Civil | Structural | Geo-Environmental | Transport Planning

Flood Risk Assessment and Drainage Strategy

Prepared for
David Wilson Homes Mercia

Proposed Development at
Hither Green Lane, Redditch, B98 9BN

Travis Baker Ltd
Trinity Point
New Road
Halesowen
West Midlands
B63 3HY

Tel: 0121 550 8037
Fax: 0121 550 8047

info@travisbaker.co.uk
www.travisbaker.co.uk

Civil | Structural | Geo-Environmental | Transport Planning

Document Control

Project Title: Hither Green Lane, Redditch, B98 9BN

Document Type: Flood Risk Assessment and Drainage Strategy

Project Number: 21169

Revision	Date	Comments	Prepared by	Checked by
-	12.07.21	First Issue	Mathew Grainger	Dave Baker
A	20.09.21	Redline Boundary update and Severn Trent Foul Capacity Response added.	Liam Hyland	Mathew Grainger
B	22.03.22	LLFA comments addressed	Dave Baker	Mathew Grainger

Contents

1.0 INTRODUCTION

1.1 Background to Report

1.1.1 Travis Baker were commissioned to prepare a flood risk assessment and accompanying drainage strategy in accordance with the requirements of the NPPF and local planning policy to support the planning application for a proposed 215 dwelling residential development off Hither Green Lane. The site is located at postcode B98 9BN.

1.1.2 Following the submission of the planning application the LLFA (NWWM) have advised that they are broadly supportive of the principle of development but have maintained a Holding Objection with the requirement for the submission of additional information. A copy of their response is in the appendices. This report revision provides additional information to address the concerns raised which summarise as follows:

- Preserve existing drainage features and incorporate them into the layout and site landscaping
- Provide attenuation to separate sub catchments of the site rather than single large feature.
- Provide source control measures for the site.
- Undertake a Simple Index Assessment for site runoff water quality.

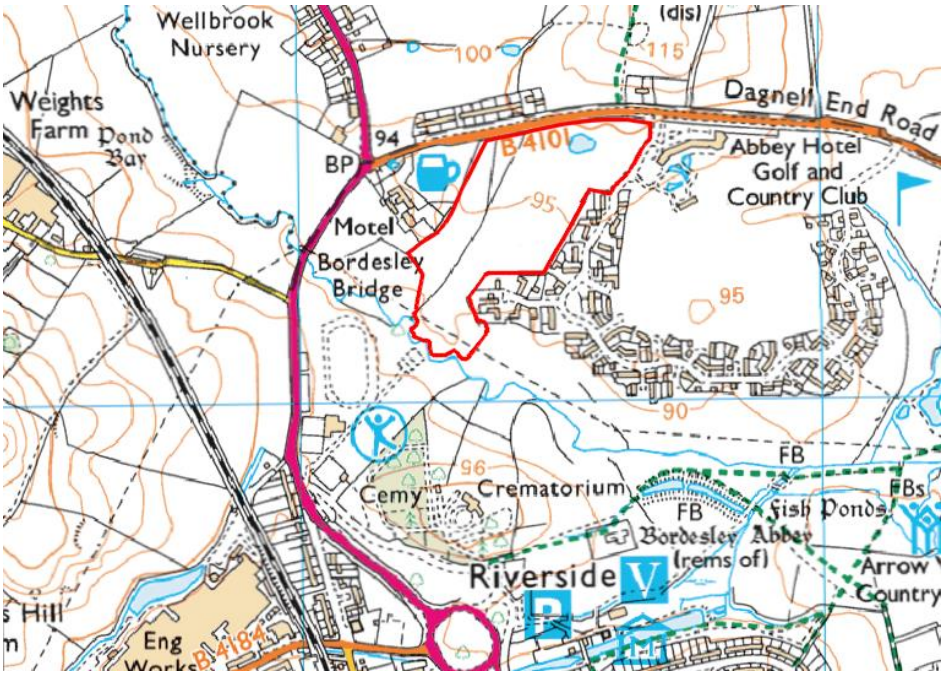
1.2 Site Location and Surroundings

1.2.1 The centre of the site lies at grid reference SP044693 (404400, 269350).

1.2.2 The area of land to be developed is currently part of The Abbey Hotel Golf and Country Club. East of the site is Hither Green Lane and existing residential housing. The development is accessed off Hither Green Lane. North of the site is Dagnell End Road. West of the site is Meadow Farm Redditch, Marston's Inn and south of the site is the River Arrow.

1.2.3 The site falls completely within the administrative boundary of Worcestershire County Council.

1.2.4 The location of the site is shown below:



1.3 Brief Development Proposals

1.3.1 The proposed development will consist of 215 dwellings, access to the development is off Hither Green Lane.

1.3.2 The highway layout will be set to best follow the existing topography.

1.3.3 The development proposals are shown in the appendices.

2.0 EXISTING TOPOGRAPHY AND LAND USE

2.1.1 A topographical survey has been undertaken by Geoff Perry Associates, a copy of which is in the appendices.

2.1.2 The land is currently part of The Abbey Hotel Golf and Country Club. The land slopes generally from north to south with levels ranging from 101.50m AOD to 90.00m.

2.1.3 There is a large existing pond located in the north of the development, this is to be retained and slightly resized and not be used for any proposed flow attenuation.

2.1.4 There are smaller pools within the site and an existing car park to the northeast. The smaller pools are entirely man made and were constructed as features of the golf course, not as drainage features of the land itself.

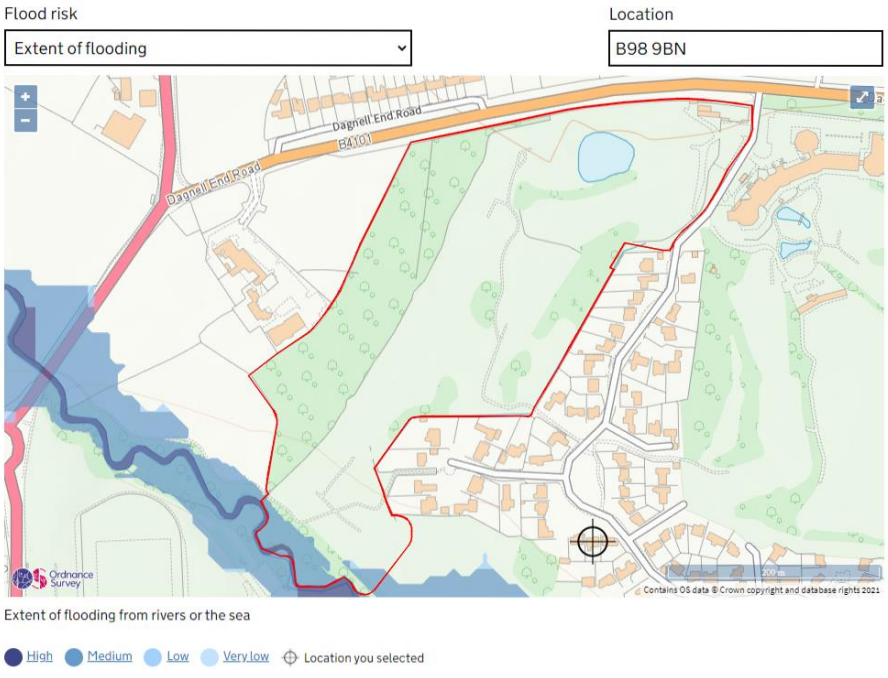
2.2 Existing Drainage Provision and Run-Off

2.2.1 With reference to the topographical survey and Severn Trent Water sewer records there is an existing combined sewer to the very south of the site, running next to the river arrow.

2.2.2 The land falls north to south and it would appear that drainage of surface water is by overland flow and also some very shallow cut off ditches to the River Arrow.

2.3 Existing Fluvial Flood Risk

2.3.1 The information available from the GOV.UK website indicates that the majority of the site is within flood zone 1. However, a small proportion of the site to the south is located within Flood Zone 3 (1.0% or greater probability of flooding annually) and flood zone 2 (0.1% or greater probability of flooding annually). The flood mapping is shown below.



2.3.2 In order to confirm more accurately the potential for flooding to the site, a request was made to the environment Agency for flood level data in the vicinity of the site. A copy of their response Product 4 (Detailed Flood Risk Data) for flood data for the development adjacent to the River Arrow, Redditch. Ref 212168. Date 24th June 2021 is in the appendices.

2.3.3 The level data provided has been integrated and interpolated. The flood levels nearest to the site are;

1% (Climate Change) = 89.000m – 88.600m

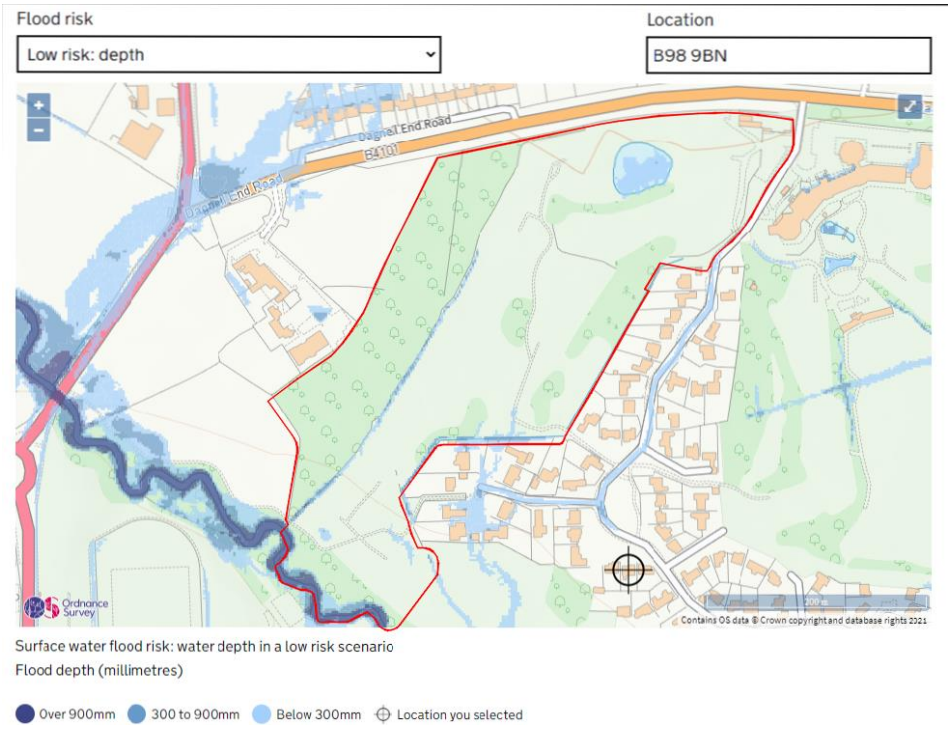
0.5% = 89.100m – 88.700m

2.3.4 These levels have been transposed onto the drainage strategy drawing and as can be seen pose no threat and do not encroach into the area proposed for development.

2.3.5 A sequential test is therefore not required.

2.4 Flood Risk from Other Sources

2.4.1 The GOV.UK mapping showing the risk of surface water flooding to the site is below:



2.4.2 The areas of the site which are potentially susceptible to surface water flooding relate to the low points and small ditches within the existing site, along with the existing pond and pools. Upon redevelopment the small ditches and pools will become redundant.

3.0 THE DEVELOPMENT PROPOSALS

3.1 Proposed Sustainable Drainage Systems

3.1.1 As with any development, the first method of surface water disposal which should be investigated is by infiltration to the ground. A geo-environmental assessment has been prepared by Georisk Management Ltd. Report-no: 16101/1 states and the following;

Infiltration testing has been carried out in selected trial pits. The test results show that no significant infiltration was recorded over a timed period of approximately 4 hours and; therefore, it is considered that surface water from the development could not be effectively discharged by soakaway drainage and an alternative drainage solution will need to be sought.

3.1.2 It is therefore proposed that the disposal of surface water from the site is by positive means.

3.1.3 As described previously the existing larger pond to the north of the site will be retained. Contact has been made with the current operator of the golf course and it has been confirmed that there are no current positive surface water outfalls into or out of the pond and the water level has remained fairly constant for at least the last 10 years. It is therefore considered that the water level should not drop post development.

3.1.4 The smaller ponds located within this area of the current golf club were installed as features and hazards of the fairway / greens. They do not form part of the natural drainage sub-catchments of the area.

3.1.5 A preliminary (and subject to further detailed design) drainage strategy has been prepared by Travis Baker and is shown on drawing numbers 21169-1, 2 and 3 Preliminary Drainage Strategy and Finished Floor Levels.

3.1.6 The HR Wallingford IH124 methodology has been used to calculate the existing pre-development greenfield run-off rate for the development area. With reference to the results in the appendices, the current rate of run-off is 4.92 litres per second per hectare.

3.1.7 A total impermeable area of 4 hectares means flow attenuation will be required to limit flows to 19.6 litres per second.

3.1.8 It is proposed that the required storage will be in the form of an attenuation basin with a vortex flow control providing the flow restriction.

3.1.9 Drainage design has been developed using the Causeway FLOW hydraulic modelling software. The required volume for the attenuation basin has been calculated as 2986 cubic metres with the restricted discharge rate of 19.6 litres per second. This attenuation volume accounts for the critical 100 year + 40% rainfall events.

3.1.10 The input details and simulation results are in the appendices. These will be developed further at detailed design stage into a fully detailed model. However, at this stage, the calculations provide a robust assessment of the storage required and the ability for this to be incorporated into the development.

3.1.11 The attenuation basin has been designed with a varying (up to 1.2m) permanent water level along with 2m wide grass terraces to maximise biodiversity. The side slope gradients are 1:3 where grass terraces are located and 1:5 in the other areas.

3.1.12 As the attenuation area will be above ground and the permanent standing water will provide ecological and amenity benefits. This will not affect the hydraulic performance of the feature. The basin will also include a sediment forebay located at the inflow headwall, which will provide initial treatment and sediment collection.

3.1.13 The landscaping proposals will also be designed to introduce various ecological habitats which will be attractive to animals, insects and birds etc. They will form an intrinsic part of the overall landscaping and provide areas of interest to the residents.

3.1.14 In addition to the basin some areas of hardstanding will be drained via the installation of filter drains, which are shown on the drainage strategy drawing. These will provide an additional level of water quality treatment.

3.1.15 In order to assess the performance of the sustainable drainage features a Simple Index Assessment (CIRIA SuDS Manual) has been undertaken using the HR Wallingford tool. Three separate assessments have been undertaken covering Rooves, Parking and Roads. The results in the appendices show that the proposed SuDS features provide adequate surface water quality management.

3.1.16 It is proposed that upon completion of the development the piped drainage systems upstream of the balancing pond, together with the downstream flow controls will be offered to Severn Trent Water for adoption into the public sewer network via the Section 104 adoption mechanism.

3.1.17 The long-term successful operation of the attenuation basin will be assured as it will be maintained by a bespoke management company under the requirements of the Flood and Water Management Act. A proposed SUDS management Strategy is in the Appendices.

3.1.18 The ultimate fully detailed design of the systems will be subject to the vetting and approval of these bodies and also the LLFA who will be consulted when applications are made for the discharge of relevant drainage related planning conditions.

3.2 Proposed finished floor levels and flood protection

3.2.1 There are very small areas of the site which are potentially affected by surface water flooding but as described previously these will become redundant and not affect the development. The 215 dwellings lie wholly within flood zone 1.

3.2.2 Therefore, there is no requirement for proposed finished floor levels to be artificially raised above surrounding ground levels.

3.3 Foul Water Drainage

3.3.1 Foul water generated by the proposals will be directed to the existing combined 375mm public sewer. A new manhole will be constructed between the existing Severn Trent Water manholes 2101 and 3001 to provide the outfall to the development.

3.3.2 Severn Trent Water have been approached for confirmation of available foul water capacity in the public foul water sewer network. A copy of their response is in the appendices.

3.3.3 Severn Trent Water were contacted with regard to the increase in plot count. A sewer capacity assessment was requested to understand if there will be an impact on the existing network. The assessment will not have an impact on the development. A copy of their response is in the appendices.

4.0 CONCLUSIONS

4.1 Flood Risk, Flood Consequences and Development Location

4.1.1 The proposed developable area of the site lies totally within Flood Zone 1 and are not at significant risk of flooding from surface water or other sources.

4.1.2 Provision for the satisfactory disposal of surface and foul water are provided for, and suitable sustainable drainage features will be included in the site proposals.

4.1.3 The piped drainage systems will be submitted for technical approval by STW such that a Section 104 Agreement is in place. The sewerage will ultimately be adopted into the public sewer network.

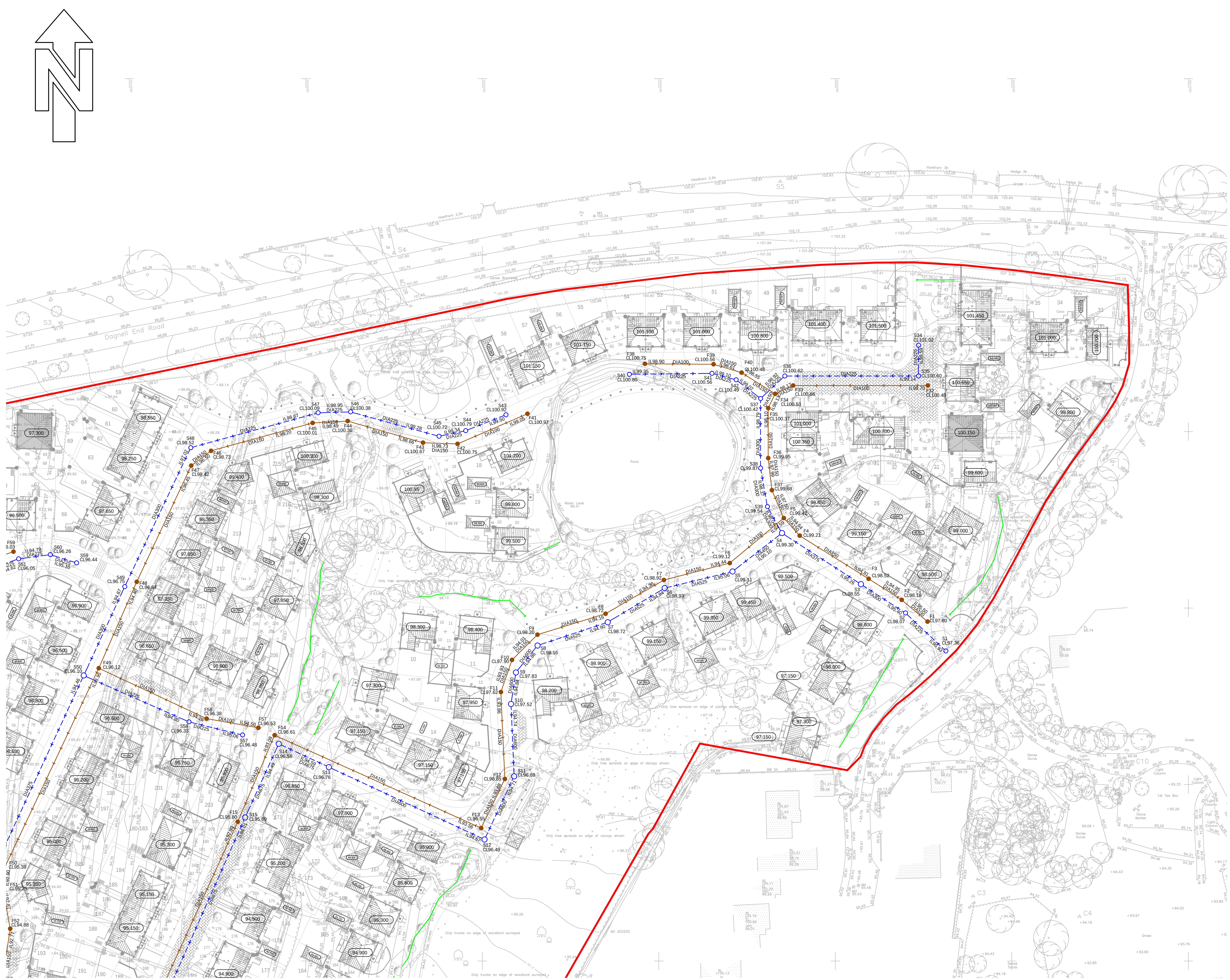
4.1.4 The surface water attenuation basin and downstream control structure will also be suitably and regularly maintained. This will ensure that the proposals will continue to operate as intended throughout the life of the development.

4.1.5 It is considered that the proposed scheme is in accordance with relevant planning policy and that approval to this application should not be withheld on flooding grounds.

5.0 APPENDICES

- Appendix 1 - Travis Baker Drawing 21169 – 1, 2 and 3 Preliminary Drainage Strategy and Finished Floor Levels
- Appendix 2 - Topographical Survey
- Appendix 3 - Environment Agency Product 4 Detailed Flood Risk Data
- Appendix 4 - HR Wallingford Greenfield Runoff Rate Calculation
- Appendix 5 - 21169 - Hither Green SW Input and Results
- Appendix 6 - SUDS Maintenance Strategy
- Appendix 7 - Severn Trent Water Development Enquiry Response and Sewer Records
- Appendix 8 – Seven Trent Water Existing Sewer Capacity Check
- Appendix 9 – Simple Index Assessments for SuDS features
- Appendix 10 – NWWM (LLFA) response

Appendix 1 – Travis Baker Drawing 21169 – 1, 2 and 3 Preliminary Drainage Strategy and Finished Floor Levels



KEY

- SITE BOUNDARY
- (00.000) FINISHED FLOOR LEVEL
- SECTION 104 ADOPTABLE SURFACE WATER SEWER
- SECTION 104 ADOPTABLE FOUL WATER SEWER
- PROPOSED EASEMENT
- SECTION 104 ADOPTABLE FLOW CONTROL
- SECTION 104 ADOPTABLE HEADWALL
- EX - FWS — EXISTING FOUL WATER SEWER
- EXCEEDANCE FLOW ROUTES
- FILTER DRAIN

1. THE INFORMATION SHOWN ON THIS DRAWING IS PRELIMINARY ONLY AND SUBJECT TO DETAILED DESIGN.
2. ROADS HAVE BEEN DESIGNED AT 300mm ABOVE EXISTING GROUND LEVEL WHERE POSSIBLE.
3. PLOTS ARE PRIMARILY SET APPROX. 450mm ABOVE EXISTING GROUND LEVEL HOWEVER ADJUSTED TO TIE IN TO THE ROAD DESIGN.
4. THE DRAINAGE HAS BEEN DESIGNED TO 1:100YR RETURN PERIOD + 40% CLIMATE CHANGE.
5. 10% URBAN CREEP HAS BEEN APPLIED TO PRIVATE IMPERMEABLE AREAS.
6. ONLY SIGNIFICANT RETAINING 450mm+ IS SHOWN
7. MAX GARDEN GRADIENTS ASSUMED 1:12

REV	DESCRIPTION	DATE	BY	AUTH
C	DRAINAGE AMENDED & FILTER DRAIN ADDED. AMENDED	23.03.22	MG	DB
B	LASTEST LAYOUT ADDED. RED LINE BOUNDARY AMENDED	20.09.21	LH	MG
A	RETAINERS, TANKING AND EXPOSED BRICKWORK ADDED.	13.08.21	LH	MG

Travis Baker
Trinity Point
New Road
Halesowen
West Midlands
B63 3HY

Tel: 0121 550 8037
Fax: 0121 550 8047

info@travisbaker.co.uk
www.travisbaker.co.uk

CLIENT
DAVID WILSON HOMES MERCIA

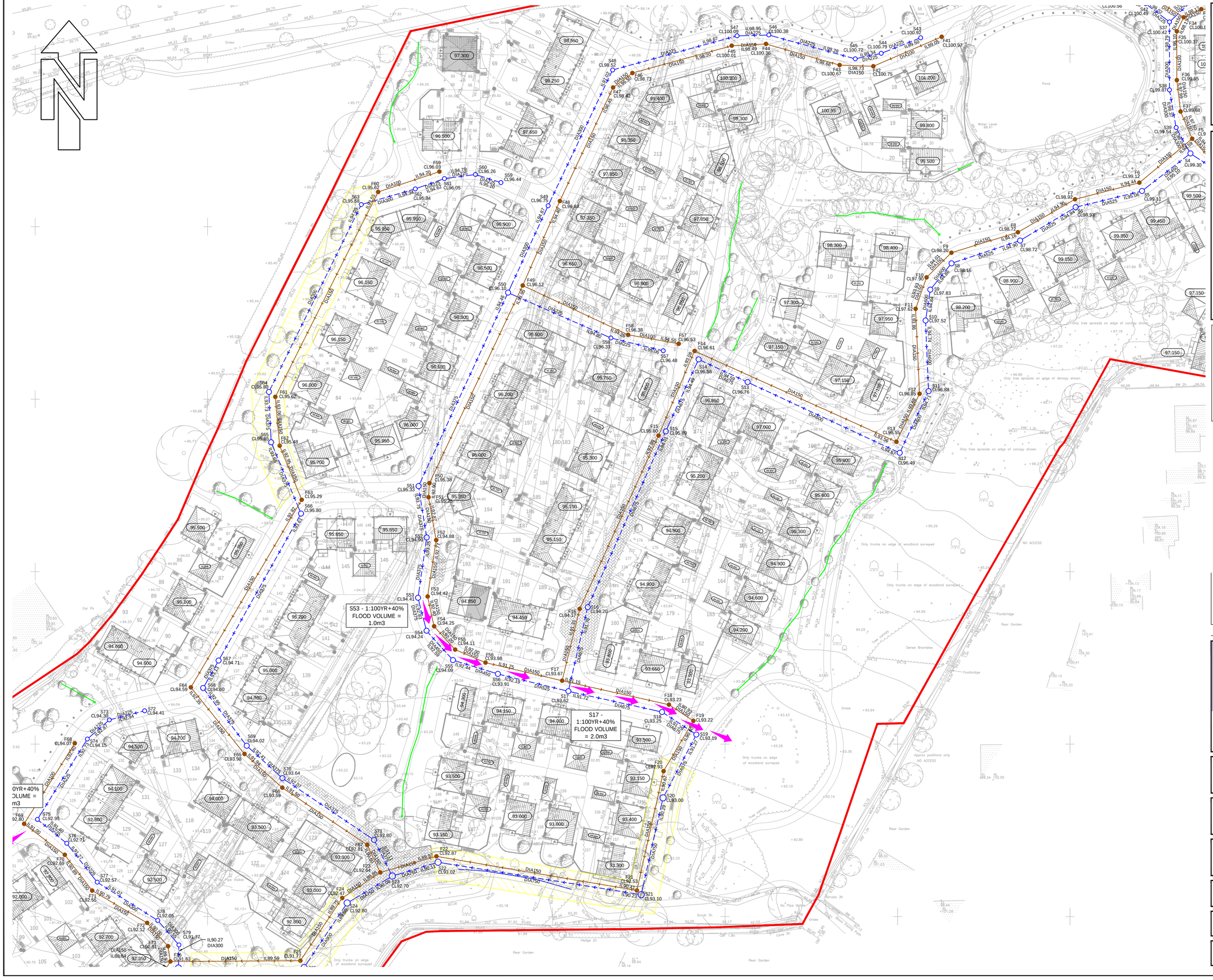
PROJECT
HITHER GREEN, REDDITCH

TITLE
PRELIMINARY DRAINAGE STRATEGY AND FINISHED FLOOR LEVELS - SHEET 1

DRAWN	AUTHORISED	SCALE	DATE
MG	DB	1:500@A1	05.07.21

PROJECT NO.	DRAWING NO.	REV
21169	1	C

STATUS.
PRELIMINARY



1. DO NOT SCALE FROM THIS DRAWING. IF IN DOUBT CONTACT TRAVIS BAKER LIMITED.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS RELATING TO THIS PROJECT.
4. ALL DIMENSIONS SHOULD BE CHECKED ON SITE PRIOR TO CONSTRUCTION. ANY DISCREPANCIES SHOULD BE IMMEDIATELY NOTIFIED IN WRITING TO TRAVIS BAKER LIMITED.
5. THE CONTRACTOR SHALL PRIOR TO CONSTRUCTION CHECK AND VERIFY THAT THE DETAILS SHOWN ON THIS DRAWING ARE FULLY COMPATIBLE WITH ANY AS CONSTRUCTED DIMENSIONS OR LEVELS. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY IN WRITING TO TRAVIS BAKER LIMITED.
6. THIS DRAWING HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF THE COMMISSIONING PARTY AND UNLESS AGREED IN WRITING BY TRAVIS BAKER LIMITED NO OTHER PARTY MAY USE OR RELY ON ITS CONTENTS. NO LIABILITY IS ACCEPTED BY TRAVIS BAKER LIMITED FOR ANY USE OF THIS DRAWING OTHER THAN FOR THE PURPOSE FOR WHICH IT WAS ORIGINALLY PREPARED.
7. IT SHOULD BE NOTED THAT THIS DRAWING MAY INCLUDE DATA PROVIDED BY THIRD PARTIES. NO LIABILITY IS ACCEPTED BY TRAVIS BAKER LIMITED AS TO THE ACCURACY OF THIS DATA.
8. THIS DRAWING SHALL NOT BE REPRODUCED IN ANY WAY WITHOUT THE WRITTEN PERMISSION OF TRAVIS BAKER LIMITED.

KEY

- SITE BOUNDARY
- 00.000 — FINISHED FLOOR LEVEL
- SECTION 104 ADOPTABLE SURFACE WATER SEWER
- SECTION 104 ADOPTABLE FOUL WATER SEWER
- PROPOSED EASEMENT
- SECTION 104 ADOPTABLE FLOW CONTROL
- SECTION 104 ADOPTABLE HEADWALL
- EXISTING FOUL WATER SEWER
- EXCEEDANCE FLOW ROUTES
- FILTER DRAIN

1. THE INFORMATION SHOWN ON THIS DRAWING IS PRELIMINARY ONLY AND SUBJECT TO DETAILED DESIGN.
2. ROADS HAVE BEEN DESIGNED AT 300mm ABOVE EXISTING GROUND LEVEL WHERE POSSIBLE.
3. PLOTS ARE PRIMARILY SET APPROX. 450mm ABOVE EXISTING GROUND LEVEL HOWEVER ADJUSTED TO TIE IN TO THE ROAD DESIGN.
4. THE DRAINAGE HAS BEEN DESIGNED TO 1:100YR RETURN PERIOD + 40% CLIMATE CHANGE.
5. 10% URBAN CREEP HAS BEEN APPLIED TO PRIVATE IMPERMEABLE AREAS.
6. ONLY SIGNIFICANT RETAINING 450mm+ IS SHOWN
7. MAX GARDEN GRADIENTS ASSUMED 1:12

REV	DESCRIPTION	DATE	BY	AUTH
C	DRAINAGE AMENDED & FILTER DRAIN ADDED. AMENDED	23.03.22	MG	DB
B	LASTEST LAYOUT ADDED. RED LINE BOUNDARY AMENDED	20.09.21	LH	MG
A	RETAINERS, TANKING AND EXPOSED BRICKWORK ADDED.	13.08.21	LH	MG

travis baker

Travis Baker
Trinity Point
New Road
Halesowen
West Midlands
B63 3HY

Tel: 0121 550 8037
Fax: 0121 550 8047

info@travisbaker.co.uk
www.travisbaker.co.uk

CLIENT
DAVID WILSON HOMES MERCIA

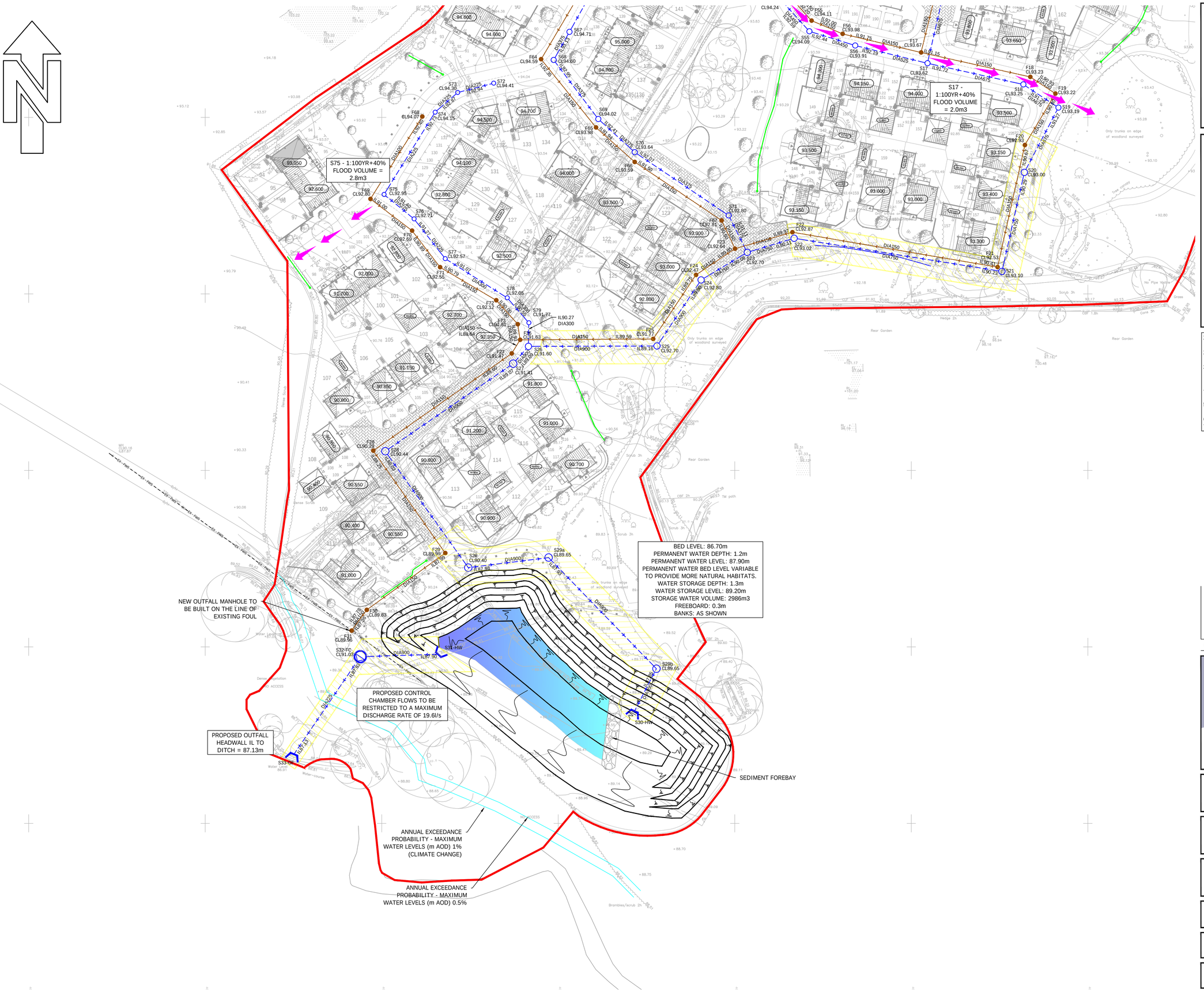
PROJECT
HITHER GREEN, REDDITCH

TITLE
PRELIMINARY DRAINAGE STRATEGY AND FINISHED FLOOR LEVELS - SHEET 2

DRAWN	AUTHORISED	SCALE	DATE
MG	DB	1:500@A1	05.07.21

PROJECT NO.	DRAWING NO.	REV
21169	2	C

STATUS.
PRELIMINARY



1. DO NOT SCALE FROM THIS DRAWING. IF IN DOUBT CONTACT TRAVIS BAKER LIMITED.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS RELATING TO THIS PROJECT.
4. ALL DIMENSIONS SHOULD BE CHECKED ON SITE PRIOR TO CONSTRUCTION. ANY DISCREPANCIES SHOULD BE IMMEDIATELY NOTIFIED IN WRITING TO TRAVIS BAKER LIMITED.
5. THE CONTRACTOR SHALL PRIOR TO CONSTRUCTION CHECK AND VERIFY THAT THE DETAILS SHOWN ON THIS DRAWING ARE FULLY COMPATIBLE WITH ANY AS CONSTRUCTED DIMENSIONS OR LEVELS. ANY DISCREPANCIES TO BE REPORTED IMMEDIATELY IN WRITING TO TRAVIS BAKER LIMITED.
6. THIS DRAWING HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF THE COMMISSIONING PARTY AND UNLESS AGREED IN WRITING BY TRAVIS BAKER LIMITED NO OTHER PARTY MAY USE OR RELY ON ITS CONTENTS. NO LIABILITY IS ACCEPTED BY TRAVIS BAKER LIMITED FOR ANY USE OF THIS DRAWING OTHER THAN FOR THE PURPOSE FOR WHICH IT WAS ORIGINALLY PREPARED.
7. IT SHOULD BE NOTED THAT THIS DRAWING MAY INCLUDE DATA PROVIDED BY THIRD PARTIES. NO LIABILITY IS ACCEPTED BY TRAVIS BAKER LIMITED AS TO THE ACCURACY OF THIS DATA.
8. THIS DRAWING SHALL NOT BE REPRODUCED IN ANY WAY WITHOUT THE WRITTEN PERMISSION OF TRAVIS BAKER LIMITED.

KEY

- SITE BOUNDARY
- 00.000 — FINISHED FLOOR LEVEL
- SECTION 104 ADOPTABLE SURFACE WATER SEWER
- SECTION 104 ADOPTABLE FOUL WATER SEWER
- PROPOSED EASEMENT
- SECTION 104 ADOPTABLE FLOW CONTROL
- SECTION 104 ADOPTABLE HEADWALL
- EX - FWS — EXISTING FOUL WATER SEWER
- EXCEEDANCE FLOW ROUTES
- FILTER DRAIN

1. THE INFORMATION SHOWN ON THIS DRAWING IS PRELIMINARY ONLY AND SUBJECT TO DETAILED DESIGN.
2. ROADS HAVE BEEN DESIGNED AT 300mm ABOVE EXISTING GROUND LEVEL WHERE POSSIBLE.
3. PLOTS ARE PRIMARILY SET APPROX. 450mm ABOVE EXISTING GROUND LEVEL HOWEVER ADJUSTED TO TIE IN TO THE ROAD DESIGN.
4. THE DRAINAGE HAS BEEN DESIGNED TO 1:100YR RETURN PERIOD + 40% CLIMATE CHANGE.
5. 10% URBAN CREEP HAS BEEN APPLIED TO PRIVATE IMPERMEABLE AREAS.
6. ONLY SIGNIFICANT RETAINING 450mm+ IS SHOWN
7. MAX GARDEN GRADIENTS ASSUMED 1:12

REV	DESCRIPTION	DATE	BY	AUTH
C	DRAINAGE AMENDED & FILTER DRAIN ADDED. AMENDED	23.03.22	MG	DB
B	LASTEST LAYOUT ADDED. RED LINE BOUNDARY AMENDED	20.09.21	LH	MG
A	RETAINERS, TANKING AND EXPOSED BRICKWORK ADDED.	13.08.21	LH	MG

travis baker

Travis Baker
Trinity Point
New Road
Halesowen
West Midlands
B63 3HY

Tel: 0121 550 8037
Fax: 0121 550 8047

info@travisbaker.co.uk
www.travisbaker.co.uk

CLIENT
DAVID WILSON HOMES MERCIA

PROJECT
HITHER GREEN, REDDITCH

TITLE
PRELIMINARY DRAINAGE STRATEGY AND FINISHED FLOOR LEVELS - SHEET 3

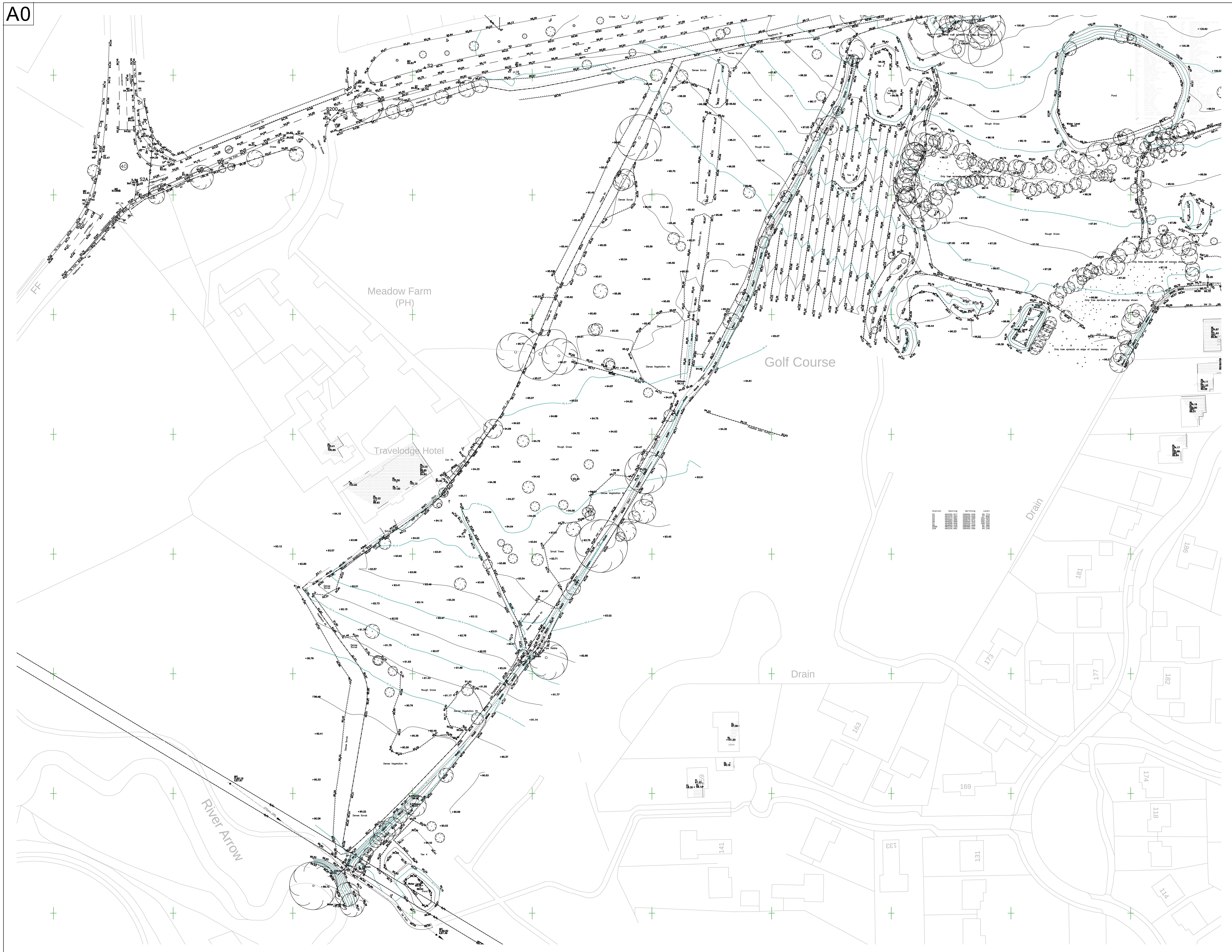
DRAWN	AUTHORISED	SCALE	DATE
MG	DB	1:500@A1	05.07.21

PROJECT NO.	DRAWING NO.	REV
21169	3	C

STATUS.
PRELIMINARY

Appendix 2 – Topographical Survey

A0



The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work starts. The Contractor is to comply in all respects with current Building Legislation, British Standard Specifications, Building Regulations, Construction (Design & Management) Regulations, Party Wall Act, etc. whether or not specifically stated on this drawing. This drawing must be read with and checked against any structural, geotechnical or other specialist documentation provided. This drawing is not intended to show details of foundations, ground conditions or ground contaminants. Each area of ground relied upon to support any structure depicted (including drainage) must be investigated by the Contractor. A suitable method of foundation should be provided allowing for existing ground conditions. Any suspect or fluid ground, contaminates on or within the ground, should be further investigated by a suitable expert. Any earthwork constructions shown indicate typical slopes for guidance only & should be further investigated by a suitable expert. Where existing trees are to be retained they should be subject to a full Arboricultural inspection for safety. All trees are to be planted so as to ensure they are a minimum of 5 metres from buildings and 3 metres from drainage and services. A suitable method of foundation is to be provided to accommodate the proposed tree planting.
Geoff Perry Associates Limited do not accept any responsibility for any losses (financial or otherwise) to any Client or third party arising out of the Clients (be it Developer or Contractor but not limited thereto) non-compliance with afore mentioned provisos.
c This drawing is the property of Geoff Perry Associates Limited and may not be copied or used for any purpose other than that for which it is supplied without the express written authority of Geoff Perry Associates Limited.
This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via a Global Position System (GPS) and the O.S. Active Network (OS Net). A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models. The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.
No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.
Please refer to Survey Station Table to enable establishment of the on-site grid.
3D Information frozen on layer TRIANGLES

Scale Check:

1:20 - 0 200mm 400mm 600mm 800mm 1000 1200 1400 1600 1800 2000
1:100 - 0 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m
1:50 - 0 1m 2m 3m 4m 5m
1:5 - 0 100mm 200mm 300mm 400mm 500mm

Revisions:

Client:
Barratt Developments Plc

Project:
Dagnell End Road, Redditch

Title:
Site Survey
Sheet 1 of 2

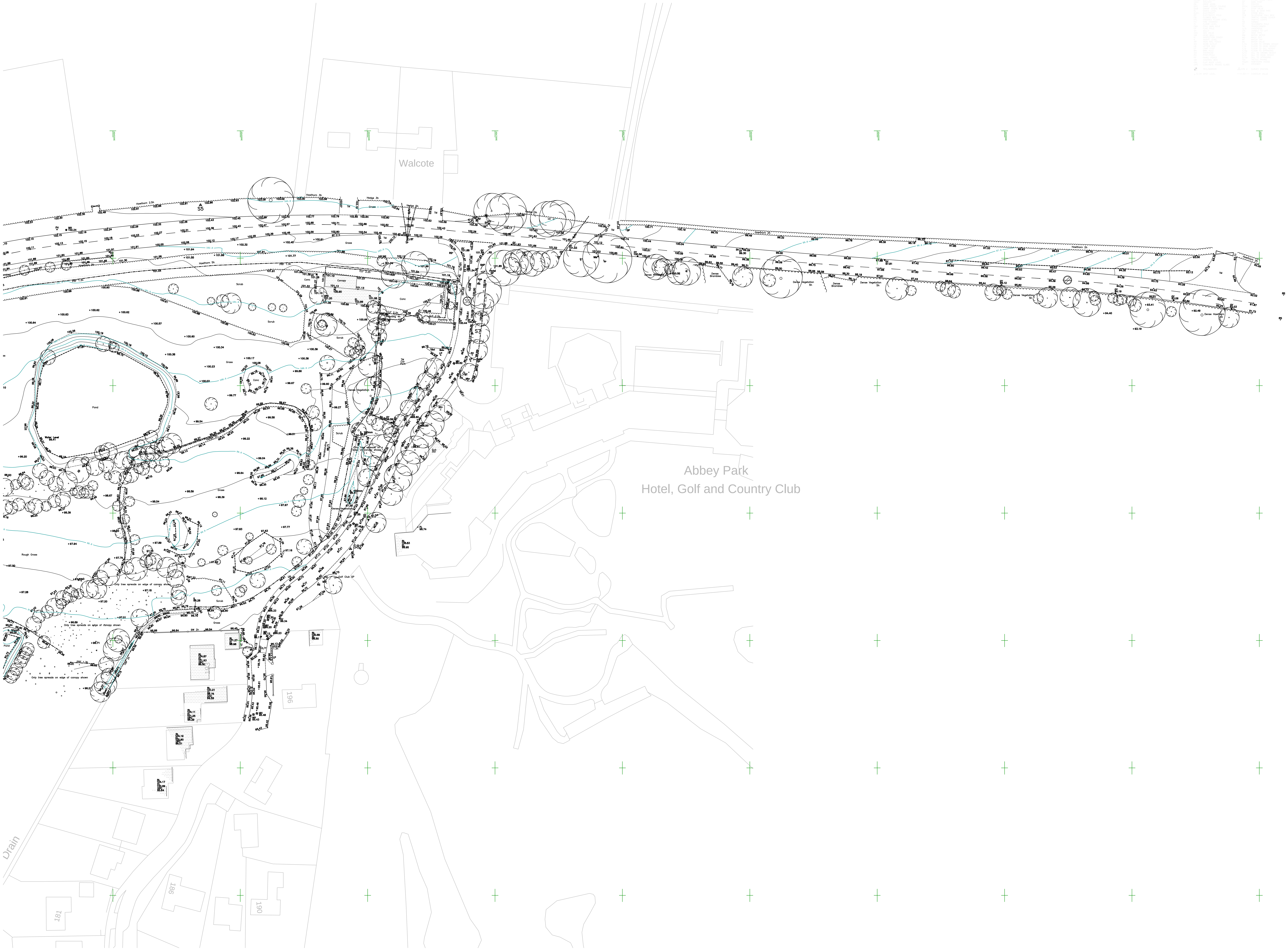
Date: July 2016 Scale: 1:500 @ A0
Drawn by: ICP Checked by DW

Job No.	Drwg No.	Rev.
S 219	635	

gp SURVEYING

The Shrubbery, 28 Erdington Road,
Aldridge, Walsall, WS9 8UH
t: 01922 744900 f: 01922 744901
enquiries@geoffperryassoc.co.uk

A0



The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work starts. The Contractor is to comply in all respects with current Building Legislation, British Standard Specifications , Building Regulations, Construction (Design & Management) Regulations, Party Wall Act, etc. whether or not specifically stated on this drawing. This drawing must be read with and checked against any structural, geotechnical or other specialist documentation provided. This drawing is not intended to show details of foundations, ground conditions or ground contaminants. Each area of ground relied upon to support any structure depicted (including drainage) must be investigated by the Contractor. A suitable method of foundation should be provided allowing for existing ground conditions. Any suspect or fluid ground, contaminates on or within the ground, should be further investigated by a suitable expert. Any earthwork constructions shown indicate typical slopes for guidance only & should be further investigated by a suitable expert. Where existing trees are to be retained they should be subject to a full Arboricultural inspection for safety. All trees are to be planted so as to ensure they are a minimum of 5 metres from buildings and 3 metres from drainage and services. A suitable method of foundation is to be provided to accommodate the proposed tree planting.

Geoff Perry Associates Limited do not accept any responsibility for any losses (financial or otherwise) to any Client or third party arising out of the Clients (be it Developer or Contractor but not limited thereto) non-compliance with afore mentioned provisos.

This survey has been orientated to the Ordnance Survey (O.S) National Grid (OSGB36) via a Global Position System (GPS) and the O.S. Active Network (OS Net). A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models. The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.
No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.
Please refer to Survey Station Table to enable establishment of the on-site grid.
3D Information frozen on layer TRIANGLES

Scale Check:

1:20 - 0 200mm 400mm 600mm 800mm 1000 1200 1400 1600 1800 2000
1:100- 0 1m 2m 3m 4m 5m 6m 7m 8m 9m 10m
1:50 - 0 1m 2m 3m 4m 5m
1:5 - 0 100mm 200mm 300mm 400mm 500mm

Revisions:

Client:
Barratt Developments Plc

Project:
Dagnell End Road, Redditch

Title:
Site Survey
Sheet 2 of 2

Date: July 2016 Scale: 1:500 @ A0
Drawn by: ICP Checked by DW

Job No.	Drwg No.	Rev.
S 219	635	

SURVEYING

The Shrubbery, 28 Erdington Road,
Aldridge, Walsall, WS9 8UH
t: 01922 744900 f: 01922 744901
enquiries@geoffperryassoc.co.uk

Appendix 3 – Environment Agency Product 4 Detailed Flood Risk Data

Product 4 (Detailed Flood Risk Data) for Flood data for development adjacent to River Arrow, Redditch

Reference number: 212168
Date of issue: 24 June 2021

Model Information

The following information and attached maps contain a summary of the modelled information relevant to the area of interest. The information provided is based on the best available data as of the date of issue.

Model Name	Release Date
River Arrow	2009

The Environment Agency Fluvial Modelling Standards recent publication "Delivering Benefits Through Evidence" can be found in the attached sharefile link https://ea.sharefile.com/d-s8ab48c627aaa4f01b5bd81bc05a8fbde

Flood Map for Planning (Rivers and Sea)

The Flood Map for Planning (Rivers and Sea) indicates the area at risk of flooding, **assuming no flood defences exist**, for a flood event with a 0.5% chance of occurring in any year for flooding from the sea, or a 1% chance of occurring in any year for fluvial (river) flooding (Flood Zone 3). It also shows the extent of the Extreme Flood Outlines (Flood Zone 2) which represents the extent of a flood event with a 0.1% chance of occurring in any year, or the highest recorded historic extent if greater. The Flood Zones refer to the land at risk of flooding and **do not** refer to individual properties. It is possible for properties to be built at a level above the floodplain but still fall within the risk area.

This Flood Map only indicates the extent and likelihood of flooding from rivers or the sea. It should also be remembered that flooding may occur from other sources such as surface water, sewers, road drainage, etc.

To find out which flood zone a location is in please use: https://flood-map-for-planning.service.gov.uk/

Definition of flood zones

- **Zone 1** - The area is within the lowest probability of flooding from rivers and the sea, where the chance of flooding in any one year is less than 0.1% (i.e. a 1000 to 1 chance).

Email: Enquiries_Westmids@environment-agency.gov.uk
Website: www.gov.uk/government/organisations/environment-agency

- **Zone 2** - The area which falls between the extent of a flood with an annual probability of 0.1% (i.e. a 1000 to 1 chance) fluvial and tidal, or greatest recorded historic flood, whichever is greater, and the extent of a flood with an annual probability of 1% (i.e. a 100 to 1 chance) fluvial / 0.5% (i.e. a 200 to 1 chance) tidal. (Land shown in light blue on the Flood Map).
- **Zone 3** - The chance of flooding in any one year is greater than or equal to 1% (i.e. a 100 to 1 chance) for river flooding and greater than or equal to 0.5% (i.e. a 200 to 1 chance) for coastal and tidal flooding.

Note: The Flood Zones shown on the Environment Agency's Flood Map for Planning (Rivers and Sea) do not take account of the possible impacts of climate change and consequent changes in the future probability of flooding. Reference should therefore also be made to the Strategic Flood Risk Assessment when considering location and potential future flood risks to developments and land uses.

Node Data

The attached map shows a selection of 1D model node points near to your site. The fluvial levels for these node points are shown below.

Fluvial Flood Levels (m AOD)

The modelled levels are given in m AOD (N), m AOD indicates metres Above Ordnance Datum (Newlyn).

The information is taken from the model referenced above and does not include the updated climate change figures.

				Annual Exceedance Probability -Maximum Water Levels (mAOD) Defended								
Node Label	MODEL	EASTING	NORTHING	20% (1 in 5)	10% (1 in 10)	5% (1 in 20)	2% (1 in 50)	1.33% (1 in 75)	1% (1 in 100)	1% (Climate Change)	0.5% (1 in 200)	0.1% (1 in 1000)
RAR27249	Arrow & Alne SFRM 2009	404641	268905	86.17	86.34	86.5	86.71	86.81	86.88	86.94	86.98	87.26
RAR28245	Arrow & Alne SFRM 2009	404006	269290	88.99	89.21	89.5	89.98	90.28	90.57	90.86	91	91.79
RAR28245D	Arrow & Alne SFRM 2009	404021	269278	88.91	89.11	89.33	89.65	89.8	89.93	90.14	90.28	90.92

				AEP-Max. Water levels m(AOD) Undefended	
Node Label	MODEL	EASTING	NORTHING	1% (1 in 100)	0.1% (1 in 1000)
RAR27249	Arrow & Alne SFRM 2009	404641	268905	86.88	87.26
RAR28245	Arrow & Alne SFRM 2009	404006	269290	90.57	91.79
RAR28245D	Arrow & Alne SFRM 2009	404021	269278	89.93	90.92

Email: Enquiries_Westmids@environment-agency.gov.uk
Website: www.gov.uk/government/organisations/environment-agency

Climate Change

In February 2016 the 'Flood Risk Assessments: Climate Change Allowances' were published on GOV.UK. This is in replacement of previous climate change allowances for planning applications. The data provided in this product does not include the new allowances. You will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding. The fluvial climate change factors are now more complex and a single uplift percentage across England cannot be justified.

The Environment Agency will incorporate the new allowances into future modelling studies. For now, it remains the applicant's responsibility to demonstrate through their proposal and flood risk assessments that new developments will be safe in flood risk terms for its lifetime.

Recorded Flood Outlines

Following examination of our records of historical flooding we have no record of flooding in the area. The absence of coverage for an area does not mean that the area has never flooded, only that we do not currently have records of flooding in this area. It is also possible that the pattern of flooding in this area has changed and that this area would now flood or not flood under different circumstances.

You may also wish to contact your Local Authority or Internal Drainage Board, to see if they have other relevant local flood information.

Flood Defences

There are no formal flood defences owned or operated by the Environment Agency protecting this site. You may wish to contact the Local Authority to obtain further information regarding localised flooding from drains, culverts and small watercourses, and regarding existing or planned flood defence measures.

Planning development/s

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency Information for Flood Risk Assessments. You can also request pre application advice:

https://www.gov.uk/planning-applications-assessing-flood-risk
https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Supporting Information

Surface Water

Managing the risk of flooding from surface water is the responsibility of Lead Local Flood Authorities. The 'risk of flooding from surface water' map has been produced by the Environment Agency on behalf of government, using information and input from Lead Local Flood Authorities.

You may wish to contact your Local Authority who may be able to provide further detailed information on surface water.

It is not possible to say for certain what the flood risk is but we use the best information available to provide an indication so that people can make informed choices about living with or managing the risks. The information we supply does not provide an indicator of flood risk at an individual site level. Further information can be found on the Agency's website:

https://flood-warning-information.service.gov.uk/long-term-flood-risk

Flood Risk from Reservoirs

The Flood Risk from Reservoirs map can be found on the Long Term Flood Risk Information website:

https://flood-warning-information.service.gov.uk/long-term-flood-risk/map?map=Reservoirs

Flood Alert & Flood Warning Area

We issue flood alert/warnings to specific areas when flooding is expected. If you receive a flood warning you should take immediate action.

You can check whether you are in a Flood Alert/Warning Area and register online using the links below:

https://www.gov.uk/check-flood-risk

https://www.gov.uk/sign-up-for-flood-warnings

If you would prefer to register by telephone, or if you need help during the registration process, please call Floodline on 0345 988 1188.

The associated dataset for flood warning areas is available here: https://data.gov.uk/dataset/flood-warning-areas3

The associated dataset for flood alert areas is available here: https://data.gov.uk/dataset/flood-alert-areas2

Flood Risk Activity Permits

We now consider applications for works, which may be Flood Risk Activities, under Environmental Permitting Regulations. This replaces the process of applying for a Flood Defence Consent. You may need an environmental Permit for flood risk activities if you want to do work:

- in, under, over or near a main river (including where the river is in a culvert)
- on or near a flood defence on a main river
- in the flood plain of a main river
- on or near a sea defence

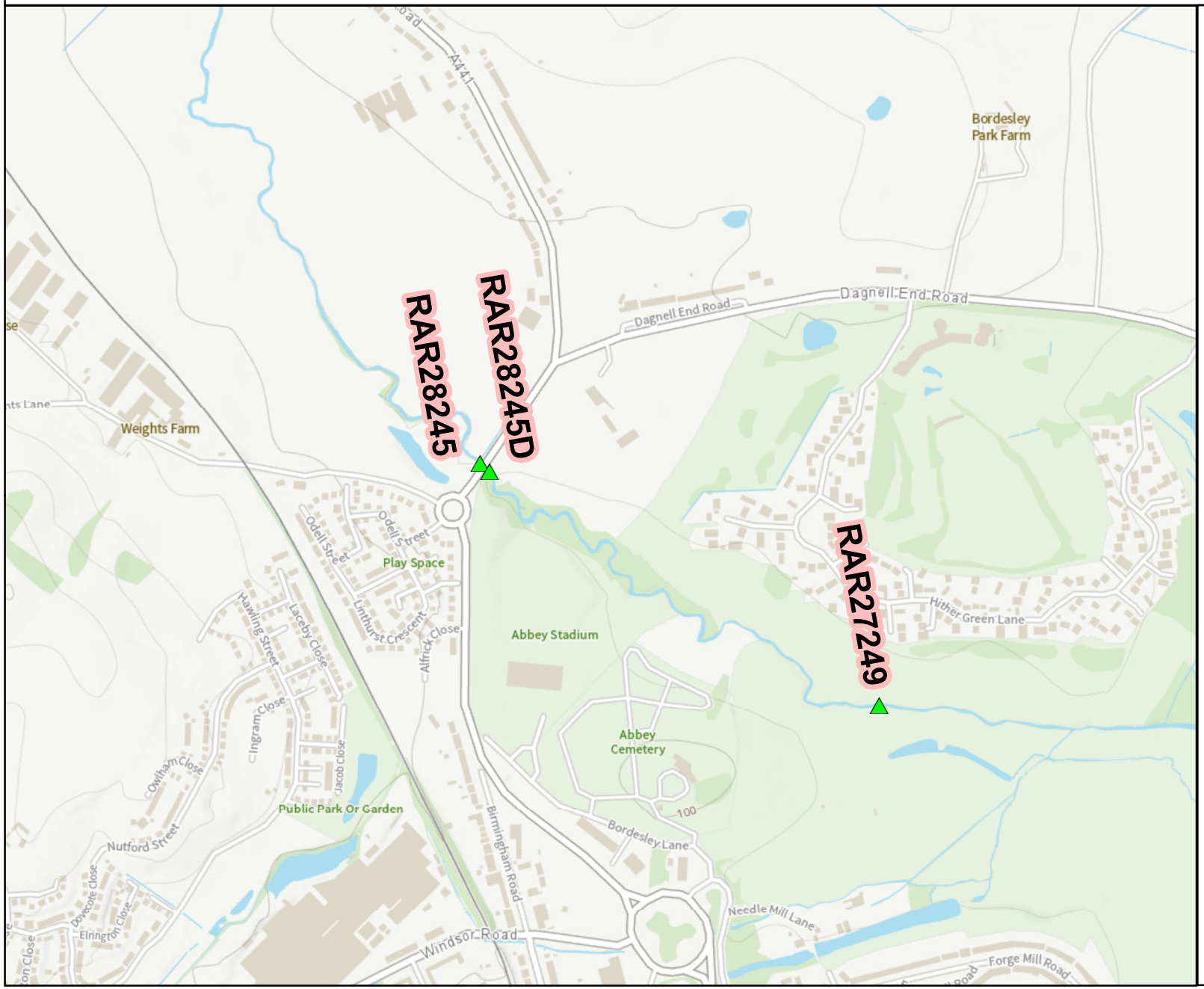
Please go to this website to find out more about how to apply:
https://www.gov.uk/guidance/flood-risk-activities-environmental-permits.
Please be aware that Bespoke and Standard Rules permits can take up to 2 months to determine and will incur a charge.

Further details about the Environment Agency information supplied can be found on the GOV.UK website:

https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather

Email: Enquiries_Westmids@environment-agency.gov.uk
Website: www.gov.uk/government/organisations/environment-agency

Node Point Location Plan, Ref. 212168



Environment Agency

Legend

- Modelled Levels selection

Scale: 1:9,000
Created: 24/06/2021
Eastings: 404,198
Northings: 269,239

N
W E
S

Appendix 4 – HR Wallingford Greenfield Runoff Rate Calculation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Mathew Grainger
Site name:	Hither Green Lane
Site location:	Redditch

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.32094° N
Longitude:	1.93949° W
Reference:	3894177153
Date:	Jul 07 2021 09:28

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	711	711
Hydrological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 30 years:	2	2
Growth curve factor 100 years:	2.57	2.57
Growth curve factor 200 years:	3.04	3.04

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	4.92	4.92
1 in 1 year (l/s):	4.08	4.08
1 in 30 years (l/s):	9.83	9.83
1 in 100 year (l/s):	12.64	12.64
1 in 200 years (l/s):	14.95	14.95

Appendix 5 – 21169 – Hither Green SW Input and Results

Drainage Design Report

Flow

v10.1

Network	Storm Network 1
Filename	21169-HITHER GREEN SW&FW.PFD
Username	Mathew Grainger (mathew.grainger@travisbaker.co.uk)
Last analysed	12/07/2021 12:06:05
Report produced on	12/07/2021 12:23:18

Causeway Sales

Tel:	+44(0) 1628 552000
Fax:	+44(0) 1628 552001
Email:	marketing@causeway.com
Web:	www.causeway.com

Technical support web portal:

http://support.causeway.com

Rainfall Methodology	FSR
Return Period (years)	2
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	20.000
Ratio-R	0.400
CV	0.750
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	9.000
Preferred Cover Depth (m)	1.200
Include Intermediate Ground	Yes
Enforce best practice design rules	Yes

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)	US Node	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Sump (m)	Node Type	MH Type
1.000	15.711	34.4	225	Circular_Default Sewer Type	97.357	95.932	1.200	98.066	95.475	2.366	1	1200			Manhole	Adoptable	2	1200			Manhole	Adoptable
1.001	15.055	242.8	300	Circular_Default Sewer Type	98.066	95.400	2.366	98.553	95.338	2.915	2	1200			Manhole	Adoptable	3	1500			Manhole	Adoptable
1.002	26.616	320.7	375	Circular_Default Sewer Type	98.553	95.263	2.915	99.295	95.180	3.740	3	1500			Manhole	Adoptable	4	1500			Manhole	Adoptable
2.000	8.730	19.5	225	Circular_Default Sewer Type	101.017	99.592	1.200	100.600	99.145	1.230	34	1200			Manhole	Adoptable	35	1200			Manhole	Adoptable
2.001	37.870	169.8	225	Circular_Default Sewer Type	100.600	99.145	1.230	100.619	98.922	1.472	35	1200			Manhole	Adoptable	36	1200			Manhole	Adoptable
2.002	9.378	167.5	225	Circular_Default Sewer Type	100.619	98.922	1.472	100.416	98.866	1.325	36	1200			Manhole	Adoptable	37	1200			Manhole	Adoptable
3.000	23.396	94.1	225	Circular_Default Sewer Type	100.797	99.352	1.220	100.564	99.103	1.236	40	1200			Manhole	Adoptable	41	1200			Manhole	Adoptable
3.001	7.114	82.3	225	Circular_Default Sewer Type	100.564	99.103	1.236	100.487	99.017	1.245	41	1200			Manhole	Adoptable	42	1200			Manhole	Adoptable
3.002	8.708	57.7	225	Circular_Default Sewer Type	100.487	99.017	1.245	100.416	98.866	1.325	42	1200			Manhole	Adoptable	37	1200			Manhole	Adoptable
2.003	19.712	46.8	300	Circular_Default Sewer Type	100.416	98.791	1.325	99.870	98.370	1.200	37	1200			Manhole	Adoptable	38	1200			Manhole	Adoptable
2.004	11.089	33.8	300	Circular_Default Sewer Type	99.870	98.370	1.200	99.542	98.042	1.200	38	1200			Manhole	Adoptable	39	1200			Manhole	Adoptable
2.005	8.563	3.1	300	Circular_Default Sewer Type	99.542	98.042	1.200	99.295	95.255	3.740	39	1200			Manhole	Adoptable	4	1500			Manhole	Adoptable
1.003	17.766	403.8	450	Circular_Default Sewer Type	99.295	95.105	3.740	99.111	95.061	3.600	4	1500			Manhole	Adoptable	5	1500			Manhole	Adoptable
1.004	19.785	494.6	525	Circular_Default Sewer Type	99.111	94.986	3.600	98.932	94.946	3.461	5	1500			Manhole	Adoptable	6	1500			Manhole	Adoptable
1.005	18.792	494.5	525	Circular_Default Sewer Type	98.932	94.946	3.461	98.715	94.908	3.282	6	1500			Manhole	Adoptable	7	1500			Manhole	Adoptable
1.006	20.943	487.1	525	Circular_Default Sewer Type	98.715	94.908	3.282	98.164	94.865	2.774	7	1500			Manhole	Adoptable	8	1500			Manhole	Adoptable
1.007	9.792	576.0	600	Circular_Default Sewer Type	98.164	94.790	2.774	97.830	94.773	2.457	8	1500			Manhole	Adoptable	9	1500			Manhole	Adoptable
1.008	9.041	565.0	600	Circular_Default Sewer Type	97.830	94.773	2.457	97.519	94.757	2.162	9	1500			Manhole	Adoptable	10	1500			Manhole	Adoptable
1.009	20.500	569.5	600	Circular_Default Sewer Type	97.519	94.757	2.162	96.878	94.721	1.557	10	1500			Manhole	Adoptable	11	1500			Manhole	Adoptable
1.010	19.751	580.9	600	Circular_Default Sewer Type	96.878	94.721	1.557	96.493	94.687	1.206	11	1500			Manhole	Adoptable	12	1500			Manhole	Adoptable
1.011	48.638	579.0	600	Circular_Default Sewer Type	96.493	94.687	1.206	96.759	94.603	1.556	12	1500			Manhole	Adoptable	13	1500			Manhole	Adoptable
1.012	15.649	652.0	675	Circular_Default Sewer Type	96.759	94.528	1.556	96.585	94.504	1.406	13	1500			Manhole	Adoptable	14	1500			Manhole	Adoptable
1.013	22.936	46.5	675	Circular_Default Sewer Type	96.585	94.504	1.406	95.886	94.011	1.200	14	1500			Manhole	Adoptable	15	1500			Manhole	Adoptable
1.014	55.774	24.7	675	Circular_Default Sewer Type	95.886	94.011	1.200	94.199	91.757	1.767	15	1500			Manhole	Adoptable	16	1500			Manhole	Adoptable
1.015	25.009	675.9	675	Circular_Default Sewer Type	94.199	91.757	1.767	93.622	91.720	1.227	16	1500			Manhole	Adoptable	17	1500			Manhole	Adoptable
4.000	12.275	75.2	225	Circular_Default Sewer Type	100.925	99.500	1.200	100.793	99.337	1.231	43	1200			Manhole	Adoptable	44	1200			Manhole	Adoptable
4.001	7.714	146.7	225	Circular_Default Sewer Type	100.793	99.337	1.231	100.716	99.284	1.207	44	1200			Manhole	Adoptable	45	1200			Manhole	Adoptable
4.002	25.980	78.2	225	Circular_Default Sewer Type	100.716	99.284	1.207	100.377	98.952	1.200	45	1200			Manhole	Adoptable	46	1200			Manhole	Adoptable
4.003	9.207	32.7	225	Circular_Default Sewer Type	100.377	98.952	1.200	100.095	98.670	1.200	46	1200			Manhole	Adoptable	47	1200			Manhole	Adoptable
4.004	37.399	23.8	225	Circular_Default Sewer Type	100.095	98.670	1.200	98.521	97.096	1.200	47	1200			Manhole	Adoptable	48	1200			Manhole	Adoptable
4.005	43.607	20.3	300	Circular_Default Sewer Type	98.521	97.021	1.200	96.747	94.875	1.572	48	1200			Manhole	Adoptable	49	1200			Manhole	Adoptable
4.006	27.721	81.1	300	Circular_Default Sewer Type	96.747	94.875	1.572	96.100	94.533	1.267	49	1200			Manhole	Adoptable	50	1500			Manhole	Adoptable
5.000	15.625	60.0	225	Circular_Default Sewer Type	96.485	95.060	1.200	96.335	94.800	1.310	57	1200			Manhole	Adoptable	58	1200			Manhole	Adoptable
5.001	32.569	169.6	225	Circular_Default Sewer Type	96.335	94.800	1.310	96.100	94.608	1.267	58	1200			Manhole	Adoptable	50	1500			Manhole	Adoptable
4.007	61.808	87.8	375	Circular_Default Sewer Type	96.100	94.458	1.267	95.329	93.754	1.200	50	1500			Manhole	Adoptable	51	1500			Manhole	Adoptable
4.008	15.057	30.2	375	Circular_Default Sewer Type	95.329	93.754	1.200	94.902	93.255	1.272	51	1500			Manhole	Adoptable	52	1500			Manhole	Adoptable
4.009	17.692	42.0	375	Circular_Default Sewer Type	94.902	93.255	1.272	94.408	92.833	1.200	52	1500			Manhole	Adoptable	53	1500			Manhole	Adoptable
4.010	9.865	58.4	375	Circular_Default Sewer Type	94.408	92.833	1.200	94.239	92.664	1.200	53	1500			Manhole	Adoptable	54	1500			Manhole	Adoptable
4.011	11.440	75.8	450	Circular_Default Sewer Type	94.239	92.589	1.200	94.088	92.438	1.200	54	1500			Manhole	Adoptable	55	1500			Manhole	Adoptable
4.012	13.596	77.3	450	Circular_Default Sewer Type	94.088	92.438	1.200	93.912	92.262	1.200	55	1500			Manhole	Adoptable	56	1500			Manhole	Adoptable
4.013	21.059	66.4	525	Circular_Default Sewer Type	93.912	92.187	1.200	93.622	91.870	1.227	56	1500			Manhole	Adoptable	17	1500			Manhole	Adoptable
1.016	27.824	65.1	675	Circular_Default Sewer Type	93.622	91.720	1.227	93.255	91.293	1.287	17	1500			Manhole	Adoptable	18	1500			Manhole	Adoptable
1.017	11.893	495.5	675	Circular_Default Sewer Type	93.255	91.293	1.287	93.186	91.269	1.242	18	1500			Manhole	Adoptable	19	1500			Manhole	Adoptable
1.018	20.738	22.8	675	Circular_Default Sewer Type	93.186	91.269	1.242	93.000	90.361	1.964	19	1500			Manhole	Adoptable	20	1800			Manhole	Adoptable
1.019	28.758	495.8	750	Circular_Default Sewer Type	93.000	90.286	1.964	93.100	90.228	2.122	20	1800			Manhole	Adoptable	21	1800			Manhole	Adoptable
1.020	59.628	500.0	750	Circular_Default Sewer Type	93.100	90.228	2.122	93.025	90.109	2.166	21	1800			Manhole	Adoptable	22	1800			Manhole	Adoptable
1.021	13.860	500.0	750	Circular_Default Sewer Type	93.025	90.109	2.166	92.697	90.081	1.866	22	1800			Manhole	Adoptable	23	1800			Manhole	Adoptable
6.000	7.762	24.6	225	Circular_Default Sewer Type	96.440	95.102	1.113	96.264	94.787	1.252	59	1200			Manhole	Adoptable	60	1200			Manhole	Adoptable
6.001	9.084	55.2	225	Circular_Default Sewer Type	96.264	94.787	1.252	96.047	94.622	1.200	60	1200			Manhole	Adoptable	61	1200			Manhole	Adoptable
6.002	8.938	43.4	225	Circular_Default Sewer Type	96.047	94.622	1.200	95.841	94.416	1.200	61	1200			Manhole	Adoptable	62	1200			Manhole	Adoptable
6.003	16.294	56.4	300	Circular_Default Sewer Type	95.841	94.341	1.200	95.582	94.052	1.230	62	1200			Manhole	Adoptable	63	1200			Manhole	Adoptable
6.004	60.578	244.3	300	Circular_Default Sewer Type	95.582	94.052	1.230	95.800	93.804	1.696	63	1200			Manhole	Adoptable	64	1500			Manhole	Adoptable
6.005	14.593	324.3	375	Circular_Default Sewer Type	95.800	93.729	1.696	95.850	93.684	1.791	64	1500			Manhole	Adoptable	65	1500			Manhole	Adoptable
6.006	22.417	320.2	375	Circular_Default Sewer Type	95.850	93.684	1.791	95.800	93.614	1.811	65	1500			Manhole	Adoptable	66	1500			Manhole	Adoptable
6.007	48.858	101.8	375	Circular_Default Sewer Type	95.800	93.614	1.811	94.709	93.134	1.200	66	1500			Manhole	Adoptable	67	1500			Manhole	Adoptable
6.008	9.149	49.4	375	Circular_Default Sewer Type	94.709	93.134	1.200	94.600	92.949	1.276	67	1500			Manhole	Adoptable	68	1500			Manhole	Adoptable
6.009	20.965	39.1	375	Circular_Default Sewer Type	94.600	92.949	1.276	94.016	92.413	1.228	68	1500			Manhole	Adoptable	69	1500			Manhole	Adoptable
6.010	13.953	40.5	375	Circular_Default Sewer Type	94.016	92.413	1.228	93.645	92.068	1.202	69	1500			Manhole	Adoptable	70	1500			Manhole	Adoptable
6.011	32.065	33.5	375	Circular_Default Sewer Type	93.645	92.068	1.202	92.803	91.111	1.317	70	1500			Manhole	Adoptable	71	1500			Manhole	Adoptable
6.012	11.725	17.9	375	Circular_Default Sewer Type	92.803	91.111	1.317	92.697	90.456	1.866	71	1500			Manhole	Adoptable	23	1800			Manhole	Adoptable
1.022	15.230	500.0	750	Circular_Default Sewer Type	92.697	90.081	1.866	92.800	90.051	1.999	23	1800			Manhole	Adoptable	24	1800			Manhole	Adoptable
1.023	22.498	30.4	900	Circular_Default Sewer Type	92.800	89.901	1.999	92.700	89.161	2.639	24	1800			Manhole	Adoptable	25	1800			Manhole	Adoptable
1.024	36.411	498.8	900	Circular_Default Sewer Type	92.700	89.161	2.639	91.596	89.088	1.608	25	1800			Manhole	Adoptable	26	1800			Manhole	Adoptable

7.000	10.549	146.3	225	Circular_Default Sewer Type	94.413	92.942	1.246	94.296	92.870	1.201	72	1200			Manhole	Adoptable	73	1200			Manhole	Adoptable
7.001	8.472	60.6	225	Circular_Default Sewer Type	94.296	92.870	1.201	94.155	92.730	1.200	73	1200			Manhole	Adoptable	74	1200			Manhole	Adoptable
7.002	27.431	20.7	225	Circular_Default Sewer Type	94.155	92.730	1.200	92.948	91.403	1.320	74	1200			Manhole	Adoptable	75	1200			Manhole	Adoptable
7.003	10.965	84.3	225	Circular_Default Sewer Type	92.948	91.403	1.320	92.710	91.273	1.212	75	1200			Manhole	Adoptable	76	1200			Manhole	Adoptable
7.004	14.335	109.4	225	Circular_Default Sewer Type	92.710	91.273	1.212	92.567	91.142	1.200	76	1200			Manhole	Adoptable	77	1200			Manhole	Adoptable
7.005	20.750	40.1	300	Circular_Default Sewer Type	92.567	91.067	1.200	92.053	90.550	1.203	77	1200			Manhole	Adoptable	78	1200			Manhole	Adoptable
7.006	9.361	33.4	300	Circular_Default Sewer Type	92.053	90.550	1.203	91.770	90.270	1.200	78	1200			Manhole	Adoptable	79	1200			Manhole	Adoptable
7.007	6.676	11.5	300	Circular_Default Sewer Type	91.770	90.270	1.200	91.596	89.688	1.608	79	1200			Manhole	Adoptable	26	1800			Manhole	Adoptable
1.025	6.517	500.0	900	Circular_Default Sewer Type	91.596	89.088	1.608	91.409	89.075	1.434	26	1800			Manhole	Adoptable	27	2100			Manhole	Adoptable
1.026	43.897	42.2	900	Circular_Default Sewer Type	91.409	89.075	1.434	90.435	88.035	1.500	27	2100			Manhole	Adoptable	28	2100			Manhole	Adoptable
1.027	25.855	507.0	900	Circular_Default Sewer Type	90.435	88.035	1.500	90.400	87.984	1.516	28	2100			Manhole	Adoptable	29	2100			Manhole	Adoptable
1.028	30.611	501.8	900	Circular_Default Sewer Type	90.400	87.984	1.516	90.723	87.923	1.900	29	2100			Manhole	Adoptable	30-HW	1800			Manhole	Adoptable
1.029	11.528	501.2	900	Circular_Default Sewer Type	90.723	87.923	1.900	90.700	87.900	1.900	30-HW	1800			Manhole	Adoptable	31-HW	1500			Manhole	Adoptable
1.030	32.293	496.8	900	Circular_Default Sewer Type	90.700	87.900	1.900	91.035	87.835	2.300	31-HW	1500			Manhole	Adoptable	32-FC	3000			Manhole	Adoptable
1.031	35.511	50.7	900	Circular_Default Sewer Type	91.035	87.835	2.300	89.000	87.135	0.965	32-FC	3000			Manhole	Adoptable	33-OF	1800			Manhole	Adoptable

Rainfall Methodology	FSR		Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
FSR Region	England and Wales		2	0	0	0
M5-60 (mm)	20.000		30	0	0	0
Ratio-R	0.400		100	40	0	0
Summer CV	0.750					
Winter CV	0.840					
Analysis Speed	Normal					
Skip Steady State	Yes					
Drain Down Time (mins)	240					
Additional Storage (m³/ha)	20.0					
Storm Durations (mins)	15					
	30					
	60					
	120					
	180					
	240					
	360					
	480					
	600					
	720					
	960					
	1440					
Check Discharge Rate(s)	Yes					
Check Discharge Volume	Yes					
100 year 360 minute (m³)						

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	
SAAR (mm)	
Soil Index	1
SPR	0.10
Region	1
Growth Factor 1 year	0.85
Growth Factor 30 year	1.95
Growth Factor 100 year	2.48
Betterment (%)	0
QBar	
Q 1 year (l/s)	
Q 30 year (l/s)	
Q 100 year (l/s)	

Site Makeup	Greenfield
Greenfield Method	FSR/FEH
Positively Drained Area (ha)	
Soil Index	1
SPR	0.10
CWI	
Return Period (years)	100
Climate Change (%)	0
Storm Duration (mins)	360
Betterment (%)	0
PR	
Runoff Volume (m^3)	

Hydro-Brake®												
Node	Flap Valve	Online / Offline	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Objective	Sump Available	Product Number	Min Outlet Diameter (m)	Min Node Diameter (mm)
32-FC	No	Online	Yes		87.835	1.300	19.6	(HE) Minimise upstream storage	Yes	CTL-SHE-0193-1960-1300-1960	0.225	1500

Depth/Area/Inf Area

Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m²)	Inf. Area (m²)
31-HW	0.00000	0.00000	2.0	1.00	86.700	0	0.000	555.6	0.0
							1.200	1324.5	0.0
							1.201	1547.8	0.0
							1.800	2017.2	0.0
							1.801	2281.0	0.0
							2.300	2713.6	0.0
							2.301	3000.0	0.0
							2.800	3486.9	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.89%																
Node Event	**US Node**	**Peak (mins)**	**Level (m)**	**Depth (m)**	**Inflow (l/s)**	**Node Vol (m^3)**	**Flood (m^3)**	**Status**	**Link Event (Upstream Depth)**	**Link**	**DS Node**	**Outflow (l/s)**	**Velocity (m/s)**	**Flow/Cap**	**Link Vol (m^3)**	**Discharge Vol (m^3)**
15 minute winter	1	10	95.983	0.051	9.7	0.0965	0.0000	OK	15 minute winter	1.000	2	9.6	1.438	0.107	0.1045	
15 minute winter	2	10	95.512	0.112	19.3	0.1709	0.0000	OK	15 minute winter	1.001	3	18.9	0.831	0.266	0.3438	
15 minute winter	3	11	95.420	0.157	28.6	0.3290	0.0000	OK	15 minute winter	1.002	4	27.2	0.597	0.244	1.5204	
15 minute winter	34	10	99.635	0.043	9.7	0.0813	0.0000	OK	15 minute winter	2.000	35	9.6	0.829	0.082	0.1053	
15 minute winter	35	10	99.253	0.108	19.3	0.2005	0.0000	OK	15 minute winter	2.001	36	18.8	0.799	0.473	0.8977	
15 minute winter	36	11	99.075	0.153	28.5	0.2688	0.0000	OK	15 minute winter	2.002	37	28.1	1.039	0.703	0.2539	
15 minute winter	40	10	99.416	0.064	9.7	0.1192	0.0000	OK	15 minute winter	3.000	41	9.5	0.717	0.178	0.3140	
15 minute winter	41	10	99.206	0.102	19.2	0.1902	0.0000	OK	15 minute winter	3.001	42	18.9	1.010	0.329	0.1332	
15 minute winter	42	10	99.130	0.113	28.6	0.2087	0.0000	OK	15 minute winter	3.002	37	28.2	1.534	0.411	0.1605	
15 minute winter	37	11	98.931	0.140	65.3	0.2495	0.0000	OK	15 minute winter	2.003	38	65.6	1.848	0.403	0.6999	
15 minute winter	38	11	98.532	0.162	74.7	0.2979	0.0000	OK	15 minute winter	2.004	39	75.1	2.949	0.392	0.2875	
15 minute winter	39	11	98.114	0.072	84.2	0.1328	0.0000	OK	15 minute winter	2.005	4	84.3	4.805	0.132	0.2112	
15 minute winter	4	11	95.409	0.304	120.5	0.6134	0.0000	OK	15 minute winter	1.003	5	119.5	1.168	0.748	1.8713	
15 minute winter	5	11	95.325	0.339	128.6	0.6871	0.0000	OK	15 minute winter	1.004	6	127.0	0.871	0.587	2.9177	
15 minute winter	6	12	95.287	0.341	136.1	0.6929	0.0000	OK	15 minute winter	1.005	7	133.1	0.924	0.615	2.7542	
15 minute winter	7	12	95.242	0.334	142.2	0.6829	0.0000	OK	15 minute winter	1.006	8	141.1	1.047	0.647	2.9206	
15 minute winter	8	12	95.178	0.388	148.6	0.8070	0.0000	OK	15 minute winter	1.007	9	148.4	0.786	0.521	1.8666	
15 minute winter	9	12	95.154	0.381	155.9	0.8051	0.0000	OK	15 minute winter	1.008	10	155.6	0.851	0.541	1.6714	
15 minute winter	10	12	95.125	0.368	163.0	0.7913	0.0000	OK	15 minute winter	1.009	11	162.3	0.914	0.566	3.6527	
15 minute winter	11	12	95.079	0.358	169.8	0.8083	0.0000	OK	15 minute winter	1.010	12	168.1	1.004	0.593	3.3130	
15 minute winter	12	13	95.021	0.334	175.6	0.7864	0.0000	OK	15 minute winter	1.011	13	174.3	1.229	0.614	6.8990	
15 minute winter	13	13	94.803	0.275	179.8	0.6175	0.0000	OK	15 minute winter	1.012	14	180.4	1.681	0.495	1.6899	
15 minute winter	14	13	94.689	0.185	185.9	0.4210	0.0000	OK	15 minute winter	1.013	15	186.5	2.802	0.135	1.5342	
15 minute winter	15	13	94.153	0.142	192.0	0.3316	0.0000	OK	15 minute winter	1.014	16	192.4	1.664	0.102	6.6386	
15 minute winter	16	13	92.102	0.345	197.9	0.7595	0.0000	OK	15 minute winter	1.015	17	200.7	1.348	0.561	4.0501	
15 minute winter	43	10	99.561	0.061	9.7	0.1136	0.0000	OK	15 minute winter	4.000	44	9.6	0.654	0.160	0.1825	
15 minute winter	44	10	99.455	0.118	19.3	0.2199	0.0000	OK	15 minute winter	4.001	45	19.0	0.913	0.443	0.1602	
15 minute winter	45	10	99.399	0.115	28.7	0.2151	0.0000	OK	15 minute winter	4.002	46	28.2	1.410	0.480	0.5227	
15 minute winter	46	10	99.065	0.113	37.9	0.2111	0.0000	OK	15 minute winter	4.003	47	37.6	1.951	0.412	0.1776	
15 minute winter	47	11	98.778	0.108	47.1	0.2022	0.0000	OK	15 minute winter	4.004	48	47.2	2.573	0.441	0.6864	
15 minute winter	48	11	97.118	0.097	56.3	0.1778	0.0000	OK	15 minute winter	4.005	49	56.5	1.927	0.228	1.2978	
15 minute winter	49	11	95.040	0.166	65.6	0.2812	0.0000	OK	15 minute winter	4.006	50	65.8	1.724	0.533	1.0577	
15 minute winter	57	10	95.117	0.057	9.7	0.1072	0.0000	OK	15 minute winter	5.000	58	9.6	0.716	0.143	0.2140	
15 minute winter	58	11	94.911	0.112	19.3	0.2033	0.0000	OK	15 minute winter	5.001	50	18.8	0.979	0.472	0.6255	
15 minute winter	50	11	94.640	0.182	93.7	0.4401	0.0000	OK	15 minute winter	4.007	51	93.7	2.014	0.439	2.8767	
15 minute winter	51	11	93.901	0.147	102.8	0.3581	0.0000	OK	15 minute winter	4.008	52	102.1	2.333	0.279	0.6607	
15 minute winter	52	11	93.423	0.168	111.2	0.4052	0.0000	OK	15 minute winter	4.009	53	110.7	1.991	0.357	0.9836	
15 minute winter	53	11	93.043	0.210	119.8	0.5118	0.0000	OK	15 minute winter	4.010	54	118.8	2.096	0.453	0.5600	
15 minute winter	54	11	92.805	0.216	127.9	0.5210	0.0000	OK	15 minute winter	4.011	55	127.4	1.698	0.343	0.8609	
15 minute winter	55	11	92.654	0.216	136.5	0.5208	0.0000	OK	15 minute winter	4.012	56	135.3	1.988	0.367	0.9301	
15 minute winter	56	11	92.379	0.192	144.4	0.4582	0.0000	OK	15 minute winter	4.013	17	144.1	2.169	0.242	1.3998	
15 minute winter	17	13	92.001	0.281	336.8	0.6528	0.0000	OK	15 minute winter	1.016	18	340.1	1.937	0.292	4.8870	
15 minute winter	18	13	91.679	0.386	345.6	0.8903	0.0000	OK	15 minute winter	1.017	19	362.0	2.447	0.864	1.7736	
15 minute winter	19	12	91.468	0.199	367.5	0.4619	0.0000	OK	15 minute winter	1.018	20	357.9	2.308	0.182	3.4466	
15 minute winter	20	13	90.799	0.513	363.4	1.5054	0.0000	OK	15 minute winter	1.019	21	359.3	1.161	0.651	9.0489	
15 minute winter	21	14	90.724	0.496	364.8	1.4451	0.0000	OK	15 minute winter	1.020	22	353.2	1.101	0.642	19.1267	

15 minute winter	22	14	90.639	0.530	357.1	1.5409	0.0000	OK	15 minute winter	1.021	23	363.1	1.126	0.660	4.4768	
15 minute winter	59	10	95.148	0.046	9.7	0.0882	0.0000	OK	15 minute winter	6.000	60	9.6	0.985	0.092	0.0775	
15 minute winter	60	10	94.874	0.087	19.3	0.1609	0.0000	OK	15 minute winter	6.001	61	19.1	1.191	0.273	0.1460	
15 minute winter	61	10	94.726	0.104	28.8	0.1954	0.0000	OK	15 minute winter	6.002	62	28.5	1.707	0.360	0.1493	
15 minute winter	62	10	94.449	0.108	38.2	0.1987	0.0000	OK	15 minute winter	6.003	63	37.9	1.185	0.256	0.5463	
15 minute winter	63	11	94.234	0.182	47.6	0.3321	0.0000	OK	15 minute winter	6.004	64	46.2	1.091	0.652	2.5695	
15 minute winter	64	11	93.939	0.210	55.3	0.4783	0.0000	OK	15 minute winter	6.005	65	55.0	0.888	0.498	0.9044	
15 minute winter	65	11	93.886	0.202	64.1	0.4559	0.0000	OK	15 minute winter	6.006	66	63.6	1.207	0.572	1.1851	
15 minute winter	66	11	93.775	0.161	72.7	0.3626	0.0000	OK	15 minute winter	6.007	67	71.7	1.622	0.362	2.1738	
15 minute winter	67	12	93.291	0.157	80.8	0.3842	0.0000	OK	15 minute winter	6.008	68	80.3	1.966	0.282	0.3741	
15 minute winter	68	11	93.090	0.141	88.5	0.3407	0.0000	OK	15 minute winter	6.009	69	88.4	2.152	0.276	0.8638	
15 minute winter	69	11	92.571	0.159	96.9	0.3859	0.0000	OK	15 minute winter	6.010	70	96.7	2.281	0.307	0.5925	
15 minute winter	70	11	92.216	0.148	105.1	0.3618	0.0000	OK	15 minute winter	6.011	71	105.0	2.676	0.303	1.2583	
15 minute winter	71	12	91.252	0.141	113.2	0.3387	0.0000	OK	15 minute winter	6.012	23	113.4	3.265	0.239	0.4076	
15 minute winter	23	14	90.583	0.502	453.1	1.4817	0.0000	OK	15 minute winter	1.022	24	456.8	1.617	0.831	4.2964	
15 minute winter	24	14	90.135	0.234	460.7	0.6814	0.0000	OK	15 minute winter	1.023	25	462.0	1.921	0.128	5.4867	
15 minute winter	25	14	89.656	0.495	465.9	1.4066	0.0000	OK	15 minute winter	1.024	26	467.9	1.394	0.527	12.2177	
15 minute winter	72	10	93.019	0.077	9.7	0.1434	0.0000	OK	15 minute winter	7.000	73	9.6	0.708	0.223	0.1426	
15 minute winter	73	10	92.961	0.091	19.3	0.1698	0.0000	OK	15 minute winter	7.001	74	19.0	1.426	0.285	0.1133	
15 minute winter	74	10	92.806	0.076	28.7	0.1426	0.0000	OK	15 minute winter	7.002	75	28.5	1.369	0.248	0.5695	
15 minute winter	75	11	91.561	0.158	38.2	0.2871	0.0000	OK	15 minute winter	7.003	76	37.6	1.133	0.664	0.3652	
15 minute winter	76	11	91.470	0.197	47.0	0.3676	0.0000	OK	15 minute winter	7.004	77	47.1	1.353	0.949	0.4979	
15 minute winter	77	11	91.188	0.121	56.2	0.2229	0.0000	OK	15 minute winter	7.005	78	56.4	1.921	0.320	0.6089	
15 minute winter	78	11	90.689	0.139	65.5	0.2558	0.0000	OK	15 minute winter	7.006	79	65.6	2.311	0.340	0.2659	
15 minute winter	79	11	90.385	0.115	74.7	0.2110	0.0000	OK	15 minute winter	7.007	26	74.8	3.381	0.227	0.1479	
15 minute winter	26	14	89.535	0.447	513.8	1.3264	0.0000	OK	15 minute winter	1.025	27	513.8	2.338	0.579	1.4822	
15 minute winter	27	14	89.321	0.246	518.8	0.9655	0.0000	OK	15 minute winter	1.026	28	519.6	1.886	0.169	12.3585	
15 minute winter	28	14	88.604	0.569	523.5	2.2217	0.0000	OK	15 minute winter	1.027	29	518.8	1.267	0.589	10.5847	
15 minute winter	29	15	88.524	0.540	522.7	2.1060	0.0000	OK	15 minute winter	1.028	30-HW	518.2	1.370	0.585	11.5831	
15 minute winter	30-HW	15	88.421	0.498	518.2	1.2673	0.0000	OK	15 minute winter	1.029	31-HW	520.9	1.600	0.588	3.7525	
240 minute winter	31-HW	240	88.246	0.346	137.7	582.5882	0.0000	OK	240 minute winter	1.030	32-FC	20.7	0.296	0.023	8.1829	
240 minute winter	32-FC	240	88.246	0.411	20.7	2.9063	0.0000	OK	240 minute winter	Hydro-Brake®	33-OF	19.6				454.7
15 minute summer	33-OF	1	87.135	0.000	18.6	0.0000	0.0000	OK								

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.89%																
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Upstream Depth)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	10	96.001	0.069	18.3	0.1288	0.0000	OK	15 minute winter	1.000	2	18.2	1.564	0.204	0.3904	
15 minute winter	2	11	95.834	0.434	36.5	0.6632	0.0000	SURCHARGED	15 minute winter	1.001	3	32.6	0.887	0.459	1.0602	
15 minute winter	3	11	95.817	0.554	49.4	1.1571	0.0000	SURCHARGED	15 minute winter	1.002	4	50.0	0.600	0.450	2.9357	
15 minute winter	34	10	99.652	0.060	18.3	0.1116	0.0000	OK	15 minute winter	2.000	35	18.2	0.945	0.154	0.2073	
15 minute winter	35	11	99.363	0.218	36.5	0.4052	0.0000	OK	15 minute winter	2.001	36	34.1	0.882	0.857	1.4988	
15 minute winter	36	10	99.191	0.269	51.2	0.4727	0.0000	SURCHARGED	15 minute winter	2.002	37	50.5	1.284	1.261	0.3518	
15 minute winter	40	10	99.441	0.089	18.3	0.1668	0.0000	OK	15 minute winter	3.000	41	18.1	0.794	0.338	0.5294	
15 minute winter	41	10	99.265	0.162	36.4	0.3006	0.0000	OK	15 minute winter	3.001	42	35.7	1.118	0.623	0.2274	
15 minute winter	42	10	99.193	0.176	54.0	0.3264	0.0000	OK	15 minute winter	3.002	37	53.4	1.749	0.778	0.2656	
15 minute winter	37	10	99.010	0.219	122.2	0.3912	0.0000	OK	15 minute winter	2.003	38	121.5	2.039	0.747	1.1713	
15 minute winter	38	11	98.625	0.255	139.7	0.4694	0.0000	OK	15 minute winter	2.004	39	139.7	3.228	0.729	0.4671	
15 minute winter	39	11	98.141	0.099	157.0	0.1826	0.0000	OK	15 minute winter	2.005	4	157.2	5.119	0.246	0.3886	
15 minute winter	4	11	95.797	0.692	220.1	1.3973	0.0000	SURCHARGED	15 minute winter	1.003	5	216.7	1.368	1.355	2.8149	
15 minute winter	5	11	95.666	0.680	234.0	1.3765	0.0000	SURCHARGED	15 minute winter	1.004	6	231.8	1.073	1.071	4.2742	
15 minute winter	6	12	95.593	0.647	249.1	1.3158	0.0000	SURCHARGED	15 minute winter	1.005	7	246.8	1.142	1.140	4.0597	
15 minute winter	7	12	95.515	0.607	264.1	1.2418	0.0000	SURCHARGED	15 minute winter	1.006	8	262.1	1.213	1.201	4.5244	
15 minute winter	8	12	95.421	0.631	279.4	1.3136	0.0000	SURCHARGED	15 minute winter	1.007	9	276.9	0.983	0.972	2.7582	
15 minute winter	9	12	95.383	0.610	294.2	1.2897	0.0000	SURCHARGED	15 minute winter	1.008	10	290.6	1.042	1.011	2.5383	
15 minute winter	10	12	95.342	0.585	307.9	1.2586	0.0000	OK	15 minute winter	1.009	11	305.8	1.111	1.067	5.6625	
15 minute winter	11	12	95.277	0.556	320.1	1.2566	0.0000	OK	15 minute winter	1.010	12	320.6	1.213	1.131	5.2084	
15 minute winter	12	12	95.196	0.509	334.9	1.1979	0.0000	OK	15 minute winter	1.011	13	333.8	1.496	1.175	10.7456	
15 minute winter	13	12	94.921	0.393	348.1	0.8814	0.0000	OK	15 minute winter	1.012	14	347.7	1.996	0.954	2.7334	
15 minute winter	14	12	94.775	0.271	361.9	0.6164	0.0000	OK	15 minute winter	1.013	15	360.9	3.277	0.262	2.5358	
15 minute winter	15	12	94.210	0.199	375.2	0.4629	0.0000	OK	15 minute winter	1.014	16	372.8	1.882	0.197	10.9015	
15 minute winter	16	12	92.292	0.535	387.1	1.1777	0.0000	OK	15 minute winter	1.015	17	387.3	1.502	1.082	7.0070	
15 minute winter	43	10	99.584	0.084	18.3	0.1582	0.0000	OK	15 minute winter	4.000	44	18.2	0.721	0.303	0.3055	
15 minute winter	44	10	99.529	0.193	36.5	0.3580	0.0000	OK	15 minute winter	4.001	45	35.7	1.010	0.834	0.2727	
15 minute winter	45	10	99.467	0.183	54.0	0.3415	0.0000	OK	15 minute winter	4.002	46	53.3	1.560	0.907	0.8895	
15 minute winter	46	11	99.132	0.180	71.4	0.3381	0.0000	OK	15 minute winter	4.003	47	71.2	2.171	0.780	0.3018	
15 minute winter	47	11	98.836	0.166	88.8	0.3116	0.0000	OK	15 minute winter	4.004	48	89.2	2.937	0.832	1.1352	
15 minute winter	48	11	97.157	0.136	106.5	0.2507	0.0000	OK	15 minute winter	4.005	49	106.7	2.142	0.431	2.1806	
15 minute winter	49	11	95.157	0.283	124.0	0.4802	0.0000	OK	15 minute winter	4.006	50	121.1	1.905	0.981	1.8678	
15 minute winter	57	10	95.139	0.079	18.3	0.1490	0.0000	OK	15 minute winter	5.000	58	18.2	0.816	0.270	0.3526	
15 minute winter	58	11	94.974	0.174	36.5	0.3170	0.0000	OK	15 minute winter	5.001	50	35.5	1.131	0.893	1.0222	
15 minute winter	50	11	94.732	0.274	173.9	0.6610	0.0000	OK	15 minute winter	4.007	51	174.8	2.265	0.819	4.7643	
15 minute winter	51	11	93.976	0.222	192.1	0.5415	0.0000	OK	15 minute winter	4.008	52	191.5	2.522	0.524	1.1511	
15 minute winter	52	11	93.525	0.270	208.8	0.6514	0.0000	OK	15 minute winter	4.009	53	207.9	2.174	0.671	1.6827	
15 minute winter	53	11	93.174	0.341	225.2	0.8313	0.0000	OK	15 minute winter	4.010	54	223.9	2.366	0.853	0.9312	
15 minute winter	54	11	92.930	0.341	241.2	0.8217	0.0000	OK	15 minute winter	4.011	55	240.2	1.899	0.646	1.4494	
15 minute winter	55	11	92.768	0.330	257.5	0.7949	0.0000	OK	15 minute winter	4.012	56	255.9	2.285	0.695	1.5223	
15 minute winter	56	11	92.472	0.285	273.2	0.6796	0.0000	OK	15 minute winter	4.013	17	272.0	2.434	0.457	2.6334	
15 minute winter	17	12	92.176	0.457	659.8	1.0611	0.0000	OK	15 minute winter	1.016	18	653.8	2.273	0.562	7.9629	
15 minute winter	18	13	91.856	0.563	668.1	1.2997	0.0000	OK	15 minute winter	1.017	19	665.8	2.682	1.590	3.1523	
15 minute winter	19	13	91.656	0.387	676.3	0.8987	0.0000	OK	15 minute winter	1.018	20	681.6	2.338	0.346	5.8978	
15 minute winter	20	13	91.419	1.133	692.1	3.3258	0.0000	SURCHARGED	15 minute winter	1.019	21	696.9	1.584	1.262	12.6570	
15 minute winter	21	13	91.266	1.038	707.4	3.0258	0.0000	SURCHARGED	15 minute winter	1.020	22	709.4	1.612	1.290	26.2435	
15 minute winter	22	13	91.009	0.900	719.9	2.6179	0.0000	SURCHARGED	15 minute winter	1.021	23	721.3	1.639	1.312	6.1001	

15 minute winter	59	10	95.165	0.063	18.3	0.1214	0.0000	OK	15 minute winter	6.000	60	18.2	1.093	0.173	0.1307	
15 minute winter	60	10	94.920	0.134	36.5	0.2471	0.0000	OK	15 minute winter	6.001	61	36.2	1.318	0.516	0.2489	
15 minute winter	61	10	94.782	0.160	54.5	0.3002	0.0000	OK	15 minute winter	6.002	62	53.9	1.954	0.681	0.2464	
15 minute winter	62	11	94.509	0.168	72.2	0.3085	0.0000	OK	15 minute winter	6.003	63	71.1	1.293	0.479	0.9040	
15 minute winter	63	11	94.437	0.386	89.4	0.7032	0.0000	SURCHARGED	15 minute winter	6.004	64	86.4	1.231	1.220	4.1014	
15 minute winter	64	11	94.065	0.336	103.7	0.7649	0.0000	OK	15 minute winter	6.005	65	103.1	1.015	0.933	1.4830	
15 minute winter	65	11	94.000	0.316	120.4	0.7133	0.0000	OK	15 minute winter	6.006	66	119.6	1.376	1.076	1.9468	
15 minute winter	66	11	93.854	0.240	136.9	0.5407	0.0000	OK	15 minute winter	6.007	67	135.4	1.836	0.683	3.6281	
15 minute winter	67	11	93.373	0.239	152.7	0.5824	0.0000	OK	15 minute winter	6.008	68	151.1	2.202	0.530	0.6308	
15 minute winter	68	11	93.160	0.211	167.4	0.5086	0.0000	OK	15 minute winter	6.009	69	166.6	2.410	0.519	1.4566	
15 minute winter	69	11	92.654	0.242	183.2	0.5868	0.0000	OK	15 minute winter	6.010	70	182.6	2.585	0.579	0.9920	
15 minute winter	70	11	92.288	0.220	198.7	0.5362	0.0000	OK	15 minute winter	6.011	71	198.9	3.078	0.574	2.1037	
15 minute winter	71	12	91.324	0.214	214.3	0.5112	0.0000	OK	15 minute winter	6.012	23	213.7	3.475	0.450	1.0264	
15 minute winter	23	13	90.895	0.814	925.5	2.4021	0.0000	SURCHARGED	15 minute winter	1.022	24	928.0	2.160	1.688	6.2090	
15 minute winter	24	13	90.290	0.389	938.5	1.1319	0.0000	OK	15 minute winter	1.023	25	940.2	2.156	0.260	9.5234	
15 minute winter	25	13	89.942	0.781	950.7	2.2206	0.0000	OK	15 minute winter	1.024	26	954.7	1.749	1.075	19.7830	
15 minute winter	72	10	93.057	0.115	18.3	0.2122	0.0000	OK	15 minute winter	7.000	73	18.1	0.805	0.422	0.2371	
15 minute winter	73	10	93.004	0.134	36.4	0.2511	0.0000	OK	15 minute winter	7.001	74	36.1	1.625	0.539	0.1890	
15 minute winter	74	11	92.846	0.116	54.3	0.2172	0.0000	OK	15 minute winter	7.002	75	53.1	1.559	0.462	0.8278	
15 minute winter	75	11	92.132	0.729	71.4	1.3251	0.0000	SURCHARGED	15 minute winter	7.003	76	68.2	1.716	1.205	0.4361	
15 minute winter	76	11	91.859	0.586	85.5	1.0943	0.0000	SURCHARGED	15 minute winter	7.004	77	84.8	2.132	1.707	0.5644	
15 minute winter	77	11	91.244	0.177	102.1	0.3252	0.0000	OK	15 minute winter	7.005	78	101.9	2.141	0.580	0.9903	
15 minute winter	78	11	90.758	0.208	119.2	0.3825	0.0000	OK	15 minute winter	7.006	79	119.0	2.543	0.617	0.4381	
15 minute winter	79	11	90.441	0.171	136.3	0.3137	0.0000	OK	15 minute winter	7.007	26	136.3	3.808	0.413	0.2389	
15 minute winter	26	13	89.753	0.665	1076.2	1.9734	0.0000	OK	15 minute winter	1.025	27	1081.9	3.001	1.220	2.4582	
15 minute winter	27	12	89.461	0.386	1089.2	1.5142	0.0000	OK	15 minute winter	1.026	28	1097.2	2.186	0.357	19.6481	
15 minute winter	28	13	89.041	1.006	1107.7	3.9273	0.0000	SURCHARGED	15 minute winter	1.027	29	1104.1	1.742	1.254	16.3837	
15 minute winter	29	13	88.890	0.906	1114.6	3.5366	0.0000	SURCHARGED	15 minute winter	1.028	30-HW	1117.8	1.808	1.263	18.6823	
15 minute winter	30-HW	13	88.708	0.785	1117.8	1.9989	0.0000	OK	15 minute winter	1.029	31-HW	1123.3	2.102	1.268	6.1100	
480 minute winter	31-HW	472	88.573	0.673	145.8	1239.2270	0.0000	OK	480 minute winter	1.030	32-FC	21.0	0.284	0.024	17.2059	
480 minute winter	32-FC	472	88.573	0.738	21.0	5.2193	0.0000	OK	480 minute winter	Hydro-Brake®	33-OF	19.6				682.3
15 minute summer	33-OF	1	87.135	0.000	19.6	0.0000	0.0000	OK								

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.89%																
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Link Event (Upstream Depth)	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	12	97.305	1.372	33.3	2.5734	0.0000	FLOOD RISK	15 minute winter	1.000	2	27.8	1.534	0.312	0.6248	
15 minute winter	2	12	97.250	1.850	54.4	2.8292	0.0000	SURCHARGED	15 minute winter	1.001	3	54.0	0.859	0.761	1.0602	
15 minute winter	3	12	97.200	1.937	79.1	4.0467	0.0000	SURCHARGED	15 minute winter	1.002	4	82.8	0.750	0.745	2.9357	
15 minute winter	34	12	100.557	0.965	33.3	1.8096	0.0000	SURCHARGED	15 minute winter	2.000	35	26.3	0.980	0.223	0.3472	
15 minute winter	35	12	100.523	1.378	56.0	2.5615	0.0000	FLOOD RISK	15 minute winter	2.001	36	52.5	1.321	1.321	1.5061	
15 minute winter	36	12	100.077	1.155	80.8	2.0283	0.0000	SURCHARGED	15 minute winter	2.002	37	78.9	1.985	1.971	0.3730	
15 minute winter	40	12	100.281	0.929	33.3	1.7320	0.0000	SURCHARGED	15 minute winter	3.000	41	26.9	0.812	0.502	0.9305	
15 minute winter	41	12	100.203	1.100	57.1	2.0423	0.0000	SURCHARGED	15 minute winter	3.001	42	53.9	1.354	0.939	0.2829	
15 minute winter	42	12	100.076	1.059	83.0	1.9610	0.0000	SURCHARGED	15 minute winter	3.002	37	80.8	2.033	1.179	0.3463	
15 minute winter	37	12	99.750	0.959	185.8	1.7094	0.0000	SURCHARGED	15 minute winter	2.003	38	186.8	2.652	1.147	1.3881	
15 minute winter	38	12	98.990	0.620	213.4	1.1388	0.0000	SURCHARGED	15 minute winter	2.004	39	213.7	3.309	1.115	0.6496	
15 minute winter	39	12	98.231	0.189	242.9	0.3473	0.0000	OK	15 minute winter	2.005	4	241.3	4.756	0.378	0.5016	
15 minute winter	4	12	97.142	2.037	345.2	4.1151	0.0000	SURCHARGED	15 minute winter	1.003	5	346.1	2.184	2.164	2.8149	
15 minute winter	5	12	96.813	1.827	372.1	3.6983	0.0000	SURCHARGED	15 minute winter	1.004	6	372.8	1.726	1.722	4.2742	
15 minute winter	6	12	96.620	1.674	398.8	3.4026	0.0000	SURCHARGED	15 minute winter	1.005	7	399.7	1.850	1.846	4.0597	
15 minute winter	7	12	96.404	1.496	425.7	3.0611	0.0000	SURCHARGED	15 minute winter	1.006	8	426.5	1.975	1.955	4.5244	
15 minute winter	8	12	96.142	1.352	452.5	2.8136	0.0000	SURCHARGED	15 minute winter	1.007	9	453.4	1.610	1.592	2.7582	
15 minute winter	9	12	96.034	1.261	479.4	2.6650	0.0000	SURCHARGED	15 minute winter	1.008	10	480.3	1.705	1.670	2.5466	
15 minute winter	10	12	95.916	1.159	506.3	2.4925	0.0000	SURCHARGED	15 minute winter	1.009	11	507.2	1.801	1.771	5.7744	
15 minute winter	11	12	95.723	1.002	533.2	2.2629	0.0000	SURCHARGED	15 minute winter	1.010	12	534.0	1.896	1.883	5.5634	
15 minute winter	12	12	95.514	0.827	560.0	1.9458	0.0000	SURCHARGED	15 minute winter	1.011	13	561.8	2.024	1.978	12.8285	
15 minute winter	13	12	95.065	0.537	587.8	1.2043	0.0000	OK	15 minute winter	1.012	14	588.6	2.303	1.615	3.9602	
15 minute winter	14	12	94.876	0.372	614.6	0.8470	0.0000	OK	15 minute winter	1.013	15	616.0	3.560	0.447	4.2283	
15 minute winter	15	13	94.339	0.328	642.0	0.7642	0.0000	OK	15 minute winter	1.014	16	630.1	2.105	0.333	14.7442	
15 minute winter	16	13	93.818	2.061	656.1	4.5363	0.0000	SURCHARGED	15 minute winter	1.015	17	645.9	1.809	1.804	8.9277	
15 minute winter	43	12	100.778	1.278	33.3	2.3963	0.0000	FLOOD RISK	15 minute winter	4.000	44	24.1	0.739	0.401	0.4882	
15 minute winter	44	12	100.742	1.405	55.1	2.6124	0.0000	FLOOD RISK	15 minute winter	4.001	45	48.1	1.209	1.123	0.3068	
15 minute winter	45	12	100.640	1.355	76.8	2.5360	0.0000	FLOOD RISK	15 minute winter	4.002	46	72.1	1.814	1.226	1.0333	
15 minute winter	46	12	100.048	1.096	99.3	2.0556	0.0000	SURCHARGED	15 minute winter	4.003	47	96.1	2.418	1.053	0.3662	
15 minute winter	47	12	99.572	0.902	124.0	1.6905	0.0000	SURCHARGED	15 minute winter	4.004	48	121.3	3.049	1.132	1.4873	
15 minute winter	48	13	97.274	0.253	150.0	0.4658	0.0000	OK	15 minute winter	4.005	49	146.1	2.248	0.590	2.9196	
15 minute winter	49	13	96.624	1.749	177.5	2.9682	0.0000	FLOOD RISK	15 minute winter	4.006	50	156.4	2.222	1.267	1.9521	
15 minute winter	57	13	96.138	1.078	33.3	2.0214	0.0000	SURCHARGED	15 minute winter	5.000	58	25.7	0.864	0.383	0.6214	
15 minute winter	58	13	96.113	1.313	57.1	2.3918	0.0000	FLOOD RISK	15 minute winter	5.001	50	49.8	1.253	1.252	1.2953	
15 minute winter	50	13	95.928	1.470	237.6	3.5477	0.0000	FLOOD RISK	15 minute winter	4.007	51	217.8	2.230	1.020	6.8172	
15 minute winter	51	13	95.133	1.379	249.2	3.3642	0.0000	FLOOD RISK	15 minute winter	4.008	52	236.6	2.455	0.647	1.6607	
15 minute winter	52	13	94.818	1.564	269.9	3.7703	0.0000	FLOOD RISK	15 minute winter	4.009	53	262.5	2.380	0.848	1.9514	
15 minute winter	53	13	94.408	1.575	295.8	3.8430	1.0324	FLOOD	15 minute winter	4.010	54	290.3	2.632	1.107	1.0881	
15 minute winter	54	13	94.114	1.525	323.6	3.6761	0.0000	FLOOD RISK	15 minute winter	4.011	55	317.6	2.005	0.854	1.8126	
15 minute winter	55	13	93.957	1.519	350.9	3.6610	0.0000	FLOOD RISK	15 minute winter	4.012	56	335.0	2.365	0.910	2.1542	
15 minute winter	56	13	93.759	1.572	368.3	3.7448	0.0000	FLOOD RISK	15 minute winter	4.013	17	361.2	2.457	0.606	4.5494	
15 minute winter	17	13	93.622	1.902	977.0	4.4202	2.0627	FLOOD	15 minute winter	1.016	18	951.5	2.666	0.818	9.9326	
15 minute winter	18	13	93.166	1.874	967.3	4.3229	0.0000	FLOOD RISK	15 minute winter	1.017	19	971.0	2.759	2.319	4.2455	
15 minute winter	19	13	92.858	1.589	984.9	3.6869	0.0000	SURCHARGED	15 minute winter	1.018	20	990.4	2.775	0.503	7.4030	
15 minute winter	20	13	92.441	2.155	1003.7	6.3246	0.0000	SURCHARGED	15 minute winter	1.019	21	1010.8	2.297	1.831	12.6570	
15 minute winter	21	13	92.122	1.894	1024.1	5.5202	0.0000	SURCHARGED	15 minute winter	1.020	22	1031.2	2.343	1.876	26.2435	
15 minute winter	22	13	91.584	1.475	1045.6	4.2887	0.0000	SURCHARGED	15 minute winter	1.021	23	1051.2	2.389	1.912	6.1001	

15 minute winter	59	12	96.066	0.964	33.3	1.8532	0.0000	SURCHARGED	15 minute winter	6.000	60	25.3	1.100	0.240	0.3087	
15 minute winter	60	12	96.038	1.252	55.1	2.3128	0.0000	FLOOD RISK	15 minute winter	6.001	61	49.0	1.358	0.698	0.3613	
15 minute winter	61	12	95.918	1.296	79.1	2.4292	0.0000	FLOOD RISK	15 minute winter	6.002	62	73.1	1.957	0.924	0.3555	
15 minute winter	62	12	95.648	1.307	103.3	2.4024	0.0000	FLOOD RISK	15 minute winter	6.003	63	97.3	1.382	0.656	1.1474	
15 minute winter	63	12	95.469	1.417	128.1	2.5845	0.0000	FLOOD RISK	15 minute winter	6.004	64	121.9	1.731	1.722	4.2659	
15 minute winter	64	12	94.632	0.903	153.3	2.0590	0.0000	SURCHARGED	15 minute winter	6.005	65	146.1	1.325	1.322	1.6096	
15 minute winter	65	12	94.508	0.824	178.0	1.8586	0.0000	SURCHARGED	15 minute winter	6.006	66	174.6	1.583	1.570	2.4725	
15 minute winter	66	12	94.280	0.666	207.9	1.4991	0.0000	SURCHARGED	15 minute winter	6.007	67	199.7	1.931	1.007	5.3889	
15 minute winter	67	12	93.723	0.589	233.0	1.4375	0.0000	SURCHARGED	15 minute winter	6.008	68	227.2	2.332	0.796	1.0091	
15 minute winter	68	12	93.508	0.559	260.5	1.3477	0.0000	SURCHARGED	15 minute winter	6.009	69	257.2	2.489	0.802	2.3124	
15 minute winter	69	12	93.061	0.649	290.5	1.5755	0.0000	SURCHARGED	15 minute winter	6.010	70	274.0	2.632	0.869	1.5390	
15 minute winter	70	13	92.658	0.590	307.3	1.4383	0.0000	SURCHARGED	15 minute winter	6.011	71	298.6	3.125	0.861	3.5367	
15 minute winter	71	13	91.820	0.710	331.9	1.6988	0.0000	SURCHARGED	15 minute winter	6.012	23	321.1	3.698	0.676	1.2932	
15 minute winter	23	13	91.342	1.261	1374.1	3.7205	0.0000	SURCHARGED	15 minute winter	1.022	24	1376.2	3.127	2.503	6.7030	
15 minute winter	24	13	90.909	1.008	1395.3	2.9332	0.0000	SURCHARGED	15 minute winter	1.023	25	1397.1	2.290	0.386	14.2586	
15 minute winter	25	13	90.679	1.518	1416.2	4.3166	0.0000	SURCHARGED	15 minute winter	1.024	26	1418.0	2.238	1.597	23.0763	
15 minute winter	72	12	93.930	0.988	33.3	1.8290	0.0000	SURCHARGED	15 minute winter	7.000	73	27.0	0.833	0.629	0.4195	
15 minute winter	73	12	93.888	1.018	56.7	1.9079	0.0000	SURCHARGED	15 minute winter	7.001	74	53.9	1.636	0.805	0.3369	
15 minute winter	74	12	93.746	1.016	82.2	1.9048	0.0000	SURCHARGED	15 minute winter	7.002	75	80.8	2.031	0.703	1.0910	
15 minute winter	75	11	92.948	1.545	108.6	2.8073	2.3403	FLOOD	15 minute winter	7.003	76	93.6	2.354	1.652	0.4361	
15 minute winter	76	11	92.497	1.224	125.6	2.2885	0.0000	FLOOD RISK	15 minute winter	7.004	77	119.2	2.997	2.399	0.5701	
15 minute winter	77	12	91.510	0.443	150.6	0.8148	0.0000	SURCHARGED	15 minute winter	7.005	78	150.4	2.233	0.855	1.4612	
15 minute winter	78	12	91.068	0.518	181.8	0.9504	0.0000	SURCHARGED	15 minute winter	7.006	79	180.9	2.634	0.938	0.6592	
15 minute winter	79	13	90.724	0.454	212.3	0.8354	0.0000	SURCHARGED	15 minute winter	7.007	26	210.3	4.057	0.638	0.4701	
15 minute winter	26	13	90.374	1.286	1617.8	3.8161	0.0000	SURCHARGED	15 minute winter	1.025	27	1619.6	3.125	1.826	4.1303	
15 minute winter	27	13	90.167	1.092	1638.7	4.2772	0.0000	SURCHARGED	15 minute winter	1.026	28	1641.0	2.590	0.534	27.8208	
15 minute winter	28	13	89.712	1.677	1660.1	6.5472	0.0000	SURCHARGED	15 minute winter	1.027	29	1661.7	2.622	1.887	16.3862	
15 minute winter	29	13	89.365	1.381	1680.8	5.3885	0.0000	SURCHARGED	15 minute winter	1.028	30-HW	1681.9	2.654	1.900	19.4004	
720 minute winter	30-HW	720	89.093	1.170	190.8	2.9784	0.0000	SURCHARGED	720 minute winter	1.029	31-HW	189.5	0.774	0.214	7.3061	
720 minute winter	31-HW	720	89.092	1.192	189.5	2597.9090	0.0000	SURCHARGED	720 minute winter	1.030	32-FC	20.9	0.276	0.024	20.4665	
720 minute winter	32-FC	720	89.092	1.257	20.9	8.8833	0.0000	SURCHARGED	720 minute winter	Hydro-Brake®	33-OF	19.6				957.0
15 minute summer	33-OF	1	87.135	0.000	19.6	0.0000	0.0000	OK								

Appendix 6 – SUDS Maintenance Strategy

21169- Hither Green Lane
SUDS Management Strategy

1. The SUDS Proposals

1.1 The SUDs on the proposed development site are to consist of an attenuation basin. The basin will attenuate the contributions of site wide surface water with restricted flows to the receiving watercourses.

1.2 The attenuation basins provide storage for all storm events up to and including the 100 year plus 40% event, including the necessary allowance for potential urban creep.

2. Design and Adoption

2.1 This SUDS features will not be adopted by the Local Authority with designs for these areas being assessed through the planning permission process. They have been developed in line with the latest CIRIA guidance as per engineering good practice, and the yet to be adopted DeFRA SuDS design standards.

3. Maintenance

3.1 The below table is a typical maintenance regime for such assets, which is based on good practice and general current procedures:

Activity	Indicative frequency	Typical tasks	Maintenance Liability
Routine/regular maintenance	Monthly	• Litter picking	Management Company
		• Grass cutting	Management Company
		• Inspection of Inlets, outlets and control structures	Management Company
Occasional maintenance	Annually	• Silt control around components	Management Company
		• Vegetation management around components	Management Company
		• Suction sweeping of permeable paving	N/A
		• Silt removal from catchpits, soakways and cellular storage	Management Company
Remedial maintenance	As required (tasks to repair problems due to damage or vandalism)	• Inlet/outlet repair	Management Company
		• Erosion repairs	Management Company
		• Reinstatement of edgings	N/A
		• Reinstatement following pollution	Management Company
		• Removal of silt build up	Management Company

4. Maintenance

4.1 Undertaking the above maintenance regime of the SUDS features, including occasional removal of silt and vegetation that gathers in SUDS, is required to ensure long term performance.

4.2 Organic waste should be used around the SUDS components or schemes to form wildlife piles. If this is not practical it should be composted or, as a last resort, removed to a licensed landfill site. The Environment Agency has adopted a risk-based approach in relation to removal of silt from SUDS (Environment agency 2011).

4.3 Green waste from SUDS components and schemes is much the same as waste from normal landscape maintenance and can be managed by:

- Shredded for surface spreading like a mulch
- The development of wildlife piles to provide habitat, refuges, shelter etc. When they biodegrade, they can compost.
- On or offsite (Council Green Waste) composting which can provide useful mulching
- Disposal to landfill often as a last resort

5. Reliability

5.1 The reliability of SUDS is critically dependent on the quality of the design and construction, in particular the management of silt.

5.2 The proposed development of SUDS features have been designed to accommodate flows up to the 100yr + 40% envelope within which they are intended to operate with additional freeboard (circa 300mm).

5.3 We understand that this design envelope mitigates future flooding risks to the development and also provides an abundant whole life cycle design life in line with modern planning requirements.

6. Health and Safety

6.1 These SUDS features have been designed to be as shallow as possible with gentle side slopes, which should minimize health and safety risks.

6.2 The design guide used for these features (CIRIA's SUDS Manual and DeFRA's Technical Standards for Sustainable Drainage Systems) incorporates health and safety implications of these SUDS components. Also, the proposals are incorporated within the Construction, Design and Management Regulations 2015, which requires hazards to be removed by good design wherever possible rather than providing mitigation to manage risk.

6.3 Those responsible for the maintenance and management of SUDS should take appropriate health and safety precautions for activities and risk assessments should be undertaken.

Appendix 7 – Severn Trent Water Development Enquiry Response and Sewer Records

WONDERFUL ON TAP

SEVERN TRENT

30th July 2018

Severn Trent Water Ltd
Regis Road
Wolverhampton
WV6 8RU

Tel: 01902 793871

www.stwater.co.uk
net.dev.west@severntrent.co.uk

Contact: Asset Protection (waste water)

Your Ref:
Our Ref: ME/8320201

Travis Baker
Trinity Point
New Road
Halesowen
B63 3HY

FAO – Mr. D. Baker

Dear Mr. Baker,

Proposed Development at Land off Hither Green Lane, Redditch

I refer to your 'Development Enquiry Request' in respect of the above named site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes, which refer to surface water disposal from development sites.

Protective Strips

Due to recent change in legislation, there could be sewers, which have transferred over to the Company that are not shown on the statutory sewer records, but are located on your clients land. These sewers will have protective strips that we will not allow to be built over. The sewers could be identified whilst the land is being surveyed. If this is the case, please contact us for further guidance upon discovery.

Foul Water Drainage

The overall development, for 114 properties will generate approximately, 1.7784 l/s (2xDWF). With a 50/50 split of the development, due to levels generating 0.8892 l/s, per 57 properties.
The sewer records show a 375mm diameter foul water sewer, south of the site. In addition, they demonstrate a 150mm diameter foul sewer, within Hither Green Lane. I confirm that foul flows from a development with your suggested splitting of flows (57 to 375mm diameter sewer and 57 to 150mm diameter sewer) should not have an adverse hydraulic impact on the aforementioned sewers. A connection is therefore acceptable to the Company, subject to formal S106 approval (see later). Please note we do not have any recorded flooding incidents, within the area.

Surface Water Drainage

Under the terms of Section H of the Building Regulations 2010, the disposal of surface water by means of soakaways should be considered as the primary method. If this is not practical and no watercourse is available as an alternative, the use of sewerage should be considered. In addition, other sustainable drainage methods should also be explored before a discharge to the public sewerage system is considered, including a discharge to the adjacent pond. I appreciate, the requirement to split the site, due topography levels. With the majority of the flows, discharging to the River Arrow.

Having viewed the statutory sewer records, they demonstrate a 300>375mm diameter surface water sewer, within Hither Green Lane. If ground conditions are not favourable, for soakaways and other SUDs techniques, evidence should be submitted. This would satisfy the SGN (enclosed). A connection to the aforementioned surface water sewer, for (approximate) 1100m^2 area should be considered once all avenues have been exhausted. With attenuation and flows in accordance with SGN (Greenfield) or as stipulated by the Lead Local Flood Authority (Local Council Authority), as statutory consultee in the planning process.

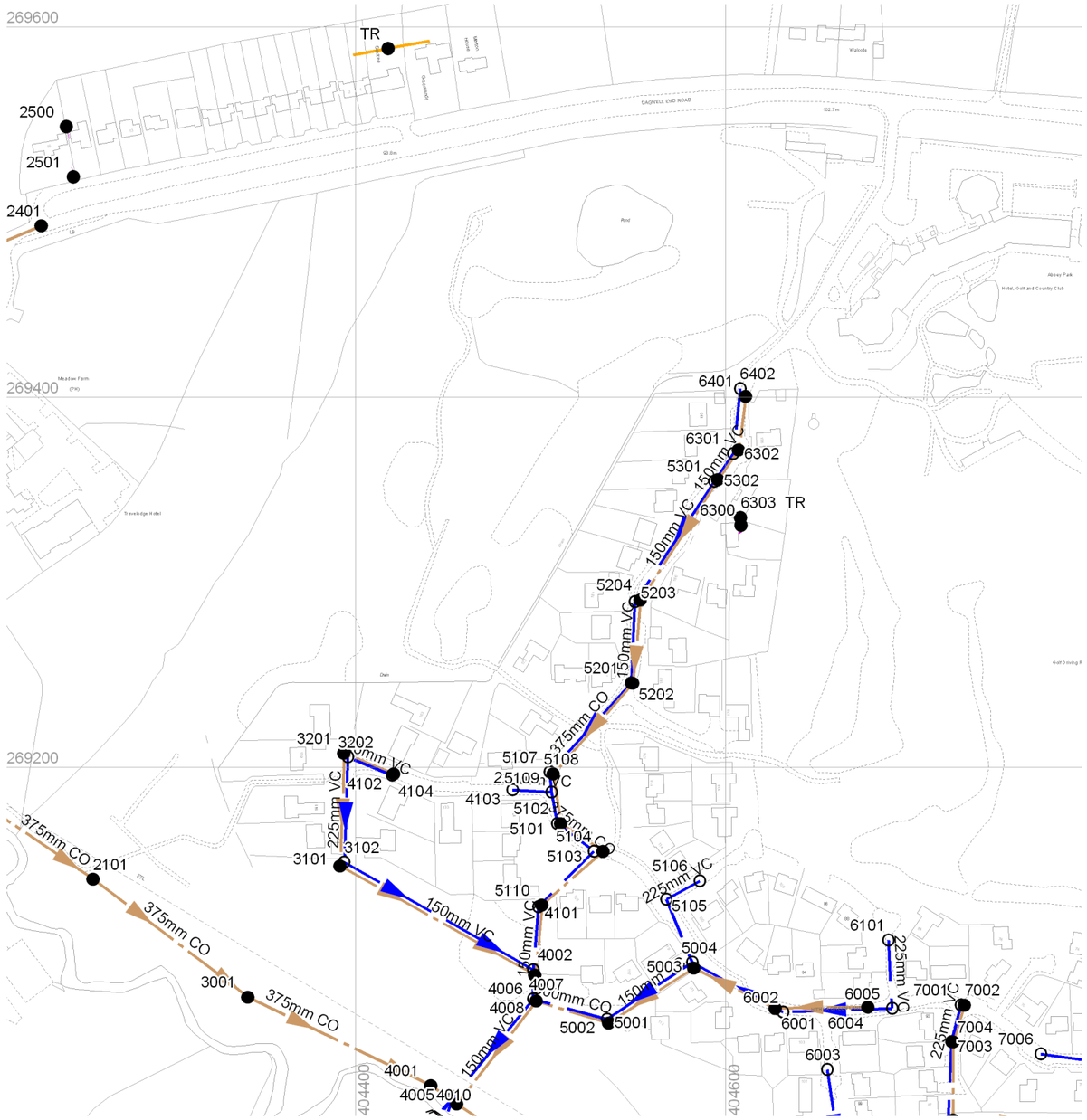
Connections

For any new connections including the use, reuse and indirect to the public sewerage system, the developer will need to submit Section 106 application. Our Developer Services department are responsible for handling all such enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 7076600 or download from www.stwater.co.uk

Please quote 8320201 in any future correspondence (including e-mails) with STW Limited. Please note that Developer Enquiry responses are only valid for 6 months from the date of this letter.

Yours Sincerely,

Matthew Evans
Asset Protection (wastewater)
Severn Trent Water Ltd



Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SP04692101	89.82	87.35	86.90	F	CO	C	375	nil	234.67	nill
SP04692401	95.33	93.11	nil	F	VC	C	300	nil	0.00	nill
SP04693001	88.63	86.90	86.43	F	CO	C	375	nil	234.09	nill
SP04693101	89.61	88.34	87.69	F	VC	C	150	nil	185.29	nill
SP04693102	89.72	88.50	88.11	S	CO	C	300	nil	300.87	nill
SP04693201	90.59	89.04	88.34	F	VC	C	150	nil	87.19	nill
SP04693202	90.62	89.46	88.62	S	VC	C	225	nil	67.90	nill
SP04694001	87.83	86.42	86.31	F	CO	C	375	nil	156.36	nill
SP04694002	89.46	88.04	87.49	S	CO	C	375	nil	29.09	nill
SP04694003	87.60	86.31	85.91	F	CO	C	375	nil	219.15	nill
SP04694004	87.59	85.80	85.75	S	CO	C	300	nil	184.40	nill
SP04694004	87.59	85.80	85.76	S	CO	C	300	nil	215.00	nill
SP04694004	87.59	85.79	85.75	S	CO	C	300	nil	213.50	nill
SP04694006	89.40	87.64	87.27	F	VC	C	150	nil	37.95	nill
SP04694007	88.89	87.44	85.82	S	CO	C	375	nil	42.13	nill
SP04694008	88.95	87.25	86.53	F	VC	C	150	nil	98.06	nill
SP04694101	91.02	89.26	88.09	S	CO	C	375	nil	29.17	nill
SP04694102	90.93	89.28	89.04	F	VC	C	150	nil	121.46	nill
SP04694103	92.43	90.92	90.85	S	VC	C	225	nil	300.29	nill
SP04694104	90.91	89.61	89.48	S	VC	C	225	nil	200.00	nill
SP04695001	90.00	88.10	87.29	F	VC	C	150	nil	50.37	nill
SP04695002	90.06	88.43	87.55	S	CO	C	300	nil	47.14	nill
SP04695003	92.89	90.66	88.21	F	VC	C	150	nil	22.42	nill
SP04695004	92.87	90.98	88.43	S	VC	C	225	nil	21.75	nill
SP04695101	92.57	90.58	90.36	S	CO	C	375	nil	113.64	nill
SP04695102	92.57	90.22	89.96	F	VC	C	150	nil	105.62	nill
SP04695103	92.92	90.29	89.25	S	CO	C	375	nil	40.80	nill
SP04695104	92.94	89.89	88.95	F	VC	C	150	nil	46.73	nill
SP04695105	92.96	91.46	91.00	S	VC	C	225	nil	79.93	nill
SP04695106	93.20	91.90	91.49	S	VC	C	225	nil	50.22	nill
SP04695107	92.60	90.89	90.80	S	CO	C	375	nil	122.78	nill
SP04695108	92.60	90.47	90.28	F	VC	C	150	nil	143.63	nill
SP04695109	92.43	90.78	90.62	S	CO	C	375	nil	107.88	nill
SP04695110	91.00	88.89	87.69	F	VC	C	150	nil	31.84	nill
SP04695201	93.96	91.41	90.90	S	CO	C	375	nil	127.69	nill
SP04695202	93.94	91.91	90.51	F	VC	C	150	nil	46.56	nill
SP04695203	94.50	91.71	91.44	S	CO	C	375	nil	163.15	nill
SP04695204	94.15	91.96	91.96	F	VC	C	150	nil	0.00	nill
SP04695301	95.24	92.42	91.73	S	CO	C	375	nil	112.96	nill
SP04695302	95.26	92.98	91.99	F	VC	C	150	nil	78.17	nill
SP04696001	93.86	91.70	90.72	F	VC	C	150	nil	50.19	nill
SP04696002	93.91	92.03	91.01	S	VC	C	225	nil	54.85	nill
SP04696003	nil	nil	89.02	S	VC	C	225	nil	0.00	nill
SP04696004	95.15	92.46	91.74	F	VC	C	150	nil	69.46	nill

- Abandoned Gravity Sewer
- Private Combined Gravity Sewer
- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)

All Private Sewers are shown in magenta
All section 104 sewers are shown in green
All Sewers that have been transferred to Severn Trent Water after the 1st October 2011, but have not been surveyed and confirmed by Severn Trent Water are shown in orange

- Culverted Watercourse
- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Housing, Building
- Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet

- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor

- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Pre-1937 Properties

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.
B. Where the node bifurcates (splits) X and Y indicates downstream sewer pipe.
C. Gradient is stated a 1 in...

MATERIALS

- - NONE
AC - ASBESTOS CEMENT
BR - BRICK
CC - CONCRETE BOX CULVERT
CI - CAST IRON
CO - CONCRETE
CSB - CONCRETE SEGMENTS (BOLTED)
CSU - CONCRETE SEGMENTS (UNBOLTED)
DI - DUCTILE IRON
GRC - GLASS REINFORCED CONCRETE
GRP - GLASS REINFORCED PLASTIC
MAC - MASONRY IN REGULAR COURSES
MAR - MASONRY RANDOMLY COURSED
PE - POLYETHLENE
PF - PITCH
PP - POLYPROPYLENE
PSC - PLASTIC STEEL COMPOSITE
PVC - POLYVINYL CHLORIDE
RPM - REINFORCED PLASTIC MATRIX
SI - SPUN (GREY) IRON
ST - STEEL
U - UNKNOWN
VC - VITRIFIED CLAY
XXX - OTHER

SHAPE

C - CIRCULAR
E - EGG SHAPED
O - OTHER
R - RECTANGLE
S - SQUARE
T - TRAPEZOIDAL
U - UNKNOWN

PURPOSE

C - COMBINED
E - FINAL EFFLUENT
F - FOUL
L - SLUDGE
S - SURFACE WATER

CATEGORIES

N
W E
S

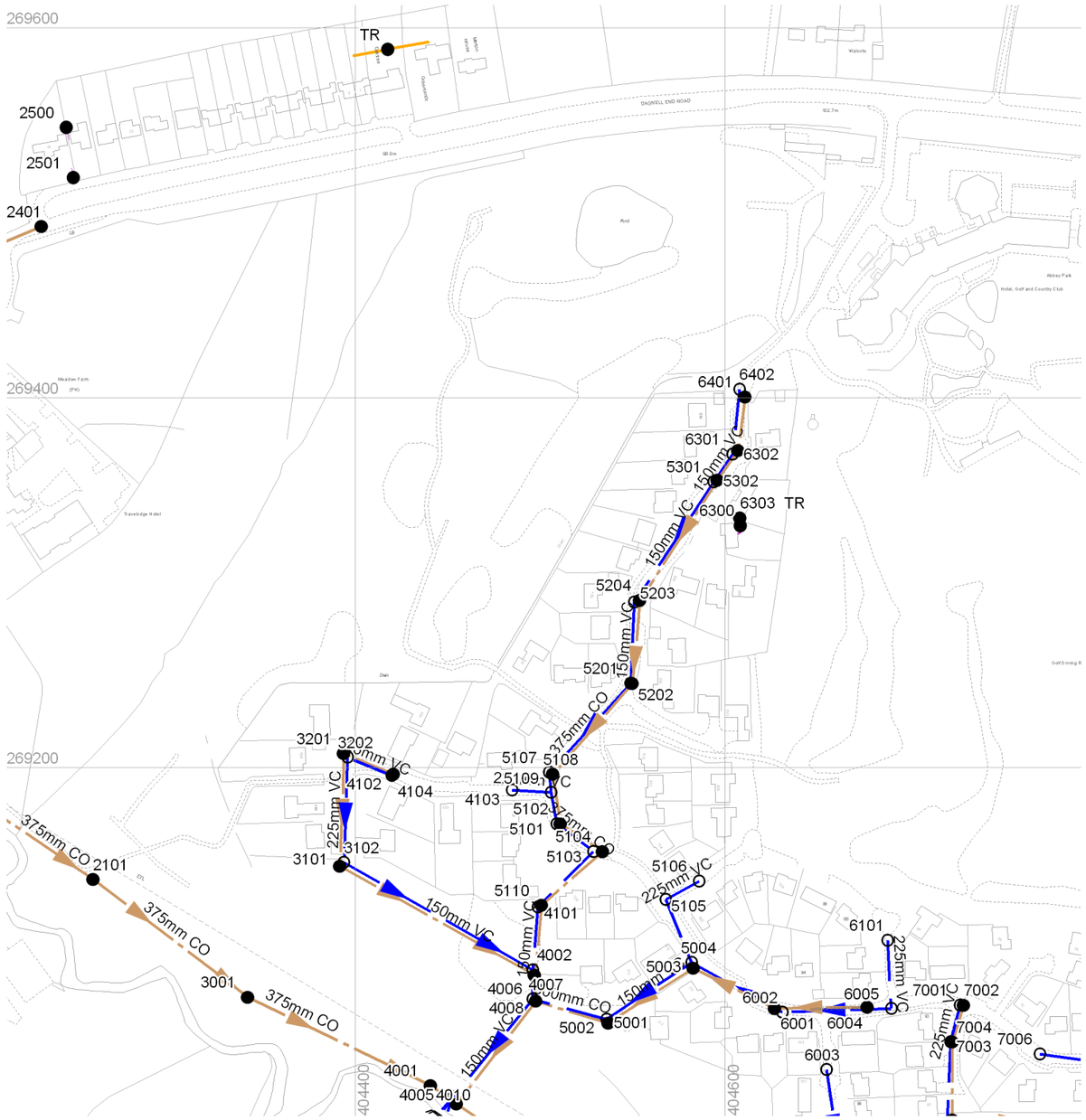
W - WEIR
C - CASCADE
DB - DAMBOARD
SE - SIDE ENTRY
FV - FLAP VALVE
BD - BACK DROP
S - SIPHON
HD - HIGHWAY DRAIN
S104 - SECTION 104

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD (Tabular)

O/S Map scale:	1:3000	**This map is centred upon:**	
Date of issue:	30.07.18	**O / S Grid reference:**	
Sheet No.	1 of 2	**x :**	404502
		y :	269311



Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SP04696005	95.50	92.91	92.03	S	VC	C	225	nil	67.08	nill
SP04696101	94.92	93.37	92.99	S	VC	C	225	nil	97.50	nill
SP04696300	nil	nil	nil	F	PVC	C	100	nil	0.00	nill
SP04696301	95.45	92.67	92.51	S	CO	C	300	nil	112.69	nill
SP04696302	95.49	93.16	92.99	F	VC	C	150	nil	114.24	nill
SP04696401	96.21	93.57	93.18	F	VC	C	150	nil	75.05	nill
SP04696402	96.16	92.88	92.69	S	CO	C	300	nil	185.42	nill
SP04697001	94.45	92.14	92.07	S	VC	C	225	nil	294.57	nill
SP04697002	94.38	92.49	92.32	F	VC	C	150	nil	122.82	nill
SP04697003	94.12	92.03	88.66	S	VC	C	225	nil	13.07	nill
SP04697004	94.06	92.29	90.17	F	VC	C	150	nil	19.81	nill
SP04697006	91.27	88.97	88.49	S	VC	C	225	nil	90.46	nill

- Abandoned Gravity Sewer
- Private Combined Gravity Sewer
- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)

All Private Sewers are shown in magenta
All section 104 sewers are shown in green
All Sewers that have been transferred to Severn Trent Water after the 1st October 2011, but have not been surveyed and confirmed by Severn Trent Water are shown in orange

- Culverted Watercourse
- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Housing, Building
- Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet

- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor

- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Pre-1937 Properties

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.
B. Where the node bifurcates (splits) X and Y indicates downstream sewer pipe.
C. Gradient is stated a 1 in...

MATERIALS

- - NONE
AC - ASBESTOS CEMENT
BR - BRICK
CC - CONCRETE BOX CULVERT
CI - CAST IRON
CO - CONCRETE
CSB - CONCRETE SEGMENTS (BOLTED)
CSU - CONCRETE SEGMENTS (UNBOLTED)
DI - DUCTILE IRON
GRC - GLASS REINFORCED CONCRETE
GRP - GLASS REINFORCED PLASTIC
MAC - MASONRY IN REGULAR COURSES
MAR - MASONRY RANDOMLY COURSED
PE - POLYETHLENE
PF - PITCH
PP - POLYPROPYLENE
PSC - PLASTIC STEEL COMPOSITE
PVC - POLYVINYL CHLORIDE
RPM - REINFORCED PLASTIC MATRIX
SI - SPUN (GREY) IRON
ST - STEEL
U - UNKNOWN
VC - VITRIFIED CLAY
XXX - OTHER

SHAPE

C - CIRCULAR
E - EGG SHAPED
O - OTHER
R - RECTANGLE
S - SQUARE
T - TRAPEZOIDAL
U - UNKNOWN

PURPOSE

C - COMBINED
E - FINAL EFFLUENT
F - FOUL
L - SLUDGE
S - SURFACE WATER

CATEGORIES

W - WEIR
C - CASCADE
DB - DAMBOARD
SE - SIDE ENTRY
FV - FLAP VALVE
BD - BACK DROP
S - SIPHON
HD - HIGHWAY DRAIN
S104 - SECTION 104

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD (Tabular)

O/S Map scale:	1:3000	**This map is centred upon: O / S Grid reference:**	
Date of issue:	30.07.18	**x :**	404502
Sheet No.	2 of 2	**y :**	269311

Appendix 8 – Severn Trent Water Existing Sewer Capacity Check

Liam Hyland

From: Network Solutions <Network.Solutions@severntrent.co.uk>
Sent: 16 September 2021 13:44
To: Mathew Grainger
Cc: Dave Baker
Subject: RE: Hither Green Lane (STW Ref ME/8320201) [Filed 20 Sep 2021 09:29]

Follow Up Flag: Follow up
Flag Status: Flagged

ST Classification: UNMARKED

Hi Mathew

Sorry for the delay in responding to your query. Envisage the flows from 216 houses (approx.. 3.38 l/s xDWF) may affect the existing performance of the network and therefore it will be necessary to undertake a sewer capacity assessment to understand the impact on the network and infrastructure further downstream.

Can you please confirm the following in order for us to prioritise the sewer capacity assessment and ensure that we can promote a growth scheme if necessary:

- Proposed submission of your Planning Application
- Proposed planned start and completion date.
- Any phasing details of the proposed development
- Planned occupation dates

Sadeq Hadi (Sid),
Senior Evaluation Technician,
Network Solutions,
Developer Services,
Network.solutions@severntrent.co.uk

WONDERFUL ON TAP

SEVERN TRENT

From: Mathew Grainger <mathew.grainger@travisbaker.co.uk>
Sent: 12 July 2021 12:35
To: Net Dev West <net.dev.west@severntrent.co.uk>
Cc: Dave Baker <dave.baker@travisbaker.co.uk>
Subject: Hither Green Lane (STW Ref ME/8320201)

Good Afternoon,

A development enquiry was carry out by Severn Trent Water on 30th July 2019, for the above named development. The enquiry states;

The overall development, for 114 properties will generate approximately, 1.7784 l/s (2xDWF). With a 50/50 split of the development, due to levels generating 0.8892 l/s, per 57 properties. The sewer records show a 375mm diameter foul water sewer, south of the site. In addition, they demonstrate a 150mm diameter foul sewer, within Hither Green Lane. I confirm that foul flows from a development with your suggested splitting of flows (57 to 375mm diameter

sewer and 57 to 150mm diameter sewer) should not have an adverse hydraulic impact on the aforementioned sewers.

The number of dwellings has now increased to 216 and our recent preliminary drainage design shows all the foul drainage discharging to the 375mm diameter foul water sewer in the south.

Are you able to confirm if the southern 375dia sewer has enough capacity for the 216 dwellings?

Kind Regards

Mathew Grainger
Associate

Travis Baker Limited
Trinity Point, New Road, Halesowen, West Midlands, B63 3HY

T. 0121 550 8037 DD. 0121 504 0910 W. http://www.travisbaker.co.uk/

Civil Engineering | Geo-Environmental Engineering | Structural Engineering | Transport Planning

Appendix 9 – Simple Index Assessments for SuDS features

SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type	Residential parking				
Pollution Hazard Level	Low				
Pollution Hazard Indices					
TSS	0.5				
Metals	0.4				
Hydrocarbons	0.4				
SuDS components proposed					
Component 1	Pond or wetland	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 2	Filter drain (where the trench is not designed as an infiltration component)	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Filter drains should be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 3	None				
SuDS Pollution Mitigation Indices					
TSS	0.9				
Metals	0.9				
Hydrocarbons	0.7				
Groundwater protection type	None				
Groundwater protection Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices					
TSS	0.9	Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England			
Metals	0.9				
Hydrocarbons	0.7				
Acceptability of Pollution Mitigation					
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				

SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type	Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)				
Pollution Hazard Level	Low				
Pollution Hazard Indices					
TSS	0.5				
Metals	0.4				
Hydrocarbons	0.4				
SuDS components proposed					
Component 1	Pond or wetland	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 2	None				
Component 3	None				
SuDS Pollution Mitigation Indices					
TSS	0.7				
Metals	0.7				
Hydrocarbons	0.5				
Groundwater protection type	None				
Groundwater protection Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices					
TSS	0.7	Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England			
Metals	0.7				
Hydrocarbons	0.5				
Acceptability of Pollution Mitigation					
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				

SUMMARY TABLE		DESIGN CONDITIONS			
		1	2	3	4
Land Use Type	Residential roofing				
Pollution Hazard Level	Very low				
Pollution Hazard Indices					
TSS	0.2				
Metals	0.2				
Hydrocarbons	0.05				
SuDS components proposed					
Component 1	Pond or wetland	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Component 2	None				
Component 3	None				
SuDS Pollution Mitigation Indices					
TSS	0.7				
Metals	0.7				
Hydrocarbons	0.5				
Groundwater protection type	None				
Groundwater protection Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices					
TSS	0.7	Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England			
Metals	0.7				
Hydrocarbons	0.5				
Acceptability of Pollution Mitigation					
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				

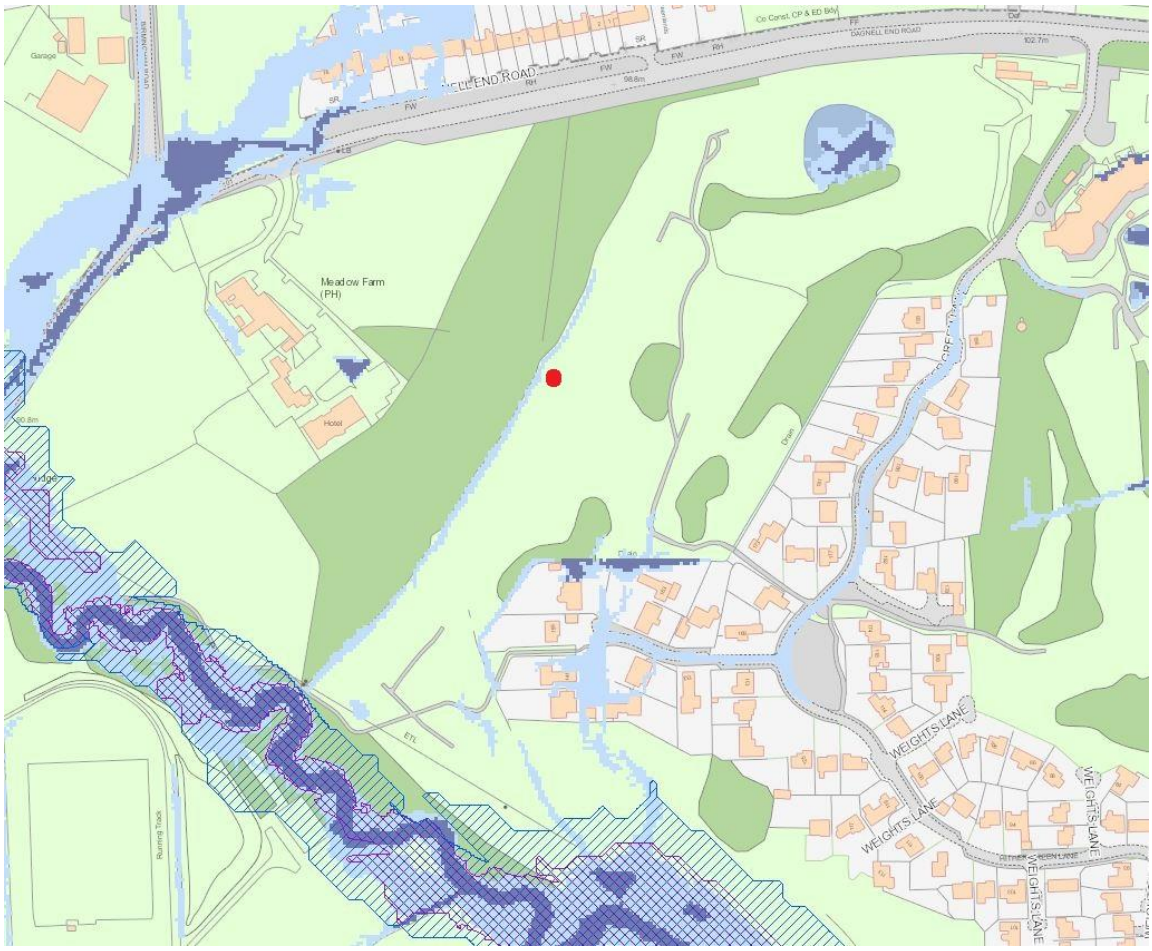
Appendix 10 – NWWM (LLFA) response

21/01830/FUL - Land West Of Hither Green Lane

Residential development (Class C3) with a vehicular access point onto Hither Green Lane, play areas, public open space including footways and cycleways, sustainable urban drainage systems and all other ancillary and enabling infrastructure.

Case Officer: Paul Lester

Deadline for comments: 11/02/2022



Comments

While NWWM is broadly supportive of the principle of development on this site, based on the current proposal for the site there are a several elements that are contrary to policies 17&18 of the Redditch Local Plan. We would raise a **Holding Objection** to this application until the proposed drainage layout is revised and it addresses concerns raised in the following comments.

The site is located within the catchment of the River Arrow, the site slopes gently from the north east to the south west. Environment Agency fluvial mapping indicates that the site is located mainly within Flood Zone 1, but small areas of the southern part of the site, adjacent to the Arrow, are covered by zones 2 and 3. The EA surface water flood maps show some minor pooling on the site and this is concentrated around existing

drainage features. The supporting FRA suitably covers the main sources of flood risk to the site and concludes that the development site is not at significant flood risk.

There are a series of existing ditchlines which current drain the site. Principally there are two main features one which runs approximately down the centre of the site and a second which follows along the eastern site boundary. There are also several existing ponds located on the site. The largest in the north western part of the site as well as another smaller features on the eastern side. The topographical survey in the FRA does not cover the south eastern part of the site, so it is unclear on the exact details of other features in this part of the site, however a total of 4 ponds have been identified in the preliminary ecological assessment.

Within the FRA an outline drainage strategy has been proposed, the proposed level of retention is acceptable (up to 1 in 100 year AEP + 40% for climate change) and the proposed off site discharge rate is acceptable. However, beyond surface water attenuation the proposed drainage scheme provides minimal further benefits. Calculations for the scheme have been provided, however they have not been assessed as they will need to be revised to accommodate revisions to the drainage layout if the scheme to be acceptable to the LLFA.

The current layout does not suitably consider existing drainage features/ water features and all but the northern pond have been lost. The supplied green space assessment flags the benefits of the existing water features and the ecology report highlights that development proposals should seek to retain/ minimise losses of the standing water habitats. Features should be retained and incorporated by the proposed layout not simply removed. The housing layout should be set around these features, it is likely there could be water nuisance issues for new properties built in the location of former features.

While it is retained northern pond is surrounded by new development which is all proposed to be positively drained and bypass this feature. The result of this is likely the pond will dry up as much of its, already limited catchment area, is lost. The other ponds on the site have not be retained or utilised in the drainage layout.

The use of a single retention feature which is located on the periphery of the development will limit benefits with respect to water quality and amenity. It does include permanent water, which is positive however this it uniformly deep, natural ponds provide a mixture of depth profiles. There are no source control SuDS features provided by the scheme. Features such as permeable paving or drained tree pits should be incorporated into the design.

The site should be split into its natural catchment areas and a series of smaller retention features should be proposed. With the appropriate inclusion of source control features this should ensure there is still suitable attenuation volume provided by the scheme. These features should be incorporated into open space areas so that they provide amenity value. Pedestrian routes can be provided adjacent swales to provide green corridors through the development.

There is minimal reference to water quality for surface water runoff from the site. The stages of treatment approach previously detailed by the CIRIA SuDS manual was amended in the 2015 manual to the Simple Index approach. While the majority of the land uses on the site are classed as low risk it is required that this approach is applied, and mitigation measures are included within the drainage design as appropriate.

It is unclear from STW records if or where the adjacent Meadow Farm pub is connected to mains sewer for foul or surface water. Its needs to be ensured that any existing drainage arrangements for this property which cross the development site should be picked up by the new drainage provided for the development to ensure that it does not negatively affect the property or the proposed development.

In summary the proposed drainage scheme offers limited benefits to the site beyond surface water attenuation. The following alterations will need to be implemented if this scheme is to be acceptable to the LLFA.

- Preserve existing drainage features and incorporate them into the layout and site landscaping
- Provide attenuation to separate sub catchments of the site rather than single large feature.
- Provide source control measures for the site.
- Undertake a Simple Index Assessment for site runoff water quality.