

Our Reference: 2020 – EG09 – B

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Date: 05/11/20

SABS Drainage Impact Assessment to Support the Proposed Drive Thru Coffee Shop at ASDA Superstore, Holt Road, Wrexham

Introduction

Flood Risk and Drainage Solutions Ltd have been commissioned by Euro Garages Ltd to provide a Detailed Drainage Design for the development of a drive through coffee shop, located on part of the existing car parking area serving the ASDA site on Holt Road in Wrexham.

Existing Site

At present the site comprises of car parking area associated with the ASDA Supermarket to the north of the application site

- Developable area = 0.195Ha

Redline Boundary



Development Proposals

Development proposals comprise of the erection of a drive through coffee shop with associated car parking provisions and a reduction in impermeable area approx. 50% compared to the existing situation.

Post development the impermeable area of the site will reduce from 100% i.e. 0.195Ha to approximately 52% 0.102Ha.

Existing Drainage

A CCTV Survey was unavailable at the time of writing, however it is understood that the existing car parking area is currently positively drained via a network of linear drainage channels which ultimately pass through a bypass separator, before discharging into a Public Sewer Network.

Welsh Water Sewer Records show that the nearest public surface water sewer is a public combined sewer located on Stryt Holt Road located south east of the site.

It is also noted that the ASDA Store is served by a private foul sewer which serves the petrol filling forecourt.

Hierarchy of Surface Water Disposal

The hierarchy for disposal of surface water from new developments is outlined within the Building Regulations Approved Document H and specifies the following methods in order of preference:

- Infiltration via soakaway or other suitable infiltration device
- Discharge to watercourse
- Discharge to public surface water sewer
- Discharge to public combined sewer

Infiltration Rates

Percolation Testing was undertaken in accordance with BRE Digest 365 by Swan Environmental Ltd dated 29/10/2020.

- BH1 average infiltration rate = 2.95×10^{-5} m/s or 0.1062m/hr (Infiltration Trench 3 and Infiltration Basin)
- BH2 average infiltration rate = 3.98×10^{-6} m/s or 0.01430m/hr (Infiltration Trench 1 & 2)

Surface Water Runoff Volumes

- Rainfall Depth = 70.04mm during the 100 Year 6 Hour Event

M5-D=M5-6x-Z1

M5-D=17x2.0

M5-D=34

M5-DxZ2

34x2.06=70.04mm

Existing Site Impermeable Area = 0.195Ha

- Existing Volume = 136.5m³ During the 100 Year Event

Proposed Site Impermeable Area = 0.102Ha

- Proposed Volume = 85.70m³ During the 100 Year + 20% Climate Change Event

Proposed Surface Water Drainage Strategy

Surface water flows from the application site are to be collected via rainwater down pipes and a network of trapped gullies, before being directed into 3No infiltration trenches and an infiltration basin with wetland located on land to the west of the site.

Proposed Surface Water Discharge Rates

The proposed surface water drainage strategy has been modelled using FLOW Software for the 1 year + 20% climate change, 30 year + 20% climate change and 100 year + 20% climate change events, the results are tabulated below for reference.

Proposed Discharge Rates

Return Period	Comment
1 Year + 20% Climate Change	OK
30 Year + 20% Climate Change	Surcharged
100 Year + 20% Climate Change	Flood Risk

Half Drain Down within 24 Hours

Modelling during normal conditions shows that all the structures drained down within 1440 mins i.e. 24 hours during the 100 year + 20% climate change event.

Freeboard

Modelling during normal conditions shows that the basin has freeboard of 0.510m during the 100 year + 20% climate change event.

Exceedance Route

Modelling normal conditions during the 100 year + 20% climate change event shows that the proposed drainage network has sufficient capacity to accommodate flows below ground level with no flooding.

System Failure

System failure was simulated by reducing the infiltration rate by 50%. During system failure the proposed drainage network has sufficient capacity to retain flows below ground and crest level of the structure.

Management/Maintenance

Following development, the drainage network serving the site will remain private, upon request from the LPA the developer is to provide evidence of the funding mechanism for the management and maintenance of the drainage system.

Typical maintenance requirements for infiltration basins and soakaways are provided below:

TABLE 13.2 Operation and maintenance requirements for infiltration basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter, debris and trash	Monthly
	Cut grass – for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional maintenance	Reseed areas of poor vegetation growth	Annually, or as required
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	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 pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies	Half yearly
	Inspect infiltration surfaces for compaction and ponding	Monthly

TABLE 13.1 Operation and maintenance requirements for soakaways

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Foul Flows

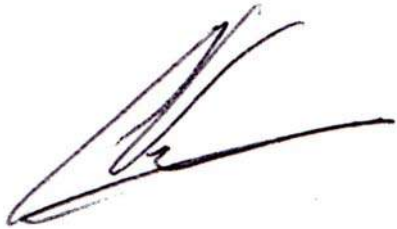
Foul flows from the proposed development are to be connected to the private foul drainage system serving the ASDA Store following on-site investigations.

Attachments

- Location Plan
- Development Proposals
- Existing Site
- Percolation Testing
- Welsh Water Sewer Records
- Proposed Drainage Layout Drawing
- Typical Drainage Details Drawing and Manhole Schedule
- Modelled Surface Water Network Simulation Report (Normal Conditions)
- Modelled Surface Water Network Simulation Report (System Failure)

We trust that the above is acceptable and look forward to hearing from you in due course; however, should you have any queries, please do not hesitate to contact me.

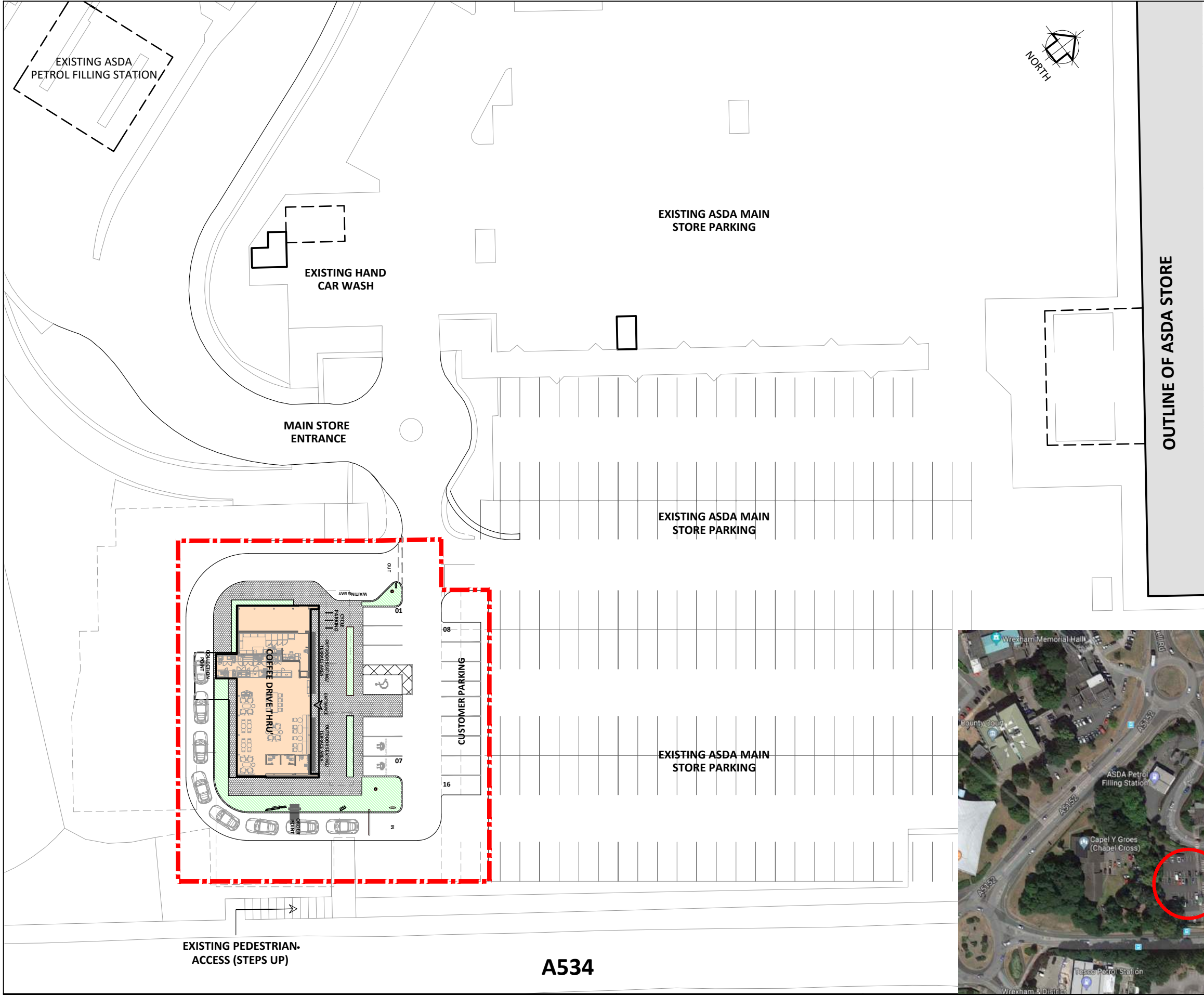
Yours Sincerely,

A handwritten signature in dark ink, appearing to be 'Chris Vose', with a stylized, sweeping flourish extending to the right.

Chris Vose BSc

Flood Risk and Drainage Solutions Ltd

Location Plan



SCHEDULE OF AREAS	
Site Boundary (red line)	0.168 H / 0.414 A
Proposed Coffee Drive Thru GIA	167m² / 1800ft²
Drive Thru Parking	16 Spaces (Inc. 1DDA)

GENERAL NOTES

This drawing has been prepared for feasibility purposes only & has been prepared of Ordnance Survey Data.

Do not scale off this drawing - if dimensions are required contact Jennings Design Ltd.

Site boundary has been shown for indicative purposes only, overlay of ownership boundary is to be confirmed upon receipt of title documentation.

CDM 2015 - Designer
There are no unusual hazards or risks on site other than those specified on the drawing or below;



STATUS			FEASIBILITY SCHEME		CLIENT	Euro Garages		0 5 10 15 20 25 30 35 40 SCALE - METRES 1:500 @ A3 © Protected by UK Copyright Law	
DRAWN BY		MDB	ISSUE DATE	September '19	SCALE	1:500 @ A3	ADDRESS		
PLAN NUMBER		190815-SK1		REVISION	--	ASDA - Wrexham Holt Rd Wrexham LL13 8HL	JENNINGS DESIGN LTD York House Valley Court Canal Road Bradford West Yorkshire BD1 4SP Tel: 01274 395 422 Email: office@jennings-design.com		

Development Proposals

Existing Site

Percolation Testing



BRE365 Infiltration Testing

Holt Road, Wrexham, LL13 8HL



Revision number: 1
Report status: Final
Date: October 2020

Issued by: Swan Environmental Services Ltd
Offices 24/25
The Rear Walled Garden
Nostell Estate
Nostell
Wakefield
WF4 1AB

Client: EuroGarages Ltd

Contact: Torsten Barnett

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Revision history			
Revision No.	Date	Revision detail	By
0	26/10/2020	Initial draft	A Mayes
1	27/10/2020	Revision 1	C Radiven

Quality Assurance		
Date	Checked by	Position
29/10/2020	S Harrison	Director

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Table 2	Environmental Setting
Table 3	Ground Conditions
Table 4	Summary of Infiltration Rate (m/s)

Appendices

Appendix 1	Site Layout Plans
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EXECUTIVE SUMMARY

Overview	Swan Environmental Services Limited (Swan) undertook a BRE365 Infiltration testing on the 21 st October 2020 at Asda Superstore, Holt Rd, Wrexham, LL13 8HL
Site Setting	The Site is currently an Asda car park in the southern most corner, directly south of the car wash. The site can be accessed via the roundabout where Powell Rd, A5152, Bodhyfryd and the Alexander C.P. school car park access meet.
Environmental Setting	According to the British Geological Survey, the site is indicated to be underlain by Superficial Glaciofluvial Sheet Deposits (sands and gravels) overlying the Salop Formation (mudstone, sandstone and conglomerate). From information obtained on Defra interactive mapping the superficial and bedrock deposits are both categorised as Secondary A aquifers. The nearest pertinent surface water feature is named as the River Gwenfro located approximately 850m to the south east.
Field Observations	No staining or odours were observed during the coring of the boreholes. Groundwater was not encountered in any of the boreholes.
Infiltration Results	The lowest infiltration rate for design is 1.37E-06 m/s .
Conclusions	It can be concluded that soakaway drainage will be a feasible option for surface water disposal from the site. The application of soakaway drainage will ultimately be dependent on the specific requirements of the development.
Recommendations	It is calculated that the lowest site wide infiltration rate of 1.37E-06/4.45E-06m/s has been considered for granular sand and chalk strata. Therefore, at this rate the site is suitable for standard infiltration. Any soakaways should be designed in accordance with BRE Special Design 365 - Soakaway Design.

1. INTRODUCTION

1.1 Context and Objectives

Swan Environmental Services Ltd was retained by EuroGarages Ltd to undertake Infiltration testing in accordance with BRE365 on the 21st October 2020 at Asda Superstore, Holt Rd, Wrexham, LL13 8HL

The Site is currently an Asda car park in the southern most corner, directly south of the car wash. The site can be accessed via the roundabout where Powell Rd, A5152, Bodhyfryd and the Alexander C.P. school car park access meet.

The purpose of the investigation was to supply soakaway test data in accordance with BRE365 at 2no. positions beneath a proposed drive through coffee shop development to be incorporated as part of the surface water disposal system. We were requested to target the most permeable strata at each location.

1.2 Background Information

A desk study and intrusive Site Investigation works were carried out as follows

- Phase 1 Desk Study Assessment by Environmental Protection Strategies Ltd dated October 2019.
- Phase 2 Geo-Environmental Site Assessment by Environmental Protection Strategies Ltd dated October 2020.

1.3 Scope of works

The scope of the work comprised:

- Review of aforementioned background information.
- Preparation of Health and Safety information.
- BRE365 Infiltration Testing involved:
 - Excavation of 2no. trial pit locations.
 - Installation of monitoring pipework.
 - Introduction of water to installed pipework.
 - Monitoring of water levels within installed pipework.
- Assessment of infiltration rates.
- Report submission of site findings.

The scope of works was developed in accordance with BRE365 (Soakaway Design).

2. SITE DESCRIPTION

2.1 General

The following table describes the background details of the site.

Table 1: Site Details	
Site Address	Holt Rd, Wrexham, LL13 8HL
The Site	The Site is currently an Asda car park in the southern most corner, directly south of the car wash. The site can be accessed via the roundabout where Powell Rd, A5152, Bodhyfryd and the Alexander C.P. school car park access meet.
Surrounding Land Use	The land use around the site is as follows; • North- The Asda access road is adjacent with a hand car wash, Asda car park, Asda superstore and school beyond. • West – Chapel Cross and associated car park and PFS adjacent with the A5152 and further buildings with car parks beyond. • East – Asda car park and Holt Rd adjacent with building material supplier and residential housing beyond. • South – Holt Rd is adjacent with another PFS, supermarket and car park beyond.

2.2 Environmental Setting

Table 2: Environmental setting	
Geology	Available British Geological Survey (BGS) geological maps and according to the BGS onshore geo-index, superficial Glaciofluvial Sheet Deposits (sands and gravels) overlying the Salop Formation (mudstone, sandstone and conglomerate).
Hydrogeology	According to Natural England's Magic Map, the site is indicated to be underlain by a Secondary A Aquifer which is understood to be associated with the Salop Formation. According to Natural England's Magic Map, the underlying Superficial geology is a Secondary A Aquifer associated with the Glaciofluvial Sheet Deposits.

Surface water

The River Gwenfro is situated approximately 850m south of the site.

3. FIELD INVESTIGATIONS

3.1 Summary of Field Work

Site works were carried out by Swan Environmental Services on the 21st October 2020.

The locations were excavated to a depth of between 2.0 to 2.5m bgl, with a granular backfill and monitoring pipe install at each location, with a suitable response zone according to strata and proposed soakaway depth.

No evidence of staining or odours were encountered in the borehole locations and no groundwater was encountered.

Following completion of the infiltration testing the standpipes were removed and the trial pit locations backfilled with the generated arisings.

3.2 Test Pit Rationale

The test locations were selected in order to provide maximum coverage of the site and test all geological units within the site boundary, in accordance with the proposed locations by the drainage engineer. Trial pit locations are annotated on the site layout drawing presented in Appendix 1.

The soakaway tests were carried out in the unsaturated zone within granular strata at up to 2.50mbgl to acquire permeability results relevant to the soakaway design.

The test procedure was repeated three times (where possible) to replicate soil moisture conditions typical of the site when the soakaways become operative.

3.3 Soil Observations

No significant visual or olfactory evidence of contamination was observed during the advancement of the exploratory holes. The majority of the site is underlain by sand and gravel. No groundwater was encountered during excavations. The ground conditions are summarised below.

Table 3: Ground Conditions		
Borehole	Description of Findings	Response Zone
BH1	- Made Ground (0.0 – 0.15mbgl): Black Gravel of Asphalt - Made Ground (0.15 – 0.90mbgl): Light Grey Gravel of Limestone - Sand (0.90 – 1.30mbgl): Medium to Coarse Brown Sand	1.0 – 2.0m

	Sand (1.30 – 2.15mbgl): Coarse Brown Sand	
BH2	- Made Ground (0.0 – 0.19mbgl): Black Gravel of Asphalt - Made Ground (0.19 – 0.45mbgl): Light Grey Gravel of Limestone - Sand (0.45 – 1.35mbgl): Medium to Coarse Brown Sand - Clay (1.35 – 1.75mbgl): Brown Clay - Made Ground (1.75 – 1.85mbgl): Black Gravel of Asphalt - Made Ground (1.85 – 2.0mbgl): Brown Gravel of brick and mixed lithologies - Sand (2.0 – 2.5mbgl): Coarse Dark Brown Sand	2.0m – 2.5m

4. INFILTRATION RESULTS

The average infiltration rate for each borehole location is provided in Table 4 below.

Table 4: Summary of Infiltration Rate (m/s)			
Window Sample Location	Test Rates	Average Infiltration Rate (m/s)	Lowest Infiltration Rate
BH1	• 5.15E-05 • 2.78E-05 • 9.09E-06	2.95E-05m/s	1.37E-06
BH2	• 7.81E-06 • 2.77E-06 • 1.37E-06	3.98E-06m/s	

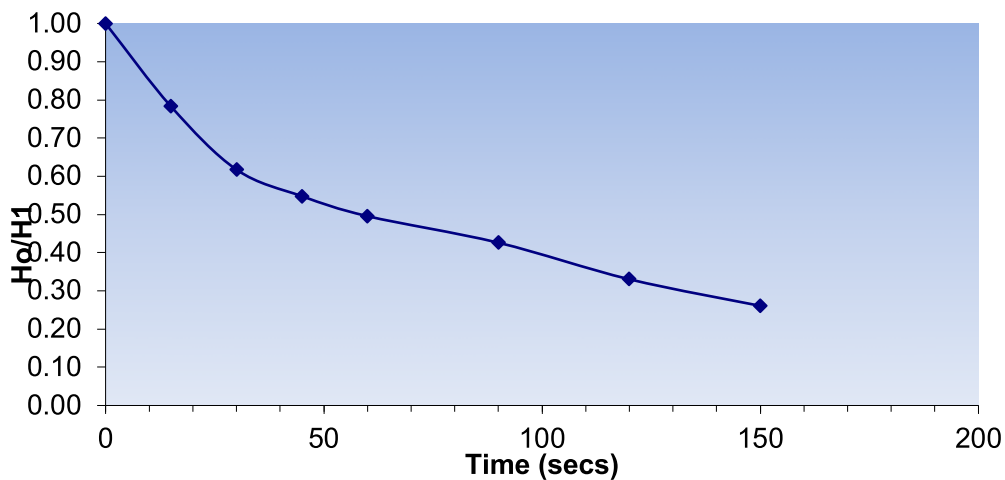
4.1 BH1 Results

Testing of the generally granular chalk in BH1 to the west of the site produced average infiltration rates of **2.95E-05m/s**. This rate is deemed suitable for surface water drainage design.

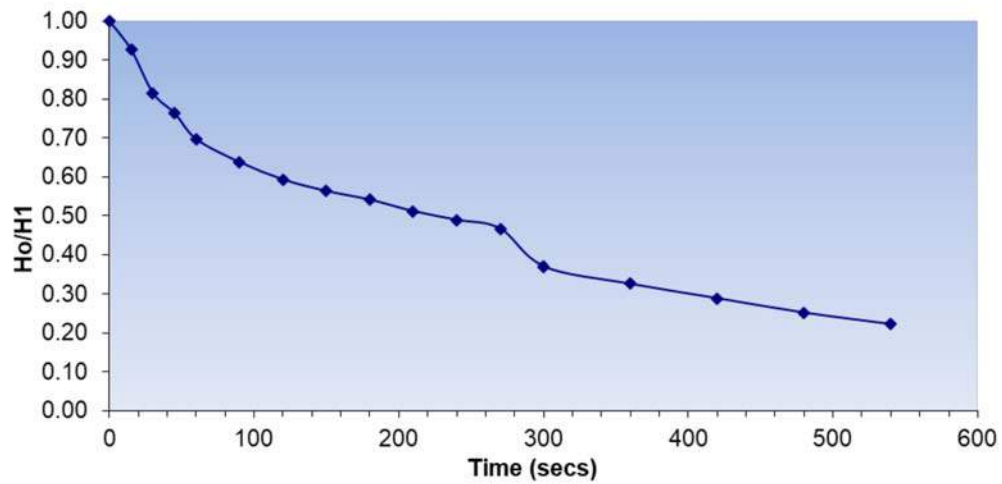
A series of graphs is presented below to illustrate the design infiltration rate below.

INFILTRATION GRAPH

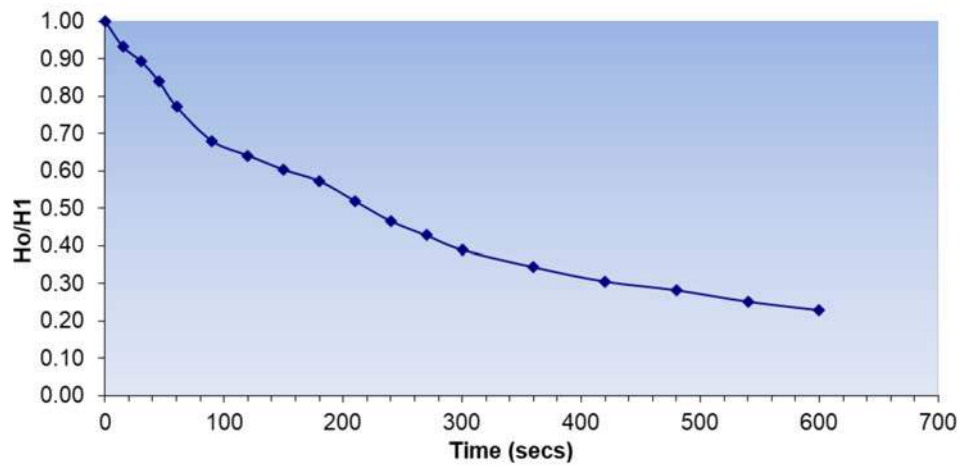
Test 1



Test 2



Test 3



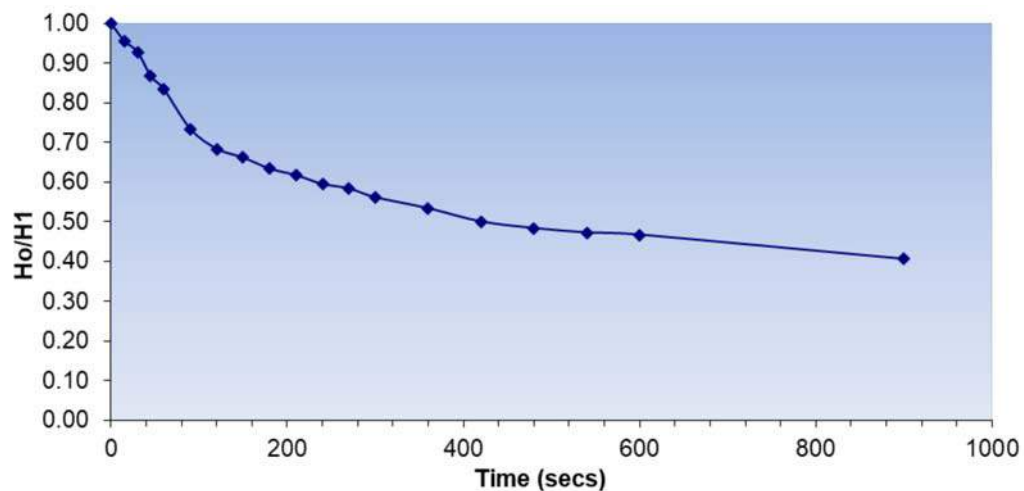
4.2 BH2 Results

Testing of the generally gravelly granular chalk in BH2 to the east of the site produced average infiltration rates of **3.98E-06m/s**. This rate is deemed suitable for surface water drainage design.

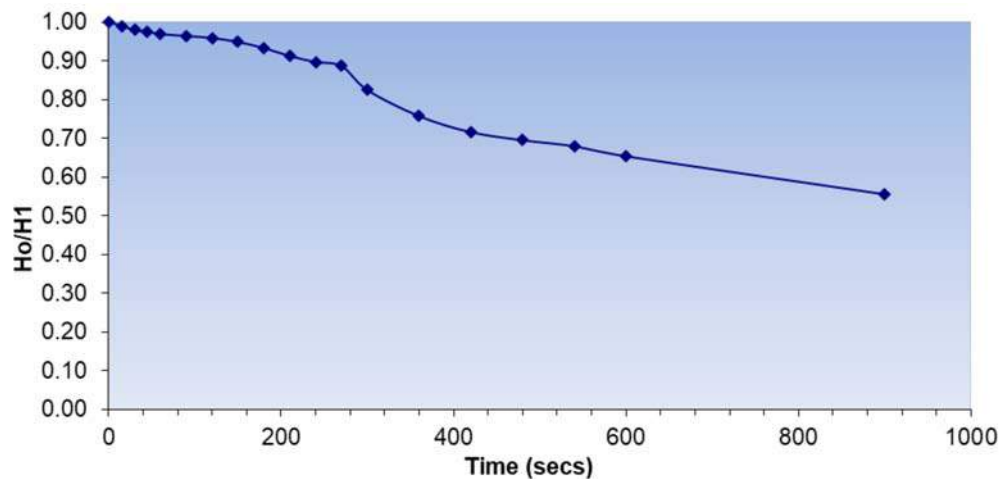
A series of graphs is presented below to illustrate the design infiltration rate below.

INFILTRATION GRAPHS

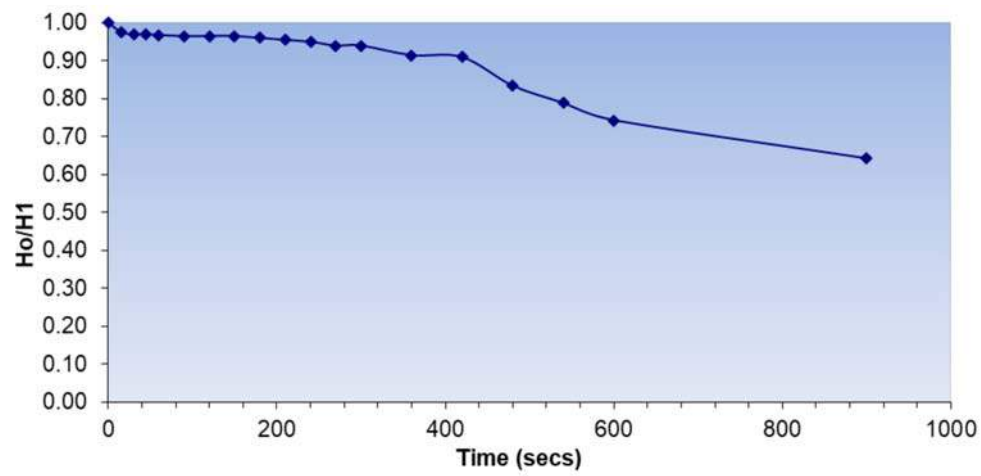
Test 1



Test 2



Test 3



5. CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- It can be concluded that soakaway drainage will be a feasible option for surface water disposal from the site.
- The application of soakaway drainage will ultimately be dependent on the specific requirements of the development.

Recommendations

- It is calculated that the lowest site wide infiltration rate of **1.37E-06** has been considered for granular sand strata. Therefore, at this rate the site is suitable for standard infiltration.
- If borehole soakaways are considered, regardless of suitability, through location specific investigation, these should be considered in consultation with the Environment Agency.
- Any soakaways should be designed in accordance with BRE Special Design 365 - Soakaway Design.



Welsh Water Sewer Records

Asda Wrexham



LEGEND(Representative of most common features)

Waste network:	Foul chamber	Outfall
Surface water chamber	Combined chamber	Lamphole
Combined sewer overflow	Special purpose chamber	Storm Overflow
Treatment works	Pumping station	Rising main
Private sewer subject to Sect. 104 adoption agreement	Private Sewer Transfer	Lateral Drain
Inspection Chamber		

NB: Sewer symbol colour indicates the type.
RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

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

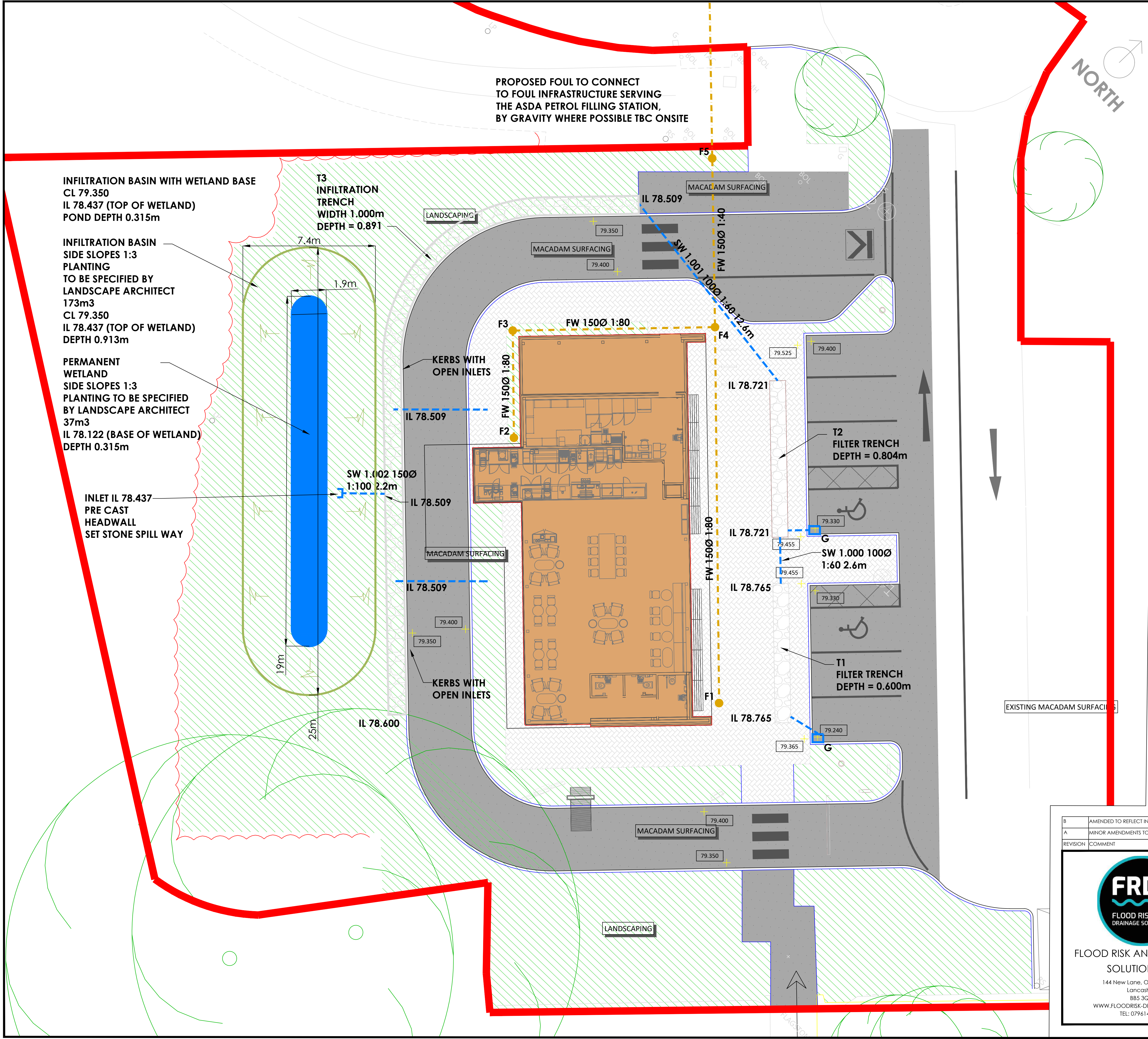
Service pipes are not generally shown but their presence should be anticipated.

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

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Map Ref: 334001,350731
Map scale: 1:2500
Printed by: Denning Kelly-Ann
Printed on: 26 Sep 2019

Proposed Drainage Layout Drawing



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 8. POSITION OF RAINWATER DOWN PIPES TO BE CONFIRMED BY THE ARCHITECT.

SURFACE WATER ATTENUATION

INFILTRATION BASIN WITH WETLAND BASE
TOP AREA = 173m²
BASE AREA = 37m²
DEPTH OF BASIN = 0.913m
DEPTH OF POND = 0.345m
SIDE SLOPES 1:3

FOUL

FOUL FLOWS FROM THE PROPOSED DEVELOPMENT TO BE DIRECTED TO EXISTING ASDA FOUL NETWORK TO BE CONFIRMED ON-SITE

KEY

- 90.150 PROPOSED LEVELS
- SW 1.000 PROPOSED SURFACE WATER DRAIN
- FW 1.000 PROPOSED FOUL DRAIN
- F1 PROPOSED FOUL MANHOLE
- G PROPOSED SURFACE WATER GULLY
- DRY DETENTION BASIN
- INFILTRATION TRENCH

B	AMENDED TO REFLECT INFILTRATION BASIN WITH WETLAND BASE	05/11/20	CV
A	MINOR AMENDMENTS TO DEVELOPMENT AREA	21/02/20	CV
REVISION	COMMENT	DATE	BY
FRDS FLOOD RISK AND DRAINAGE SOLUTIONS FLOOD RISK AND DRAINAGE SOLUTIONS LTD 144 New Lane, Oswaldtwistle, Lancashire, BB5 3QW WWW.FLOODRISK-DRAINAGE.CO.UK TEL: 07961477330		CLIENT:	EURO GARAGES
		DATE:	30/01/2020
		STATUS:	
		DRAWN BY:	CV
PROJECT:		SCALE:	1:100
DRAWING TITLE:		SIZE:	A1
DRAWING REFERENCE:		REVISION:	
			2020-EG09-01

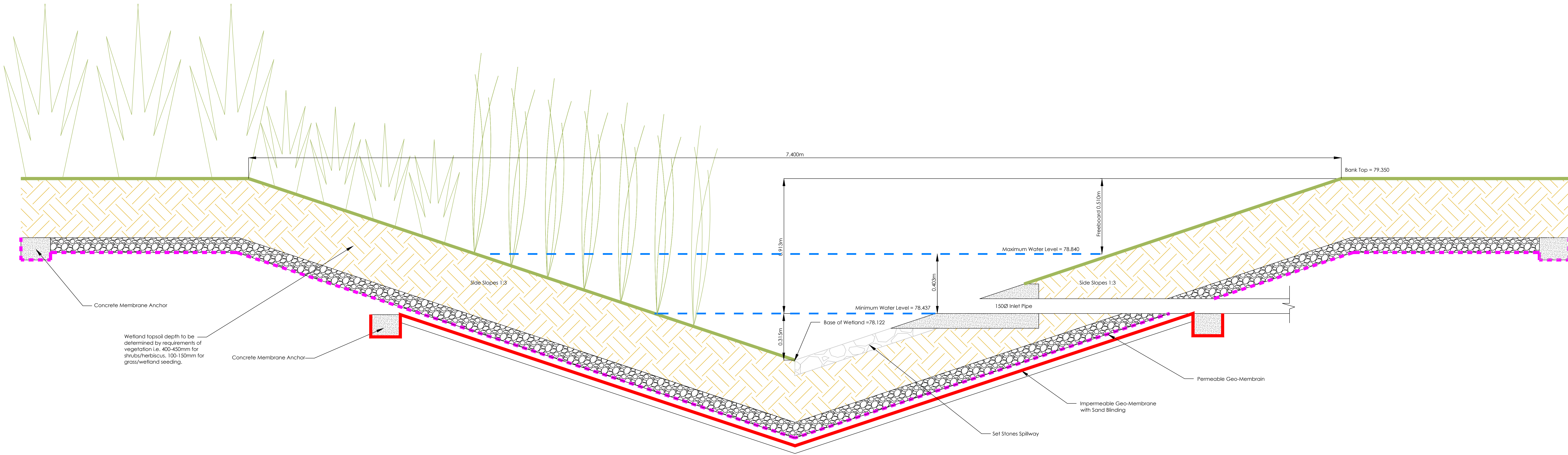
Typical Drainage Details Drawing and Manhole Schedule

SURFACE WATER/FOUL MANHOLE SCHEDULE						
REFERENCE	CL	IL	DEPTH TO IL	MANHOLE DIA	CHAMBER TYPE	COVER TYPE
F1	79.525	78.875	0.650	450	PPIC	A15
F2	79.525	78.829	0.696	450	PPIC	A15
F3	79.525	78.754	0.771	450	PPIC	A15
F4	79.525	78.613	0.912	450	PPIC	A15
F5	79.600	78.578	1.022	450	PPIC	A15

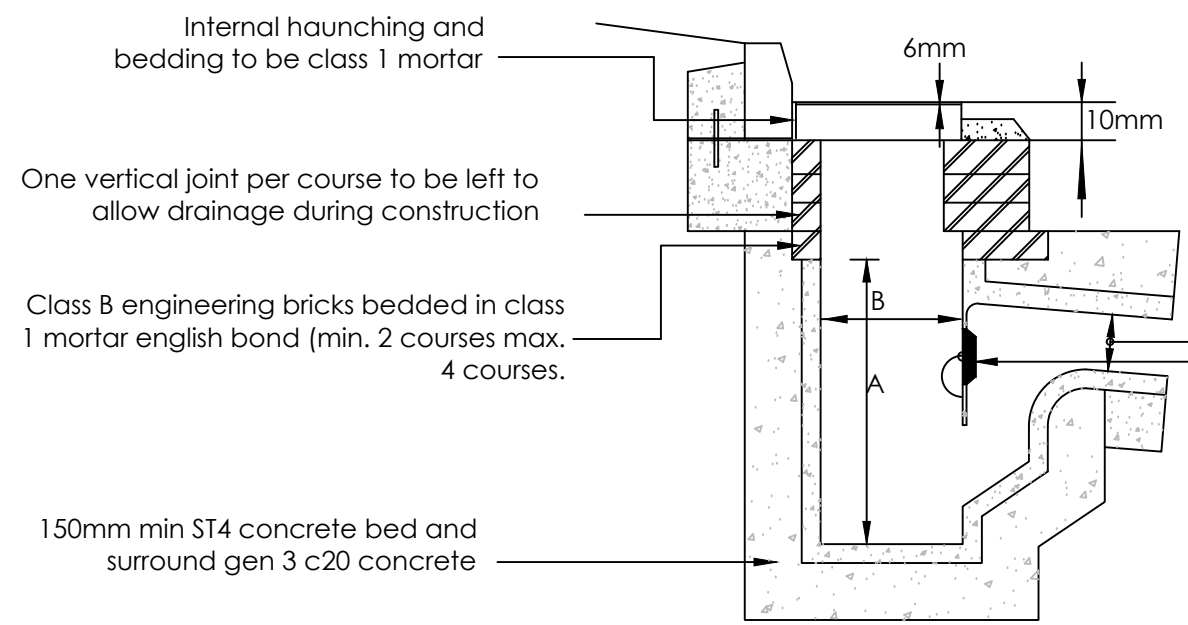
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 - THE LOCATION AND LEVELS OF EXISTING DRAINAGE PIPES AND CULVERTS MUST BE CHECKED ON-SITE PRIOR TO CONSTRUCTION.
 - PROPOSED FINISHED LEVELS HAVE ONLY BEEN ASSUMED AND SHOULD BE FINALISED BY A CIVIL ENGINEER.
 - POSITION OF RAINWATER DOWN PIPES TO BE CONFIRMED BY THE ARCHITECT.



NOTE: Planting to be specified by landscape architect

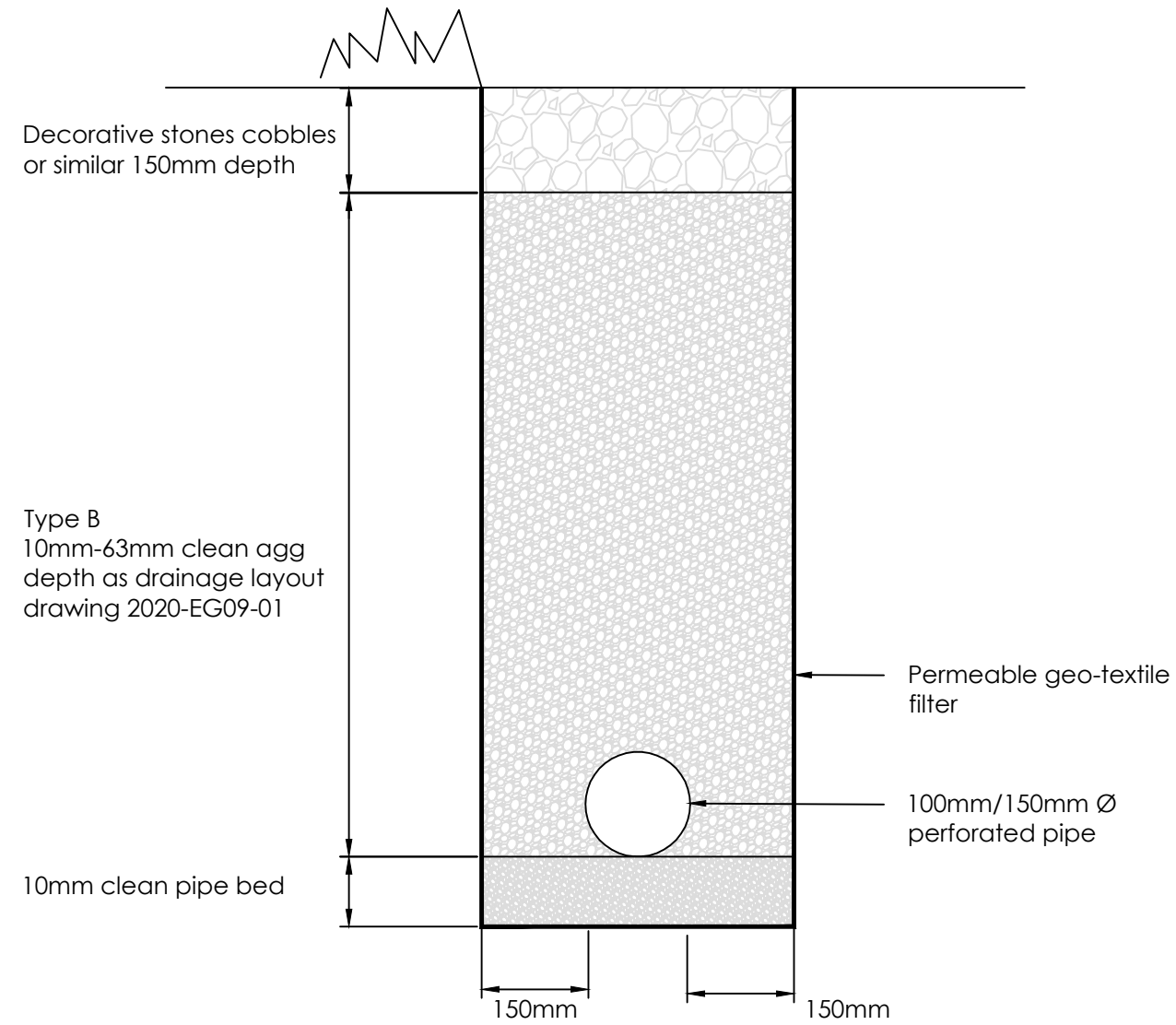


Infiltration Basin with
Wetland Base
Detail
Scale 1:10



Pre-Cast Concrete
Road Gully
(1:20)

Gully grated to be BS EN 124 class 250.
Ductile iron with captive hinge size 325 x 312mm clear opening.
Pedestrian friendly mesh type gravel to be fitted in shared access ways.
Gully Dimensions:
A = 750mm B = 375mm
Trapping p.conc gully pot to BS 5911 PA4-2



Typical Filter Drain
Scale 1:10

A	AMENDED TO REFLECT INFILTRATION BASIN WITH WETLAND BASE		05/11/20	CV
REVISION	COMMENT		DATE	BY
 FLOOD RISK AND DRAINAGE SOLUTIONS LTD 144 New Lane, Oswaldtwistle, Lancashire, BB5 3JW WWW.FLOODRISK-DRAINAGE.CO.UK TEL: 07961477330			CLIENT:	DATE: 30/01/2020
				EURO GARAGES
				STATUS:
			PROJECT:	DRAWN BY: CV
			DRIVE THRU COFFEE SHOP ASDA WREXHAM	SCALE: AS SHOWN
			DRAWING TITLE: SABS PRE APPLICATION TYPICAL DRAINAGE DETAILS AND MANHOLE SCHEDULE	SIZE: A0
DRAWING REFERENCE: 2020-EG09-02			REVISION:	

Modelled Surface Water Network Simulation Report (Normal Conditions)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	150.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	0.500
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.600	59.1	100	Circular	79.365	78.765	0.500	79.525	78.721	0.704
1.001	12.600	59.4	100	Circular	79.525	78.721	0.704	79.350	78.509	0.741
1.002	2.200	100.0	150	Circular	79.350	78.459	0.741	79.350	78.437	0.763
DUMMY	1.000	100.0	150	Circular	79.350	78.437	0.763	79.350	78.427	0.773

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	T1	1	Manhole	Adoptable	T2	1	Manhole	Adoptable
1.001	T2	1	Manhole	Adoptable	T3	1	Manhole	Adoptable
1.002	T3	1	Manhole	Adoptable	BASIN	1	Manhole	Adoptable
DUMMY	BASIN	1	Manhole	Adoptable	DUMMY	1200	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
T1	79.365	0.600	1				
				0	1.000	78.765	100
T2	79.525	0.804	1				
				0	1.001	78.721	100
T3	79.350	0.891	1				
				0	1.002	78.459	150
BASIN	79.350	0.913	1				
				0	DUMMY	78.437	150
DUMMY	79.350	0.923	1200				
				1	DUMMY	78.427	150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	17.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

Node DUMMY Online Orifice Control

Flap Valve	x	Invert Level (m)	78.427	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.001		

Node T1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01430	Safety Factor	2.0	Invert Level (m)	78.765
Side Inf Coefficient (m/hr)	0.01430	Porosity	0.30	Time to half empty (mins)	5

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	6.8	6.8	0.600	6.8	6.8

Node T2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01430	Safety Factor	2.0	Invert Level (m)	78.721
Side Inf Coefficient (m/hr)	0.01430	Porosity	0.30	Time to half empty (mins)	3

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	7.6	7.6	0.804	7.6	7.6

Node T3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.10620	Safety Factor	2.0	Invert Level (m)	78.459
Side Inf Coefficient (m/hr)	0.10620	Porosity	0.30	Time to half empty (mins)	168

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	38.5	38.5	0.891	38.5	38.5

Node BASIN Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	78.350
Side Inf Coefficient (m/hr)	0.10620	Porosity	1.00	Time to half empty (mins)	120

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	37.0	0.0	1.000	173.0	173.0

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.88%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	T1	10	78.810	0.045	2.5	0.1180	0.0000	OK
15 minute winter	T2	10	78.780	0.059	5.0	0.1617	0.0000	OK
15 minute winter	T3	11	78.565	0.106	13.9	1.3760	0.0000	OK
480 minute winter	BASIN	328	78.552	0.115	1.5	10.2265	0.0000	OK
480 minute winter	DUMMY	328	78.552	0.125	0.1	0.1410	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	T1	1.000	T2	2.5	0.599	0.312	0.0107	
15 minute winter	T1	Infiltration		0.0				
15 minute winter	T2	1.001	T3	4.8	1.023	0.611	0.0591	
15 minute summer	T2	Infiltration		0.0				
15 minute winter	T3	1.002	BASIN	11.9	0.983	0.672	0.0267	
15 minute summer	T3	Infiltration		0.6				
60 minute summer	BASIN	DUMMY	DUMMY	0.6	0.536	0.033	0.0080	
480 minute winter	BASIN	Infiltration		0.4				
480 minute winter	DUMMY	Orifice		0.0				0.0

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.88%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	T1	12	78.971	0.206	6.0	0.5449	0.0000	SURCHARGED
15 minute winter	T2	12	78.952	0.231	9.8	0.6298	0.0000	SURCHARGED
360 minute winter	T3	272	78.749	0.290	5.6	3.7791	0.0000	SURCHARGED
360 minute winter	BASIN	272	78.749	0.312	4.4	25.5774	0.0000	SURCHARGED
360 minute winter	DUMMY	272	78.749	0.322	0.1	0.3640	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	T1	1.000	T2	4.3	0.651	0.550	0.0203	
15 minute summer	T1	Infiltration		0.0				
15 minute winter	T2	1.001	T3	8.2	1.047	1.037	0.0986	
15 minute summer	T2	Infiltration		0.0				
15 minute winter	T3	1.002	BASIN	25.5	1.451	1.439	0.0381	
15 minute summer	T3	Infiltration		0.6				
15 minute winter	BASIN	DUMMY	DUMMY	1.5	0.428	0.086	0.0175	
360 minute winter	BASIN	Infiltration		0.9				
360 minute winter	DUMMY	Orifice		0.0				0.0

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.88%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	T1	12	79.118	0.353	7.7	0.9323	0.0000	FLOOD RISK
15 minute winter	T2	12	79.093	0.371	11.8	1.0134	0.0000	SURCHARGED
360 minute winter	T3	272	78.840	0.381	7.3	4.9671	0.0000	SURCHARGED
360 minute winter	BASIN	272	78.840	0.403	5.9	34.4523	0.0000	SURCHARGED
360 minute winter	DUMMY	272	78.840	0.413	0.1	0.4671	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	T1	1.000	T2	4.7	0.658	0.598	0.0203	
15 minute summer	T1	Infiltration		0.0				
15 minute winter	T2	1.001	T3	9.5	1.212	1.207	0.0986	
15 minute summer	T2	Infiltration		0.0				
15 minute winter	T3	1.002	BASIN	31.4	1.785	1.770	0.0387	
15 minute summer	T3	Infiltration		0.6				
15 minute winter	BASIN	DUMMY	DUMMY	1.7	0.634	0.093	0.0176	
360 minute winter	BASIN	Infiltration		1.2				
360 minute winter	DUMMY	Orifice		0.0				0.0

Modelled Surface Water Network Simulation Report (System Failure)

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	150.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	0.500
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	2.600	59.1	100	Circular	79.365	78.765	0.500	79.525	78.721	0.704
1.001	12.600	59.4	100	Circular	79.525	78.721	0.704	79.350	78.509	0.741
1.002	2.200	100.0	150	Circular	79.350	78.459	0.741	79.350	78.437	0.763
DUMMY	1.000	100.0	150	Circular	79.350	78.437	0.763	79.350	78.427	0.773

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	T1	1	Manhole	Adoptable	T2	1	Manhole	Adoptable
1.001	T2	1	Manhole	Adoptable	T3	1	Manhole	Adoptable
1.002	T3	1	Manhole	Adoptable	BASIN	1	Manhole	Adoptable
DUMMY	BASIN	1	Manhole	Adoptable	DUMMY	1200	Manhole	Adoptable

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
T1	79.365	0.600	1				
				0	1.000	78.765	100
T2	79.525	0.804	1				
				0	1.001	78.721	100
T3	79.350	0.891	1				
				0	1.002	78.459	150
BASIN	79.350	0.913	1				
				0	DUMMY	78.437	150
DUMMY	79.350	0.923	1200				
				1	DUMMY	78.427	150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	17.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	20	0	0
30	20	0	0
100	20	0	0

Node DUMMY Online Orifice Control

Flap Valve	x	Invert Level (m)	78.427	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.001		

Node T1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00715	Safety Factor	2.0	Invert Level (m)	78.765
Side Inf Coefficient (m/hr)	0.00715	Porosity	0.30	Time to half empty (mins)	5

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	6.8	6.8	0.600	6.8	6.8

Node T2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00715	Safety Factor	2.0	Invert Level (m)	78.721
Side Inf Coefficient (m/hr)	0.00715	Porosity	0.30	Time to half empty (mins)	4

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	7.6	7.6	0.804	7.6	7.6

Node T3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.05310	Safety Factor	2.0	Invert Level (m)	78.459
Side Inf Coefficient (m/hr)	0.05310	Porosity	0.30	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	38.5	38.5	0.891	38.5	38.5

Node BASIN Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	78.350
Side Inf Coefficient (m/hr)	0.05310	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	37.0	0.0	1.000	173.0	173.0

Results for 1 year +20% CC Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	T1	10	78.810	0.045	2.5	0.1182	0.0000	OK
15 minute winter	T2	10	78.780	0.059	5.0	0.1619	0.0000	OK
720 minute winter	T3	510	78.605	0.146	1.6	1.8962	0.0000	OK
720 minute winter	BASIN	510	78.605	0.168	1.2	13.8212	0.0000	SURCHARGED
720 minute winter	DUMMY	510	78.605	0.178	0.0	0.2008	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	T1	1.000	T2	2.5	0.599	0.313	0.0107	
15 minute winter	T1	Infiltration		0.0				
15 minute winter	T2	1.001	T3	4.8	1.023	0.612	0.0593	
15 minute summer	T2	Infiltration		0.0				
15 minute winter	T3	1.002	BASIN	12.2	0.989	0.689	0.0272	
15 minute summer	T3	Infiltration		0.3				
30 minute winter	BASIN	DUMMY	DUMMY	0.6	0.455	0.033	0.0078	
720 minute winter	BASIN	Infiltration		0.3				
720 minute winter	DUMMY	Orifice		0.0				0.0

Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	T1	12	78.973	0.208	6.0	0.5497	0.0000	SURCHARGED
15 minute winter	T2	12	78.954	0.233	9.7	0.6348	0.0000	SURCHARGED
720 minute winter	T3	540	78.820	0.361	3.4	4.7105	0.0000	SURCHARGED
720 minute winter	BASIN	540	78.820	0.383	2.7	32.4532	0.0000	SURCHARGED
720 minute winter	DUMMY	540	78.820	0.393	0.0	0.4450	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	T1	1.000	T2	4.3	0.649	0.550	0.0203	
15 minute summer	T1	Infiltration		0.0				
15 minute winter	T2	1.001	T3	8.1	1.047	1.037	0.0986	
15 minute summer	T2	Infiltration		0.0				
15 minute winter	T3	1.002	BASIN	25.8	1.466	1.454	0.0382	
15 minute summer	T3	Infiltration		0.3				
15 minute winter	BASIN	DUMMY	DUMMY	1.5	0.471	0.082	0.0176	
720 minute winter	BASIN	Infiltration		0.6				
720 minute winter	DUMMY	Orifice		0.0				0.1

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	T1	12	79.120	0.355	7.7	0.9375	0.0000	FLOOD RISK
15 minute winter	T2	12	79.095	0.374	11.8	1.0190	0.0000	SURCHARGED
600 minute winter	T3	555	78.919	0.460	5.0	5.9892	0.0000	SURCHARGED
600 minute winter	BASIN	555	78.919	0.482	4.1	43.0154	0.0000	SURCHARGED
600 minute winter	DUMMY	555	78.919	0.492	0.1	0.5559	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	T1	1.000	T2	4.7	0.657	0.598	0.0203	
15 minute summer	T1	Infiltration		0.0				
15 minute winter	T2	1.001	T3	9.5	1.212	1.206	0.0986	
15 minute summer	T2	Infiltration		0.0				
15 minute winter	T3	1.002	BASIN	31.7	1.799	1.784	0.0387	
15 minute summer	T3	Infiltration		0.3				
15 minute winter	BASIN	DUMMY	DUMMY	1.7	0.582	0.097	0.0176	
600 minute winter	BASIN	Infiltration		0.7				
600 minute winter	DUMMY	Orifice		0.0				0.1