



Report Title

DRAINAGE STRATEGY REPORT

Project

WYNNSTAY PARK, WREXHAM

Report Reference

CC2052-CAM-ZZ-XX-RP-C-00-0001

Client

CARTREFI GO LTD.

Date

MARCH 2020

REPORT CONTROL SHEET

Client: Cartrefi Go Ltd.

Project: Wynnstay Park, Wrexham

Job Number: CC2052

Report Title: Drainage Strategy Report

Report Reference: CC2052-CAM-ZZ-XX-RP-C-00-0001

Prepared By: B Whyman MEng (Hons) GMICE MCIHT

Reviewed and Authorised By: W D W James BScEng(Hons) CEng MIStructE Euring,
MBIFM FFB

Revision	Date	Description	Prepared By	Authorised By
P01	20/03/2020	Draft Issue	B Whyman	W D W James

Contents

1	INTRODUCTION	2
2	SITE LOCATION	3
3	EXISTING SITE	5
4	DEVELOPMENT PROPOSALS	7
5	FLOOD RISK	7
6	FOUL DRAINAGE	9
7	SURFACE WATER DRAINAGE	10
8	CONCLUSIONS	15
	APPENDIX A – Topographical Survey	A
	APPENDIX B – Existing Site Plan	B
	APPENDIX C – Council & DCWW Drainage Records	C
	APPENDIX D – Proposed Site Layout	D
	APPENDIX E – Flood Mapping	E
	APPENDIX F – Greenfield Runoff Estimation	F
	APPENDIX G – Proposed Drainage Strategy Plan	G
	APPENDIX H – Surface Water Drainage Calculations	H
	APPENDIX I – Exceedance Flow Routes	I

1 INTRODUCTION

- 1.1 Cambria Consulting Ltd has been commissioned by Cartrefi Go Ltd, to provide a Drainage Strategy Report in support of a planning application for a development of 43 affordable homes with associated parking and public open space at Wynnstay Technology Park, Wrexham.
- 1.2 As a result of the enactment of Schedule 3 of the Flood Water Management Act 2010 by Welsh Government, the development will require Sustainable Drainage (SuDs) Approval as well as planning approval in order to be constructed. This report has been produced to satisfy both approval processes.
- 1.3 The objectives of this report are to;
- Identify suitable outfall locations for the Surface Water and Foul Drainage from the development.
 - Establish whether there is sufficient capacity within the Foul sewerage network for the development.
 - Produce outline hydraulic calculations to estimate peak development design flows and resultant storage / attenuation requirements
 - Consult with the Lead Local Flood Authority and Dwr Cymru Welsh Water regarding the proposals.
 - Provide a schematic layout of the proposed foul and surface water drainage proposals.
 - Demonstrate compliance with the new National SuDs design standards, specifically standards S1-S6.

2 SITE LOCATION

- 2.1 The development site is located in the Wynnstay Technology Park, Wrexham as indicated in Fig 1 below. National Grid Reference for the site is SJ2945043234.
- 2.2 The site is located some 1 kilometre west of Ruabon centre, south of the A539 Ffordd Llangollen and east of the Plas Madoc residential area.

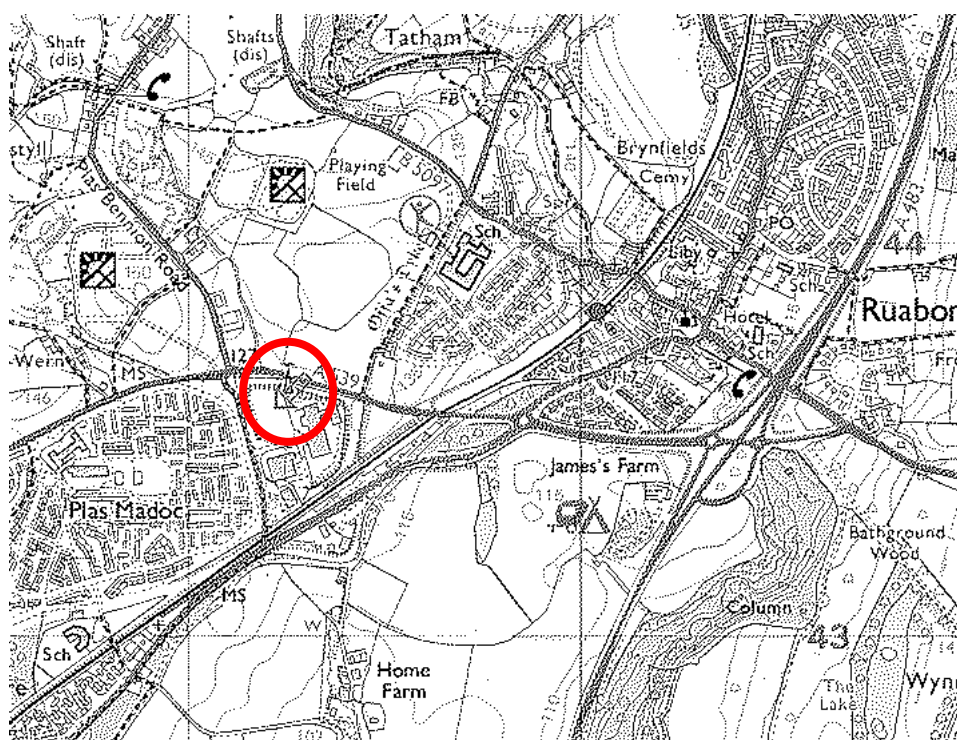


Figure 1 - Location Plan

- 2.3 The site has remained a vacant plot within the wider industrial park. An aerial photograph of the site is shown in Figure 2.
- 2.4 Historical mapping shows a colliery at the site in the late nineteenth and early twentieth centuries. The surrounding industrial units were developed in the 1970s/80s and in March 1990 an airshaft within the site was grouted and capped.
- 2.5 The gross site area (planning application red line) is some 1.7ha. The site is considered 'greenfield' for drainage design purposes.

Wynnstay Park – Drainage Strategy



Figure 2 – Aerial Photograph

3 EXISTING SITE

Topography

- 3.1 A topographical survey of the site was undertaken by A.R.M Surveys Ltd in October 2019, a copy of the survey drawing is included within **Appendix A**.
- 3.2 The survey shows a gentle gradient of approximately 1/40 across the development plateau, falling toward the southwest. Ground level across the plateau ranges from to 126.0m AOD at the northeast to 123.0 at the southwest.
- 3.3 Coal Authority records indicate that the top of the buried cap to the airshaft is at a level of 121.15m AOD.
- 3.4 A steep 1:3 bank forms the northern boundary of the development area. Thick woodland strips form the northern and western boundaries of the site.

Ground Conditions

- 3.5 No intrusive ground investigation information is available at the time of writing.
- 3.6 A preliminary environmental assessment (desk study) indicates that probable ground conditions are made ground (mudstone, coal, sandstone) overlying glaciofluvial sands and gravels down to approximately 14m bgl.
- 3.7 Superficial deposits are designated Unproductive Strata. Bedrock is designated as Secondary (A) Aquifer – permeable layers capable of supporting water supplies at a local rather than strategic scale.
- 3.8 There is potential for ground contamination within the made ground but the risk is considered low given the time elapsed since industrial activity at the site and the intervening decades of rainfall on the soil.
- 3.9 The Soilscales Viewer (Cranfield University) indicates that the soils at the site are *slightly acid loamy* with *slightly impeded* drainage. Soilscale categorises soils in the wider locality but still in relatively close proximity to the site as ranging from *impeded drainage* to *freely draining*. These indicative soil category areas are shown on the Existing Site Plan in **Appendix B**.
- 3.10 Until intrusive ground investigation and soakaway testing programme is completed it is not possible to ascertain with any degree of certainty whether or not infiltration will be a viable method of surface water drainage disposal at this site.

Drainage Infrastructure

- 3.11 Local authority and Welsh Water drainage record plans are included in **Appendix C**.
- 3.12 The Council record shows a culverted watercourse running within the site in the wooded strip close to the western boundary. Upstream of the site this watercourse is open, becoming culverted prior to crossing the A539 Ffordd Llangollen.
- 3.13 The Council record also indicates a drain running down the eastern boundary of the site where a ditch-line is observed on the ground (see photo, Figure 3). The Council record also shows ‘french drain’ land drainage routes around the perimeter of the development plateau, which outfall to the culvert at the southwestern corner of the site.
- 3.14 The Welsh Water sewer record shows a 225mm combined sewer running down the eastern edge of the adjacent Plas Madoc estate. A 225mm surface water sewer is shown in the industrial estate road to the south of the development site. It is assumed that this sewer collects the road gullies here and outfalls to the culverted watercourse.
- 3.15 The culverted watercourse through the site will need to be surveyed to confirm line, level and any lateral connections on the site. All other land drains should be surveyed as far as possible to establish whether they are interception/cut off drains onsite or conveying flows from upstream of the site.



Figure 3 – Ditch down eastern site boundary

4 DEVELOPMENT PROPOSALS

- 4.1 The proposed site layout plan, drawing number 18/1786/03 Rev D produced by Sean Caddick Architectural is included in **Appendix D**.
- 4.2 Development proposals includes the following;
- 34 no. 2-3 bed affordable 2-storey homes and 9 no. 1-2 bed affordable bungalows
 - New estate road access off adjacent road down western site boundary
 - 2 POS areas (645sqm and 700sqm). Southern POS area located above the capped shaft.
d Realignment of the existing powerhouse car park
 - SuDs infrastructure and landscaping

5 FLOOD RISK

- 5.1 The Development Advice Map (DAM) show the site is in Flood Zone A and therefore at little risk of flooding from fluvial or tidal sources. An extract of the DAM map is shown in Figure 4.



Figure 4 – Extract from DAM map

- 5.2 Surface Water flood mapping shows the site is not at risk of surface water flooding. An extract of the surface water flood map is shown in Figure 5. This map does indicate a high risk area immediately north of the development site. This is due to the open watercourse becoming piped to the north of the site. The map illustrates that should the existing culvert entrance north of the site become blocked, the flood flowpath would be along the road west of the site,

Wynnstay Park – Drainage Strategy

bypassing the site itself.



Figure 5 – Extract from Surface Water Flood Mapping

- 5.3 Reservoir flood mapping indicates that the site is not at risk of reservoir flooding.
- 5.4 DAM, surface water and reservoir flood maps are included in **Appendix E** of this report.

6 FOUL DRAINAGE

- 6.1 The proposed development will be served by a S104-adoptable gravity drainage system. No pumping requirement is envisaged given the topography and location of the surrounding sewer network.
- 6.2 A foul connection point to the combined sewer in Plas Madoc is shown. An alternative connection point could be to the foul sewer in the road to the south of the site, which would avoid crossing the road to the west of the site. DCWW will confirm any restrictions on the connection point under a pre-application enquiry.
- 6.3 An indicative drainage layout showing spine foul sewers in the estate roads is shown on the proposed drainage strategy plan in **Appendix G**. Should it be agreed that part or all of the estate road is designed to be porous, it is likely that any foul sewers in these areas will need to run instead in footway or even through back gardens, subject to DCWW's S104 design requirements.

7 SURFACE WATER DRAINAGE

7.1 In October 2018, Welsh Government published the ‘Statutory standards for sustainable drainage systems – designing, constructing, operating and maintaining Surface Water Drainage Systems’. This standard is now mandatory for new developments with either a construction area greater than 100m² or more than 1 dwelling.

7.2 The principles which underpin the design of surface water management schemes to meet the Standards are as follows;

SuDS schemes should aim to;

- Manage water on or close to the surface and as close to the source of the runoff as possible;
- Treat rainfall as a valuable natural resource
- Ensure pollution is prevented at source, rather than relying on the drainage system to treat or intercept it;
- Manage rainfall to help protect people from increased flood risk, and the environment from morphological and associated ecological damage resulting from changes in flow rates, patterns and sediment movement caused by the development;
- Take account of likely future pressures on flood risk, the environment and water resources such as climate change and urban creep;
- Use the SuDS Management Train, using drainage components in series across a site to achieve a robust surface water management system (rather than using a single “end of pipe” feature, such as a pond, to serve the whole development);
- Maximise the delivery of benefits for amenity and biodiversity;
- Seek to make the best use of available land through multifunctional usage of public spaces and the public realm;
- Perform safely, reliably and effectively over the design life of the development taking into account the need for reasonable levels of maintenance;
- Avoid the need for pumping where possible; and
- Be affordable, taking into account both construction and long term maintenance costs and the additional environmental and social benefits afforded by the system

7.3 There are six mandatory standards to be achieved within the National SuDS standards, S1-S6. The following sections demonstrate compliance with each of these standards.

Standard S1 – Surface Water Run-off Destination

- 7.4 This standard reviews the disposal routes for surface water run-off. The destinations are split into 5 levels with level 1 being the most preferential and level 5 being the least preferred and only used in exceptional circumstances.

Priority Level 1: Surface water runoff is collected for use;

- 7.5 Water butts will be fitted to downpipes on all dwellings to encourage reuse and reduce flows to the drainage system.

Priority Level 2: Surface water runoff is infiltrated to ground;

- 7.6 Infiltration to underlying soils will be utilized as far as possible across the site subject to the results of a soakaway testing programme and groundwater assessment (not yet undertaken).
- 7.7 Should infiltration prove fully viable across then site the proposed destination will be direct infiltration to subsoil within each individual plot curtilage via porous paving / individual plot raingardens, and a porous estate road proposed for adoption by the Highway Authority.

Priority Level 3: Surface water runoff is discharged to a surface water body;

- 7.8 Should infiltration prove unviable or only partially viable then flows will be conveyed to and disposed in areas where infiltration is viable as far as practicable. Where this is not achievable, attenuated connection will be made to the culverted watercourse on site.

Priority Level 4: Surface water runoff is discharged to a surface water sewer, highway drain, or other drainage system;

- 7.9 This destination is not deemed required for this development.

Priority Level 5: Surface water runoff is discharged to a combined sewer;

- 7.10 This destination is not deemed required for this development.

Standard S2 – Surface Water runoff hydraulic control

Greenfield Run-off Rates

- 7.11 The Greenfield Runoff rate for the site has been estimated using HR Wallingford's Estimation Tool on the uksuds.com website. The estimate, calculated using IH124 methodology, gives a QBar value of 2.2 l/s/ha. This Greenfield run-off Estimate is included in **Appendix F**.
- 7.12 It is anticipated that all greenfield runoff from the existing site will end up in the culverted watercourse, either via existing land drainage on the site, or via road gullies and the storm drain in the industrial estate road to the south of the site, as indicated on the Existing Site Plan in **Appendix B**.
- 7.13 Offsite runoff rate and volume will reduce to zero if intrusive SI confirms that full infiltration is viable.

- 7.14 Should culvert connection be required then discharge will be limited to as close as practicable the greenfield rate which is calculated at this site to be 2.2lit/sec/ha. The communal bioretention area shown indicatively in the drainage strategy plan in **Appendix G** is sized assuming a 5 lit/sec discharge rate and a hydrobrake orifice diameter of 105mm to minimise risk of blockage.
- 7.15 This outline sizing for illustrative purposes only, assumes zero attenuation of flows upstream of the bioretention area. In reality, following detailed design, flow will be slowed significantly by the upstream suds train devices such that discharge much closer to the greenfield rate will be achievable.
- 7.16 A series of upstream SuDS train features are proposed for this development, as shown indicatively on the plan in Appendix G. These will include:
- Individual domestic raingardens in each property back garden
 - Swale strips along plot frontages and the northern POS area
 - Bioretention area / Detention basin in the southern POS area to attenuate the balance of the flow downstream to greenfield rate, prior to offsite connection
 - Porous paving to all driveways and parking areas
 - Porous estate road (subject to agreement with adopting Authority)
- 7.17 A simple network Microdrainage model of the proposed surface water drainage system is included in **Appendix H**. This demonstrates that the southern POS area can accommodate a bioretention/detention area with sufficient storage to contain the 100yr+cc critical event with outlet rate limited to 5lit/sec.
- 7.18 Whilst it is acknowledged that this is higher than the estimated greenfield rate, this simple model also assumes no suds train attenuation at all throughout the network. When the detailed design is developed, incorporating all raingardens, swale strips and porous paving devices throughout the system, the volume requirement of the main bioretention/detention area will reduce significantly such that true greenfield attenuation of $2.2 \times 0.624 \text{ha} = 1.4 \text{ lit/sec}$ will be achievable.

Interception of run-off

- 7.19 Interception mechanisms will be required to ensure compliance with the requirement of zero runoff for the first 5mm rainfall for 80% of storm events during the summer and 50% in winter.
- 7.20 Permeable paving and soft suds (individual plot rain gardens & communal bioretention area / swale strips) will ensure compliance for first 5mm interception.

Exceedance

- 7.21 An exceedance overland flow route plan is included in **Appendix I**. This shows any exceedance flows would travel down the estate roads fronting the properties and down the

perimeter land drains to the rear of properties, towards the southern POS area containing the bioretention/detention area.

- 7.22 The hydrobrake chamber outlet to this area will contain a weir wall which will overtop in exceedance / blockage events ensuring flows to the culvert remain below-ground.
- 7.23 A new land drain along the southern boundary will intercept flows overtopping the southern POS area, again conveying these flows to the culvert.
- 7.24 The new southern boundary land drain should not be linked to the existing land drain running down the eastern boundary of the site. This existing eastern boundary land drain should be left to convey flows as it did pre-development.

Standard S3 – Water Quality

- 7.25 A SuDS treatment train will be required to satisfy Standard S3 of the new SuDs design standards. This is necessary to prevent negative impacts on the water quality of the downstream receiving watercourses and/or drainage systems.
- 7.26 The number of treatment levels within the train will be dependent on the type of land use proposed and the discharge point.
- 7.27 The SuDS train devices proposed (permeable paving, raingardens, swale strips and bioretention area) will deliver the requisite cleansing and filtration of runoff for this residential (low pollution hazard level) development.

Standard S4 – Amenity

- 7.28 The purpose of Standard S4 is ensure the design of SuDS components to ensure that they enhance the provision of high quality, attractive public spaces which can provide health and wellbeing benefits.
- 7.29 Public Open Space plays a prominent role on this development site.
- 7.30 Suds train devices throughout the site, both individual plot raingardens in private back gardens and larger swale strips and bioretention area in the communal green space, will be carefully design to promote aesthetics and public well-being as well as the necessary drainage function.

Standard S5 – Biodiversity

- 7.31 Standard S5 requires the design of the surface water management system to maximise the biodiversity benefits.
- 7.32 The soft suds train devices proposed (raingardens, swale strips and bioretention area) will be carefully designed with gradients/profiles, planting species and soil properties selected

with specialist horticulturist/ecologist input to ensure suitable habitat is delivered to promote biodiversity.

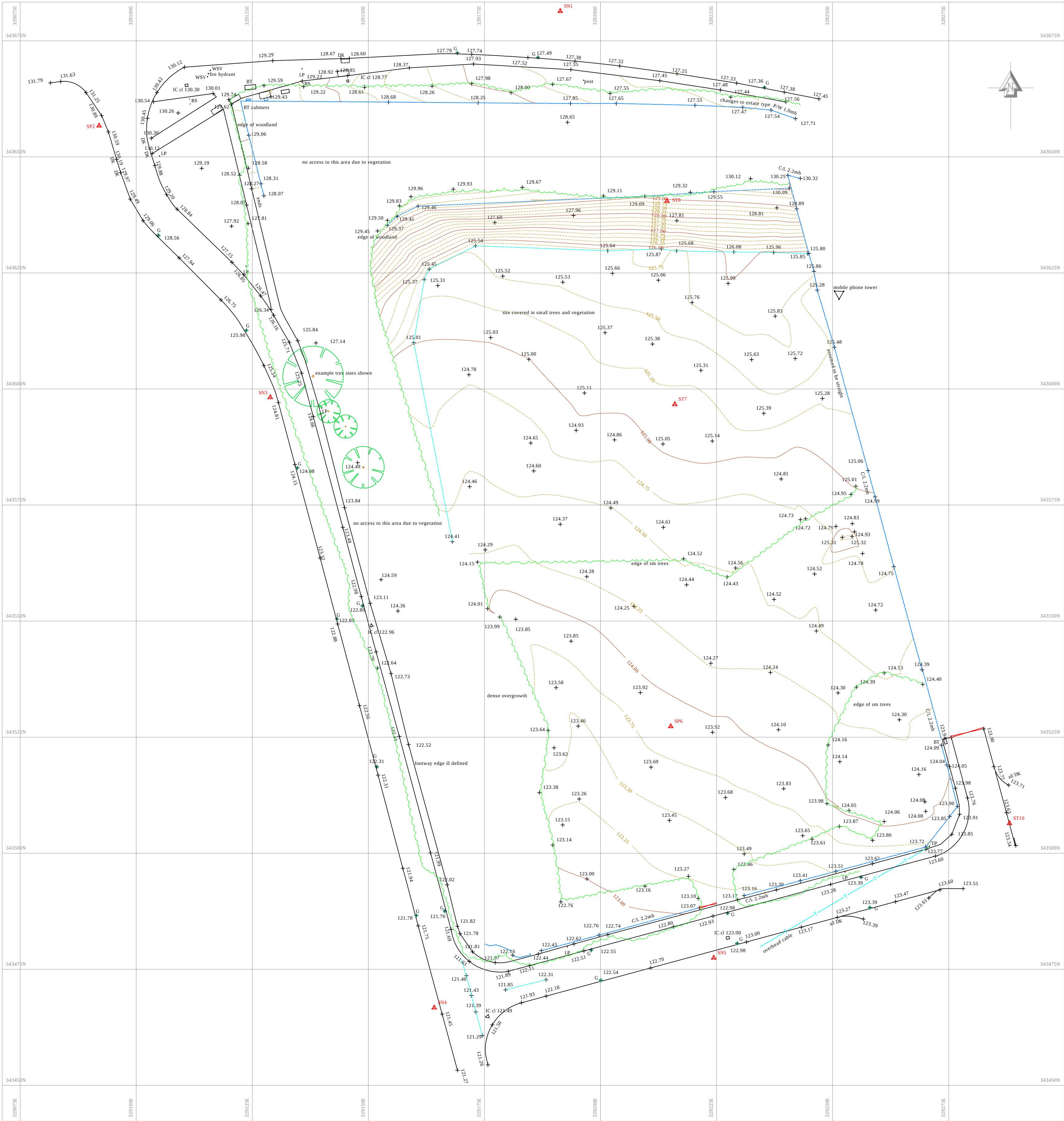
Standard S6 – Design of drainage for Construction, Operation and Maintenance and Structural Integrity

- 7.33 Mandatory adoption by the Suds Approval Body only applies where the SuDs feature serves more than 1 property. Should infiltration be viable at this development, SAB-adoptable elements will be limited to the communal soft suds areas and any associated conveyance pipes/channels.
- 7.34 Porous road adoption is envisaged only if underlying ground infiltration is favourable and is subject to Highway Authority acceptance of construction details and maintenance plan, standards for which are now becoming established across the Welsh Authorities.
- 7.35 All areas of the proposed SuDS infrastructure are in accessible areas for ease of maintenance. The bioretention / detention basin is accessible by a maintenance vehicle which can park in a designated grasscrete space off the end of the estate road.
- 7.36 The proposed and existing land drainage around the perimeter of the development should be located in an accessible strip behind the rear garden fences.
- 7.37 Bioretention area to have bespoke maintenance plan.
- 7.38 Other suds devices (porous paving / raingardens in private areas) are low maintenance surface/shallow items with established regular maintenance regimes.
- 7.39 The SuDs solution has been designed in accordance with the SuDS manual and is generally served by shallow SuDs features. There are no inherent safety issues with the proposed scheme and any issues will be addressed via designer's risk assessments during the remainder of the design process.

8 CONCLUSIONS

- 8.1 A surface water drainage strategy based wholly or else as much as practically possible on infiltration disposal will be pursued, subject to favourable ground conditions. At the time of writing, in the absence of intrusive site investigation and soakaway test results, a strategy of attenuated connection to watercourse is presented as the next preferred option.
- 8.2 The proposed surface water drainage needs to be restricted to 1.4/s (QBar) to mimic greenfield runoff rates. Outline sizing calculations have indicated that this rate will be achievable with the proposed layout.
- 8.3 Attenuation storage will be provided in the form of individual private raingardens and swale strips dispersed throughout the site, porous paving to all driveways and parking areas, and the balance of any requisite attenuation volume provided by a bioretention / detention area sympathetically integrated into the southern POS area.
- 8.4 Permeable pavement construction & raingarden / bioretention areas will improve the water quality of surface water run-off.
- 8.5 The adoption of a porous estate road is also an option that should be actively pursued with the Highway Authority in tandem with the SAB Authority.
- 8.6 Proposed foul drainage will connect via gravity to the existing public sewer network.

APPENDIX A – Topographical Survey



SURVEY STATIONS			
Name	Easting	Northing	Height
SN1	329191.335	343681.375	127.949
SP2	329092.013	343656.705	130.987
SN3	329128.874	343598.195	125.048
SN4	329164.189	343466.718	121.629
SN5	329224.402	343477.451	123.087
SP6	329215.136	343527.319	123.950
ST10	329288.108	343506.438	125.224
ST7	329216.013	343596.691	126.852
ST8	329214.345	343640.487	130.647

Legend

BT	British Telecom Cover	OHCL	Overhead Cable Level
CL	Ceiling Level	O.S.B.M	OS Bench Mark
DK	Dropped Kerb	PLP	Ped Lamp Post
EP	Electric Pole	RS	Road Sign
FL	Floor Level	TCSL	Tree Clear Stem Level
G	Gully	TP	Telegraph Pole
GSV	Gas Stop Valve	TTL	Top Tree Level
HTL	Hedge Top Level	TWL	Top Wall Level
IC	Inspection Cover	UTL	Unable To Lift
IL	Invert Level	UTM	Unable To Measure
LP	Lamp Post	WSV	Water Stop Valve

Fence types

A/B	Armco Barrier	P/R	Post & Rail
C/L	Chain Link	P/W	Post & Wire
E/F	Estate Fencing	S/S	Steel Security
I/R	Iron Railing	V/C	Vertical Closeboard
P/F	Timber panel		

	Borehole		Survey station
	Water		Wall
	Gas		Building
	Telecom		Bottom of bank
	Electric		Top of bank
	Unknown		Contour major
	Fence		Contour minor
	Hedge		Surface edge
	Foliage		Tree canopy
			Gate

Notes.

Copyright of this plan is held by A.R.M. Surveys Limited.
No responsibility is taken for amendments by others.
Do not scale from copies or PDFs.

This survey was carried out to an agreed specification.
Detail and features not included in the original
specification will not be shown.

The drawing scale indicates the accuracy of the
digital data.

Levels on road kerb strings are taken in the channel.

Hedge widths are indicative, text notes show widths.

Stock boundary fences may not be shown where they
occur adjacent to other boundary features.

Areas of the site obscured by overgrowth or spoil may
have detail omitted from the survey.

The origin and orientation of the survey grid is based on
national grid co-ordinates via GNSS with active os
network OSGB36 (15) centred around station SN5 with
the data presented on a plane grid.

A.R.M. Surveys Ltd
Suite 9
Sabrina Court
Shrewsbury
SY3 7BF
Tel 01743 248265

Client
Gratton Oakes

Project
Ruabon,
LL14 6RW.

Job	1166-1019-T	Scale	1:500
Topographical Survey	Floor Plans	Elevations	
3D Laser scan	Lease Plans	Drainage Survey	
Date	Dwg no	Rev	Surveyor
07.10.19	01/01	-	MM / AB
Grid	Contours	Level Datum	Checked
25m	0.25m	See notes	MM

APPENDIX B – Existing Site Plan

GREENFIELD RUNOFF (UK SUDS ESTIMATION TOOL, IH124):		
	lit/sec/ha	EXISTING SITE (1.7 ha)
QBAR	2.20	3.74
Q30	3.91	6.65
Q100	4.79	8.14



THIS DRAWING IS COPYRIGHT © CAMBRIA CONSULTING LTD.
DO NOT SCALE FROM THIS DRAWING.

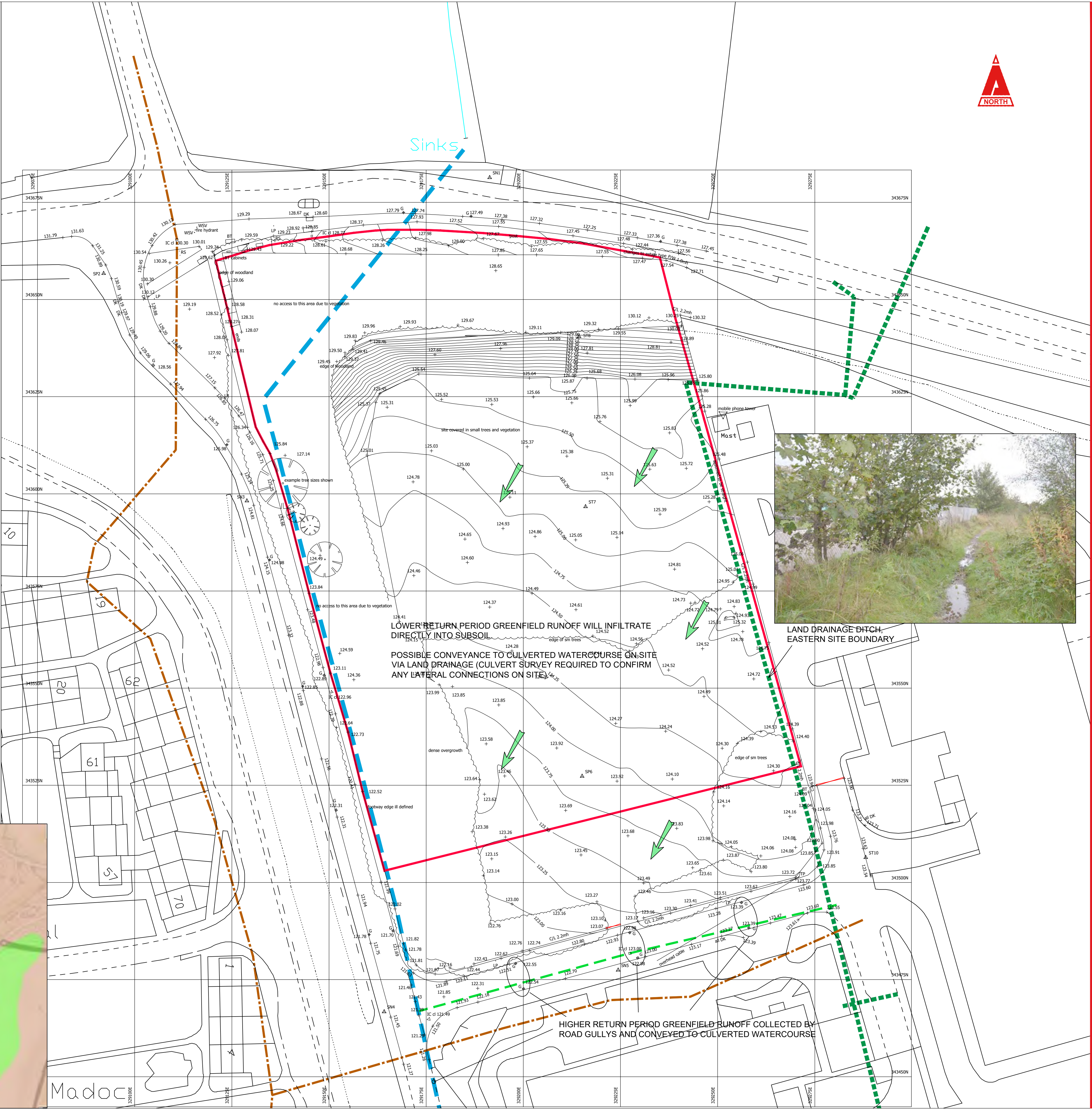
CONTRACTORS MUST CHECK ALL DIMENSIONS ON SITE.
ONLY FIGURED DIMENSIONS ARE TO BE WORKED FROM.
DISCREPANCIES MUST BE REPORTED IMMEDIATELY TO
CAMBRIA CONSULTING LIMITED BEFORE PROCEEDING.

THE CONTRACTOR IS TO REFER TO THE SPECIFICATION,
FULL SCHEDULE OF RESIDUAL RISKS IN THE CONTRACT
DOCUMENTATION AND ALSO TO INFORMATION FROM OTHER
DESIGNERS, IN PARTICULAR THE MSE CONSULTANT
REGARDING EXISTING LIVE SERVICES.

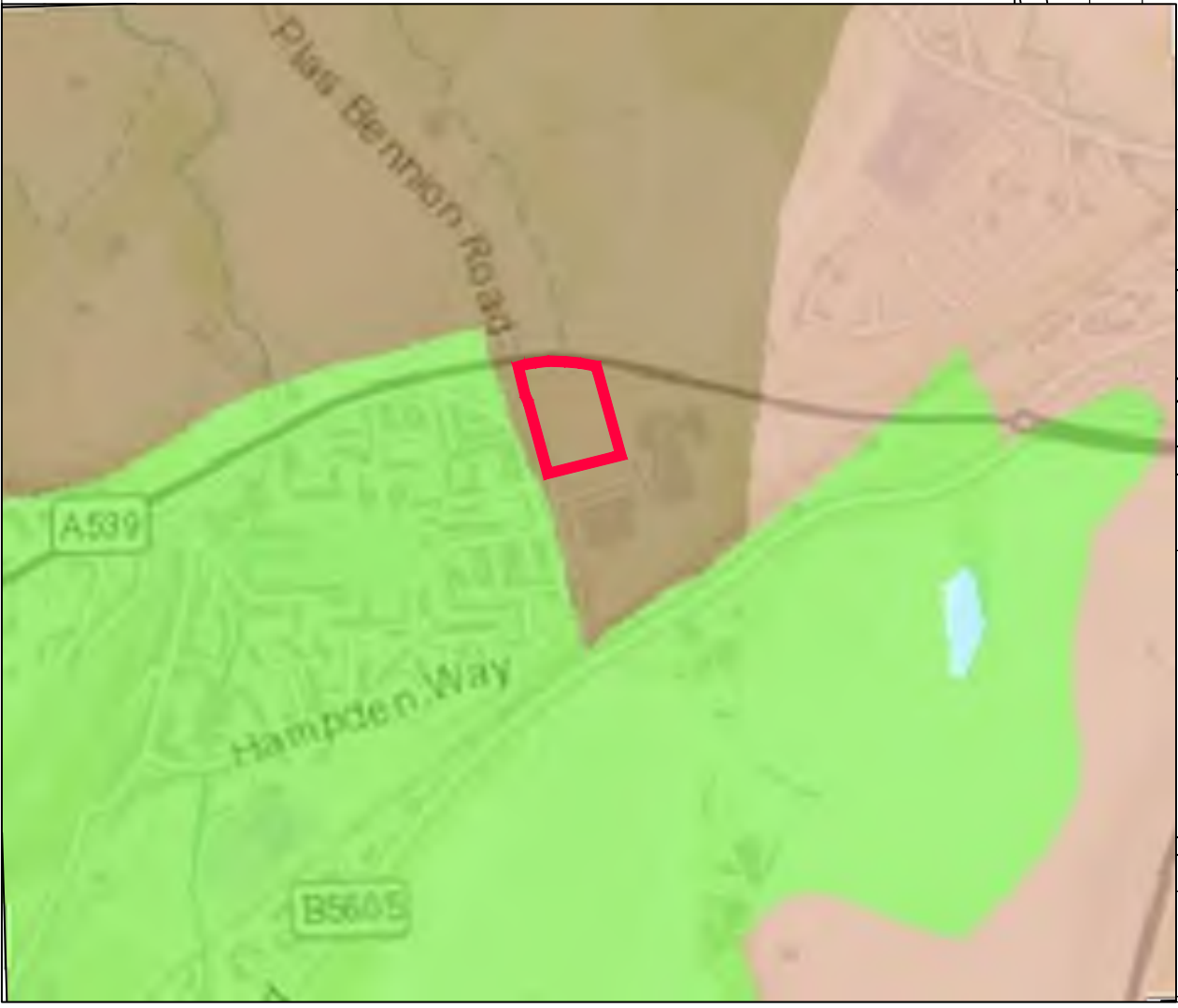
 THIS SYMBOL IS USED TO HIGHLIGHT INSTANCES
OF RISK WITHIN THE CONSTRUCTION PROCESS.

ALWAYS CHECK FOR LATER REVISIONS OF THIS DRAWING.

- KEY:
-  EXISTING CULVERTED WATERCOURSE
 -  EXISTING LAND DRAIN ("FRENCH DRAIN")
 -  EXISTING STORM SEWER
 -  EXISTING FOUL SEWER
 -  GREENFIELD RUNOFF FLOW-ROUTE FOLLOWING TOPOGRAPHY



- SOIL INFORMATION:
-  SLOWLY PERMEABLE SEASONALLY WET ACID LOAMY AND CLAYEY. IMPEDED DRAINAGE
 -  SLIGHTLY ACID LOAMY AND CLAYEY. SLIGHTLY IMPEDED DRAINAGE
 -  SLIGHTLY ACID LOAMY. FREELY DRAINING



P01	FIRST ISSUE.	GT	BW	BW
Rev	Description	By	Chk	App

Client:

Project:
WYNNSTAY PARK

Drawing Title:
EXISTING SITE PLAN

Drawing No.
CC2052 CAM 00 00 GA C 52 1100

Project No. Org. Vol. Level Type Dis. Class No.

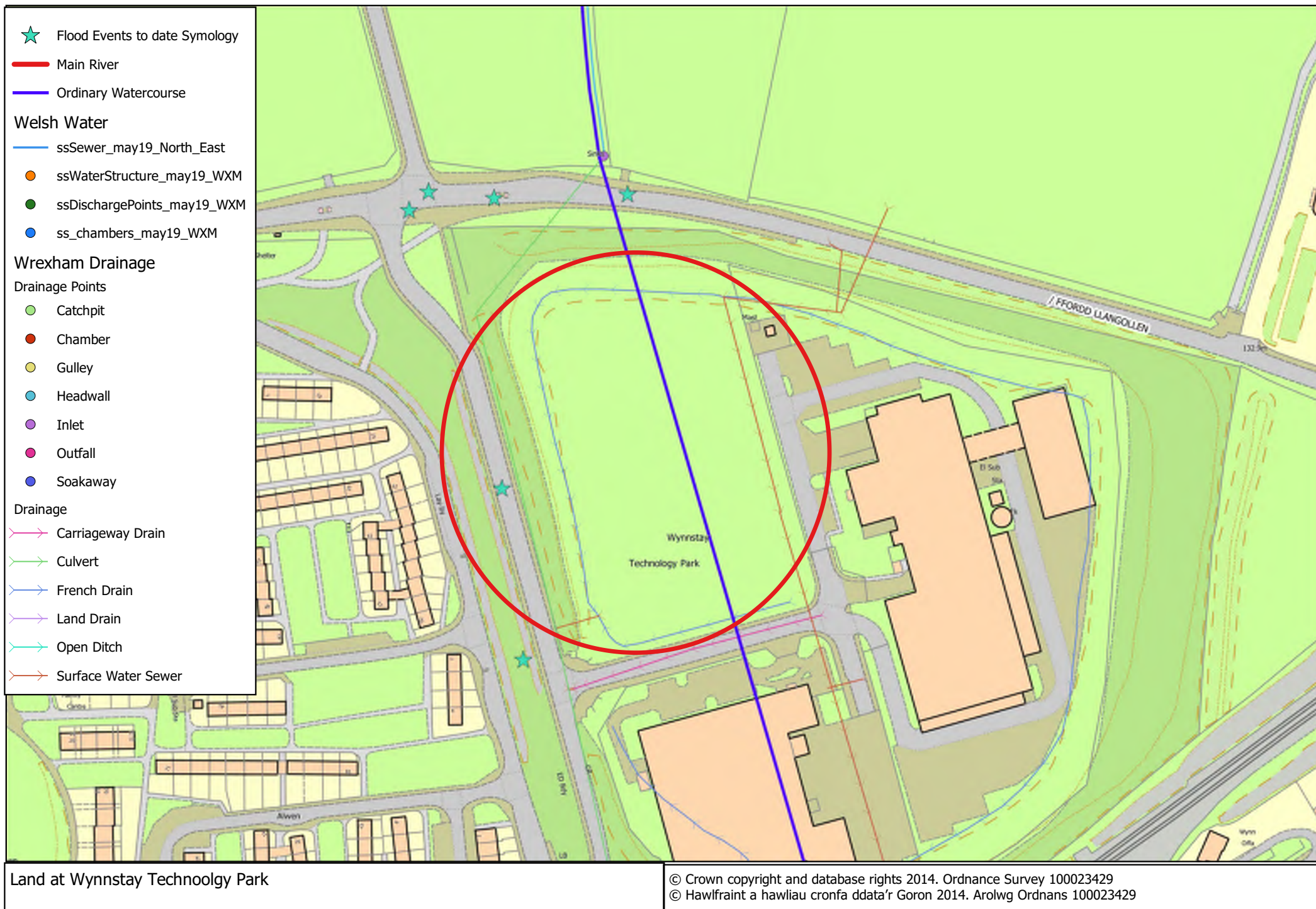
Suitability Status: PRELIMINARY Scale @A1: 1:500 Rev: P01

CAMBRIA
Constructive Thinking

Civil & Structural Engineers
Cambria House
16 Plas St. Pol de Leon
Penarth Marina
Cardiff, CF64 1TR

T 029 2099 3333
E admin@cambria.co.uk
W www.cambria.co.uk
@cambriauk
uk.linkedin.com/in/cambria

APPENDIX C – Council & DCWW Drainage Records



Land at Wynnstey Technology Park

© Crown copyright and database rights 2014. Ordnance Survey 100023429
© Hawlfraint a hawliau cronfa ddata'r Goron 2014. Arolwg Ordnans 100023429



329217,343555

Scale: 1:1423

06/02/2020

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos cement or Pitch Fibre (PF)) may be found to be asbestos cement (AC) or Pitch Fibre (PF). It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Dwr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. The information which is supplied hereby by the company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 based particular, but without prejudice to be generality of that foregoing, it should be noted that the records that are available to the company may not disclose the existence of a drain sewer or disposal main laid before 1 September 1989, or if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the company's right to be compensated for any damage to its apparatus.

**EXACT LOCATION OF
ALL APPARATUS TO
BE DETERMINED ON
SITE**

Reproduced from the Ordnance Survey's maps with the permission of the Controller of Her Majesty's Stationary Office. Crown Copyright. Licence No: WU298565



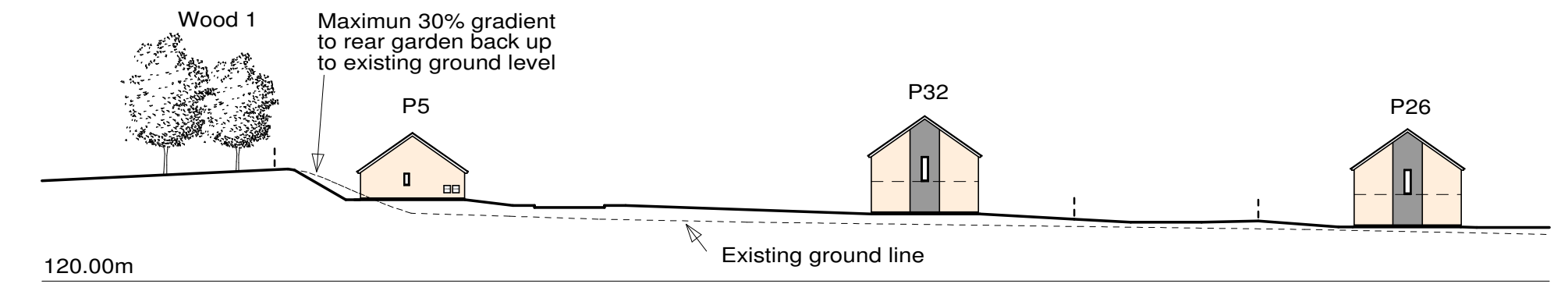
LEGEND

- | | | |
|-----|----------------------------|--|
| b-d | Sluice Valve | Gravity Sewer |
| ◆ | Air Valve SINGLE | Rising Main |
| × | Tap | Outfall |
| ⊗ | Pressure Reducing Valve | Pumping Station |
| □ | Meter | Lamphole |
| ■ | Bulk Meter | Combined Sewer Overflow |
| ● | Fire Hydrant | Special Purpose Chamber |
| ○ | Cap | Treatment Works |
| — | Non Dwr Cymru | Private Sewer Transfer |
| — | Existing Distribution Main | Lateral Drain |
| ■ | Inspection Chamber | AD |
| | | Sewer symbol colour indicates the sewer type |
| | | RED - Combined |
| | | GREEN - Surface Water |
| | | BROWN - Foul |

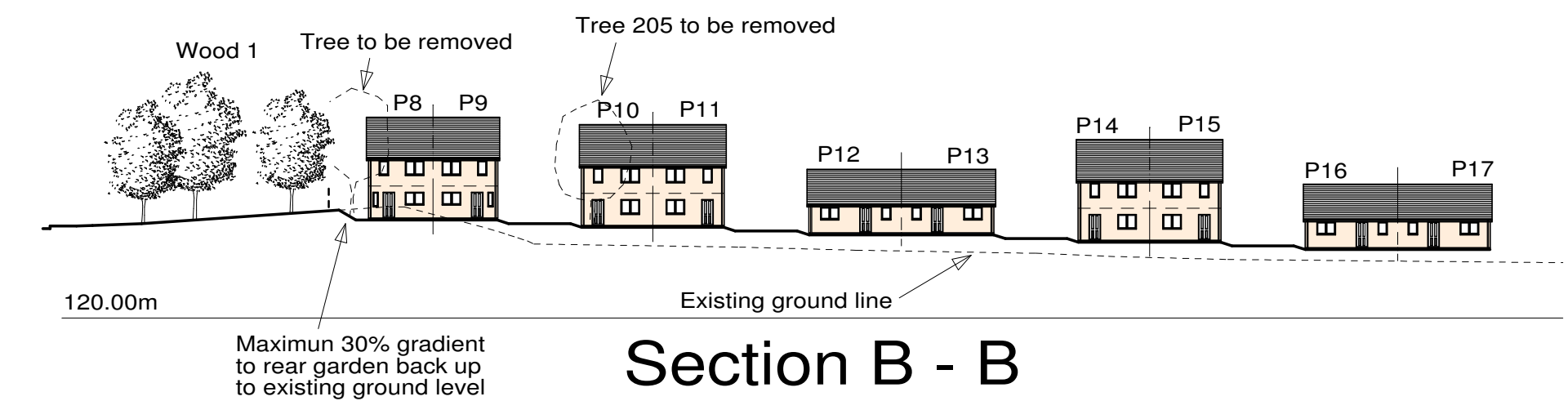
APPENDIX D – Proposed Site Layout



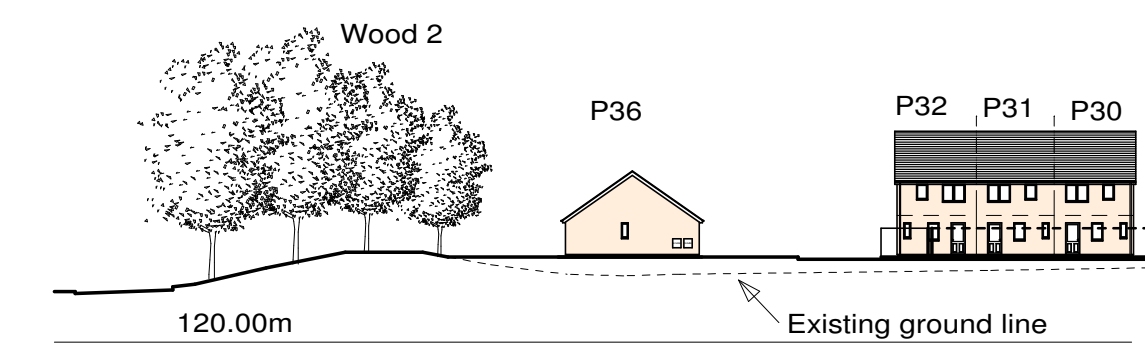
Ordnance Survey, (c) Crown Copyright 2018. All rights reserved. Licence number 100022432



Section A - A



Section B - B



Section C - C

Open Space total 1331m²

Woodland area total 3582m²

26No. 2 Bedroom Social Housing Dwelling @ 84m²

8No. 3 Bedroom Social Housing Dwelling @ 95m²

4No. 1 Bedroom Social Bungalow @ 51m²

5No. 2 Bedroom Social Bungalow @ 58m²



----- 1.8m high timber fence
—— 1.8m brick wall

Revision:	
A Layout amended following comments from pre app consultation.	18/09/19
B Site sections added.	15/01/20
C layout amended.	23/02/20
D layout amended.	25/02/20

Sean Caddick Architectural
13 Belvidere Walk
Shrewsbury
SY2 5LT
[email: seancaddick@live.co.uk](mailto:seancaddick@live.co.uk)
Tel: 07971 166529

Client:
Cartell GO Ltd

Project:
Residential Development
Wynnstey Park
Ruabon
Wrexham

Drawing title:
Proposed Block Plan

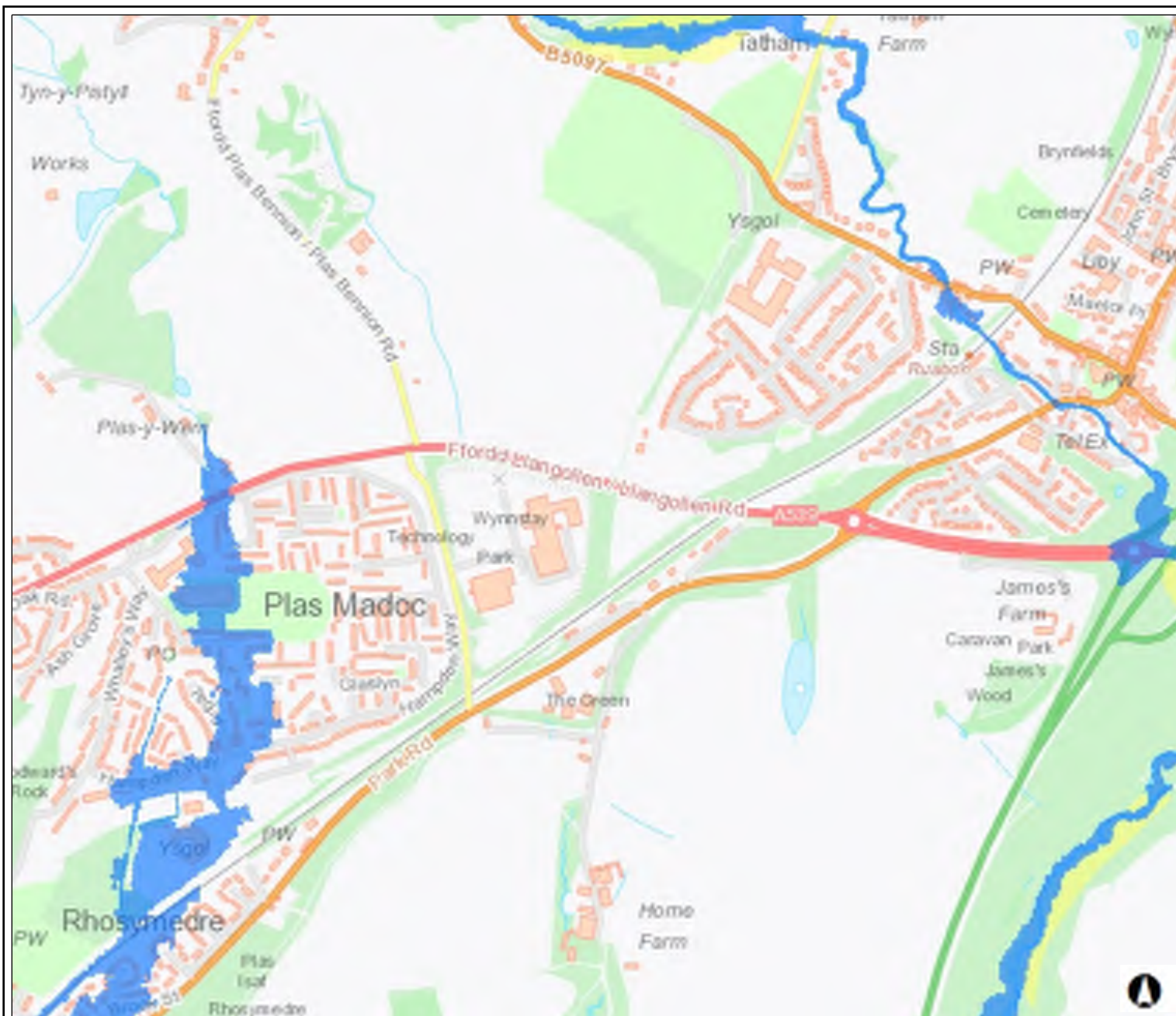
Scale:
1:500 @ A1

Date:
August 2019

Drawing number:
18/1786/03

Revision:
D

APPENDIX E – Flood Mapping



Map Title

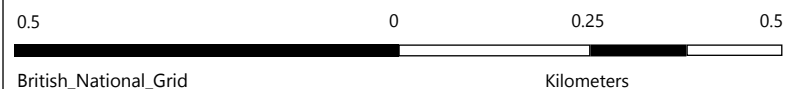
Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

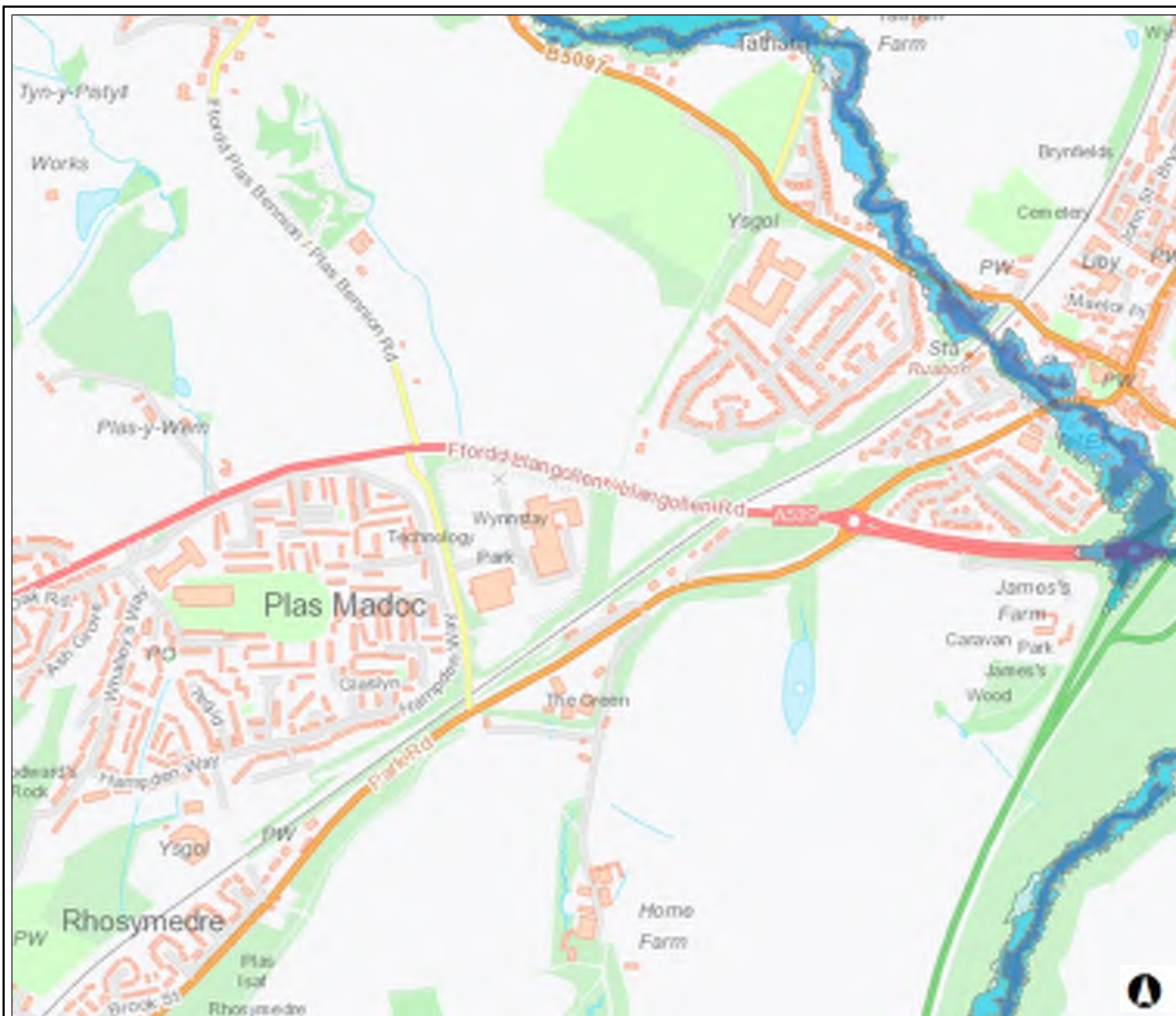
- Zone C1
- Zone C2
- Zone B
- Zone A

Graddfa / Scale 1: 10,000

Dyddiad / Date
06/03/2020



Ceir rhestr lawn o delerau ac amondau yn <https://naturalresources.wales/rhybuddsafonol> neu drwy gysylltu ag ymholiadau@cyfoethnaturiolcymru.gov.uk. A full list of terms and conditions is available from the <https://naturalresources.wales/StandardNotice> or by contacting enquire@naturalresourceswales.gov.uk © Crown copyright and database rights 2017 Ordnance Survey 100019741. Geological Mapping: British Geological Survey ©NERC. Centre for Ecology & Hydrology © NERC (CEH). Defra and Met Office © Crown copyright. © Cranfield University. © James Hutton Institute. Land & Property Services © Crown copyright and database right.



Map Title

Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

Reservoir Depths

-  0 - 0.3m
-  0.3 - 2.0m
-  Greater than 2.0m

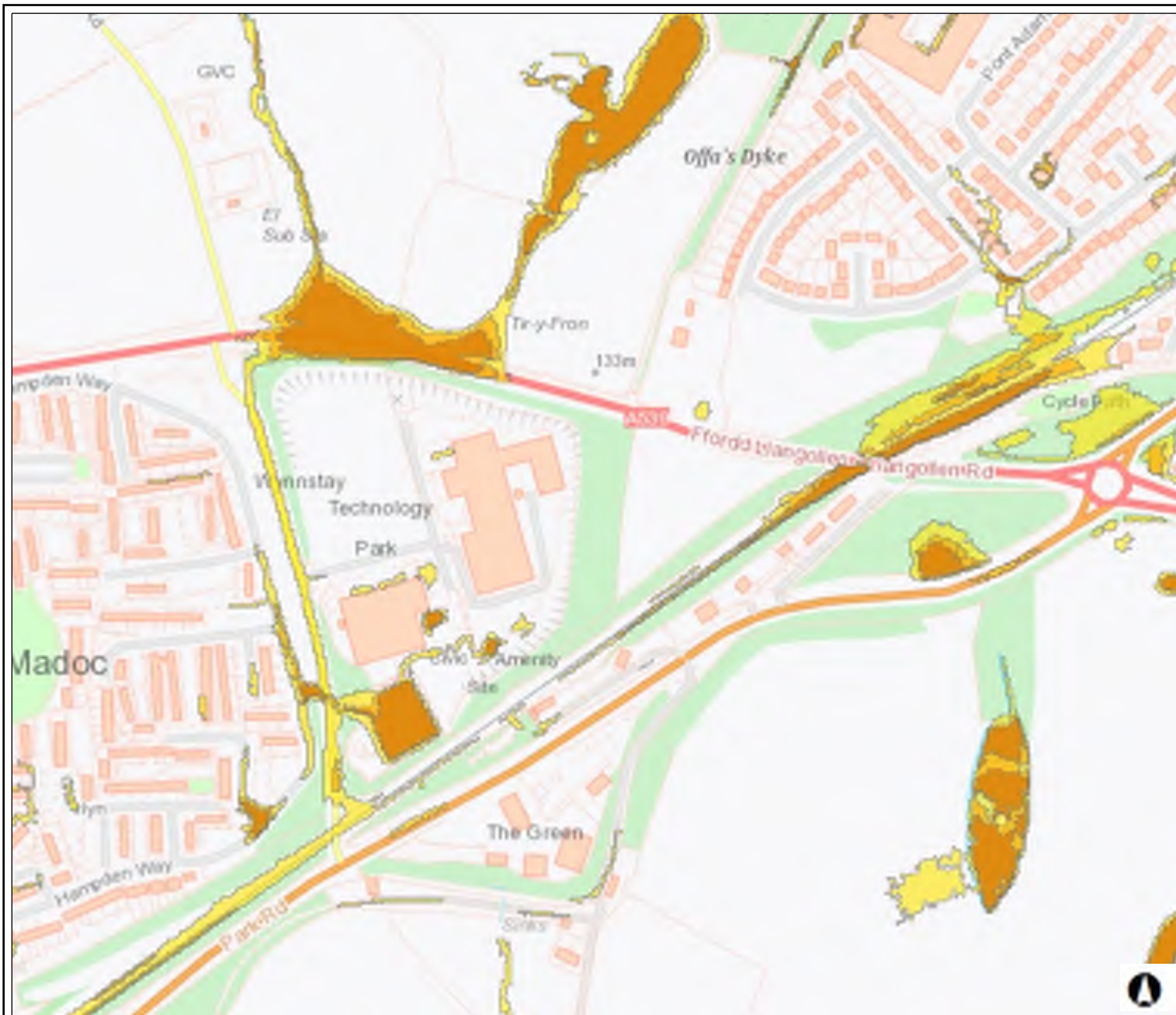
Graddfa / Scale 1: 10,000

Dyddiad / Date
06/03/2020

0.5 0 0.25 0.5

British_National_Grid Kilometers

Ceir rhestr lawn o delerau ac amondau yn <https://naturalresources.wales/rhybuddsafonol> neu drwy gysylltu ag ymholiada@cyfoethnaturiolcymru.gov.uk. A full list of terms and conditions is available from the <https://naturalresources.wales/StandardNotice> or by contacting enquire@naturalresourceswales.gov.uk © Crown copyright and database rights 2017 Ordnance Survey 100019741. Geological Mapping: British Geological Survey ©NERC. Centre for Ecology & Hydrology © NERC (CEH). Defra and Met Office © Crown copyright. © Cranfield University. © James Hutton Institute. Land & Property Services © Crown copyright and database right.



Map Title

Map Perygl Llifogydd / Flood Risk Map

Allwedd / Map Key

-  High Surface Water Flood Risk - Extent
-  Medium Surface Water Flood Risk - Extent
-  Low Surface Water Flood Risk - Extent

Graddfa / Scale 1: 5,001

Dyddiad / Date
06/03/2020

0.3 0 0.13 0.3

British_National_Grid Kilometers

Ceir rhestr lawn o delerau ac amondau yn <https://naturalresources.wales/rhybuddsafonol> neu drwy gysylltu ag ymholiadau@cyfoethnaturiolcymru.gov.uk. A full list of terms and conditions is available from the <https://naturalresources.wales/StandardNotice> or by contacting enquire@naturalresourceswales.gov.uk © Crown copyright and database rights 2017 Ordnance Survey 100019741. Geological Mapping: British Geological Survey ©NERC. Centre for Ecology & Hydrology © NERC (CEH). Defra and Met Office © Crown copyright. © Cranfield University. © James Hutton Institute. Land & Property Services © Crown copyright and database right.

APPENDIX F – Greenfield Runoff Estimation

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Graeme Tulip
Site name:	Wynnstey Tech Park
Site location:	Ruabon

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:	52.98473° N
Longitude:	3.05592° W
Reference:	2690772510
Date:	Feb 13 2020 15:14

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:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	822	822
Hydrological region:	9	9
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.78	1.78
Growth curve factor 100 years:	2.18	2.18
Growth curve factor 200 years:	2.46	2.46

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):	2.2	2.2
1 in 1 year (l/s):	1.94	1.94
1 in 30 years (l/s):	3.91	3.91
1 in 100 year (l/s):	4.79	4.79
1 in 200 years (l/s):	5.41	5.41

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

APPENDIX G – Proposed Drainage Strategy Plan



Sinks

NEW LAND DRAINAGE
AT TOE OF CUT

NEW LAND DRAIN OUTFALL TO
EXISTING LAND DRAINAGE

NEW LAND DRAIN OUTFALL
TO CULVERTED WATERCOURSE

BIORETENTION / DETENTION BASIN:

BED AREA @ 121.5m AOD: 280m²
TOP AREA @ 123.0m: 620m²

SIDE SLOPES 1:2 FOR PURPOSES OF OUTLINE SIZING, TO BE
REFINED DURING DETAILED DESIGN WITH BANK/SHELF
PROFILES TO SUIT PLANTING / WILDLIFE HABITAT.

MAX WATER DEPTH (100YR+CC): 0.96m

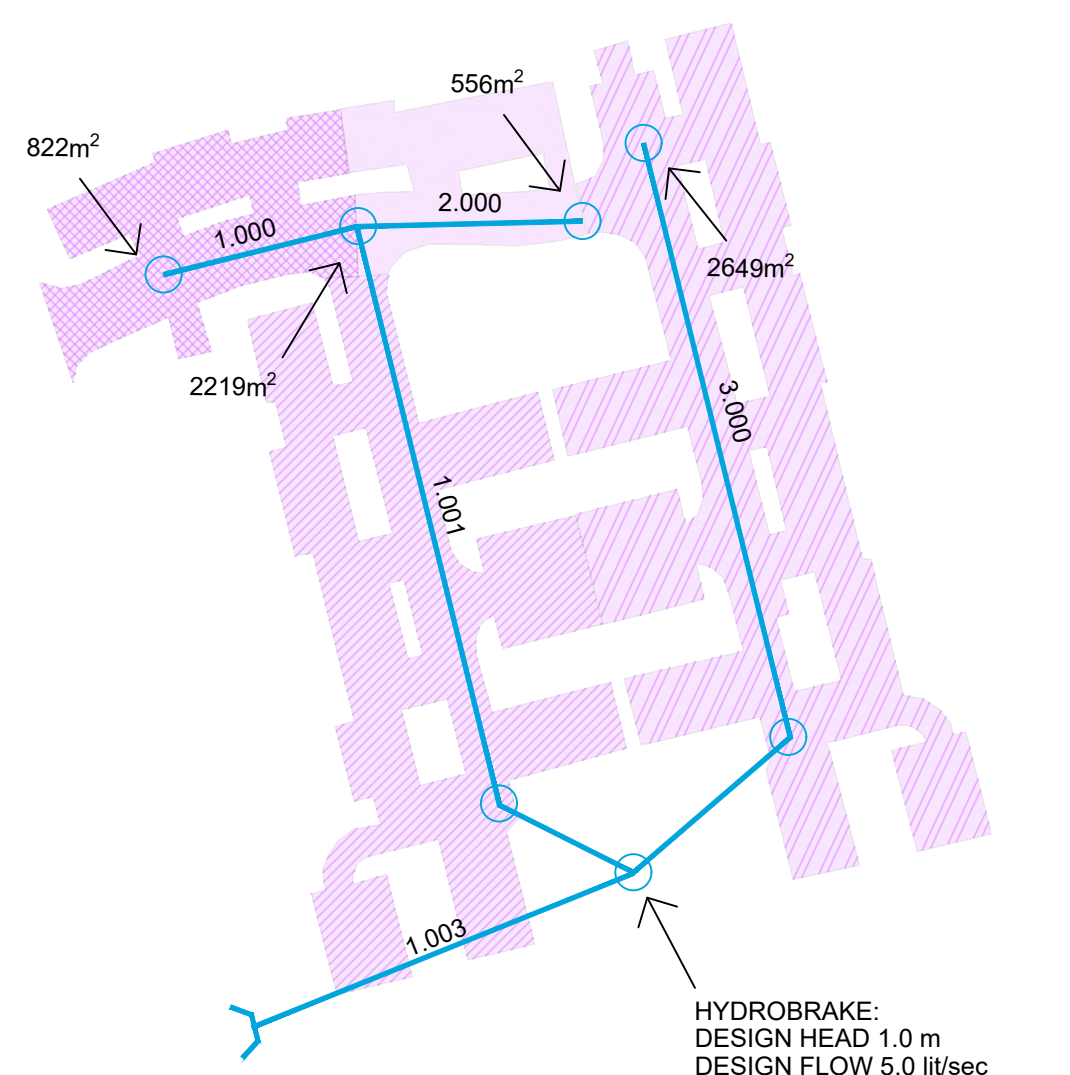
FREEBOARD ABOVE MAX WL TO GROUND LEVEL: 0.54m

PLANTING, FILTER MEDIUM & DRAINAGE LAYER DETAILS TO
BE CONFIRMED.

UNLINED TO UTILISE ANY INHERENT INFILTRATION
POTENTIAL.

IMPORTANT NOTE: SIZE SHOWN IS INDICATIVE **MAXIMUM**
ASSUMING ZERO INFILTRATION & NO UPSTREAM SUDS TRAIN
DEVICES TO SLOW & TREAT FLOWS.
SUDS AREA SIZE WILL **REDUCE** AT DETAILED DESIGN STAGE
WHEN GROUND INFILTRATION POTENTIAL IS KNOWN AND
DETAILED LEVELS & UPSTREAM SUDS TRAIN DEVICES ARE
DEVELOPED.

CONNECTION TO
CULVERTED
WATERCOURSE



MODEL SCHEMATIC

THIS DRAWING IS COPYRIGHT © CAMBRIA CONSULTING LTD.
DO NOT SCALE FROM THIS DRAWING.

CONTRACTORS MUST CHECK ALL DIMENSIONS ON SITE.
ONLY FIGURED DIMENSIONS ARE TO BE WORKED FROM.
DISCREPANCIES MUST BE REPORTED IMMEDIATELY TO
CAMBRIA CONSULTING LIMITED BEFORE PROCEEDING.

THE CONTRACTOR IS TO REFER TO THE SPECIFICATION,
FULL SCHEDULE OF RESIDUAL RISKS IN THE CONTRACT
DOCUMENTATION AND ALSO TO INFORMATION FROM OTHER
DESIGNERS, IN PARTICULAR THE MSE CONSULTANT
REGARDING EXISTING LIVE SERVICES.

 THIS SYMBOL IS USED TO HIGHLIGHT INSTANCES
OF RISK WITHIN THE CONSTRUCTION PROCESS.
ALWAYS CHECK FOR LATER REVISIONS OF THIS DRAWING.

KEY:

-  EXISTING CULVERTED WATERCOURSE
-  EXISTING LAND DRAIN ("FRENCH DRAIN")
-  EXISTING STORM SEWER
-  EXISTING FOUL SEWER
-  PROPOSED SW DRAIN
-  PROPOSED LAND DRAIN
-  PROPOSED FW SEWER
-  SOFT SUDS AREA (COMMUNAL BIORETENTION / DETENTION BASIN; INDIVIDUAL PLOT RAIN-GARDENS)
-  POROUS SURFACING

P01	FIRST ISSUE.	GT	BW	BW
Rev	Description	By	Chk	App

Client:

Project:
WYNNSTAY PARK

Drawing Title:
PROPOSED DRAINAGE
STRATEGY

Drawing No.
CC2052 CAM 00 00 GA C 52 1101

Project No.	Org.	Vol.	Level	Type	Dis.	Class	No.
-------------	------	------	-------	------	------	-------	-----

Suitability Status:	Scale @A1:	Rev:
PRELIMINARY	1:500	P01

CAMBRIA
Constructive Thinking

Civil & Structural Engineers
Cambria House
16 Plas St. Pol de Leon
Penarth Marina
Cardiff, CF64 1TR

T 029 2099 3333
E admin@cambria.co.uk
W www.cambria.co.uk
@cambriauk
uk.linkedin.com/in/cambria

APPENDIX H – Surface Water Drainage Calculations

Tulip Engineering Consultancy Ltd		Page 1
34 Culfor Road Loughor Swansea, SA4 6TY	Wynnstay Park Wrexham	
Date 05/03/2020 21:52 File SW NETWORK.MDX	Designed by GT Checked by	
Innovyze	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.302	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.414	4-8	0.210

Total Area Contributing (ha) = 0.624

Total Pipe Volume (m³) = 21.418

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	23.000	0.500	46.0	0.082	4.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	35.000	1.000	35.0	0.055	4.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	85.000	1.300	65.4	0.222	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	15.000	0.200	75.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.16	124.000	0.082	0.0	0.0	0.0	2.32	164.3	11.1
2.000	50.00	4.22	124.500	0.055	0.0	0.0	0.0	2.67	188.5	7.4
1.001	50.00	4.95	123.500	0.359	0.0	0.0	0.0	1.95	137.7	48.6
1.002	50.00	5.08	122.200	0.359	0.0	0.0	0.0	1.82	128.5	48.6

Tulip Engineering Consultancy Ltd		Page 2
34 Culfor Road Loughor Swansea, SA4 6TY	Wynnstay Park Wrexham	
Date 05/03/2020 21:52 File SW NETWORK.MDX	Designed by GT Checked by	
Innovyze	Network 2019.1	

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.000	90.000	1.500	60.0	0.265	4.00	0.0	0.600	o	300	Pipe/Conduit	
3.001	10.000	0.100	100.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	45.000	0.500	90.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	50.00	4.74	124.000	0.265	0.0	0.0	0.0	2.03	143.7	35.9
3.001	50.00	4.84	122.500	0.265	0.0	0.0	0.0	1.57	111.1	35.9
1.003	50.00	5.54	121.500	0.624	0.0	0.0	0.0	1.66	117.2	84.5

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.003		122.500	121.000	0.000	0	0

Tulip Engineering Consultancy Ltd		Page 3
34 Culfor Road Loughor Swansea, SA4 6TY	Wynnstay Park Wrexham	
Date 05/03/2020 21:52 File SW NETWORK.MDX	Designed by GT Checked by	
Innovyze	Network 2019.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 7, DS/PN: 1.003, Volume (m³): 3.3

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	121.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.296	5.0
Kick-Flo®	0.637	4.1
Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		

Tulip Engineering Consultancy Ltd		Page 4
34 Culfor Road Loughor Swansea, SA4 6TY	Wynnstay Park Wrexham	
Date 05/03/2020 21:52 File SW NETWORK.MDX	Designed by GT Checked by	
Innovyze	Network 2019.1	
</		

APPENDIX I – Exceedance Flow Routes



Sinks

THIS DRAWING IS COPYRIGHT © CAMBRIA CONSULTING LTD.
DO NOT SCALE FROM THIS DRAWING.

CONTRACTORS MUST CHECK ALL DIMENSIONS ON SITE.
ONLY FIGURED DIMENSIONS ARE TO BE WORKED FROM.
DISCREPANCIES MUST BE REPORTED IMMEDIATELY TO
CAMBRIA CONSULTING LIMITED BEFORE PROCEEDING.

THE CONTRACTOR IS TO REFER TO THE SPECIFICATION,
FULL SCHEDULE OF RESIDUAL RISKS IN THE CONTRACT
DOCUMENTATION AND ALSO TO INFORMATION FROM OTHER
DESIGNERS, IN PARTICULAR THE MSE CONSULTANT
REGARDING EXISTING LIVE SERVICES.

 THIS SYMBOL IS USED TO HIGHLIGHT INSTANCES
OF RISK WITHIN THE CONSTRUCTION PROCESS.
ALWAYS CHECK FOR LATER REVISIONS OF THIS DRAWING.

KEY:

 EXCEEDANCE FLOW ROUTE

P01	FIRST ISSUE.	GT	BW	BW
Rev	Description	By	Chk	App

Client:

Project:
WYNNSTAY PARK

Drawing Title:
EXCEEDANCE FLOWROUTE
PLAN

Drawing No.
CC2052 CAM 00 00 GA C 52 1102

Project No. Org. Vol. Level Type Dis. Class No.

Suitability Status: PRELIMINARY Scale @A1: 1:500 Rev: P01

CAMBRIA
Constructive Thinking

Civil & Structural Engineers T 029 2099 3333
Cambria House E admin@cambria.co.uk
16 Plas St. Pol de Leon W www.cambria.co.uk
Penarth Marina @cambriauk
Cardiff, CF64 1TR uk.linkedin.com/in/cambriauk

Cambria Consultants Ltd

16 Plas St, Pol de Leon
Penarth Marina
Cardiff
CF63 1TR
United Kingdom

t: +44 29 2009 3333

e: admin@Cambria.co.uk

CAMBRIA

Constructive Thinking

W: www.cambria.co.uk