

Proposed Residential Development

Land at Ruabon, Wrexham

Technical Note – Drainage Strategy

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Introduction

- 1 This Technical Note has been prepared by Weetwood Services Ltd ('Weetwood') on behalf of Pure Residential and Commercial Ltd.
- 2 An outline planning application for "mixed use development comprising commercial, *residential with associated vehicular access off the A539 and B5606 and other related improvements*" and "*all matters reserved except means of access*", was granted on 2 October 2015 (planning ref: P/2014/0021).
- 3 The commercial element of the development has been constructed. The remaining proposals are for 319 residential dwellings and public open space in Phases 1 and 2. This Technical Note focuses on Phase 1 only, which comprises 132 residential dwellings and public open space. The proposed layout is presented in **Annex A**.
- 4 The following planning condition relating to drainage were imposed on the planning permission:
 - *Condition 12: "Prior to the commencement of the relevant phase of the development, a scheme for the comprehensive and integrated drainage of the site indicating provision for foul water, surface water and land drainage has been submitted to and approved in writing by the Local Planning Authority. Prior to the submission of those details, an assessment shall be carried out into the potential for disposing of surface water by means of Sustainable urban Drainage Systems (SuDS) in accordance with the principles of sustainable drainage systems set out in Technical Advice Note 15: Development and Flood Risk, and the results of the assessment shall be submitted in writing to the Local Planning Authority. Where a SuDS scheme is to be implemented, the submitted details shall:
 - i) Provide information about the design storm period and intensity, the method employed to delay and control the surface water discharged from the site and the measures taken to prevent pollution of receiving ground water and/or surface waters;
 - ii) Specify the responsibilities of each party for the implementation of the SUDS scheme, together with a timetable for that implementation; and,
 - iii) Provide a timescale for implementation, management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public authority or statutory undertaker and any other arrangements to secure the operation of the scheme throughout its lifetime.*

Purpose of this Document

- 5 This document presents further details of the proposed surface water and foul water drainage schemes to accompany an application to discharge the aforementioned planning condition.

Site Details

- 6 The site is located off the A539 and B5605, Ruabon, Wrexham at Ordnance Survey National Grid Reference SJ 298 432 as shown in **Figure 1**.

- 7 The site is approximately 8.74 ha, is predominantly greenfield and includes a lake feature located centrally and to the north of the site.
- 8 A topographic survey of the site carried out by Brunel Surveys Ltd (**Annex B**) indicates that site levels range from 115.25 to 107.54 metres Above Ordnance Datum (m AOD) and generally fall in an easterly direction. A ditch runs along the southern boundary of the development and has two outfall locations, to the south west (outside the site boundary) and to the east (within the site boundary), discharging to two local watercourses.
- 9 The lake has an outfall pipe which discharges to a local watercourse via the south west outfall.
- 10 Soils mapping indicates soil conditions to the centre and west of the site to be slowly permeable, seasonally wet acid loamy and clayey soils with impeded drainage. Soil conditions to the east are suggested as freely draining slightly acid loamy soils. According to British Geological Survey mapping, the site is underlain by superficial Till deposits and mudstone bedrock.
- 11 Infiltration testing has been undertaken by MLM Consulting Engineers Ltd in a number of trial pits across the site (see **Annex C**). The findings are summarised as follows:
 - The depth of the trial pits (TP) varied from 1.9 m to 2.2 m;
 - No groundwater was encountered;
 - Tests failed in three of the four trial pit locations. TP32 obtained an infiltration rate of 2.96×10^{-4} m/s, however, this trial pit was located outside the site boundary.
- 12 The geo-environmental report by MLM Consulting Engineers Ltd indicates the site for the Phase 1 residential development is not suitable for infiltration.
- 13 The proposed developable area for the Phase 1 residential element is taken as approximately 7.51 ha. The greenfield surface water runoff rates for the site, calculated using ICP SUDS method within MicroDrainage are presented in **Table 1**. Details of the input parameters and the output results are provided in **Annex D**.

Table 1: Greenfield Runoff Rate

AEP of Rainfall Event	Greenfield Runoff Rate (l/s/ha)	Greenfield Runoff Rate for 7.51 ha Site (l/s)
1 in 1	2.2	16.5
QBAR	2.4	18.0
1 in 30	4.3	32.3
1 in 100	5.3	39.8

Proposed Surface Water Drainage Scheme

- 14 In accordance with the Statutory Standards for Sustainable Drainage Systems, surface water runoff should be disposed of according to the following hierarchy:
 - Priority Level 1: Collected for use
 - Priority Level 2: Infiltrated to ground
 - Priority Level 3: Discharged to a surface water body
 - Priority Level 4: Discharged to surface water sewer, highway drain, or another drainage system
 - Priority Level 5: Discharged to a combined sewer.
- 15 Infiltration testing indicates that the disposal of surface water by infiltration would not be feasible at the site.
- 16 Due to the site layout, the present outfall pipe from the lake will need to be diverted. Surface water runoff from development west of the lake outfall pipe will need to connect into the diverted pipe route due to site topography, ultimately discharging to the south west outfall. The developable area to the west equates to 0.27 ha.
- 17 Surface water east of the pipe diversion will discharge to the local watercourse via the outfall point to the east. The developable area to the east equates to 7.24 ha.

- 18 The greenfield QBAR rate for the developable area to the west equates to 0.6 l/s. It is therefore proposed to restrict surface water runoff discharging to the south west outfall to 5.0 l/s as it is recognised that a flow control with a diameter of less than 100 mm and/or a design discharge rate of 5.0 l/s may pose a risk of blockage to the drainage system. As such a minimum discharge rate of 5.0 l/s may be used in accordance with national guidance.
- 19 It is proposed to restrict surface water runoff to the east outfall to the existing greenfield QBAR rate of 17.4 l/s, based on the 7.24 ha developable area.
- 20 Surface water runoff from roofs, private drives and adoptable highways, will drain via a piped network to several attenuation basins which will provide attenuation storage and form part of the landscaped public open space SuDS strategy. The attenuation basins will also incorporate ditches to ensure water drains adequately towards the outfall points.
- 21 The attenuation storage facilities have been modelled using the Network module of MicroDrainage (**Annex E**). The required storage volume has been sized to store the 1 in 100 AEP rainfall event including a 40% increase in rainfall intensity to allow for climate change.
- 22 Assuming a peak discharge rate of 5.0 l/s to the south west outfall, a total storage volume of 81.4 m³ would be required, excluding the pipe network. The storage volume could be accommodated within attenuation basin A, with an area of 153.5 m² and a depth of 1.0 m, which would fill to a depth of 0.887 m affording 0.113 m freeboard.
- 23 Assuming a peak discharge rate of 17.4 l/s to the east outfall, a total storage volume of 1,429.4 m³ would be required, excluding the pipe network. The storage volume could be accommodated within four attenuation basins. Each attenuation basin has the following design details:
- Attenuation basin B
 - o Area = 793.7 m², depth = 1.0 m, fill depth = 0.787 m, freeboard = 0.213 m
 - Attenuation basin C
 - o Area = 564.6 m², depth = 1.0 m, fill depth = 0.784 m, freeboard = 0.216 m
 - Attenuation basin D
 - o Area = 743.4 m², depth = 1.0 m, fill depth = 0.780 m, freeboard = 0.220 m
 - Attenuation basin E
 - o Area = 428.0 m², depth = 1.0 m, fill depth = 0.978 m, freeboard = 0.022 m
- 24 Additional SuDS features, such as rainwater harvesting (rainwater butts to some dwellings), permeable paving or swales maybe incorporated into the surface water drainage strategy at the detailed design stage.
- 25 The proposed surface water drainage layout is provided in **Annex F**.
- 26 Natural land drainage from the site will be directed to the existing ditch located on the southern development boundary.
- 27 Residential roofs have a very low pollution hazard level and individual property driveways and low traffic roads have a low pollution hazard level. Table 26.2 of the CIRIA SuDS Manual 2015 indicates that the maximum pollution hazard indices associated with low traffic roads for total suspended solids, hydrocarbons and metals are 0.50, 0.40 and 0.40.
- 28 Table 26.3 of the CIRIA SuDS Manual 2015 indicates that the SuDS mitigation indices for attenuation basins for total suspended solids, hydrocarbons and metals are 0.50, 0.50 and 0.6 respectively. As such, the proposed drainage system incorporates adequate water quality treatment. In addition, surface water will pass through a filter drain further improving water quality.
- 29 In terms of amenity and biodiversity the site will maintain the existing lake feature while the proposed layout incorporates landscaped areas/trees in various locations which will provide aesthetic benefits and interception of surface water, thus helping with volume control (via evapotranspiration). The public open space is earmarked for attenuation basins which will help biodiversity.
- 30 SuDS elements which serve more than one property will be adopted and maintained by the SuDS Approving Body (SAB), in accordance with the Statutory Standards for SuDS.

31 An indicative maintenance schedule is provided in **Table 1**.

Table 1: Illustrative Maintenance Schedule

Schedule	Required action	Frequency
Attenuation Basin		
Regular maintenance	Remove litter and debris	Monthly
	Cut grass	Monthly during grow season Or as required)
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly for first year, then annually or as required
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets/outlets	Annually (or as required)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every two years, or as required
	Remove sediments from inlets/outlets and main basin when required	
Remedial actions	Repair erosion or other damage by reseedling or re-turfing	As required
	Realignment of rip-rap	
	Repair/rehabilitation of inlets/outlets	
	Relevel uneven surface and reinstate design levels	
Flow Control Unit		
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six Monthly
	Remove sediment, oil, grease and floatables	As necessary – Indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six Monthly
	Inspect filter media and establish appropriate replacement frequencies	Six Monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first year of operation, then every six months

Proposed Foul Water Drainage Scheme

- 32 The Dŵr Cymru Welsh Water (DCWW) public sewer records and development enquiry response (**Annex G**) indicate the presence of a 525 mm diameter combined sewer crossing the development site.
- 33 Foul water within the area is treated at Five Fords Wastewater Treatment Works (WwTW).

- 34 DCWW has advised that the impact of foul flows from the proposed development can be accommodated within the public sewerage system.
- 35 The proposed point of connection will be to manhole SJ30430401, located outside of the site boundary to the north east.
- 36 Due to site topography, all 300 mm diameter foul sewers will be laid at minimal gradients to enable a gravity connection where feasible. DCWW have confirmed by way of email (**Annex H**) that the proposed foul pipe sizes and gradients are acceptable.
- 37 Where gravity connections are not viable, an adoptable pumping station will be utilised for a part of the site.
- 38 The preliminary drainage layout, which is to be confirmed at the detailed design stage, is provided in **Annex F**.
- 39 A Section 104 application will be made to DCWW for the adoption of the foul water drainage network at the detailed design stage.

Summary

- 40 This document presents preliminary surface water and foul water drainage schemes for the proposed development of land at Ruabon, Wrexham for residential use, and accompanies an application to discharge planning condition 12 of the 2015 planning permission (planning ref. P/2014/0021).

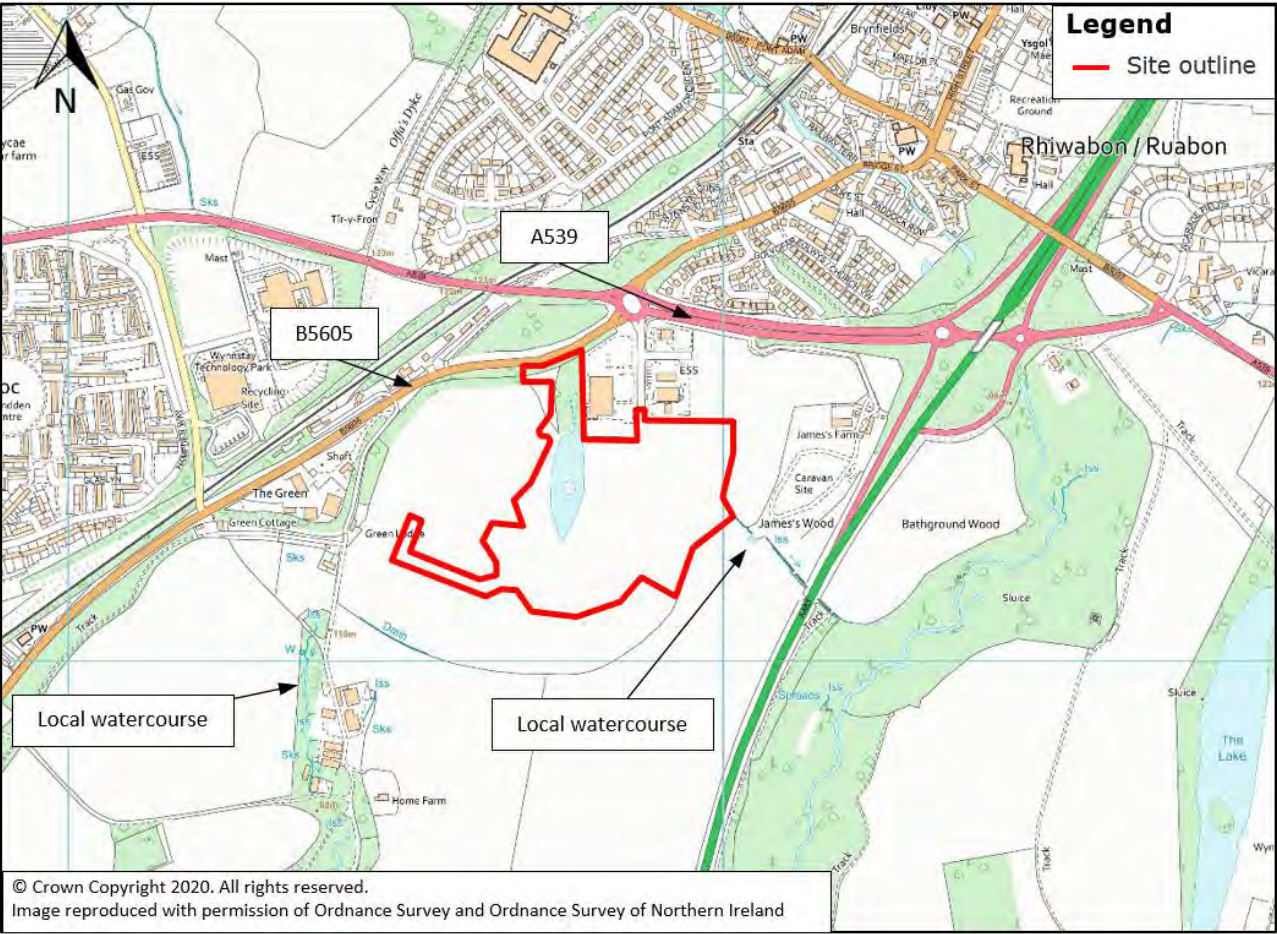


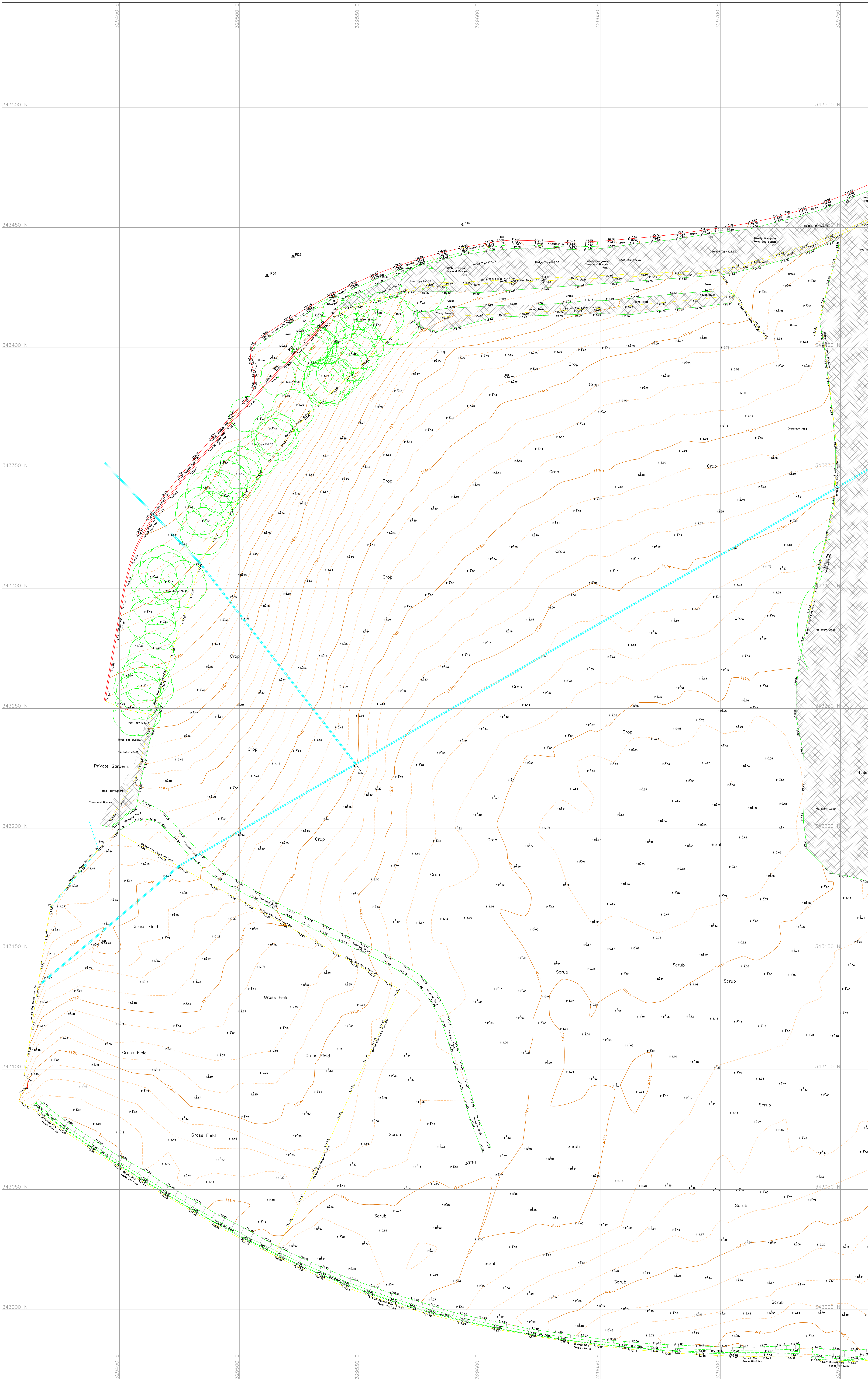
Figure 1: Site Location

ANNEX A:

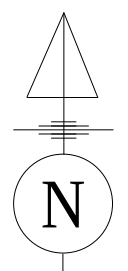
Proposed Layout

ANNEX B:

Topographic Survey



Sheet 1



Grid and Levels to National Grid
Projection OSTN02 and OSGM02
Scale Factor = 1

Station Coordinates			
No	Easting	Northing	Level
RD1	329511.409	343430.017	125.693
RD2	329522.228	343438.008	125.566
RD3	329526.521	343413.542	120.405
RD4	329520.864	343451.011	118.609
RD5	329728.324	343454.643	114.886
RD6	329821.256	343500.196	114.847
RD7	329853.692	343540.146	115.492
STN1	329594.493	343060.552	111.399

UTILITIES LEGEND	
	STORM WATER SEWER (SWS)
	COVERED SEWER (CWS)
	ELECTRIC CABLE
	LOW VOLTAGE CABLE
	HIGH VOLTAGE CABLE
	CABLE TELEVISION
	TELEPHONE CABLE
	WATER
	UNDERGROUND WATER SUPPLY
	GAS (MP)
	GAS (HP)
	GAS (HP)
	HEATING PIPES
	MULTIPLE SERVICE ROUTE
	UNKNOWN SERVICE METALLIC
	UNKNOWN SERVICE FOUND WITH GPR
	UNKNOWN SERVICE CABLE
	EMPTY DUCT

NOTES:
This survey has been carried out to the standard as described by The Survey Association (TSA), for a Level 4 Survey.
Utilities on this drawing have been detected using non-invasive technologies. The performance of these technologies can be generally affected by ground conditions which are out of the control of Brunel Surveys. Consequently some utilities may be undetectable and therefore, whilst Brunel Surveys uses its best endeavours to detect all utilities we cannot guarantee that 100% detection can always be achieved.
In respect of the information provided by a utility survey and statutory plans, any groundworks should be undertaken with extreme caution and in accordance with health and safety regulations, guidelines HSG 47 AVOIDING DANGER FROM UNDERGROUND SERVICES.

LEGEND	
	SURVEY STATION
	GATE
	BANK
	FOLIAGE
	CLIFF
	AV Air Valve
	BH Bore Hole
	BL Building
	BS Bus Stop
	CATV Cable TV Cover
	CL Cover Level
	CP Cotton Pit
	C Culvert
	D Depth in Meters
	EB Electric Box
	EC Electric Cabinet
	EIC Electric Inspection Cover
	ET End of Trace
	EP Electric Pole
	ER Earth Road
	FH Fire Hydrant
	FF Flooded Floor Level
	GV Gas Valve
	GPR Ground Penetrating Radar
	H Height
	IL Invert Level
	KI Kerb Inlet
	LC Lamp Column
	MH Manhole
	MP Marker Post
	MP-M Marker Post (Telecoms)
	MP-GV Marker Post (Gas Valve)
	MP-WM Marker Post (Water Meter)
	MW Monitoring Well
	NPV No Plot Visible
	OHC Overhead Cable
	P Post
	R Reflector
	RS Road Sign
	RNP Road Name Plate
	S Scrub
	SC Shop Cock (Water)
	SL Silt Level
	SSL Silt Settling Level
	SP Sign Post
	SV Stop Valve (Water)
	TL Threshold Level
	TL Traffic Light
	TL-CAB Traffic Light Cabinet
	TS Traffic Sign
	UTL Cable TV Inspection Cover
	UTL Unable to Lift
	UTS Unable to Survey
	UTT Unable to Trace
	VP Vent Pipe
	WL Water Level
	WM Water Meter
	WO Wash Out

Brunel Surveys Ltd
UNIT 59, SHREVENHAM HUNDRED BUSINESS PARK
WATCHFIELD, SWINDON, WILSHIRE, SN6 8TZ
TEL : (01753) 764700 FAX : (01753) 764664
WEB : www.brunelsurveys.com
Email: admin@brunelsurveys.com

Land and Measured Building Survey
Photomontage, 3D Visualisations and
Underground Utility Surveys

CLIENT
NRAP Architects
13-15 Covent Garden
Cambridge
CB1 2HS

JOB TITLE
Topographical Survey
Land at Ruabon Park
Ruabon
Wrexham
LL14 6DP

REVISIONS

SCALE
A0 Sheet @ 1 to 500

DATE
July 2013

DRAWN BY
DS/SP

CHECKED BY
PAH

DRAWING No.
12908-500-001
Sheet 1

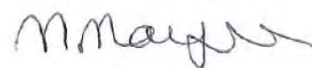
ANNEX C:

Trial Pit Plan and Infiltration Testing Results

Carter Jonas
Ruabon Park, Wrexham
Phase 2 Preliminary Geoenvironmental Assessment Report

Document Ref: 773135-REP-ENV-002
Revision: 0
Date: 27 November 2015

Prepared: Michael Maynard
Geoenvironmental Engineer



Checked: Hugh Dyer
Senior Geoenvironmental
Engineer

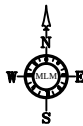


Approved: Jason Monk
Technical Director



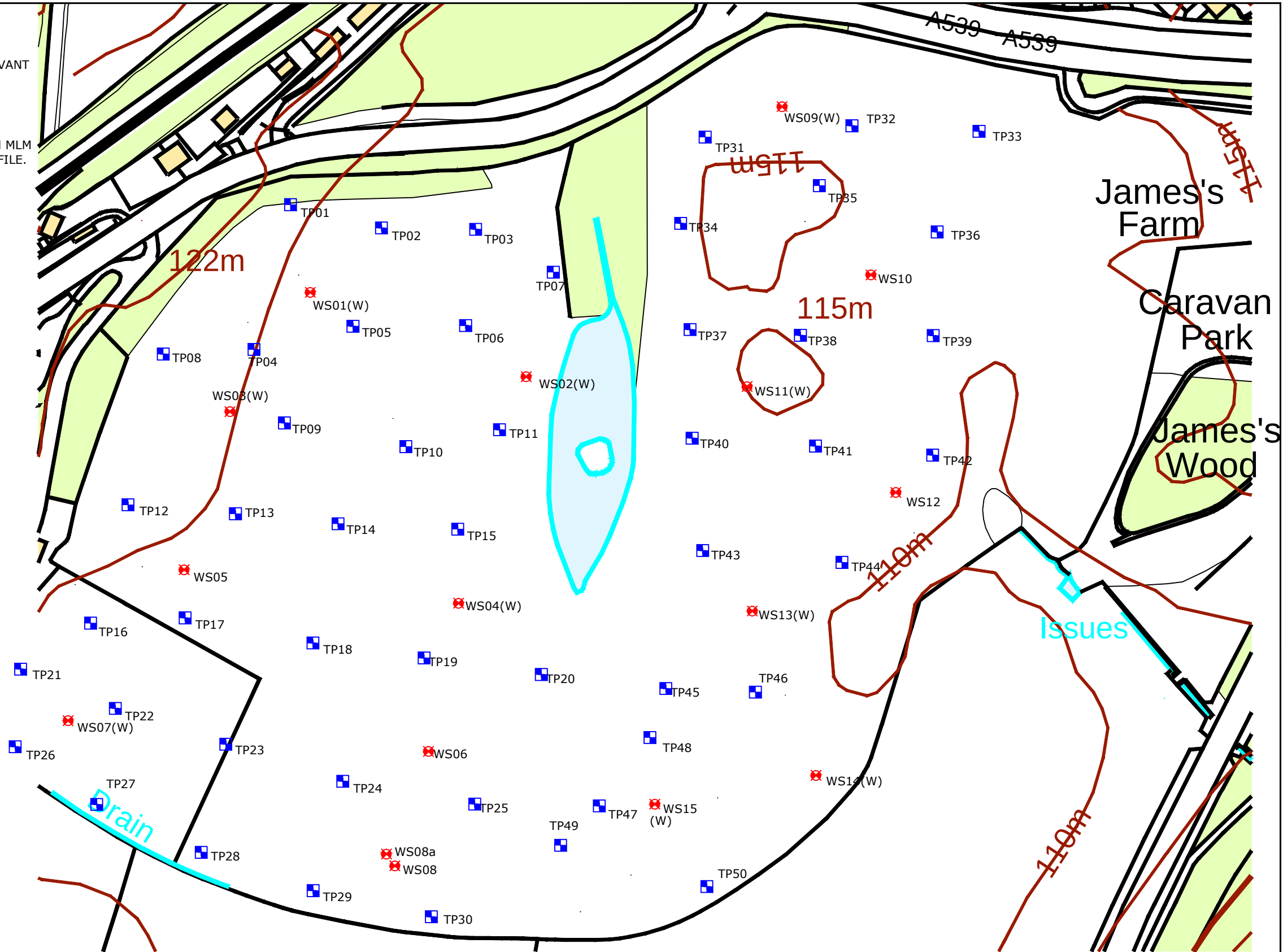
NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEER'S, ARCHITECT'S AND SPECIALIST'S DRAWINGS AND THE SPECIFICATION.
2. DO NOT SCALE FROM THIS DRAWING MANUALLY OR ELECTRONICALLY. WRITTEN PERMISSION MUST BE OBTAINED FROM MLM PRIOR TO SCALING ELECTRONICALLY OR USING THIS ELECTRONIC FILE.



LEGEND

- TP1 TRIAL PIT LOCATION
- WS1 WINDOWLESS SAMPLER BOREHOLE LOCATION
- (W) MONITORING WELL LOCATION



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MLM

MLM Environmental

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Website: www.mlm.uk.com

Drawing Status:

FINAL ISSUE

Client

CARTER JONAS

Project

RUABON PARK, WREXHAM

Drawing Title

EXPLORATORY HOLE LOCATION PLAN

Drawn/Design

ER

Date

OCT 2015

Scales

NTS

@ A1

Checked

HD

Approved

DG

1:2500

@ A3

Drawing No.

773135-DWG-ENV-001

Rev

.

Rev	Date	Description	Made	Ckd
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SOAKAWAY TEST RESULTS

Based on BRE Digest 365: Soakaway Design (2007)



www.mlm.uk.com

Project Name: Ruabon Park, Wrexham

Location: Wrexham, Wales

Project Ref: 773135

Test Location: **TP21**

Soil Infiltration Rate (m/sec)

Test Failed

Readings:

Time (mins)	Water Level (m bgl)
1	0.40
2	0.41
3	0.41
4	0.42
5	0.42
10	0.44
16	0.46
20	0.48
25	0.49
30	0.50
60	0.58
120	0.67
180	0.80
240	0.83
300	0.90
360	0.96

Trial Pit Dimensions (m)

Length	2.90
Width	0.75
Depth	2.20

Assumed Invert Level (m bgl)

0.40

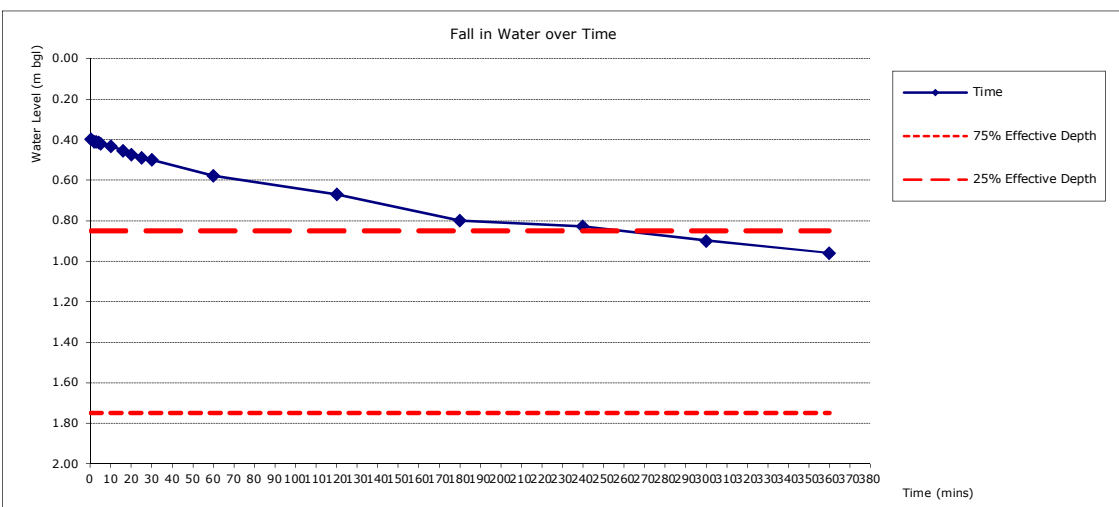
Ground Conditions:

Refer to engineers logs

Was trial pit filled with gravel (Yes/No):

No

Remarks:



Soil Infiltration Rate (m/sec) $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

Fill Porosity	Assumed porosity of granular fill material based on CIRIA 156 (%)	0.35
V_{p75-25}	Effective depth storage volume of water in the trial pit between 75% and 25% effective depth	1.96
Revised V_{p75-25}	Reduced effective storage volume as a result of gravel fill	0.69
a_{p50}	The internal surface area of the trial pit up to 50% effective depth and including the base area	8.75
t_{p75-25}	The time for the water level to fall from 75% to 25% effective depth	

Soil Infiltration Rate (m/sec) $f = 1.958$

f Test Failed

SOAKAWAY TEST RESULTS

Based on BRE Digest 365: Soakaway Design (2007)



www.mlm.uk.com

Project Name: Ruabon Park, Wrexham

Location: Wrexham, Wales

Project Ref: 773135

Test Location: **TP12**

Soil Infiltration Rate (m/sec)

Test Failed

Readings:

Time (mins)	Water Level (m bgl)
1	0.31
2	0.33
3	0.36
4	0.37
5	0.38
10	0.44
16	0.51
20	0.55
25	0.58
30	0.62
60	0.72
120	0.76
180	1.00
240	1.05
300	1.13
360	1.20

Trial Pit Dimensions (m)

Length	2.80
Width	0.75
Depth	2.00

Assumed Invert Level (m bgl)

0.31

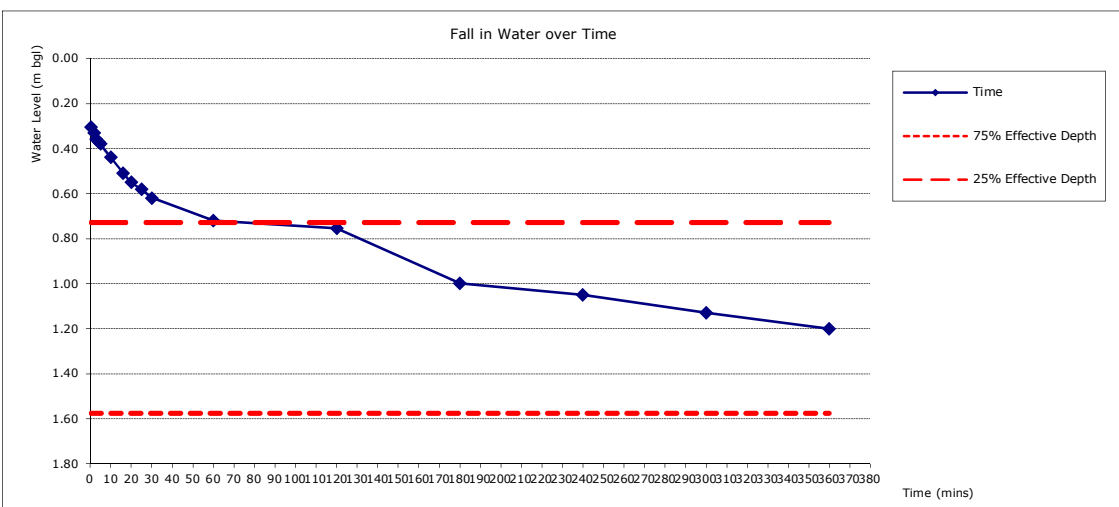
Ground Conditions:

Refer to engineers logs

Was trial pit filled with gravel (Yes/No):

No

Remarks:



Soil Infiltration Rate (m/sec) $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

Fill Porosity	Assumed porosity of granular fill material based on CIRIA 156 (%)	0.35
V_{p75-25}	Effective depth storage volume of water in the trial pit between 75% and 25% effective depth	1.78
Revised V_{p75-25}	Reduced effective storage volume as a result of gravel fill	0.62
a_{p50}	The internal surface area of the trial pit up to 50% effective depth and including the base area	8.12
t_{p75-25}	The time for the water level to fall from 75% to 25% effective depth	

Soil Infiltration Rate (m/sec) $f = 1.780$

f Test Failed

SOAKAWAY TEST RESULTS

Based on BRE Digest 365: Soakaway Design (2007)



www.mlm.uk.com

Project Name: Ruabon Park, Wrexham

Location: Wrexham, Wales

Project Ref: 773135

Test Location: **TP33**

Soil Infiltration Rate (m/sec)

Test Failed

Readings:

Time (mins)	Water Level (m bgl)
1	0.35
2	0.37
3	0.39
4	0.41
5	0.42
10	0.45
16	0.47
20	0.50
25	0.53
40	0.58
50	0.65
60	0.67
90	0.71
120	0.79
150	0.85
180	0.87
240	1.02
300	1.15

Trial Pit Dimensions (m)

Length	3.30
Width	0.70
Depth	1.90

Assumed Invert Level (m bgl)

0.35

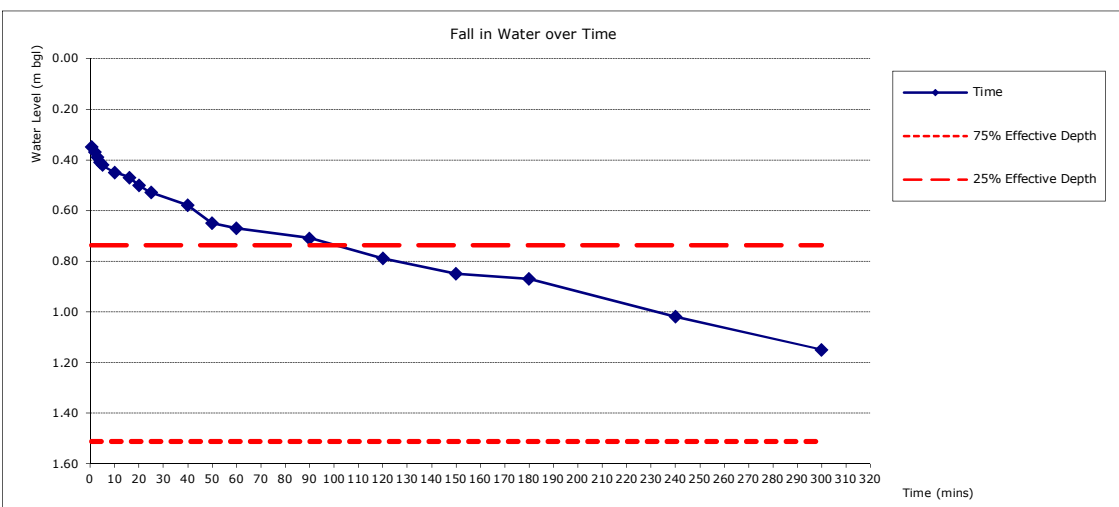
Ground Conditions:

	Refer to engineers logs

Was trial pit filled with gravel (Yes/No):

No

Remarks:



Soil Infiltration Rate (m/sec) $f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$

Fill Porosity	Assumed porosity of granular fill material based on CIRIA 156 (%)	0.35
V_{p75-25}	Effective depth storage volume of water in the trial pit between 75% and 25% effective depth	1.79
Revised V_{p75-25}	Reduced effective storage volume as a result of gravel fill	0.63
a_{p50}	The internal surface area of the trial pit up to 50% effective depth and including the base area	8.51
t_{p75-25}	The time for the water level to fall from 75% to 25% effective depth	

Soil Infiltration Rate (m/sec) $f = 1.790$

f Test Failed

SOAKAWAY TEST RESULTS

Based on BRE Digest 365: Soakaway Design (2007)



www.mlm.uk.com

Project Name: Ruabon Park, Wrexham

Location: Wrexham, Wales

Project Ref: 773135

Test Location: **TP32**

Soil Infiltration Rate (m/sec)

2.96E-04

Readings:

Time (mins)	Water Level (m bgl)
1	1.34
2	1.37
3	1.40
4	1.42
5	1.49
6	1.51
7	1.53
8	1.58
9	1.62
10	1.67
11	1.71
12	1.76
13	1.80

Trial Pit Dimensions (m)

Length	3.30
Width	0.70
Depth	1.90

Assumed Invert Level (m bgl)

1.34

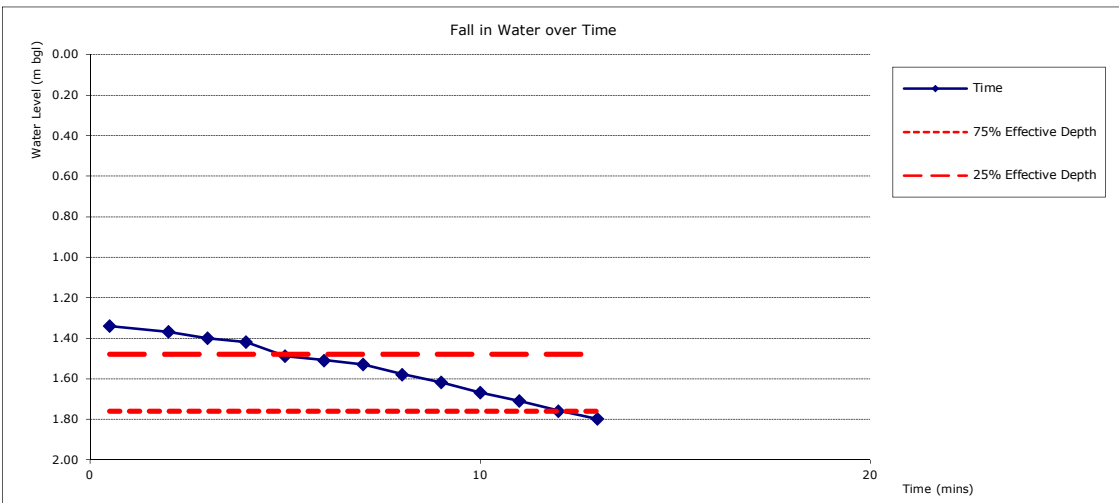
Ground Conditions:

	Refer to engineers logs

Was trial pit filled with gravel (Yes/No):

No

Remarks:



Soil Infiltration Rate (m/sec)

$$f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

Fill Porosity	Assumed porosity of granular fill material based on CIRIA 156 (%)	0.35
V_{p75-25}	Effective depth storage volume of water in the trial pit between 75% and 25% effective depth	0.65
Revised V_{p75-25}	Reduced effective storage volume as a result of gravel fill	0.23
a_{p50}	The internal surface area of the trial pit up to 50% effective depth and including the base area	4.55
t_{p75-25}	The time for the water level to fall from 75% to 25% effective depth	8.00

Soil Infiltration Rate (m/sec)

$$f = \frac{0.647}{2184}$$

f 2.96E-04

ANNEX D:

Greenfield Runoff Rates

Weetwood		Page 1
Joseph's Well Hanover Walk Leeds, LS3 1AB		
Date 15/07/2020 17:39 File	Designed by MichaelDarby Checked by	
XP Solutions Source Control 2020.1		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.300
Area (ha)	1.000	Urban	0.000
SAAR (mm)	900	Region Number	Region 9

Results 1/s

QBAR Rural	2.4
QBAR Urban	2.4
Q1 year	2.2
Q1 year	2.2
Q30 years	4.3
Q100 years	5.3

©1982-2020 Innovyze

ANNEX E:

Surface Water Drainage Calculations

Weetwood		Page 1
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

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	0.298	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.000
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 at outfall SSD2 (pipe S2.009)

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.123	4-8	0.114

Total Area Contributing (ha) = 0.237

Total Pipe Volume (m³) = 24.728

Time Area Diagram at outfall S (pipe S4.017)

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.809	4-8	1.792	8-12	0.310

Total Area Contributing (ha) = 2.911

Total Pipe Volume (m³) = 404.274

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length	Fall	Slope	I.Area	T.E.	Base	k	HYD	DIA	Section	Type	Auto
(m)	(m)	(1:X)	(ha)	(mins)	Flow	(l/s)	(mm)	SECT	(mm)			Design

Network Results Table

PN	Rain	T.C.	US/IL	Σ I.Area	Σ Base	Foul	Add Flow	Vel	Cap	Flow
(mm/hr)	(mins)	(m)	(ha)	Flow	(l/s)	(l/s)	(l/s)	(m/s)	(l/s)	(l/s)

Page 4

Micro Drainage

Joseph's Well

Hanover Walk

Leeds, LS3 1AB

4914

Ruabon

SW Calculations

Date 18/09/2020 15:59

File 2020-09-07 4914 R1.mdx

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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
S4.011	43.869	0.150	292.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S4.012	26.518	0.100	265.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S4.013	24.475	0.100	244.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S4.014	21.784	0.100	217.8	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S4.015	77.545	0.150	517.0	0.095	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S8.000	24.494	0.250	98.0	0.027	5.00	0.0	0.600	o	150	Pipe/Conduit	
S8.001	51.250	0.250	205.0	0.099	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.002	24.749	0.300	82.5	0.029	0.00	0.0	0.600	o	300	Pipe/Conduit	
S9.000	46.482	0.200	232.4	0.102	5.00	0.0	0.600	o	300	Pipe/Conduit	
S9.001	21.581	0.200	107.9	0.092	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.003	43.635	1.100	39.7	0.042	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.004	13.430	0.800	16.8	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit	
S10.000	45.000	0.550	81.8	0.165	5.00	0.0	0.600	o	300	Pipe/Conduit	
S10.001	9.434	0.600	15.7	0.108	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.005	31.841	0.100	318.4	0.032	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S8.006	25.289	0.050	505.8	0.119	0.00	0.0	0.600	o	1200	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)
S4.011	41.36	9.42	108.350	1.741	0.0	0.0	0.0	1.42	401.2	195.0
S4.012	40.75	9.71	108.200	1.741	0.0	0.0	0.0	1.49	421.5	195.0
S4.013	40.22	9.98	108.100	1.741	0.0	0.0	0.0	1.55	438.9	195.0
S4.014	39.94	10.12	108.000	1.741	0.0	0.0	0.0	2.53	2862.4	195.0
S4.015	38.49	10.91	107.900	1.836	0.0	0.0	0.0	1.64	1853.1	195.0
S8.000	50.00	5.40	112.250	0.027	0.0	0.0	0.0	1.02	17.9	3.7
S8.001	49.94	6.18	111.850	0.126	0.0	0.0	0.0	1.09	77.4	17.0
S8.002	49.16	6.42	111.600	0.155	0.0	0.0	0.0	1.73	122.5	20.6
S9.000	50.00	5.75	111.700	0.102	0.0	0.0	0.0	1.03	72.6	13.8
S9.001	50.00	5.99	111.500	0.194	0.0	0.0	0.0	1.51	107.0	26.3
S8.003	48.24	6.71	111.300	0.391	0.0	0.0	0.0	2.50	177.0	51.1
S8.004	48.06	6.77	110.200	0.461	0.0	0.0	0.0	3.86	272.6	60.0
S10.000	50.00	5.43	110.550	0.165	0.0	0.0	0.0	1.74	123.0	22.3
S10.001	50.00	5.47	110.000	0.273	0.0	0.0	0.0	3.98	281.7	37.0
S8.005	47.30	7.02	107.950	0.766	0.0	0.0	0.0	2.09	2365.1	98.1
S8.006	46.57	7.28	107.850	0.885	0.0	0.0	0.0	1.66	1873.6	111.6

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Weetwood		Page 5
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

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
S11.000	36.879	0.350	105.4	0.082	5.00	0.0	0.600	o	300	Pipe/Conduit	
S11.001	8.352	0.150	55.7	0.058	0.00	0.0	0.600	o	300	Pipe/Conduit	
S11.002	10.568	0.300	35.2	0.037	0.00	0.0	0.600	o	300	Pipe/Conduit	
S11.003	10.132	1.000	10.1	0.013	0.00	0.0	0.600	o	300	Pipe/Conduit	
S8.007	11.423	0.050	228.5	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S4.016	16.615	0.050	332.3	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
S12.000	4.098	0.100	41.0	0.000	5.00	0.0	0.600	o	600	Pipe/Conduit	
S4.017	25.342	0.150	168.9	0.000	0.00	0.0	0.600	o	225	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)
S11.000	50.00	5.40	110.500	0.082	0.0	0.0	0.0	1.53	108.2	11.1
S11.001	50.00	5.47	110.150	0.140	0.0	0.0	0.0	2.11	149.2	19.0
S11.002	50.00	5.53	110.000	0.177	0.0	0.0	0.0	2.66	187.9	24.0
S11.003	50.00	5.57	109.700	0.190	0.0	0.0	0.0	4.97	351.1	25.7
S8.007	46.36	7.35	107.800	1.075	0.0	0.0	0.0	2.47	2794.7	135.0
S4.016	38.25	11.04	107.750	2.911	0.0	0.0	0.0	2.05	2314.8	301.5
S12.000	50.00	5.02	110.300	0.000	0.0	0.0	0.0	3.81	1077.7	0.0
S4.017	37.53	11.46	107.700	2.911	0.0	0.0	0.0	1.00	39.9<	301.5

Weetwood		Page 6
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1	115.000	1.350	Open Manhole	1200	S2.000	113.650	150				
S2	114.500	1.350	Open Manhole	1200	S2.001	113.150	150	S2.000	113.150	150	
S3	114.350	1.350	Open Manhole	1200	S2.002	113.000	150	S2.001	113.000	150	
S4	114.050	1.500	Open Manhole	1200	S2.003	112.550	300	S2.002	112.700	150	
S5	112.750	1.500	Open Manhole	1200	S2.004	111.250	300	S2.003	111.250	300	
S6	111.600	1.650	Open Manhole	1500	S2.005	109.950	450	S2.004	110.100	300	
S7	111.600	1.690	Open Manhole	1500	S2.006	109.910	450	S2.005	109.910	450	
S8	111.550	1.690	Open Manhole	1500	S2.007	109.860	450	S2.006	109.860	450	
S9	111.500	1.675	Open Manhole	1500	S2.008	109.825	450	S2.007	109.825	450	
Sbasin	110.810	1.000	Junction		S3.000	109.810	450				
S10	111.400	1.650	Open Manhole	1800	S2.009	109.750	450	S2.008	109.750	450	
								S3.000	109.750	450	
SSD2	111.500	1.770	Open Manhole	0		OUTFALL		S2.009	109.730	450	
S11	111.300	1.500	Open Manhole	1200	S4.000	109.800	300				
S12	111.300	1.750	Open Manhole	1500	S4.001	109.550	450	S4.000	109.700	300	
S13	111.300	1.800	Open Manhole	1500	S4.002	109.500	450	S4.001	109.500	450	
S14	111.350	1.930	Open Manhole	1500	S4.003	109.420	450	S4.002	109.420	450	
S15	111.400	2.200	Open Manhole	1500	S4.004	109.200	600	S4.003	109.350	450	
S16	111.550	2.410	Open Manhole	1500	S4.005	109.140	600	S4.004	109.140	600	
S17	111.650	2.530	Open Manhole	1500	S4.006	109.120	600	S4.005	109.120	600	
S18	111.700	2.620	Open Manhole	1500	S4.007	109.080	600	S4.006	109.080	600	
S19	111.400	2.360	Open Manhole	1500	S4.008	109.040	600	S4.007	109.040	600	
S20	111.300	2.280	Open Manhole	1500	S4.009	109.020	600	S4.008	109.020	600	
S21	111.300	2.900	Open Manhole	2100	S4.010	108.400	1200	S4.009	108.950	600	
S22	111.400	2.250	Open Manhole	1500	S5.000	109.150	375				
S23	111.400	2.400	Open Manhole	1500	S5.001	109.000	375	S5.000	109.000	375	
S24	111.500	1.500	Open Manhole	1200	S6.000	110.000	300				
S25	111.400	1.550	Open Manhole	1200	S6.001	109.850	300	S6.000	109.850	300	
S26	111.400	1.650	Open Manhole	1200	S6.002	109.750	300	S6.001	109.750	300	
S27	111.400	2.590	Open Manhole	1500	S5.002	108.810	450	S5.001	108.885	375	
								S6.002	108.960	300	
S28	111.400	2.700	Open Manhole	1500	S5.003	108.700	450	S5.002	108.700	450	
S29	111.500	3.000	Open Manhole	1500	S5.004	108.500	600	S5.003	108.650	450	
S30	111.500	3.100	Open Manhole	1500	S5.005	108.400	600	S5.004	108.400	600	
S31	112.100	1.700	Open Manhole	1500	S7.000	110.400	375				
S32	112.650	2.900	Open Manhole	1500	S7.001	109.750	375	S7.000	109.750	375	
S33	112.650	3.000	Open Manhole	1500	S7.002	109.650	375	S7.001	109.650	375	

Weetwood								Page 7	
Joseph's Well Hanover Walk Leeds, LS3 1AB				4914 Ruabon SW Calculations					
Date 18/09/2020 15:59 File 2020-09-07 4914 R1.mdx				Designed by TB Checked by					
XP Solutions				Network 2020.1					
Manhole Schedules for Storm									
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)
S34	111.800	2.350	Open Manhole	1500	S7.003	109.450	450	S7.002	109.525
S35	112.000	2.650	Open Manhole	1500	S7.004	109.350	450	S7.003	109.350
S36	112.100	2.900	Open Manhole	1500	S7.005	109.200	450	S7.004	109.200
S37	112.000	3.650	Open Manhole	2100	S4.011	108.350	600	S4.010	108.350
								S5.005	108.350
								S7.005	109.100
S38	111.500	3.300	Open Manhole	1500	S4.012	108.200	600	S4.011	108.200
S39	111.500	3.400	Open Manhole	1500	S4.013	108.100	600	S4.012	108.100
S40	111.500	3.500	Open Manhole	2100	S4.014	108.000	1200	S4.013	108.000
S41	111.750	3.850	Open Manhole	2100	S4.015	107.900	1200	S4.014	107.900
S42	113.600	1.350	Open Manhole	1200	S8.000	112.250	150		
S43	113.800	1.950	Open Manhole	1200	S8.001	111.850	300	S8.000	112.000
S44	113.250	1.650	Open Manhole	1200	S8.002	111.600	300	S8.001	111.600
S45	113.200	1.500	Open Manhole	1200	S9.000	111.700	300		
S46	113.300	1.800	Open Manhole	1200	S9.001	111.500	300	S9.000	111.500
S47	112.800	1.500	Open Manhole	1200	S8.003	111.300	300	S8.002	111.300
								S9.001	111.300
S48	111.700	1.500	Open Manhole	1200	S8.004	110.200	300	S8.003	110.200
S49	112.050	1.500	Open Manhole	1200	S10.000	110.550	300		
S50	111.500	1.500	Open Manhole	1200	S10.001	110.000	300	S10.000	110.000
S51	111.600	3.650	Open Manhole	2100	S8.005	107.950	1200	S8.004	109.400
								S10.001	109.400
S52	111.350	3.500	Open Manhole	2100	S8.006	107.850	1200	S8.005	107.850
S53	112.000	1.500	Open Manhole	1200	S11.000	110.500	300		
S54	112.050	1.900	Open Manhole	1200	S11.001	110.150	300	S11.000	110.150
S55	111.950	1.950	Open Manhole	1200	S11.002	110.000	300	S11.001	110.000
S56	111.800	2.100	Open Manhole	1200	S11.003	109.700	300	S11.002	109.700
S57	111.750	3.950	Open Manhole	2100	S8.007	107.800	1200	S8.006	107.800
								S11.003	108.700
S58	111.300	3.550	Open Manhole	2400	S4.016	107.750	1200	S4.015	107.750
								S8.007	107.750
SBASIN	111.300	1.000	Junction		S12.000	110.300	600		
S59	111.350	3.650	Open Manhole	2100	S4.017	107.700	225	S4.016	107.700
								S12.000	110.200
S	108.350	0.800	Open Manhole	0		OUTFALL		S4.017	107.550
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Weetwood		Page 10
Joseph's Well Hanover Walk Leeds, LS3 1AB	4914 Ruabon SW Calculations	
Date 18/09/2020 15:59 File 2020-09-07 4914 R1.mdx	Designed by TB Checked by	
XP Solutions	Network 2020.1	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S29	329806.432	343185.691	329806.432	343185.691	Required	
S30	329845.258	343159.693	329845.258	343159.693	Required	
S31	329814.187	343266.286	329814.187	343266.286	Required	
S32	329879.156	343266.349	329879.156	343266.349	Required	
S33	329886.967	343258.553	329886.967	343258.553	Required	
S34	329884.408	343234.512	329884.408	343234.512	Required	
S35	329879.506	343208.702	329879.506	343208.702	Required	
S36	329864.134	343172.617	329864.134	343172.617	Required	
S37	329858.323	343150.290	329858.323	343150.290	Required	
S38	329896.802	343129.221	329896.802	343129.221	Required	
S39	329923.296	343128.094	329923.296	343128.094	Required	
S40	329935.969	343149.032	329935.969	343149.032	Required	
S41	329936.620	343170.806	329936.620	343170.806	Required	
S42	329878.313	343361.248	329878.313	343361.248	Required	
S43	329878.313	343336.754	329878.313	343336.754	Required	

Weetwood		Page 12
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SBASIN	330006.802	343230.725			No Entry	
S59	330008.748	343227.119	330008.748	343227.119	Required	
S	330025.695	343208.277			No Entry	



Weetwood		Page 13
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	o	150	S1	115.000	113.650	1.200	Open Manhole	1200
S2.001	o	150	S2	114.500	113.150	1.200	Open Manhole	1200
S2.002	o	150	S3	114.350	113.000	1.200	Open Manhole	1200
S2.003	o	300	S4	114.050	112.550	1.200	Open Manhole	1200
S2.004	o	300	S5	112.750	111.250	1.200	Open Manhole	1200
S2.005	o	450	S6	111.600	109.950	1.200	Open Manhole	1500
S2.006	o	450	S7	111.600	109.910	1.240	Open Manhole	1500
S2.007	o	450	S8	111.550	109.860	1.240	Open Manhole	1500
S2.008	o	450	S9	111.500	109.825	1.225	Open Manhole	1500
S3.000	o	450	Sbasin	110.810	109.810	0.550	Junction	
S2.009	o	450	S10	111.400	109.750	1.200	Open Manhole	1800
S4.000	o	300	S11	111.300	109.800	1.200	Open Manhole	1200
S4.001	o	450	S12	111.300	109.550	1.300	Open Manhole	1500
S4.002	o	450	S13	111.300	109.500	1.350	Open Manhole	1500
S4.003	o	450	S14	111.350	109.420	1.480	Open Manhole	1500
S4.004	o	600	S15	111.400	109.200	1.600	Open Manhole	1500
S4.005	o	600	S16	111.550	109.140	1.810	Open Manhole	1500
S4.006	o	600	S17	111.650	109.120	1.930	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S2.000	41.951	83.9	S2	114.500	113.150	1.200	Open Manhole	1200
S2.001	10.086	67.2	S3	114.350	113.000	1.200	Open Manhole	1200
S2.002	10.086	33.6	S4	114.050	112.700	1.200	Open Manhole	1200
S2.003	56.572	43.5	S5	112.750	111.250	1.200	Open Manhole	1200
S2.004	41.503	36.1	S6	111.600	110.100	1.200	Open Manhole	1500
S2.005	15.190	379.8	S7	111.600	109.910	1.240	Open Manhole	1500
S2.006	19.253	385.1	S8	111.550	109.860	1.240	Open Manhole	1500
S2.007	13.142	375.5	S9	111.500	109.825	1.225	Open Manhole	1500
S2.008	29.552	394.0	S10	111.400	109.750	1.200	Open Manhole	1800
S3.000	21.429	357.2	S10	111.400	109.750	1.200	Open Manhole	1800
S2.009	6.420	321.0	SSD2	111.500	109.730	1.320	Open Manhole	0
S4.000	19.633	196.3	S12	111.300	109.700	1.300	Open Manhole	1500
S4.001	18.872	377.4	S13	111.300	109.500	1.350	Open Manhole	1500
S4.002	31.669	395.9	S14	111.350	109.420	1.480	Open Manhole	1500
S4.003	25.894	369.9	S15	111.400	109.350	1.600	Open Manhole	1500
S4.004	32.412	540.2	S16	111.550	109.140	1.810	Open Manhole	1500
S4.005	11.698	584.9	S17	111.650	109.120	1.930	Open Manhole	1500
S4.006	20.897	522.4	S18	111.700	109.080	2.020	Open Manhole	1500

Weetwood		Page 14
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S4.007	o	600	S18	111.700	109.080	2.020	Open Manhole	1500
S4.008	o	600	S19	111.400	109.040	1.760	Open Manhole	1500
S4.009	o	600	S20	111.300	109.020	1.680	Open Manhole	1500
S4.010	o	1200	S21	111.300	108.400	1.700	Open Manhole	2100
S5.000	o	375	S22	111.400	109.150	1.875	Open Manhole	1500
S5.001	o	375	S23	111.400	109.000	2.025	Open Manhole	1500
S6.000	o	300	S24	111.500	110.000	1.200	Open Manhole	1200
S6.001	o	300	S25	111.400	109.850	1.250	Open Manhole	1200
S6.002	o	300	S26	111.400	109.750	1.350	Open Manhole	1200
S5.002	o	450	S27	111.400	108.810	2.140	Open Manhole	1500
S5.003	o	450	S28	111.400	108.700	2.250	Open Manhole	1500
S5.004	o	600	S29	111.500	108.500	2.400	Open Manhole	1500
S5.005	o	600	S30	111.500	108.400	2.500	Open Manhole	1500
S7.000	o	375	S31	112.100	110.400	1.325	Open Manhole	1500
S7.001	o	375	S32	112.650	109.750	2.525	Open Manhole	1500
S7.002	o	375	S33	112.650	109.650	2.625	Open Manhole	1500
S7.003	o	450	S34	111.800	109.450	1.900	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S4.007	18.403	460.1	S19	111.400	109.040	1.760	Open Manhole	1500
S4.008	11.441	572.1	S20	111.300	109.020	1.680	Open Manhole	1500
S4.009	36.900	527.1	S21	111.300	108.950	1.750	Open Manhole	2100
S4.010	27.547	550.9	S37	112.000	108.350	2.450	Open Manhole	2100
S5.000	18.075	120.5	S23	111.400	109.000	2.025	Open Manhole	1500
S5.001	25.215	219.3	S27	111.400	108.885	2.140	Open Manhole	1500
S6.000	24.608	164.1	S25	111.400	109.850	1.250	Open Manhole	1200
S6.001	10.270	102.7	S26	111.400	109.750	1.350	Open Manhole	1200
S6.002	34.344	43.5	S27	111.400	108.960	2.140	Open Manhole	1500
S5.002	42.867	389.7	S28	111.400	108.700	2.250	Open Manhole	1500
S5.003	13.272	265.4	S29	111.500	108.650	2.400	Open Manhole	1500
S5.004	46.726	467.3	S30	111.500	108.400	2.500	Open Manhole	1500
S5.005	16.097	321.9	S37	112.000	108.350	3.050	Open Manhole	2100
S7.000	64.969	100.0	S32	112.650	109.750	2.525	Open Manhole	1500
S7.001	11.036	110.4	S33	112.650	109.650	2.625	Open Manhole	1500
S7.002	24.177	193.4	S34	111.800	109.525	1.900	Open Manhole	1500
S7.003	26.271	262.7	S35	112.000	109.350	2.200	Open Manhole	1500

Weetwood		Page 15
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S7.004	o	450	S35	112.000	109.350	2.200	Open Manhole	1500
S7.005	o	450	S36	112.100	109.200	2.450	Open Manhole	1500
S4.011	o	600	S37	112.000	108.350	3.050	Open Manhole	2100
S4.012	o	600	S38	111.500	108.200	2.700	Open Manhole	1500
S4.013	o	600	S39	111.500	108.100	2.800	Open Manhole	1500
S4.014	o	1200	S40	111.500	108.000	2.300	Open Manhole	2100
S4.015	o	1200	S41	111.750	107.900	2.650	Open Manhole	2100
S8.000	o	150	S42	113.600	112.250	1.200	Open Manhole	1200
S8.001	o	300	S43	113.800	111.850	1.650	Open Manhole	1200
S8.002	o	300	S44	113.250	111.600	1.350	Open Manhole	1200
S9.000	o	300	S45	113.200	111.700	1.200	Open Manhole	1200
S9.001	o	300	S46	113.300	111.500	1.500	Open Manhole	1200
S8.003	o	300	S47	112.800	111.300	1.200	Open Manhole	1200
S8.004	o	300	S48	111.700	110.200	1.200	Open Manhole	1200
S10.000	o	300	S49	112.050	110.550	1.200	Open Manhole	1200
S10.001	o	300	S50	111.500	110.000	1.200	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S7.004	39.223	261.5	S36	112.100	109.200	2.450	Open Manhole	1500
S7.005	23.071	230.7	S37	112.000	109.100	2.450	Open Manhole	2100
S4.011	43.869	292.5	S38	111.500	108.200	2.700	Open Manhole	1500
S4.012	26.518	265.2	S39	111.500	108.100	2.800	Open Manhole	1500
S4.013	24.475	244.7	S40	111.500	108.000	2.900	Open Manhole	2100
S4.014	21.784	217.8	S41	111.750	107.900	2.650	Open Manhole	2100
S4.015	77.545	517.0	S58	111.300	107.750	2.350	Open Manhole	2400
S8.000	24.494	98.0	S43	113.800	112.000	1.650	Open Manhole	1200
S8.001	51.250	205.0	S44	113.250	111.600	1.350	Open Manhole	1200
S8.002	24.749	82.5	S47	112.800	111.300	1.200	Open Manhole	1200
S9.000	46.482	232.4	S46	113.300	111.500	1.500	Open Manhole	1200
S9.001	21.581	107.9	S47	112.800	111.300	1.200	Open Manhole	1200
S8.003	43.635	39.7	S48	111.700	110.200	1.200	Open Manhole	1200
S8.004	13.430	16.8	S51	111.600	109.400	1.900	Open Manhole	2100
S10.000	45.000	81.8	S50	111.500	110.000	1.200	Open Manhole	1200
S10.001	9.434	15.7	S51	111.600	109.400	1.900	Open Manhole	2100

Weetwood		Page 16
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S8.005	o	1200	S51	111.600	107.950	2.450	Open Manhole	2100
S8.006	o	1200	S52	111.350	107.850	2.300	Open Manhole	2100
S11.000	o	300	S53	112.000	110.500	1.200	Open Manhole	1200
S11.001	o	300	S54	112.050	110.150	1.600	Open Manhole	1200
S11.002	o	300	S55	111.950	110.000	1.650	Open Manhole	1200
S11.003	o	300	S56	111.800	109.700	1.800	Open Manhole	1200
S8.007	o	1200	S57	111.750	107.800	2.750	Open Manhole	2100
S4.016	o	1200	S58	111.300	107.750	2.350	Open Manhole	2400
S12.000	o	600	SBASIN	111.300	110.300	0.400	Junction	
S4.017	o	225	S59	111.350	107.700	3.425	Open Manhole	2100

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S8.005	31.841	318.4	S52	111.350	107.850	2.300	Open Manhole	2100
S8.006	25.289	505.8	S57	111.750	107.800	2.750	Open Manhole	2100
S11.000	36.879	105.4	S54	112.050	110.150	1.600	Open Manhole	1200
S11.001	8.352	55.7	S55	111.950	110.000	1.650	Open Manhole	1200
S11.002	10.568	35.2	S56	111.800	109.700	1.800	Open Manhole	1200
S11.003	10.132	10.1	S57	111.750	108.700	2.750	Open Manhole	2100
S8.007	11.423	228.5	S58	111.300	107.750	2.350	Open Manhole	2400
S4.016	16.615	332.3	S59	111.350	107.700	2.450	Open Manhole	2100
S12.000	4.098	41.0	S59	111.350	110.200	0.550	Open Manhole	2100
S4.017	25.342	168.9	S	108.350	107.550	0.575	Open Manhole	0

Weetwood		Page 18
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
8.005	-	-	100	0.032	0.032	0.032
8.006	-	-	100	0.119	0.119	0.119
11.000	-	-	100	0.082	0.082	0.082
11.001	-	-	100	0.058	0.058	0.058
11.002	-	-	100	0.037	0.037	0.037
11.003	-	-	100	0.013	0.013	0.013
8.007	-	-	100	0.000	0.000	0.000
4.016	-	-	100	0.000	0.000	0.000
12.000	-	-	100	0.000	0.000	0.000
4.017	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				3.148	3.148	3.148

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)
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S2.009	SSD2	111.500	109.730	0.000	0	0
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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)
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S4.017	S	108.350	107.550	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.298
Return Period (years)	2	Profile Type	Summer
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Weetwood		Page 19
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	
<u>Synthetic Rainfall Details</u> Storm Duration (mins) 30		
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Weetwood		Page 20
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S10, DS/PN: S2.009, Volume (m³): 11.9

Unit Reference MD-SHE-0100-5000-1400-5000
Design Head (m) 1.400
Design Flow (l/s) 5.0
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 100
Invert Level (m) 109.750
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	5.0
Flush-Flo™	0.416	5.0
Kick-Flo®	0.855	4.0
Mean Flow over Head Range	-	4.4

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	3.3	1.200	4.7	3.000	7.1	7.000	10.7
0.200	4.6	1.400	5.0	3.500	7.7	7.500	11.0
0.300	4.9	1.600	5.3	4.000	8.2	8.000	11.4
0.400	5.0	1.800	5.6	4.500	8.6	8.500	11.7
0.500	5.0	2.000	5.9	5.000	9.1	9.000	12.0
0.600	4.9	2.200	6.2	5.500	9.5	9.500	12.3
0.800	4.3	2.400	6.4	6.000	9.9		
1.000	4.3	2.600	6.7	6.500	10.3		

Hydro-Brake® Optimum Manhole: S59, DS/PN: S4.017, Volume (m³): 29.8

Unit Reference MD-SHE-0151-1740-3550-1740
Design Head (m) 3.550
Design Flow (l/s) 17.4
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 151
Invert Level (m) 107.700
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Weetwood		Page 21																																																																								
Joseph's Well	4914																																																																									
Hanover Walk	Ruabon																																																																									
Leeds, LS3 1AB	SW Calculations																																																																									
Date 18/09/2020 15:59	Designed by TB																																																																									
File 2020-09-07 4914 R1.mdx	Checked by																																																																									
XP Solutions	Network 2020.1																																																																									
<u>Hydro-Brake® Optimum Manhole: S59, DS/PN: S4.017, Volume (m³): 29.8</u>																																																																										
<table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>3.550</td><td>17.4</td></tr><tr><td>Flush-Flo™</td><td>0.655</td><td>14.0</td></tr><tr><td>Kick-Flo®</td><td>1.352</td><td>11.0</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>13.6</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	3.550	17.4	Flush-Flo™	0.655	14.0	Kick-Flo®	1.352	11.0	Mean Flow over Head Range	-	13.6																																																									
Control Points	Head (m)	Flow (l/s)																																																																								
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<table><tr><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td></tr><tr><td>0.100</td><td>5.4</td><td>1.200</td><td>12.5</td><td>3.000</td><td>16.0</td><td>7.000</td><td>24.1</td></tr><tr><td>0.200</td><td>11.3</td><td>1.400</td><td>11.2</td><td>3.500</td><td>17.3</td><td>7.500</td><td>24.9</td></tr><tr><td>0.300</td><td>12.6</td><td>1.600</td><td>11.9</td><td>4.000</td><td>18.4</td><td>8.000</td><td>25.7</td></tr><tr><td>0.400</td><td>13.4</td><td>1.800</td><td>12.6</td><td>4.500</td><td>19.5</td><td>8.500</td><td>26.4</td></tr><tr><td>0.500</td><td>13.8</td><td>2.000</td><td>13.2</td><td>5.000</td><td>20.5</td><td>9.000</td><td>27.2</td></tr><tr><td>0.600</td><td>14.0</td><td>2.200</td><td>13.8</td><td>5.500</td><td>21.4</td><td>9.500</td><td>27.9</td></tr><tr><td>0.800</td><td>13.9</td><td>2.400</td><td>14.4</td><td>6.000</td><td>22.3</td><td></td><td></td></tr><tr><td>1.000</td><td>13.4</td><td>2.600</td><td>15.0</td><td>6.500</td><td>23.2</td><td></td><td></td></tr></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.4	1.200	12.5	3.000	16.0	7.000	24.1	0.200	11.3	1.400	11.2	3.500	17.3	7.500	24.9	0.300	12.6	1.600	11.9	4.000	18.4	8.000	25.7	0.400	13.4	1.800	12.6	4.500	19.5	8.500	26.4	0.500	13.8	2.000	13.2	5.000	20.5	9.000	27.2	0.600	14.0	2.200	13.8	5.500	21.4	9.500	27.9	0.800	13.9	2.400	14.4	6.000	22.3			1.000	13.4	2.600	15.0	6.500	23.2		
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
0.100	5.4	1.200	12.5	3.000	16.0	7.000	24.1																																																																			
0.200	11.3	1.400	11.2	3.500	17.3	7.500	24.9																																																																			
0.300	12.6	1.600	11.9	4.000	18.4	8.000	25.7																																																																			
0.400	13.4	1.800	12.6	4.500	19.5	8.500	26.4																																																																			
0.500	13.8	2.000	13.2	5.000	20.5	9.000	27.2																																																																			
0.600	14.0	2.200	13.8	5.500	21.4	9.500	27.9																																																																			
0.800	13.9	2.400	14.4	6.000	22.3																																																																					
1.000	13.4	2.600	15.0	6.500	23.2																																																																					
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Weetwood		Page 22
Joseph's Well Hanover Walk Leeds, LS3 1AB	4914 Ruabon SW Calculations	
Date 18/09/2020 15:59 File 2020-09-07 4914 R1.mdx	Designed by TB Checked by	
XP Solutions	Network 2020.1	

Storage Structures for Storm

Tank or Pond Manhole: Sbasin, DS/PN: S3.000

Invert Level (m) 109.810

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	50.0	1.000	153.5

Tank or Pond Manhole: S30, DS/PN: S5.005

Invert Level (m) 110.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	277.5	1.000	793.7

Tank or Pond Manhole: S38, DS/PN: S4.012

Invert Level (m) 110.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	316.0	1.000	564.6

Tank or Pond Manhole: S40, DS/PN: S4.014

Invert Level (m) 110.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	388.1	1.000	743.4

Tank or Pond Manhole: SBASIN, DS/PN: S12.000

Invert Level (m) 110.300

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	195.9	1.000	428.0

Weetwood		Page 23
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S2.000	S1	1.527	0.720	0.000	2.247
S2.001	S2	1.527	0.157	0.000	1.684
S2.002	S3	1.527	0.157	0.000	1.684
S2.003	S4	1.696	3.914	0.000	5.610
S2.004	S5	1.696	2.838	0.000	4.535
S2.005	S6	2.916	2.177	0.000	5.093
S2.006	S7	2.986	2.823	0.000	5.810
S2.007	S8	2.986	1.852	0.000	4.838
S2.008	S9	2.960	4.438	0.000	7.398
S3.000	Sbasin	0.000	3.265	97.024	100.289
S2.009	S10	4.199	0.878	0.000	5.077
S4.000	S11	1.696	1.292	0.000	2.989
S4.001	S12	3.093	2.763	0.000	5.855
S4.002	S13	3.181	4.798	0.000	7.979
S4.003	S14	3.411	3.880	0.000	7.290
S4.004	S15	3.888	8.740	0.000	12.628
S4.005	S16	4.259	2.883	0.000	7.142
S4.006	S17	4.471	5.484	0.000	9.955
S4.007	S18	4.630	4.779	0.000	9.409
S4.008	S19	4.170	2.811	0.000	6.981
S4.009	S20	4.029	9.924	0.000	13.953
S4.010	S21	10.044	28.780	0.000	38.824
S5.000	S22	3.976	1.831	0.000	5.807
S5.001	S23	4.241	2.619	0.000	6.860
S6.000	S24	1.696	1.655	0.000	3.351
S6.001	S25	1.753	0.641	0.000	2.394
S6.002	S26	1.866	2.332	0.000	4.198
S5.002	S27	4.577	6.579	0.000	11.156
S5.003	S28	4.771	1.872	0.000	6.644
S5.004	S29	5.301	12.787	0.000	18.089
S5.005	S30	5.478	4.042	513.503	523.024
S7.000	S31	3.004	7.010	0.000	10.014
S7.001	S32	5.125	1.053	0.000	6.178
S7.002	S33	5.301	2.505	0.000	7.806
S7.003	S34	4.153	3.940	0.000	8.092
S7.004	S35	4.683	6.000	0.000	10.683
S7.005	S36	5.125	3.383	0.000	8.508
S4.011	S37	12.642	11.895	0.000	24.537
S4.012	S38	5.832	7.074	434.330	447.235
S4.013	S39	6.008	6.411	0.000	12.419
S4.014	S40	12.123	22.262	556.212	590.596
S4.015	S41	13.335	85.157	0.000	98.492
S8.000	S42	1.527	0.412	0.000	1.938
S8.001	S43	2.205	3.538	0.000	5.743
S8.002	S44	1.866	1.665	0.000	3.531
S9.000	S45	1.696	3.201	0.000	4.897
S9.001	S46	2.036	1.441	0.000	3.476
S8.003	S47	1.696	3.000	0.000	4.696

Weetwood		Page 24
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

Volume Summary (Static)

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
S8.004	S48	1.696	0.833	0.000	2.529
S10.000	S49	1.696	3.096	0.000	4.792
S10.001	S50	1.696	0.550	0.000	2.247
S8.005	S51	12.642	33.636	0.000	46.278
S8.006	S52	12.123	26.226	0.000	38.349
S11.000	S53	1.696	2.522	0.000	4.218
S11.001	S54	2.149	0.506	0.000	2.654
S11.002	S55	2.205	0.662	0.000	2.868
S11.003	S56	2.375	0.600	0.000	2.975
S8.007	S57	13.681	10.374	0.000	24.056
S4.016	S58	16.060	16.246	0.000	32.306
S12.000	SBASIN	0.000	0.862	304.487	305.349
S4.017	S59	12.642	0.966	0.000	13.608
Total		273.574	400.736	1905.556	2579.866

Weetwood		Page 26
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S2.000	S1		0.065	6.6	OK
S2.001	S2		0.088	6.7	OK
S2.002	S3		0.075	8.4	OK
S2.003	S4		0.060	13.2	OK
S2.004	S5		0.088	17.5	OK
S2.005	S6		0.215	17.5	OK
S2.006	S7		0.502	19.1	OK
S2.007	S8		0.714	18.2	OK
S2.008	S9		0.652	18.1	OK
S3.000	Sbasin		8.564	2.1	OK*
S2.009	S10		3.210	4.4	OK
S4.000	S11		0.062	5.9	OK
S4.001	S12		0.149	8.4	OK
S4.002	S13		0.395	16.2	OK
S4.003	S14		0.537	17.5	OK
S4.004	S15		0.264	20.9	OK
S4.005	S16		1.286	19.8	OK
S4.006	S17		0.538	20.7	OK

Weetwood										Page 27	
Joseph's Well							4914				
Hanover Walk							Ruabon				
Leeds, LS3 1AB							SW Calculations				
Date 18/09/2020 15:59							Designed by TB				
File 2020-09-07 4914 R1.mdx							Checked by				
XP Solutions							Network 2020.1				
<u>1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>											
							Water	Surcharged	Flooded		
PN	US/MH						US/CL	Level	Depth	Volume	Flow /
	Name	Event					(m)	(m)	(m)	(m³)	Cap.
S4.007	S18	15 minute	1 year	Winter	I+0%	111.700	109.232	-0.448	0.000	0.10	
S4.008	S19	15 minute	1 year	Winter	I+0%	111.400	109.203	-0.437	0.000	0.17	
S4.009	S20	360 minute	1 year	Winter	I+0%	111.300	109.161	-0.459	0.000	0.03	
S4.010	S21	360 minute	1 year	Winter	I+0%	111.300	109.161	-0.439	0.000	0.01	
S5.000	S22	15 minute	1 year	Winter	I+0%	111.400	109.176	-0.349	0.000	0.01	
S5.001	S23	360 minute	1 year	Winter	I+0%	111.400	109.162	-0.213	0.000	0.02	
S6.000	S24	15 minute	1 year	Winter	I+0%	111.500	110.060	-0.240	0.000	0.09	
S6.001	S25	15 minute	1 year	Winter	I+0%	111.400	109.921	-0.229	0.000	0.13	
S6.002	S26	15 minute	1 year	Winter	I+0%	111.400	109.829	-0.221	0.000	0.15	
S5.002	S27	360 minute	1 year	Winter	I+0%	111.400	109.162	-0.098	0.000	0.06	
S5.003	S28	360 minute	1 year	Winter	I+0%	111.400	109.162	0.012	0.000	0.07	
S5.004	S29	360 minute	1 year	Winter	I+0%	111.500	109.161	0.061	0.000	0.04	
S5.005	S30	360 minute	1 year	Winter	I+0%	111.500	109.161	0.161	0.000	0.03	
S7.000	S31	15 minute	1 year	Winter	I+0%	112.100	110.517	-0.258	0.000	0.21	
S7.001	S32	15 minute	1 year	Winter	I+0%	112.650	109.910	-0.215	0.000	0.38	
S7.002	S33	15 minute	1 year	Winter	I+0%	112.650	109.814	-0.211	0.000	0.39	
S7.003	S34	15 minute	1 year	Winter	I+0%	111.800	109.624	-0.276	0.000	0.32	
S7.004	S35	15 minute	1 year	Winter	I+0%	112.000	109.529	-0.271	0.000	0.33	
S7.005	S36	15 minute	1 year	Winter	I+0%	112.100	109.409	-0.241	0.000	0.44	
S4.011	S37	360 minute	1 year	Winter	I+0%	112.000	109.161	0.211	0.000	0.09	
S4.012	S38	360 minute	1 year	Winter	I+0%	111.500	109.159	0.359	0.000	0.09	
S4.013	S39	360 minute	1 year	Winter	I+0%	111.500	109.158	0.458	0.000	0.08	
S4.014	S40	360 minute	1 year	Winter	I+0%	111.500	109.157	-0.043	0.000	0.01	
S4.015	S41	360 minute	1 year	Winter	I+0%	111.750	109.151	0.051	0.000	0.01	
S8.000	S42	15 minute	1 year	Winter	I+0%	113.600	112.293	-0.107	0.000	0.18	
S8.001	S43	15 minute	1 year	Winter	I+0%	113.800	111.934	-0.216	0.000	0.17	
S8.002	S44	15 minute	1 year	Winter	I+0%	113.250	111.674	-0.226	0.000	0.14	
S9.000	S45	15 minute	1 year	Winter	I+0%	113.200	111.783	-0.217	0.000	0.16	
S9.001	S46	15 minute	1 year	Winter	I+0%	113.300	111.593	-0.207	0.000	0.21	
S8.003	S47	15 minute	1 year	Winter	I+0%	112.800	111.398	-0.202	0.000	0.23	
S8.004	S48	15 minute	1 year	Winter	I+0%	111.700	110.291	-0.209	0.000	0.20	
S10.000	S49	15 minute	1 year	Winter	I+0%	112.050	110.631	-0.219	0.000	0.16	
S10.001	S50	15 minute	1 year	Winter	I+0%	111.500	110.077	-0.223	0.000	0.15	
S8.005	S51	360 minute	1 year	Winter	I+0%	111.600	109.150	0.000	0.000	0.01	
S8.006	S52	360 minute	1 year	Winter	I+0%	111.350	109.151	0.101	0.000	0.01	
S11.000	S53	15 minute	1 year	Winter	I+0%	112.000	110.562	-0.238	0.000	0.09	
S11.001	S54	15 minute	1 year	Winter	I+0%	112.050	110.228	-0.222	0.000	0.15	
S11.002	S55	15 minute	1 year	Winter	I+0%	111.950	110.073	-0.227	0.000	0.13	
S11.003	S56	15 minute	1 year	Winter	I+0%	111.800	109.756	-0.244	0.000	0.08	
S8.007	S57	360 minute	1 year	Winter	I+0%	111.750	109.151	0.151	0.000	0.01	
S4.016	S58	360 minute	1 year	Winter	I+0%	111.300	109.151	0.201	0.000	0.01	
S12.000	SBASIN	15 minute	1 year	Summer	I+0%	111.300	110.300	-0.600	0.000	0.00	
S4.017	S59	360 minute	1 year	Winter	I+0%	111.350	109.150	1.225	0.000	0.38	
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Weetwood		Page 28
Joseph's Well Hanover Walk Leeds, LS3 1AB	4914 Ruabon SW Calculations	
Date 18/09/2020 15:59 File 2020-09-07 4914 R1.mdx	Designed by TB Checked by	
XP Solutions	Network 2020.1	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S4.007	S18		0.831	21.0	OK
S4.008	S19		0.857	22.5	OK
S4.009	S20		0.491	8.3	OK
S4.010	S21		4.571	8.7	OK
S5.000	S22		0.037	2.1	OK
S5.001	S23		0.636	2.4	OK
S6.000	S24		0.062	6.7	OK
S6.001	S25		0.163	10.0	OK
S6.002	S26		0.141	23.9	OK
S5.002	S27		2.343	8.1	OK
S5.003	S28		6.807	10.9	SURCHARGED
S5.004	S29		2.985	10.6	SURCHARGED
S5.005	S30		14.120	9.2	SURCHARGED
S7.000	S31		0.199	39.2	OK
S7.001	S32		0.592	47.0	OK
S7.002	S33		0.552	48.6	OK
S7.003	S34		0.511	53.0	OK
S7.004	S35		1.231	58.1	OK
S7.005	S36		1.815	77.1	OK
S4.011	S37		23.896	32.2	SURCHARGED
S4.012	S38		13.581	28.9	SURCHARGED
S4.013	S39		8.934	26.3	SURCHARGED
S4.014	S40		10.400	23.9	OK
S4.015	S41		25.575	21.8	SURCHARGED
S8.000	S42		0.043	3.0	OK
S8.001	S43		0.089	12.2	OK
S8.002	S44		0.195	14.9	OK
S9.000	S45		0.088	11.2	OK
S9.001	S46		0.271	19.9	OK
S8.003	S47		0.249	38.1	OK
S8.004	S48		0.126	44.5	OK
S10.000	S49		0.086	18.3	OK
S10.001	S50		0.131	28.7	OK
S8.005	S51		4.141	16.5	SURCHARGED
S8.006	S52		37.092	13.5	SURCHARGED
S11.000	S53		0.064	9.1	OK
S11.001	S54		0.147	14.7	OK
S11.002	S55		0.105	18.3	OK
S11.003	S56		0.071	19.6	OK
S8.007	S57		30.636	13.4	SURCHARGED
S4.016	S58		101.660	17.0	SURCHARGED
S12.000	SBASIN		0.000	0.0	OK*
S4.017	S59		21.244	14.0	SURCHARGED

Weetwood		Page 29
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 5
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.298
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
720, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.
S2.000	S1	15 minute 30 year Winter I+0%	115.000	113.760	-0.040	0.000	0.86
S2.001	S2	15 minute 30 year Winter I+0%	114.500	113.256	-0.044	0.000	0.84
S2.002	S3	15 minute 30 year Winter I+0%	114.350	113.101	-0.049	0.000	0.77
S2.003	S4	15 minute 30 year Winter I+0%	114.050	112.647	-0.203	0.000	0.22
S2.004	S5	15 minute 30 year Winter I+0%	112.750	111.360	-0.190	0.000	0.28
S2.005	S6	60 minute 30 year Winter I+0%	111.600	110.247	-0.153	0.000	0.25
S2.006	S7	60 minute 30 year Winter I+0%	111.600	110.238	-0.122	0.000	0.23
S2.007	S8	120 minute 30 year Winter I+0%	111.550	110.229	-0.081	0.000	0.16
S2.008	S9	120 minute 30 year Winter I+0%	111.500	110.226	-0.049	0.000	0.14
S3.000	Sbasin	120 minute 30 year Winter I+0%	110.810	110.217	-0.043	0.000	0.02
S2.009	S10	120 minute 30 year Winter I+0%	111.400	110.217	0.017	0.000	0.05
S4.000	S11	480 minute 30 year Winter I+0%	111.300	110.739	0.639	0.000	0.03
S4.001	S12	480 minute 30 year Winter I+0%	111.300	110.739	0.739	0.000	0.02
S4.002	S13	480 minute 30 year Winter I+0%	111.300	110.739	0.789	0.000	0.04
S4.003	S14	480 minute 30 year Winter I+0%	111.350	110.739	0.869	0.000	0.05
S4.004	S15	480 minute 30 year Winter I+0%	111.400	110.739	0.939	0.000	0.03
S4.005	S16	480 minute 30 year Winter I+0%	111.550	110.739	0.999	0.000	0.06
S4.006	S17	480 minute 30 year Winter I+0%	111.650	110.739	1.019	0.000	0.04

Weetwood		Page 30
Joseph's Well Hanover Walk Leeds, LS3 1AB	4914 Ruabon SW Calculations	
Date 18/09/2020 15:59 File 2020-09-07 4914 R1.mdx	Designed by TB Checked by	
XP Solutions	Network 2020.1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

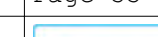
PN	US/MH Name	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S2.000	S1		0.119	16.2	OK
S2.001	S2		0.160	16.3	OK
S2.002	S3		0.140	21.2	OK
S2.003	S4		0.104	35.3	OK
S2.004	S5		0.162	48.1	OK
S2.005	S6		0.588	27.8	OK
S2.006	S7		1.969	30.3	OK
S2.007	S8		2.761	18.0	OK
S2.008	S9		2.241	20.0	OK
S3.000	Sbasin		27.620	3.4	OK*
S2.009	S10		8.383	5.0	SURCHARGED
S4.000	S11		1.056	2.1	SURCHARGED
S4.001	S12		3.384	3.0	SURCHARGED
S4.002	S13		4.943	6.2	SURCHARGED
S4.003	S14		7.120	6.7	SURCHARGED
S4.004	S15		6.590	8.0	SURCHARGED
S4.005	S16		11.557	7.9	SURCHARGED
S4.006	S17		5.736	8.7	SURCHARGED

Weetwood										Page 31	
Joseph's Well							4914				
Hanover Walk							Ruabon				
Leeds, LS3 1AB							SW Calculations				
Date 18/09/2020 15:59							Designed by TB				
File 2020-09-07 4914 R1.mdx							Checked by				
XP Solutions							Network 2020.1				
<u>30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)</u> <u>for Storm</u>											
PN	US/MH Name	Event					US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S4.007	S18	480	minute	30	year	Winter I+0%	111.700	110.739	1.059	0.000	0.04
S4.008	S19	480	minute	30	year	Winter I+0%	111.400	110.739	1.099	0.000	0.08
S4.009	S20	480	minute	30	year	Winter I+0%	111.300	110.739	1.119	0.000	0.05
S4.010	S21	480	minute	30	year	Winter I+0%	111.300	110.739	1.139	0.000	0.01
S5.000	S22	480	minute	30	year	Winter I+0%	111.400	110.741	1.216	0.000	0.00
S5.001	S23	480	minute	30	year	Winter I+0%	111.400	110.741	1.366	0.000	0.03
S6.000	S24	480	minute	30	year	Winter I+0%	111.500	110.743	0.443	0.000	0.03
S6.001	S25	480	minute	30	year	Winter I+0%	111.400	110.743	0.593	0.000	0.05
S6.002	S26	480	minute	30	year	Winter I+0%	111.400	110.743	0.693	0.000	0.06
S5.002	S27	480	minute	30	year	Winter I+0%	111.400	110.741	1.481	0.000	0.09
S5.003	S28	480	minute	30	year	Winter I+0%	111.400	110.740	1.590	0.000	0.12
S5.004	S29	480	minute	30	year	Winter I+0%	111.500	110.739	1.639	0.000	0.06
S5.005	S30	480	minute	30	year	Winter I+0%	111.500	110.739	1.739	0.000	0.04
S7.000	S31	120	minute	30	year	Winter I+0%	112.100	110.940	0.165	0.000	0.19
S7.001	S32	120	minute	30	year	Winter I+0%	112.650	110.921	0.796	0.000	0.36
S7.002	S33	120	minute	30	year	Winter I+0%	112.650	110.912	0.887	0.000	0.38
S7.003	S34	120	minute	30	year	Winter I+0%	111.800	110.882	0.982	0.000	0.31
S7.004	S35	180	minute	30	year	Winter I+0%	112.000	110.815	1.015	0.000	0.24
S7.005	S36	480	minute	30	year	Winter I+0%	112.100	110.741	1.091	0.000	0.16
S4.011	S37	480	minute	30	year	Winter I+0%	112.000	110.739	1.789	0.000	0.13
S4.012	S38	480	minute	30	year	Winter I+0%	111.500	110.736	1.936	0.000	0.13
S4.013	S39	480	minute	30	year	Winter I+0%	111.500	110.734	2.034	0.000	0.11
S4.014	S40	480	minute	30	year	Winter I+0%	111.500	110.732	1.532	0.000	0.02
S4.015	S41	480	minute	30	year	Winter I+0%	111.750	110.732	1.632	0.000	0.02
S8.000	S42	15	minute	30	year	Winter I+0%	113.600	112.320	-0.080	0.000	0.43
S8.001	S43	15	minute	30	year	Winter I+0%	113.800	112.001	-0.149	0.000	0.48
S8.002	S44	15	minute	30	year	Winter I+0%	113.250	111.732	-0.168	0.000	0.39
S9.000	S45	15	minute	30	year	Winter I+0%	113.200	111.835	-0.165	0.000	0.40
S9.001	S46	15	minute	30	year	Winter I+0%	113.300	111.663	-0.137	0.000	0.56
S8.003	S47	15	minute	30	year	Winter I+0%	112.800	111.477	-0.123	0.000	0.65
S8.004	S48	480	minute	30	year	Winter I+0%	111.700	110.734	0.234	0.000	0.08
S10.000	S49	480	minute	30	year	Winter I+0%	112.050	110.734	-0.116	0.000	0.06
S10.001	S50	480	minute	30	year	Winter I+0%	111.500	110.733	0.433	0.000	0.06
S8.005	S51	480	minute	30	year	Winter I+0%	111.600	110.732	1.582	0.000	0.02
S8.006	S52	480	minute	30	year	Winter I+0%	111.350	110.732	1.682	0.000	0.03
S11.000	S53	480	minute	30	year	Winter I+0%	112.000	110.734	-0.066	0.000	0.03
S11.001	S54	480	minute	30	year	Winter I+0%	112.050	110.734	0.284	0.000	0.06
S11.002	S55	480	minute	30	year	Winter I+0%	111.950	110.734	0.434	0.000	0.05
S11.003	S56	480	minute	30	year	Winter I+0%	111.800	110.733	0.733	0.000	0.03
S8.007	S57	480	minute	30	year	Winter I+0%	111.750	110.732	1.732	0.000	0.03
S4.016	S58	480	minute	30	year	Winter I+0%	111.300	110.732	1.782	0.000	0.05
S12.000	SBASIN	480	minute	30	year	Winter I+0%	111.300	110.731	-0.169	0.000	0.03
S4.017	S59	480	minute	30	year	Winter I+0%	111.350	110.732	2.807	0.000	0.44
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Weetwood		Page 32
Joseph's Well Hanover Walk Leeds, LS3 1AB	4914 Ruabon SW Calculations	
Date 18/09/2020 15:59 File 2020-09-07 4914 R1.mdx	Designed by TB Checked by	
XP Solutions	Network 2020.1	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

PN	US/MH Name	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S4.007	S18		8.407	9.1	SURCHARGED
S4.008	S19		7.773	10.2	SURCHARGED
S4.009	S20		5.839	13.0	SURCHARGED
S4.010	S21		18.008	14.6	SURCHARGED
S5.000	S22		2.803	0.6	SURCHARGED
S5.001	S23		4.899	3.8	SURCHARGED
S6.000	S24		0.835	2.4	SURCHARGED
S6.001	S25		2.659	3.7	SURCHARGED
S6.002	S26		1.759	9.2	SURCHARGED
S5.002	S27		8.355	13.0	SURCHARGED
S5.003	S28		10.176	17.5	SURCHARGED
S5.004	S29		5.821	17.4	SURCHARGED
S5.005	S30		94.915	9.7	SURCHARGED
S7.000	S31		0.945	36.5	SURCHARGED
S7.001	S32		9.070	44.7	SURCHARGED
S7.002	S33		3.274	47.3	SURCHARGED
S7.003	S34		5.027	51.4	SURCHARGED
S7.004	S35		6.519	42.5	SURCHARGED
S7.005	S36		8.714	28.7	SURCHARGED
S4.011	S37		44.462	45.7	SURCHARGED
S4.012	S38		97.168	42.4	SURCHARGED
S4.013	S39		11.720	39.2	SURCHARGED
S4.014	S40		114.324	37.6	SURCHARGED
S4.015	S41		32.055	27.9	SURCHARGED
S8.000	S42		0.073	7.4	OK
S8.001	S43		0.170	34.7	OK
S8.002	S44		0.506	43.0	OK
S9.000	S45		0.147	27.4	OK
S9.001	S46		0.837	52.4	OK
S8.003	S47		0.810	106.8	OK
S8.004	S48		1.633	19.0	SURCHARGED
S10.000	S49		0.203	6.6	OK
S10.001	S50		3.787	12.6	SURCHARGED
S8.005	S51		11.002	31.4	SURCHARGED
S8.006	S52		43.602	33.7	SURCHARGED
S11.000	S53		0.259	3.3	OK
S11.001	S54		3.116	5.9	SURCHARGED
S11.002	S55		1.330	7.5	SURCHARGED
S11.003	S56		1.825	7.8	SURCHARGED
S8.007	S57		36.965	40.8	SURCHARGED
S4.016	S58		109.000	59.0	SURCHARGED
S12.000	SBASIN		103.579	10.1	OK*
S4.017	S59		27.430	16.1	SURCHARGED

Weetwood		Page 33
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Number of Input Hydrographs	0	Number of Storage Structures	5
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

								Water	Surcharged	Flooded		
US/MH								US/CL	Level	Depth	Volume	Flow /
PN	Name	Event						(m)	(m)	(m)	(m³)	Cap.
S2.000	S1	15 minute	100 year	Winter	I+40%	115.000	114.320		0.520	0.000	1.32	
S2.001	S2	15 minute	100 year	Winter	I+40%	114.500	113.444		0.144	0.000	1.28	
S2.002	S3	15 minute	100 year	Winter	I+40%	114.350	113.207		0.057	0.000	1.09	
S2.003	S4	15 minute	100 year	Winter	I+40%	114.050	112.673		-0.177	0.000	0.35	
S2.004	S5	15 minute	100 year	Winter	I+40%	112.750	111.395		-0.155	0.000	0.46	
S2.005	S6	120 minute	100 year	Winter	I+40%	111.600	110.769		0.369	0.000	0.30	
S2.006	S7	120 minute	100 year	Winter	I+40%	111.600	110.742		0.382	0.000	0.29	
S2.007	S8	180 minute	100 year	Winter	I+40%	111.550	110.743		0.433	0.000	0.26	
S2.008	S9	180 minute	100 year	Winter	I+40%	111.500	110.740		0.465	0.000	0.23	
S3.000	Sbasin	180 minute	100 year	Winter	I+40%	110.810	110.697		0.437	0.000	0.04	
S2.009	S10	180 minute	100 year	Winter	I+40%	111.400	110.742		0.542	0.000	0.05	
S4.000	S11	720 minute	100 year	Winter	I+40%	111.300	111.288		1.188	0.000	0.04	
S4.001	S12	720 minute	100 year	Winter	I+40%	111.300	111.288		1.288	0.000	0.03	
S4.002	S13	720 minute	100 year	Winter	I+40%	111.300	111.288		1.338	0.000	0.06	
S4.003	S14	720 minute	100 year	Winter	I+40%	111.350	111.288		1.418	0.000	0.06	
S4.004	S15	720 minute	100 year	Winter	I+40%	111.400	111.287		1.487	0.000	0.05	
S4.005	S16	720 minute	100 year	Winter	I+40%	111.550	111.287		1.547	0.000	0.08	
S4.006	S17	720 minute	100 year	Winter	I+40%	111.650	111.287		1.567	0.000	0.06	

Weetwood		Page 34
Joseph's Well	4914	
Hanover Walk	Ruabon	
Leeds, LS3 1AB	SW Calculations	
Date 18/09/2020 15:59	Designed by TB	
File 2020-09-07 4914 R1.mdx	Checked by	
XP Solutions	Network 2020.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S2.000	S1		0.752	24.9	SURCHARGED
S2.001	S2		0.636	24.7	SURCHARGED
S2.002	S3		0.354	30.0	SURCHARGED
S2.003	S4		0.135	55.9	OK
S2.004	S5		0.255	80.3	OK
S2.005	S6		2.705	33.7	SURCHARGED
S2.006	S7		3.639	38.7	SURCHARGED
S2.007	S8		4.375	28.9	SURCHARGED
S2.008	S9		3.459	32.2	SURCHARGED
S3.000	Sbasin		81.366	6.3	FLOOD RISK*
S2.009	S10		10.215	5.0	SURCHARGED
S4.000	S11		1.677	2.7	FLOOD RISK
S4.001	S12		4.354	3.9	FLOOD RISK
S4.002	S13		5.913	8.3	FLOOD RISK
S4.003	S14		8.090	9.0	FLOOD RISK
S4.004	S15		7.559	11.2	FLOOD RISK
S4.005	S16		12.526	11.1	FLOOD RISK
S4.006	S17		6.704	12.1	SURCHARGED

Weetwood

Joseph's Well
Hanover Walk
Leeds, LS3 1AB

Date 18/09/2020 15:59
File 2020-09-07 4914 R1.mdx

XP Solutions

4914
Ruabon
SW Calculations

Designed by TB
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Network 2020.1

Page 35



100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Event	US/CL (m)	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
S4.007	S18	720 minute 100 year Winter I+40%	111.700	111.287	1.607	0.000	0.06
S4.008	S19	720 minute 100 year Winter I+40%	111.400	111.287	1.647	0.000	0.11
S4.009	S20	720 minute 100 year Winter I+40%	111.300	111.287	1.667	0.000	0.07
S4.010	S21	720 minute 100 year Winter I+40%	111.300	111.287	1.687	0.000	0.02
S5.000	S22	720 minute 100 year Winter I+40%	111.400	111.291	1.766	0.000	0.01
S5.001	S23	720 minute 100 year Winter I+40%	111.400	111.291	1.916	0.000	0.05
S6.000	S24	720 minute 100 year Winter I+40%	111.500	111.294	0.994	0.000	0.04
S6.001	S25	720 minute 100 year Winter I+40%	111.400	111.293	1.143	0.000	0.06
S6.002	S26	720 minute 100 year Winter I+40%	111.400	111.293	1.243	0.000	0.08
S5.002	S27	720 minute 100 year Winter I+40%	111.400	111.290	2.030	0.000	0.13
S5.003	S28	720 minute 100 year Winter I+40%	111.400	111.289	2.139	0.000	0.17
S5.004	S29	720 minute 100 year Winter I+40%	111.500	111.288	2.188	0.000	0.09
S5.005	S30	720 minute 100 year Winter I+40%	111.500	111.287	2.287	0.000	0.03
S7.000	S31	180 minute 100 year Winter I+40%	112.100	111.597	0.822	0.000	0.27
S7.001	S32	240 minute 100 year Winter I+40%	112.650	111.569	1.444	0.000	0.40
S7.002	S33	240 minute 100 year Winter I+40%	112.650	111.483	1.458	0.000	0.42
S7.003	S34	360 minute 100 year Winter I+40%	111.800	111.407	1.507	0.000	0.25
S7.004	S35	360 minute 100 year Winter I+40%	112.000	111.328	1.528	0.000	0.28
S7.005	S36	720 minute 100 year Winter I+40%	112.100	111.289	1.639	0.000	0.24
S4.011	S37	720 minute 100 year Winter I+40%	112.000	111.287	2.337	0.000	0.15
S4.012	S38	720 minute 100 year Winter I+40%	111.500	111.284	2.484	0.000	0.10
S4.013	S39	720 minute 100 year Winter I+40%	111.500	111.282	2.582	0.000	0.09
S4.014	S40	720 minute 100 year Winter I+40%	111.500	111.280	2.080	0.000	0.02
S4.015	S41	720 minute 100 year Winter I+40%	111.750	111.281	2.181	0.000	0.02
S8.000	S42	15 minute 100 year Winter I+40%	113.600	112.352	-0.048	0.000	0.77
S8.001	S43	15 minute 100 year Winter I+40%	113.800	112.074	-0.076	0.000	0.86
S8.002	S44	15 minute 100 year Winter I+40%	113.250	111.797	-0.103	0.000	0.69
S9.000	S45	15 minute 100 year Winter I+40%	113.200	111.926	-0.074	0.000	0.72
S9.001	S46	15 minute 100 year Winter I+40%	113.300	111.832	0.032	0.000	0.90
S8.003	S47	15 minute 100 year Winter I+40%	112.800	111.671	0.071	0.000	1.04
S8.004	S48	720 minute 100 year Winter I+40%	111.700	111.282	0.782	0.000	0.11
S10.000	S49	960 minute 100 year Winter I+40%	112.050	111.282	0.432	0.000	0.06
S10.001	S50	720 minute 100 year Winter I+40%	111.500	111.281	0.981	0.000	0.08
S8.005	S51	960 minute 100 year Winter I+40%	111.600	111.281	2.131	0.000	0.02
S8.006	S52	960 minute 100 year Winter I+40%	111.350	111.281	2.231	0.000	0.03
S11.000	S53	720 minute 100 year Winter I+40%	112.000	111.282	0.482	0.000	0.04
S11.001	S54	720 minute 100 year Winter I+40%	112.050	111.281	0.831	0.000	0.08
S11.002	S55	720 minute 100 year Winter I+40%	111.950	111.281	0.981	0.000	0.07
S11.003	S56	960 minute 100 year Winter I+40%	111.800	111.281	1.281	0.000	0.03
S8.007	S57	960 minute 100 year Winter I+40%	111.750	111.281	2.281	0.000	0.03
S4.016	S58	720 minute 100 year Winter I+40%	111.300	111.281	2.331	0.000	0.05
S12.000	SBASIN	720 minute 100 year Winter I+40%	111.300	111.278	0.378	0.000	0.01
S4.017	S59	720 minute 100 year Winter I+40%	111.350	111.280	3.355	0.000	0.47

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Weetwood		Page 36
Joseph's Well Hanover Walk Leeds, LS3 1AB	4914 Ruabon SW Calculations	
Date 18/09/2020 15:59 File 2020-09-07 4914 R1.mdx	Designed by TB Checked by	
XP Solutions	Network 2020.1	

100 year Return Period Summary of Critical Results by Maximum Level (Rank
1) for Storm

PN	US/MH Name	Overflow (l/s)	Maximum Vol (m³)	Pipe Flow (l/s)	Status
S4.007	S18		9.376	12.7	SURCHARGED
S4.008	S19		8.741	14.3	FLOOD RISK
S4.009	S20		6.808	18.3	FLOOD RISK
S4.010	S21		19.906	20.6	FLOOD RISK
S5.000	S22		3.774	0.9	FLOOD RISK
S5.001	S23		5.870	5.4	FLOOD RISK
S6.000	S24		1.457	3.0	FLOOD RISK
S6.001	S25		3.281	4.7	FLOOD RISK
S6.002	S26		2.380	12.2	FLOOD RISK
S5.002	S27		9.326	18.3	FLOOD RISK
S5.003	S28		11.145	24.8	FLOOD RISK
S5.004	S29		6.790	24.6	FLOOD RISK
S5.005	S30		376.903	8.6	FLOOD RISK
S7.000	S31		2.106	50.1	SURCHARGED
S7.001	S32		10.216	49.2	SURCHARGED
S7.002	S33		4.284	51.8	SURCHARGED
S7.003	S34		5.954	42.7	SURCHARGED
S7.004	S35		7.426	48.8	SURCHARGED
S7.005	S36		9.683	42.2	SURCHARGED
S4.011	S37		46.360	53.5	SURCHARGED
S4.012	S38		336.321	32.6	FLOOD RISK
S4.013	S39		12.688	31.0	FLOOD RISK
S4.014	S40		420.062	28.6	FLOOD RISK
S4.015	S41		33.954	24.9	SURCHARGED
S8.000	S42		0.110	13.2	OK
S8.001	S43		0.278	62.6	OK
S8.002	S44		1.043	75.6	OK
S9.000	S45		0.250	48.8	OK
S9.001	S46		2.792	84.9	SURCHARGED
S8.003	S47		2.798	171.3	SURCHARGED
S8.004	S48		3.737	24.1	SURCHARGED
S10.000	S49		0.822	7.1	SURCHARGED
S10.001	S50		4.539	15.2	FLOOD RISK
S8.005	S51		12.903	32.2	SURCHARGED
S8.006	S52		45.502	37.0	FLOOD RISK
S11.000	S53		0.879	4.3	SURCHARGED
S11.001	S54		3.796	7.5	SURCHARGED
S11.002	S55		1.949	9.0	SURCHARGED
S11.003	S56		2.445	7.8	SURCHARGED
S8.007	S57		38.864	44.5	SURCHARGED
S4.016	S58		111.481	59.5	FLOOD RISK
S12.000	SBASIN		296.092	3.7	FLOOD RISK*
S4.017	S59		29.492	17.4	FLOOD RISK

ANNEX F:

Proposed Drainage Layout

ANNEX G:

Dŵr Cymru Welsh Water Sewer Records and Development Enquiry Response

Mr Tim Brook
Weetwood Services Ltd
Suite C22 Joseph's Well Hanover Walk
Leeds
West Yorkshire
LS3 1AB

Date: 23/07/2020
Our Ref: PPA0004992

Dear Mr Brook,

Grid Ref: 329825 343197
Site Address: Ruabon Park, Ruabon
Development: Residential development – 319 units

I refer to your pre-planning enquiry received relating to the above site, seeking our views on the capacity of our network of assets and infrastructure to accommodate your proposed development. Having reviewed the details submitted I can provide the following comments which should be taken into account within any future planning application for the development.

APPRAISAL

Firstly, we note that the proposal relates to a residential development comprising of 319 units on/at Ruabon Park and acknowledge that the site benefits from outline planning consent for 319 residential units (reference P/2018/0053) dated 18/05/2018. In light of the above, this appraisal has been undertaken on the basis that there will be no more than 319 residential units in total on the Ruabon Business Park Site.

Public Sewerage Network

The proposed development site is located in the immediate vicinity of a combined public sewerage system which drains to Five Fords Wastewater Treatment Works (WwTW).

This site is crossed by public sewers with their approximate position being marked on the attached Statutory Public Sewer Record. In accordance with the Water Industry Act 1991, Dwr Cymru Welsh Water requires access to its apparatus at all times in order to carry out maintenance and repairs. No part of any building will be permitted within the protection zone of the public sewers measured 6 metres either side of the centreline. Our strong recommendation is that your site layout takes into account the location of the assets crossing the site and should be referred to in any master-planning exercises or site layout plans submitted as part of any subsequent planning application. Further information regarding Asset Protection

is provided in the attached Advice & Guidance note.

Standard Advisory Note

You are also advised that some public sewers and lateral drains may not be recorded on our maps of public sewers because they were originally privately owned and were transferred into public ownership by nature of the Water Industry (Schemes for Adoption of Private Sewers) Regulations 2011. The presence of such assets may affect the proposal. In order to assist you may contact Dwr Cymru Welsh Water on 0800 085 3968 to establish the location and status of the apparatus in and around your site. Please be mindful that under the Water Industry Act 1991 Dwr Cymru Welsh Water has rights of access to its apparatus at all times.

Foul Water Drainage – Sewerage Network

We have considered the impact of foul flows generated by the proposed development and concluded that flows can be accommodated within the public sewerage system.

Standard Advisory Note

You may need to apply to Dwr Cymru Welsh Water for any connection to the public sewer under Section 106 of the Water industry Act 1991. However, if the connection to the public sewer network is either via a lateral drain (i.e. a drain which extends beyond the connecting property boundary) or via a new sewer (i.e. serves more than one property), it is now a mandatory requirement to first enter into a Section 104 Adoption Agreement (Water Industry Act 1991). The design of the sewers and lateral drains must also conform to the Welsh Ministers Standards for Foul Sewers and Lateral Drains, and conform with the publication "Sewers for Adoption"- 7th Edition. Further information can be obtained via the Developer Services pages of www.dwrcymru.com.

Surface Water Drainage

Due to capacity constraints with the combined public sewerage network downstream of the site we wouldn't allow surface water runoff from the proposed development to discharge into the public sewerage system.

Please refer to further detailed advice relating to surface water management included in our attached Advice & Guidance note.

In addition, please note that no highway or land drainage run-off will be permitted to discharge directly or indirectly into the public sewerage system.

Sewerage Treatment

No problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from this site.



Welsh Water is owned by Glas Cymru – a 'not-for-profit' company.
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We welcome correspondence in
Welsh and English

Dŵr Cymru Cyf, a limited company registered in
Wales no 2366777. Registered office: Pentwyn Road,
Nelson, Treharris, Mid Glamorgan CF46 6LY

Rydym yn croesawu gohebiaeth yn y
Gymraeg neu yn Saesneg

Dŵr Cymru Cyf, cwmni cyfyngedig wedi'i gofrestru yng
Nghymru rhif 2366777. Swyddfa gofrestredig: Heol Pentwyn
Nelson, Treharris, Morgannwg Ganol CF46 6LY.

I trust the above information is helpful and will assist you in forming water and drainage strategies that should accompany any future planning application. I also attach copies of our water and sewer extract plans for the area, and a copy of our Planning Guidance Note which provides further information on our approach to the planning process, making connections to our systems and ensuring any existing public assets or infrastructure located within new development sites are protected.

Please note that our response is based on the information provided in your enquiry and should the information change we reserve the right to make a new representation. Should you have any queries or wish to discuss any aspect of our response please do not hesitate to contact our dedicated team of planning officers, either on 0800 917 2652 or via email at developer.services@dwrcymru.com

Please quote our reference number in all communications and correspondence.

Yours faithfully,



Owain George
Planning Liaison Manager
Developer Services

Please Note that demands upon the water and sewerage systems change continually; consequently the information given above should be regarded as reliable for a maximum period of 12 months from the date of this letter.

PPA0004992



LEGEND(Representative of most common features)

	Foul chamber		Surface water chamber		Combined chamber		Combined sewer overflow		Special purpose chamber		Treatment works		Pumping station		NB: Sewer symbol colour indicates the type: RED - Combined GREEN - Surface Water BLACK - Foul Purple - Former S24 sewers (for indicative purposes only)		Private sewer subject to Sect. 104 adoption agreement		Private Sewer Transfer		Lateral Drain		Inspection Chamber
	Outfall		Lamp pole		Storm Overflow		Rising main		Gravity sewer		Private sewer												

Notes:

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) 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.

Dŵr Cymru Cylfyngedig (the Company) gives this information as to the position of its underground apparatus by way of general guidance only and on the understanding that it is based on the best information available and is not warranted as to its correctness in the event of excavations or other works made in the vicinity of the company's apparatus. The error of location of apparatus is liable to carry out any excavations made entirely on your. The information which is supplied by the Company is done so in accordance with statutory requirements of sections 105 and 106 of the Water Industry Act 1991 which is based upon the best information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, surface water sewer, lateral drain or drainage main and any excavation should be made in accordance with the provisions of the Water Industry Act 1991 and the Company's rights to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

**EXACT LOCATIONS OF ALL APPARATUS
TO BE DETERMINED ON SITE.**

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Map Ref: 329744,343252
Map scale: 1:4000
Printed by: Jenkins Tegan
Printed on: 23 Jul 2020



ANNEX H:

Dŵr Cymru Welsh Water Email (22 July 2020)

Tim Brook

From: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Sent: 22 July 2020 12:09
To: Tim Brook
Cc: services developer
Subject: RE: Adoptable Foul Sewer Gradients - Advice Required

This should be fine Tim



Henry Jones-Hughes

Senior Adoptions Engineer | Developer Services
Dŵr Cymru Welsh Water



W: dwrcymru.com



E: developer.services@dwrcymru.com



T: 07775003618



A: PO Box 3146, Cardiff, CF30 0EH



Before you print please think about the ENVIRONMENT

If we've gone the extra mile to provide you with excellent service, let us know. You can nominate an individual or team for a Diolch award through our [website](#)

From: Tim Brook <Tim.Brook@weetwood.net>
Sent: 22 July 2020 12:07
To: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>
Cc: services developer <developer.services@dwrcymru.com>
Subject: RE: Adoptable Foul Sewer Gradients - Advice Required

***** External Mail *****

Thanks Henry,

With 300 mm diameter pipes at 1:300 gradients we can achieve a flow velocity of 0.80 m/s, higher than the minimum 0.75 m/s.

We're designing the scheme to have the minimum 1.2 m of cover without concrete protection. The sewers could be laid shallower with concrete protection, but we would still need to utilise 300 mm diameter pipes.

Kind Regards

Tim

Tim Brook

Principal Engineer

tim.brook@weetwood.net

COVID-19 statement: Our priority is always the health, safety and wellbeing of our staff, partners and clients. We are taking all necessary measures to ensure that we reduce the risk of exposure to infection. We operate a resilient IT system. All our staff are able to work from home whilst maintaining full access to all the specialist software packages we use to deliver services to our clients. Our general policy is that staff will not undertake non-essential travel. We

are able to conduct meetings virtually, either by telephone or using Teams. We continue to assess the situation and we will update our policies and guidance accordingly. Visit our website to see our updated position. Take care and be safe.

Weetwood

Development • Planning • Environment

Suite C22 Joseph's Well, Hanover Walk, Leeds LS3 1AB

T 0113 244 1377 W www.weetwood.net

Offices also in London and Mold:

70 Cowcross Street, London, EC1M 6EJ (T 0203 757 5444) &

Park House, Ffordd Byrnwr Gwair, Mold, CH7 1FQ (T 01352 700045)



[Click here to visit our company email disclaimer and policy documents](#)

From: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>

Sent: 22 July 2020 11:32

To: Tim Brook <Tim.Brook@weetwood.net>

Cc: services developer <developer.services@dwrcymru.com>

Subject: RE: Adoptable Foul Sewer Gradients - Advice Required

Hi Tim

The system will need to have a minimum flow velocity of 0.75m/s. Can the sewer be laid at a shallower depth with protection put in place.

Regards

Henry



Henry Jones-Hughes

Senior Adoptions Engineer | Developer Services

Dŵr Cymru Welsh Water



W: dwrcymru.com



E: developer.services@dwrcymru.com



T: 07775003618



A: PO Box 3146, Cardiff, CF30 0EH



Before you print please think about the ENVIRONMENT

If we've gone the extra mile to provide you with excellent service, let us know. You can nominate an individual or team for a Diolch award through our [website](#)

From: Tim Brook <Tim.Brook@weetwood.net>

Sent: 22 July 2020 11:28

To: services developer <developer.services@dwrcymru.com>

Cc: Jones-Hughes Henry <Henry.Jones-Hughes@dwrcymru.com>

Subject: Adoptable Foul Sewer Gradients - Advice Required

***** External Mail *****

Hello,

We're currently designing a residential scheme with 319 dwellings. Due to site topography, and to enable a gravity connection to an existing DCWW combined sewer, we need to propose 300 mm diameter pipes at 1:300 gradients (equates to a velocity of 0.80 m/s).

Can you please advise if those pipe sizes and gradients would be acceptable when being put forward for Section 104 adoption?

Kind Regards

Tim

Tim Brook

Principal Engineer

tim.brook@weetwood.net

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Dwr Cymru Welsh Water is firmly committed to water conservation and promoting water efficiency. Please log on to our website

www.dwrcymru.com/waterefficiency to find out how you can become water wise. Mae Dwr Cymru Welsh Water wedi ymrwymo i warchod adnoddau dwr a hyrwyddo defnydd dwr effeithiol. Mae cyngor i' ch helpu i ddefnyddio dwr yn ddoeth yn www.dwrcymru.com/waterefficiency

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Flood Consequences Assessments
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