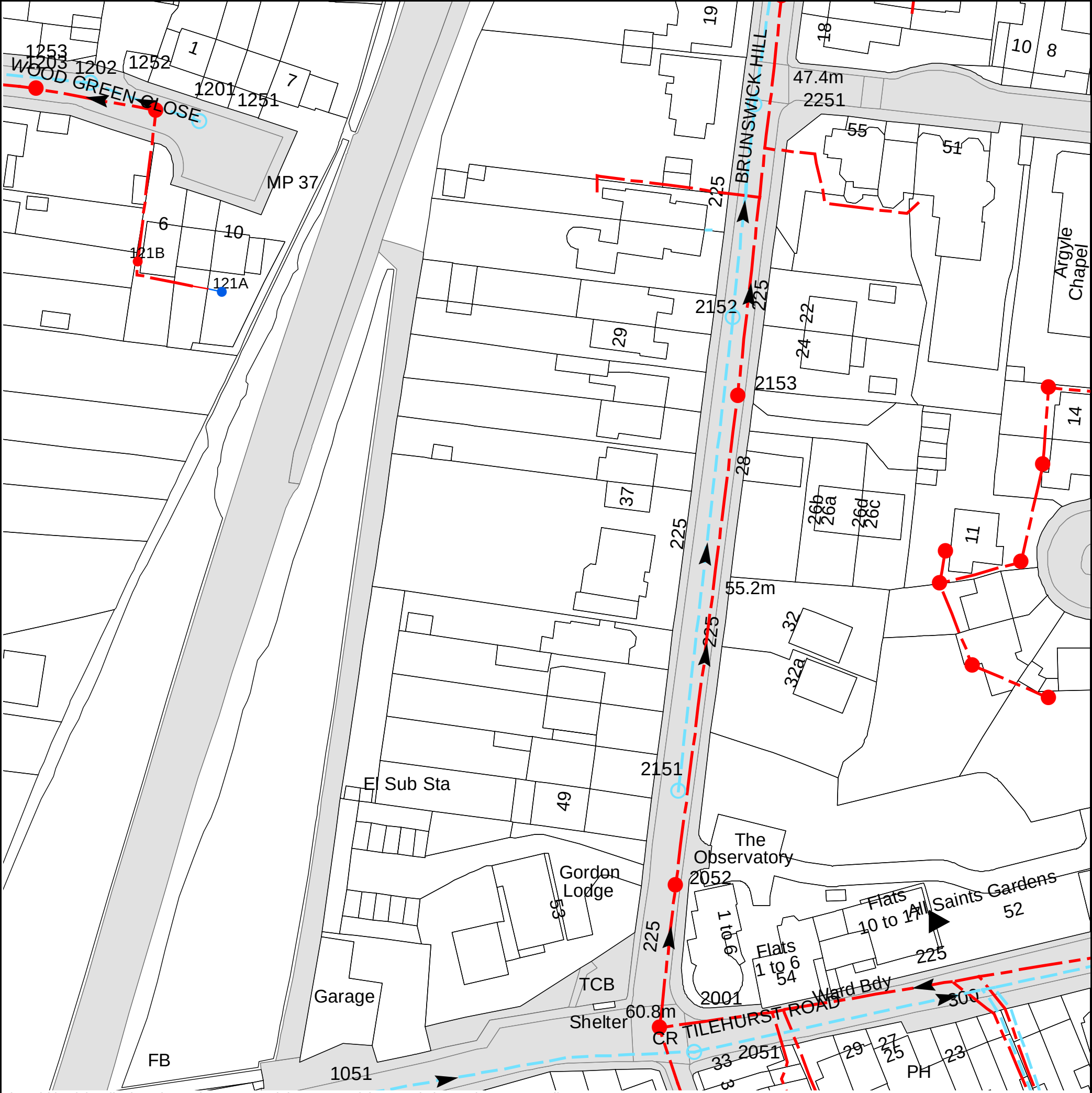
- PROPOSED TREES
- EXISTING TREES TO BE RETAINED
- TREES TO BE REMOVED
- PROPOSED INDICATIVE PLANTING
- EXISTING PLANTING
- +00.00 EXISTING SPOT SITE LEVELS
- +00.00 PROPOSED SPOT SITE LEVELS
- F.F.L. 00.00 PROPOSED HOUSE FINISHED FLOOR LEVELS (SUBJECT TO CONFIRMATION AT WORKING DRAWINGS STAGE)
- DASHED LINE INDICATES BUILDING TO BE DEMOLISHED



Rev.	Date	Detail
Status		
PLANNING		
 ASCOT DESIGN Timeless architecture Ascot Design Ltd, Berkshire House 39-51 High Street, Ascot, Berkshire, SL5 7HY Tel: 01344 299330 Fax: 01344 299331 Email: info@ascotdesign.com www.ascotdesign.com		
Client		
MR ERIC BENJAMIN		
Project Title		
39 BRUNSWICK HILL READING		
Drawing Title		
SITE PLAN		
Scale	Date	Drawn
1:200 @ A1	MARCH 17	
Drawing No.	Rev.	
16-P1333-01		
The copyright in this document and design is confidential to and the property of Ascot Design Limited		

APPENDIX B

Thames Water Asset Location Search



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 470213,173155
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

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

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

Manhole Reference	Manhole Cover Level	Manhole Invert Level
21NJ	n/a	n/a
21NF	n/a	n/a
21NK	n/a	n/a
31NG	n/a	n/a
31MM	n/a	n/a
31MN	n/a	n/a
121B	n/a	n/a
1201	45.52	44.25
1251	45.76	44.73
121A	n/a	n/a
2152	50.72	48.9
2153	n/a	n/a
2251	48.08	46.75
31ML	n/a	n/a
1202	45.04	43.69
1252	45.15	43.87
2001	60.94	55.81
2052	n/a	n/a
2151	58.13	56.46
2051	n/a	n/a
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

	Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Trunk Surface Water
	Trunk Foul
	Storm Relief
	Trunk Combined
	Vent Pipe
	Bio-solids (Sludge)
	Proposed Thames Surface Water Sewer
	Proposed Thames Water Foul Sewer
	Gallery
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Sludge Rising Main
	Proposed Thames Water Rising Main
	Vacuum

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plans are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
- 5) 'na' or '0' on a manhole level indicates that data is unavailable.

Sewer Fittings

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

	Air Valve
	Dam Chase
	Fitting
	Meter
	Vent Column

Operational Controls

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

	Control Valve
	Drop Pipe
	Ancillary
	Weir

End Items

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

	Outfall
	Undefined End
	Inlet

Other Symbols

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

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

Areas

Lines denoting areas of underground surveys, etc.

	Agreement
	Operational Site
	Chamber
	Tunnel
	Conduit Bridge

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

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

- 6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

APPENDIX C

Greenfield Runoff Rate Calculation

Lanmor Consulting Ltd		Page 1
Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	39 Brunswick Hill Reading Greenfield Runoff Rate	
Date 24/10/2017	Designed by TS	
File	Checked by RS	
XP Solutions		Source Control 2015.1

ICP SUDS Mean Annual Flood

Input

Return Period (years) 1 SAAR (mm) 700 Urban 0.000
Area (ha) 0.140 Soil 0.150 Region Number Region 6

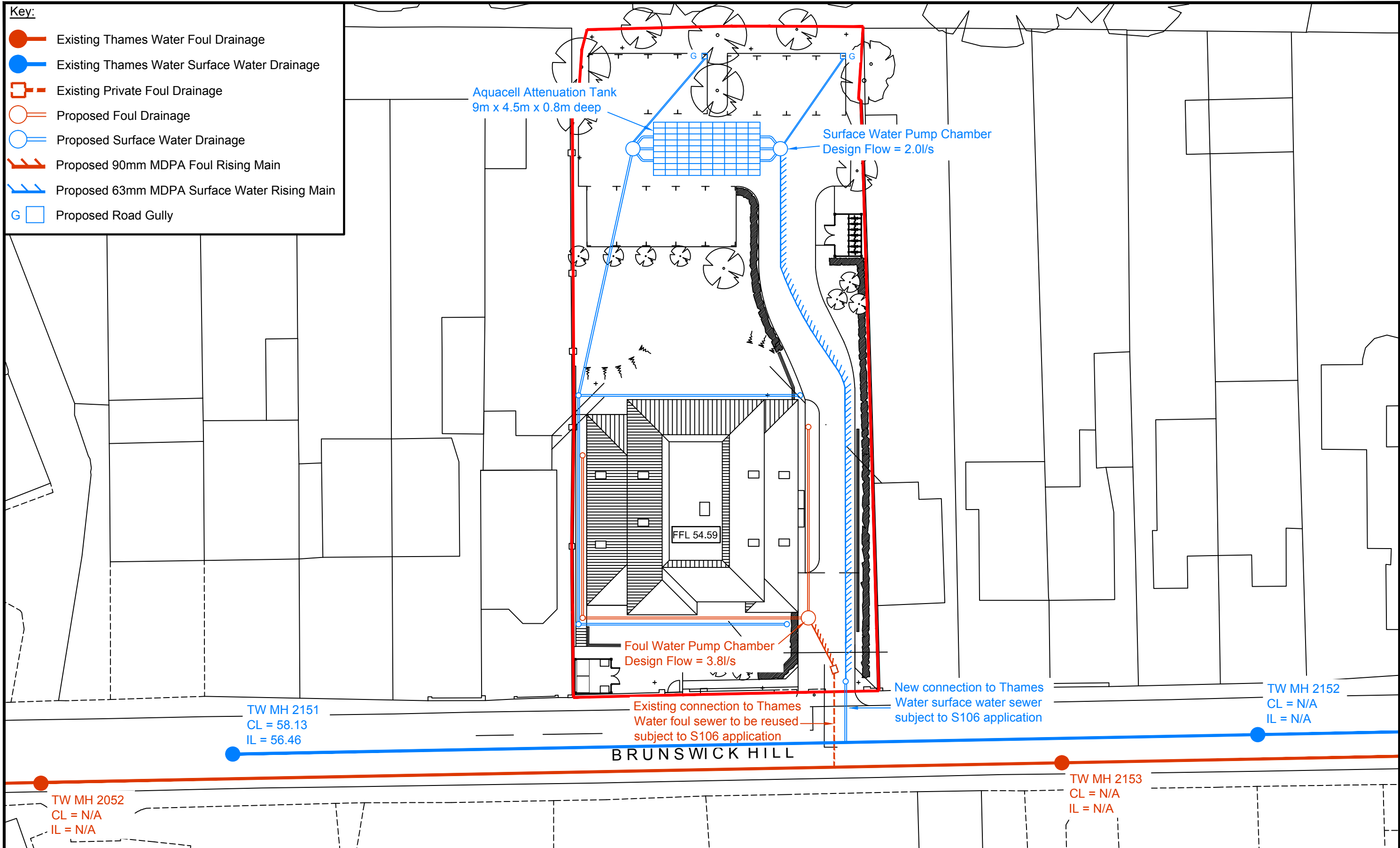
Results 1/s

QBAR Rural 0.1
QBAR Urban 0.1

Q1 year 0.0

Q1 year 0.0
Q30 years 0.1
Q100 years 0.2

170965/DS/01 – Proposed Drainage Strategy



EB Solutions Ltd

39 Brunswick Hill
Reading
Proposed Drainage Strategy

LANMOR Consulting
Civil Engineers & Transport Planning

Thorogood House, 34 Tolworth Close, Surbiton, Surrey, KT6 7EW
Telephone: 0208 339 7899 Fax: 0208 339 7898
E-mail: info@lanmor.co.uk
www.lanmor.co.uk

SCALE 1:300

DRAWN BY TS

PRJ No. 170965

DWG No. 170965/DS/01

MicroDrainage Calculations

Lanmor Consulting Ltd		Page 1
Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	39 Brunswick Hill Reading Attenuation Tank	
Date 25/10/2017	Designed by TS	
File ATTENUATION TANK.SRCX	Checked by RS	
XP Solutions		Source Control 2015.1

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	51.398	0.448	2.0	18.1	O K
30 min Summer	51.516	0.566	2.0	22.9	O K
60 min Summer	51.605	0.655	2.0	26.5	O K
120 min Summer	51.634	0.684	2.0	27.7	O K
180 min Summer	51.619	0.669	2.0	27.1	O K
240 min Summer	51.596	0.646	2.0	26.1	O K
360 min Summer	51.539	0.589	2.0	23.9	O K
480 min Summer	51.486	0.536	2.0	21.7	O K
600 min Summer	51.435	0.485	2.0	19.6	O K
720 min Summer	51.386	0.436	2.0	17.7	O K
960 min Summer	51.298	0.348	2.0	14.1	O K
1440 min Summer	51.163	0.213	2.0	8.6	O K
2160 min Summer	51.058	0.108	2.0	4.4	O K
2880 min Summer	51.035	0.085	1.7	3.4	O K
4320 min Summer	51.012	0.062	1.2	2.5	O K
5760 min Summer	51.000	0.050	1.0	2.0	O K
7200 min Summer	50.992	0.042	0.8	1.7	O K
8640 min Summer	50.986	0.036	0.7	1.4	O K
10080 min Summer	50.982	0.032	0.6	1.3	O K
15 min Winter	51.456	0.506	2.0	20.5	O K
30 min Winter	51.592	0.642	2.0	26.0	O K
60 min Winter	51.701	0.751	2.0	30.4	O K
120 min Winter	51.749	0.799	2.0	32.4	O K
180 min Winter	51.727	0.777	2.0	31.5	O K
240 min Winter	51.696	0.746	2.0	30.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.843	0.0	19.7	18
30 min Summer	85.337	0.0	25.9	32
60 min Summer	53.483	0.0	32.5	62
120 min Summer	32.428	0.0	39.4	112
180 min Summer	23.896	0.0	43.5	142
240 min Summer	19.136	0.0	46.5	172
360 min Summer	13.890	0.0	50.6	240
480 min Summer	11.074	0.0	53.8	308
600 min Summer	9.283	0.0	56.4	374
720 min Summer	8.033	0.0	58.5	440
960 min Summer	6.389	0.0	62.1	566
1440 min Summer	4.620	0.0	67.3	794
2160 min Summer	3.335	0.0	72.9	1120
2880 min Summer	2.644	0.0	77.1	1468
4320 min Summer	1.904	0.0	83.3	2204
5760 min Summer	1.506	0.0	87.8	2936
7200 min Summer	1.256	0.0	91.5	3664
8640 min Summer	1.082	0.0	94.6	4400
10080 min Summer	0.953	0.0	97.3	5112
15 min Winter	129.843	0.0	22.1	18
30 min Winter	85.337	0.0	29.0	32
60 min Winter	53.483	0.0	36.4	60
120 min Winter	32.428	0.0	44.1	116
180 min Winter	23.896	0.0	48.8	162
240 min Winter	19.136	0.0	52.1	186

Lanmor Consulting Ltd		Page 2
Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	39 Brunswick Hill Reading Attenuation Tank	
Date 25/10/2017 File ATTENUATION TANK.SRCX	Designed by TS Checked by RS	
XP Solutions	Source Control 2015.1	

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
360 min Winter	51.615	0.665	2.0	26.9	O K
480 min Winter	51.534	0.584	2.0	23.7	O K
600 min Winter	51.455	0.505	2.0	20.5	O K
720 min Winter	51.381	0.431	2.0	17.5	O K
960 min Winter	51.249	0.299	2.0	12.1	O K
1440 min Winter	51.073	0.123	2.0	5.0	O K
2160 min Winter	51.029	0.079	1.6	3.2	O K
2880 min Winter	51.013	0.063	1.3	2.5	O K
4320 min Winter	50.995	0.045	0.9	1.8	O K
5760 min Winter	50.986	0.036	0.7	1.5	O K
7200 min Winter	50.980	0.030	0.6	1.2	O K
8640 min Winter	50.976	0.026	0.5	1.1	O K
10080 min Winter	50.973	0.023	0.5	0.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
360 min Winter	13.890	0.0	56.7	262
480 min Winter	11.074	0.0	60.3	336
600 min Winter	9.283	0.0	63.1	404
720 min Winter	8.033	0.0	65.6	470
960 min Winter	6.389	0.0	69.6	596
1440 min Winter	4.620	0.0	75.4	794
2160 min Winter	3.335	0.0	81.7	1108
2880 min Winter	2.644	0.0	86.3	1472
4320 min Winter	1.904	0.0	93.2	2204
5760 min Winter	1.506	0.0	98.4	2936
7200 min Winter	1.256	0.0	102.5	3672
8640 min Winter	1.082	0.0	106.0	4384
10080 min Winter	0.953	0.0	108.9	5136

Lanmor Consulting Ltd		Page 3
Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	39 Brunswick Hill Reading Attenuation Tank	
Date 25/10/2017 File ATTENUATION TANK.SRCX	Designed by TS Checked by RS	
XP Solutions	Source Control 2015.1	

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)	18.900	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.081

Time (mins)	Area
From:	To: (ha)

0	4 0.081
---	---------

Lanmor Consulting Ltd		Page 4
Thorogood House 34 Tolworth Close Surbition Surrey KT6 7EW	39 Brunswick Hill Reading Attenuation Tank	
Date 25/10/2017	Designed by TS	
File ATTENUATION TANK.SRCX	Checked by RS	
XP Solutions		Source Control 2015.1

Model Details

Storage is Online Cover Level (m) 52.500

Tank or Pond Structure

Invert Level (m) 50.950

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	40.5	0.800	40.5	0.801	0.0

Pump Outflow Control

Invert Level (m) 50.950

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0000	0.700	2.0000	1.300	2.0000	1.900	2.0000	2.500	2.0000
0.200	2.0000	0.800	2.0000	1.400	2.0000	2.000	2.0000	2.600	2.0000
0.300	2.0000	0.900	2.0000	1.500	2.0000	2.100	2.0000	2.700	2.0000
0.400	2.0000	1.000	2.0000	1.600	2.0000	2.200	2.0000	2.800	2.0000
0.500	2.0000	1.100	2.0000	1.700	2.0000	2.300	2.0000	2.900	2.0000
0.600	2.0000	1.200	2.0000	1.800	2.0000	2.400	2.0000	3.000	2.0000

Event: 120 min Winter

