Gutteridge Hall Lane

Drainage Strategy

Job Number: 1402

Date	Version	Notes/Amendments
October 2023	1	Issued for Information

Contents **Page**

Acronyms	
AOD	Above Ordnance Datum
CIRIA	Construction Industry Research and Information Association
EA	Environment Agency
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
SuDS	Sustainable Drainage Systems

Executive Summary

I. Flume Consulting Engineers have prepared a comprehensive strategy for foul and surface water drainage for a proposed Gypsy/Traveller site development at Gutteridge Hall Lane in Weeley, Essex. The strategy complies with national frameworks and local planning requirements, incorporating the relevant guidance from Essex County Council, the Environment Agency and established industry best practices.

II. Surface Water Drainage: The proposed development incorporates a Sustainable Drainage System (SuDS) featuring permeable paving to manage surface water effectively. Although the permeable paving will remain unlined to maximise opportunities for infiltration, the design takes a conservative approach due to the soil's limited infiltration capacity as indicated by the ground investigation. Consequently, surface water is designed to discharge into the adjacent ditch at a controlled rate of 1l/s, which adheres to the Essex County Council's guidance and is as close as reasonably practicable to Greenfield run-off rates. This strategy is designed to store rainfall events up to and including the 1 in 100-year return period, with an additional 40% allowance for climate change, thus ensuring both the safety of site users and no adverse impact on third-party flood risk.

III. Foul Water Drainage: For the management of foul water, the development will utilise a Packaged Foul Water Treatment Plant, which is appropriate for the expected occupancy and designed to treat wastewater to meet EA's General Binding Rules. The system is sized to serve up to 12 individuals, thus exceeding the minimum capacity for the intended 6 occupants of the site across 2 mobile homes. The plant will treat all domestic wastewater to the required standards before it is discharged into the local watercourse/ditch, maintaining compliance with environmental regulations. A maintenance schedule is established to ensure ongoing effective operation and adherence to standards, including regular inspections, flow monitoring, and professional servicing as necessary.

Introduction

Flume Consulting Engineers have been appointed to undertake a Foul and Surface Water Drainage Strategy for the proposed development at Gutteridge Hall Lane, Weeley, Tendring, Essex, CO16 9LW.

This report has been carried out in accordance with the National Planning Policy Framework (NPPF) and the Planning Practice Guidance 'Flood Risk and Coastal Change' (PPG). This report also incorporates advice and guidance from the Environment Agency (EA), Building Regulations Part H and CIRIA documents.

Site Description and Location

The site is located to the north of Gutteridge Hall Lane, approximately 0.5km from the Weeley Brook and from the A133, and 3.5km from Little Clacton.

The site postcode is CO16 9LW and the OS grid reference is TM 14457 21419.

FIGURE 1. SITE LOCATION

Development Proposal

The developed proposals involve a change of use of land for use as a two pitch Gypsy/Traveller site.

The application site is located on the existing approved site for the Stables, which also resides within the site boundary. The proposed site will be accessed via the existing permitted access. Pedestrian access will be maintained and remain unchanged from the existing case.

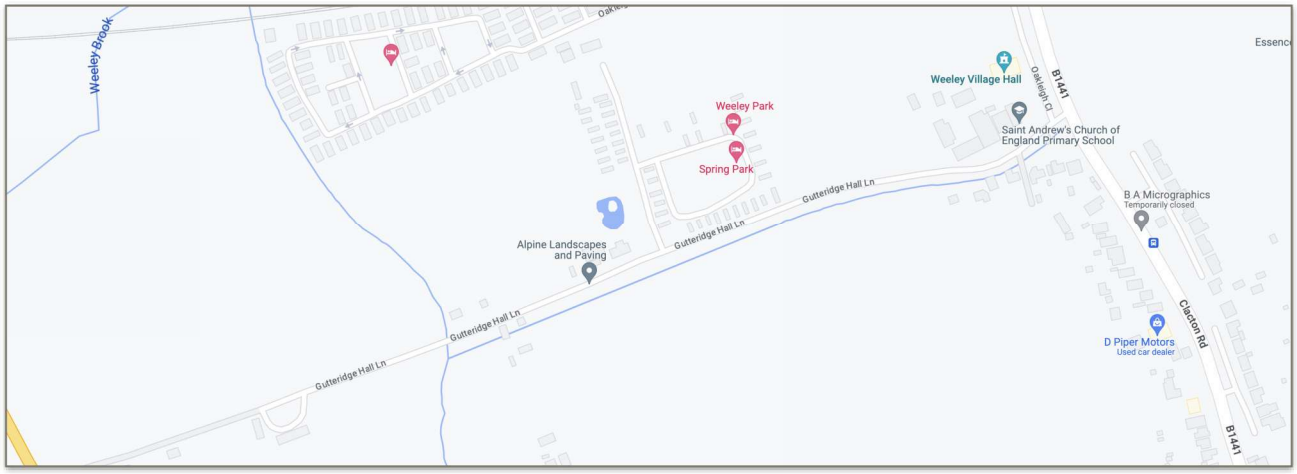


FIGURE 2. PROPOSED SITE PLAN

Flood Risk

The EA's indicative floodplain map shows that the site is located in Flood Zone 1 (Low risk). Land in this flood zone is assessed as having annual probability of river flooding less than 0.1% (Figure 3).

Developments in this flood zone do not have any restrictions, provided they do not increase the risk of flooding elsewhere.

FIGURE 3. ENVIRONMENT AGENCY FLOOD RISK FROM RIVERS OR SEA MAP (GOV.UK, 2023)

Drainage Scheme

To effectively manage the impact of urbanisation on watercourse flows, the introduction of Sustainable Drainage Systems (SuDS) is recommended. These systems are designed to emulate natural drainage patterns as closely as possible at the source, which helps to mitigate the impact of development on surface water flows. Additionally, they are important in safeguarding and enhancing water quality and in facilitating the recharge of groundwater reserves.

Accordingly, the construction of an unlined permeable pavement system is proposed. This system will encourage infiltration wherever possible. Furthermore, a flow control component will be integrated to ensure that surface water runoff rates are limited to those typical of undeveloped, or 'Greenfield', conditions, aligning with local environmental policies.

The foul water drainage will discharge into a new packaged foul treatment plant which has sufficient capacity to accommodate the additional foul water flows, before discharging into the adjacent ordinary watercourse/ditch in accordance with the Land Drainage Act 1991.

The drainage strategy is shown in Figure 4 and in Appendix A. Further information will be provided to support the drainage strategy in the forthcoming chapters.

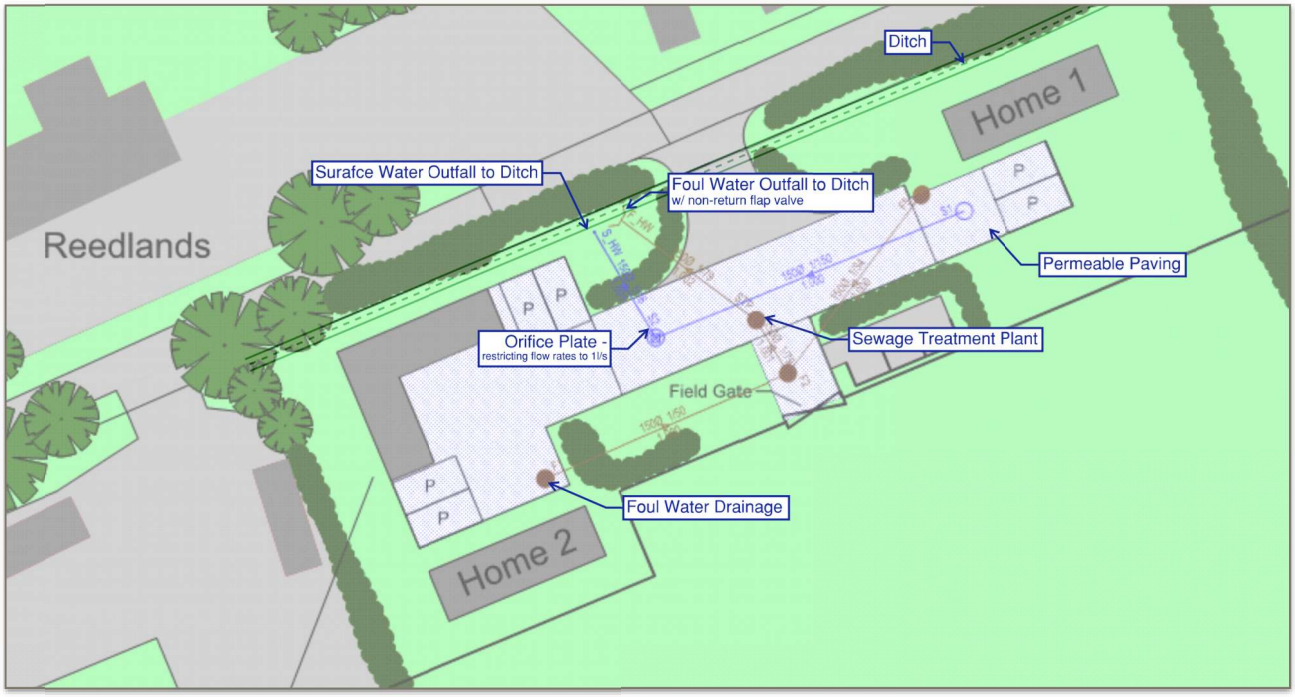


FIGURE 4. DRAINAGE STRATEGY

Surface Water Drainage

Infiltration through permeable paving is considered to be a practical solution to reduce surface water run-off rates and volumes. Infiltration through Permeable Pavements (2D plane only) can also be utilised closer to structures. Permeable Pavements serving themselves behave in a similar way to soft landscaping and can be placed directly against the edge of structures.

JAXX ENGINEERING CONSULTANCY	Infiltration Rate Testing - BIA BRE 365	JAXX ENGINEERING CONSULTANCY

Project Name :	Gutteridge Hall Lane, Weeley, Tendring, Essex, CO16 9LW	Job No : TGT3465	Performed By : CK
		Date : 13/10/23	Checked By : GW

BRE TP1 - 1				BRE TP1 - 2				BRE TP1 - 3			
Test Dimensions		H_0 =		Test Dimensions		H_0 =		Test Dimensions		H_0 =	
1.0m (w) x 1.0m (l) x 0.6m (d)		0.60		1.0m (w) x 1.0m (l) x 0.6m (d)		0.60		1.0m (w) x 1.0m (l) x 0.6m (d)		0.60	
Depth to Water (m)	Time (mins)	H	H/H_0	Depth to Water (m)	Time (mins)	H	H/H_0	Depth to Water (m)	Time (mins)	H	H/H_0
0.000	0	0.60	1.00	0.000	0	0.60	1.00	0.000	0	0.60	1.00
0.010	1	0.59	0.98	0.010	1	0.59	0.98	0.010	1	0.59	0.98
0.014	2	0.59	0.98	0.020	2	0.58	0.97	0.020	2	0.58	0.97
0.019	3	0.58	0.97	0.060	3	0.54	0.90	0.030	3	0.57	0.95
0.024	4	0.58	0.96	0.090	4	0.51	0.85	0.040	4	0.56	0.93
0.029	5	0.57	0.95	0.100	5	0.50	0.83	0.050	5	0.55	0.92
0.039	6	0.56	0.94	0.105	6	0.50	0.83	0.060	6	0.54	0.90
0.046	7	0.55	0.92	0.110	7	0.49	0.82	0.070	7	0.53	0.88
0.051	8	0.55	0.92	0.120	8	0.48	0.80	0.080	8	0.52	0.87
0.061	9	0.54	0.90	0.130	9	0.47	0.78	0.090	9	0.51	0.85
0.082	10	0.52	0.86	0.140	10	0.46	0.77	0.100	10	0.50	0.83
0.105	15	0.50	0.83	0.170	15	0.43	0.72	0.120	15	0.48	0.80
0.125	20	0.48	0.79	0.185	20	0.42	0.69	0.130	20	0.47	0.78
0.145	25	0.46	0.76	0.230	25	0.37	0.62	0.150	25	0.45	0.75
0.165	30	0.44	0.73	0.255	30	0.35	0.58	0.190	30	0.41	0.68
0.190	35	0.41	0.68	0.280	35	0.32	0.53	0.220	35	0.38	0.63
0.200	40	0.40	0.67	0.320	40	0.28	0.47	0.250	40	0.35	0.58
0.210	60	0.39	0.65	0.350	60	0.25	0.42	0.270	60	0.33	0.55
0.240	90	0.36	0.60	0.380	90	0.22	0.37	0.300	90	0.30	0.50
0.280	120	0.32	0.53	0.400	120	0.20	0.33	0.350	120	0.25	0.42
0.350	180	0.25	0.42	0.440	180	0.16	0.27	0.420	180	0.18	0.30
0.410	240	0.19	0.32	0.470	240	0.13	0.22	0.500	240	0.10	0.17
0.450	300	0.15	0.25	0.500	300	0.10	0.17	0.560	300	0.04	0.07
0.510	360	0.09	0.15	0.520	360	0.08	0.13	0.580	360	0.02	0.03
0.550	420	0.05	0.08	0.550	420	0.05	0.08	0.600	420	0.00	0.00
0.590	600	0.01	0.02	0.590	600	0.01	0.02	0.600	600	0.00	0.00
0.600	900	0.00	0.00	0.600	900	0.00	0.00	0.600	900	0.00	0.00
Volume of Excavation (m^3) =		0.60		Volume of Excavation (m^3) =		0.60		Volume of Excavation (m^3) =		0.60	
Storage volume between 75-25% 'Vp' (m^3) =		0.30		Storage volume between 75-25% 'Vp' (m^3) =		0.30		Storage volume between 75-25% 'Vp' (m^3) =		0.30	
Time for water to fall from 75-25% 'tp' (min) =		280		Time for water to fall from 75-25% 'tp' (min) =		190		Time for water to fall from 75-25% 'tp' (min) =		180	
50% Internal Surface Area (as50) =		2.20		50% Internal Surface Area (as50) =		2.20		50% Internal Surface Area (as50) =		2.20	
Soil infiltration rate 'f' (m/s) =		2.06E-06		Soil infiltration rate 'f' (m/s) =		2.13E-06		Soil infiltration rate 'f' (m/s) =		2.27E-06	

FIGURE 5. GROUND INVESTIGATION, 2023

The investigation by Jaxx Engineering indicates that the soil has limited capacity for infiltration. Despite expectations that some surface water runoff will naturally infiltrate into the ground, this report adopts a cautious approach. For the drainage design, it is presumed that no surface water infiltrates into the surrounding soil, with all surface water runoff being gradually released into the ditch at reduced rates.

The surface water run-off from the permeable paving will self-attenuate before discharging to the receiving watercourse/ditch. The calculations use a minimal infiltration rate of $1x10^{-7}$ m/s to determine the necessary thickness for the paving. The design proposes a sub-base thickness of 350mm, which is above the minimum requirement, ensuring adequate self-attenuation of the water runoff.

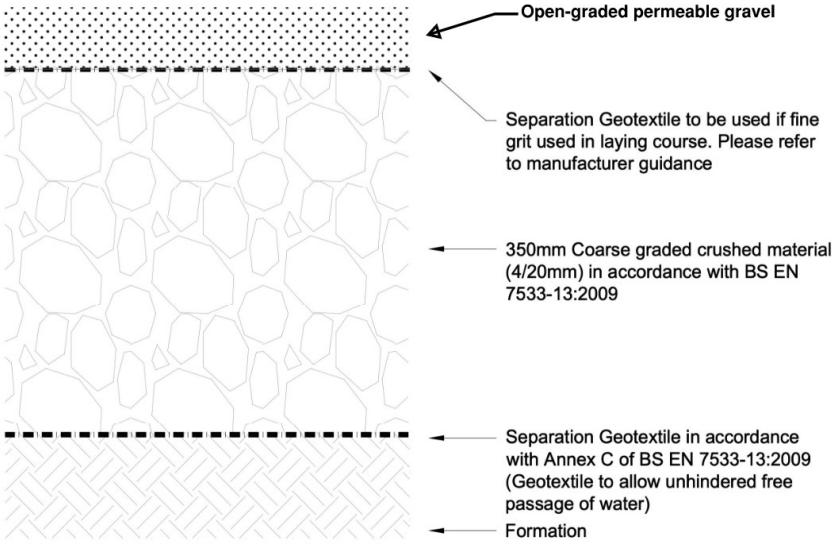


FIGURE 6. PERMEABLE PAVING - POROUS GRAVEL DETAIL

Infiltration rate = 1 x 10^{-7}m/s

		1 in 10	1 in 30	1 in 100	1 in 100 + 20%	1 in 100 + 30%
M5-60	**r**	**10**	**3.33**	**1**	**0.5**	**0.25**
20	0.4	90	120	160	210	225
	0.3	100	140	190	240	270
	0.2	135	180	250	310	370
17	0.4	70	100	140	180	190
	0.3	80	110	160	210	225
	0.2	105	150	210	270	305
14	0.4					
	0.3	60	90	130	170	180
	0.2	75	110	160	220	245

FIGURE 7. MINIMUM PAVING THICKNESSES REQUIRED - HYDRAULIC CAPACITY (INTERPAVE, 2018)

Foul Water Drainage

In compliance with Building Regulations Approved Document H, foul water drainage must be designed as follows:

'An adequate system of drainage shall be provided to carry foul water from appliances within the building to one of the following, listed in the order of priority:

a) a public sewer; or, where that is not reasonably practicable,

b) a private sewer communicating with a public sewer; or, where that is not reasonably practicable,

c) either a septic tank which has an appropriate form of secondary treatment or ***another wastewater treatment system (packaged treatment plant)****; or, where that is not reasonably practicable,*

d) a cesspool.'

This report also considers the Tendring District Council's Policy PPL5 of the Local Plan which states *"Private sewage treatment facilities will not be permitted if there is an accessible public fowl sewer. Where private sewage treatment facilities are the only practical option for sewage disposal, they will only be permitted where there would be no harm to the environment, having regard to preventing pollution of groundwater and any watercourses and odour"*.

Further information is provided in the relevant chapters below.

The foul drainage strategy is shown in the supplementary documents provided in Appendix A.

FIGURE 8. ASSET LOCATION SEARCH (ANGLIAN WATER, 2023)

Due to the lack of local municipal sewage systems or public sewer connections in the vicinity of the proposed development (Figure 8), a dedicated solution is required. The proposed installation of a HydroClear HC12 Wastewater Treatment Plant is designed to effectively manage and treat the domestic wastewater—including output from toilets, sinks, showers, and other sanitary fixtures—generated by the development's occupants.

With a capacity to serve up to 12 individuals, the HydroClear HC12 is appropriate for the development, which will house 6 people across 2 mobile homes. This ensures that the treatment plant will operate well within its capacity, even with the development at full occupancy. Consequently, the HydroClear HC12 will provide a reliable and sufficient means of sewage management for the development, compensating for the absence of public sewer infrastructure.

This streamlined approach ensures that the development's wastewater treatment needs are not only met but have additional capacity for potential future expansion or increased water usage.

In the proposed development, the management of foul water drainage is designed to align with the Environment Agency's General Binding Rules for small sewage discharges to surface water. The development incorporates an on-site packaged treatment plant that processes the wastewater to meet the required standards before it is discharged into the local ordinary watercourse, in this case, a ditch.

The on-site packaged treatment plant selected for the development is certified to meet the BS EN 12566 standards. This certification guarantees that the plant is capable of treating the foul water to the required quality before it is discharged into the local ditch. The on-site treatment plant is selected and engineered to reduce pollutants such as Biological Oxygen Demand (BOD), Suspended Solids (SS), and Ammoniacal Nitrogen (NH3) to the levels that are within the permissible limits. This ensures that the discharge will not cause a deterioration in the water quality of the receiving watercourse. The design of the foul water system takes into account the maximum daily volumes allowed under the General Binding Rules. The daily effluent produced by 6 people using the packaged treatment plant, we will use the British Water Guidance Flows and Loads, which estimates 150 litres per person per day.

Daily effluent per person = 150 litres
Number of people = 6
Total daily effluent = Daily effluent per person × Number of people
Total daily effluent = 150 litres/person/day × 6 people
Total daily effluent = 900 litres/day
Total daily effluent in cubic meters = Total daily effluent in litres / 1,000
Total daily effluent in cubic meters = 900 litres / 1,000

Total daily effluent in cubic meters = **0.9 m^3/day** < 5 m^3/day (the maximum daily discharge to a receiving watercourse as stipulated in the EA's General Binding Rules)

Management and Maintenance Schedule

The drainage design will be designed to be fully maintainable in accordance with building regulations and the recommendations of CIRIA C753 – SuDS Manual.

Consistent with the General Binding Rules, a maintenance plan for the packaged treatment plant is established to ensure that it operates effectively. Regular inspections and servicing are scheduled to prevent system failures that could lead to unauthorised discharges. Monitoring of effluent quality and flow rates is also part of the operational plan, providing ongoing compliance assurance.

The maintenance measures which should be implemented for the foul water and surface water systems are provided below.

Permeable Gravel

Maintenance Schedule	Required Action	Typical Frequency
Monitoring/Inspections	Initial Inspection.	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth - if required take remedial action.	Annually (and after severe storms)
Regular Maintenance	Rubbish and litter removal	As required
	Brushing and vacuuming - standard cosmetic sweep across surface	Once a year after Autumn leaf fall
Remedial Actions	Remedial work to any depressions or rutting considered detrimental to the structural performance.	As required
	Rehabilitation of surface with remedial sweeping	Every 10-15 years or as required.

Foul Water Packaged Treatment Plant

Daily Maintenance:

- **Visual Inspection:** Check for any visible leaks, unusual sounds, or unusual odours. Inspect pumps, motors, and other equipment.
- **Flow Monitoring:** Monitor influent and effluent flow rates to ensure they are within the specified range.
- **Check Alarms:** Review and address any alarms or warning indicators on the control panel.

Weekly Maintenance:

- **Grease and Lubrication:** Check and lubricate mechanical components like bearings and chains as needed.
- **Inspect Electrical Connections:** Examine electrical connections and ensure they are secure.
- **Calibrate Sensors:** Calibrate sensors for monitoring parameters like pH, turbidity, and chlorine levels.
- **Inspect Filters:** If your treatment plant has filtration systems, inspect and clean or replace filter media if necessary.
- **Check Chemicals:** Ensure an adequate supply of treatment chemicals and adjust dosing rates as needed.

Monthly Maintenance:

- **Clean Screens and Grates:** If your plant uses screens or grates to remove debris, clean them to maintain efficiency.
- **Inspect Valves:** Check all valves for leaks, proper operation, and lubricate them if required.
- **Record Keeping:** Maintain detailed records of maintenance activities, including any repairs or adjustments made.

Quarterly Maintenance:

- **Inspect Aeration Systems:** If your treatment plant includes aeration systems, inspect and clean diffusers and ensure they are functioning properly.
- **Inspect Sludge Handling Equipment:** Check sludge pumps, conveyors, and dewatering equipment for any issues.

Annually or as Needed:

- **Professional Service:** Schedule an annual professional service visit from the manufacturer or a qualified technician to perform comprehensive inspections and maintenance tasks.
- **Replace Consumables:** Replace parts that have reached the end of their useful life, such as belts, seals, or gaskets.
- **Review Operating Manual:** Review the manufacturer's operating manual for any specific maintenance recommendations.

Conclusions

The below ground drainage system has been designed in accordance with Building Regulations Part H, and the surface water drainage is designed to accommodate the 1 in 100 year return period plus a 40% allowance for climate change, ensuing that site users remain safe at all times, whilst ensuring there is no impact on third-party flood risk.

The proposed site will incorporate SuDS features in the form of permeable paving which will partially infiltrate any surface water to the underlying ground. However, given the relatively poor infiltration results obtained from the ground investigation works which were undertaken, surface water will be restricted to 1l/s in line with Essex County Council advice. This will be stored in the sub-base of the permeable paving before being released into the ordinary watercourse/ditch which flows adjacent to the development. The permeable paving will remain unlined to maximise opportunities for infiltration where possible.

Permeable Pavements are placed highly in the SuDS Hierarchy, and will ensure that water quality, water quantity, amenity and biodiversity are all promoted in the SuDS design.

Foul drainage will be treated on-site using a packaged treatment plant, and discharge into the adjacent ordinary watercourse. The flow rates are well within the maximum daily volumes to adhere to the EA's General Binding Rules for small foul water discharges.

Note:

This report has been prepared for the purposes of submitting to the local planning authority for review in relation to the associated drainage strategy for the proposed development, and uses the most up-to-date information available to us at the time. It should not be relied upon by anyone else or used for any other purpose. This report is confidential to our Client; it should only be shown to others with their permission. We retain copyright of this report which should only be reproduced with our permission.

	Prepared By	Checked By	Approved for issue
Name	Tom Quigg BSc MSc CEng MICE	Magaly Sedeño BA	Tom Quigg BSc MSc CEng MICE
Signature	TQ	MST	TQ
Date	2 November 2023	2 November 2023	2 November 2023

Appendix A - Below Ground Drainage Strategy

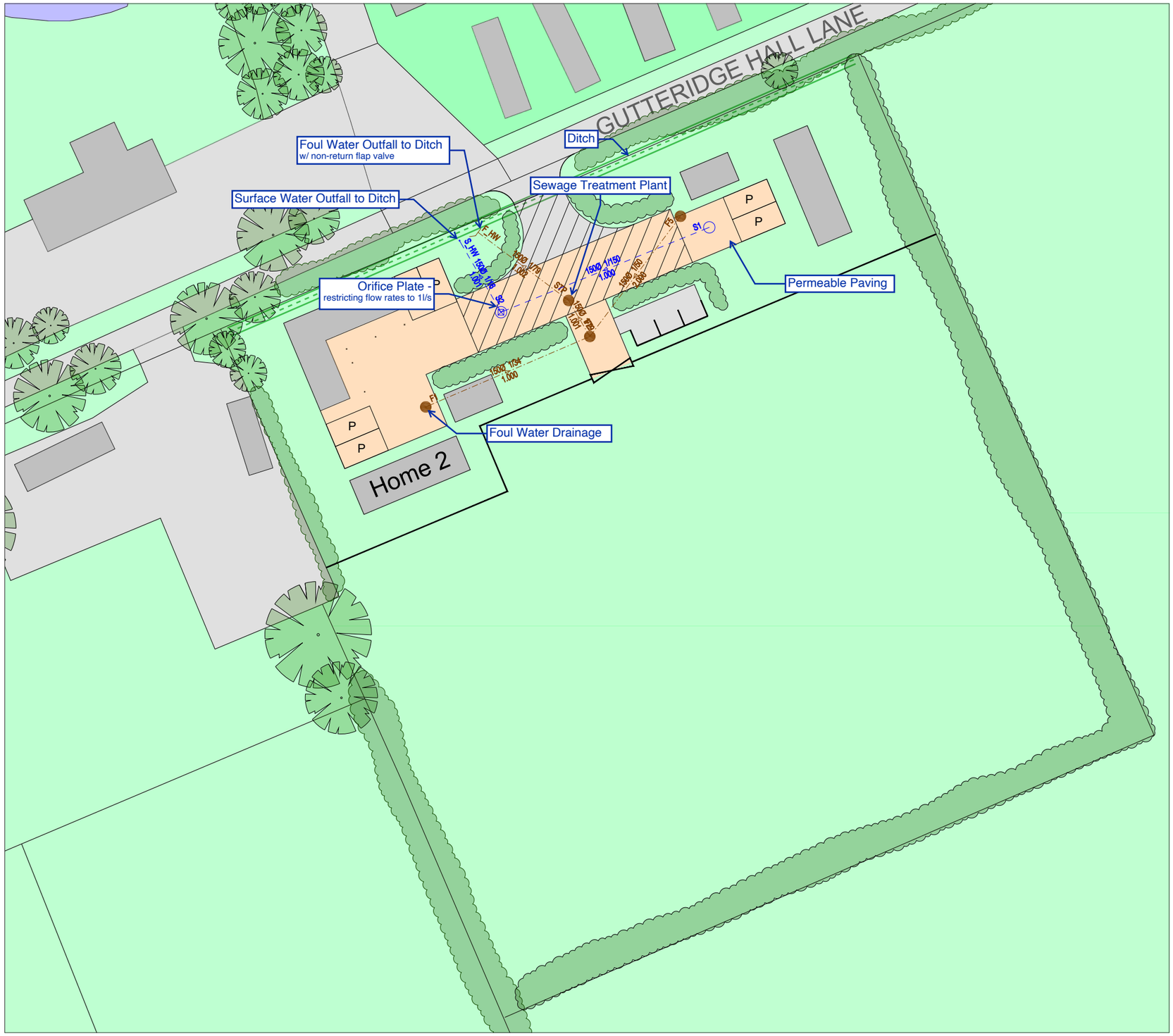
Job No.	1402	Page	SK CIV01	Rev	1
Date	02/11/2023	Eng	TQ	Chd	
Job	Gutteridge Hall Lane - Drainage Strategy				

NOTES:

1. Cover levels to Above Ordnance Datum (AOD) obtained from the latest LiDAR information. Cover levels of all existing manholes to be confirmed to ensure the below ground drainage has adequate falls to achieve self-cleansing flows.
2. Surface Water is to discharge to ground in line with national and local policy. Infiltration rates TBC prior to construction.
3. Wastewater Treatment Plant designed in accordance with Building Regulations Part H. Installation in accordance with manufacturer's instructions and with Building Regulations Part H (1.66 and 1.67)

DRAINAGE KEY

- PROPOSED FOUL WATER DRAIN
- PROPOSED SURFACE WATER DRAIN
- F1 PROPOSED FOUL WATER MANHOLE
- S1 PROPOSED SURFACE WATER MANHOLE



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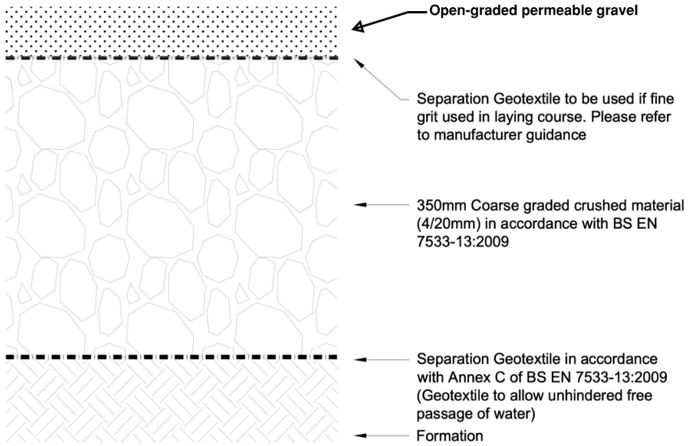
Job Gutteridge Hall Lane - Surface Water Drainage Details			



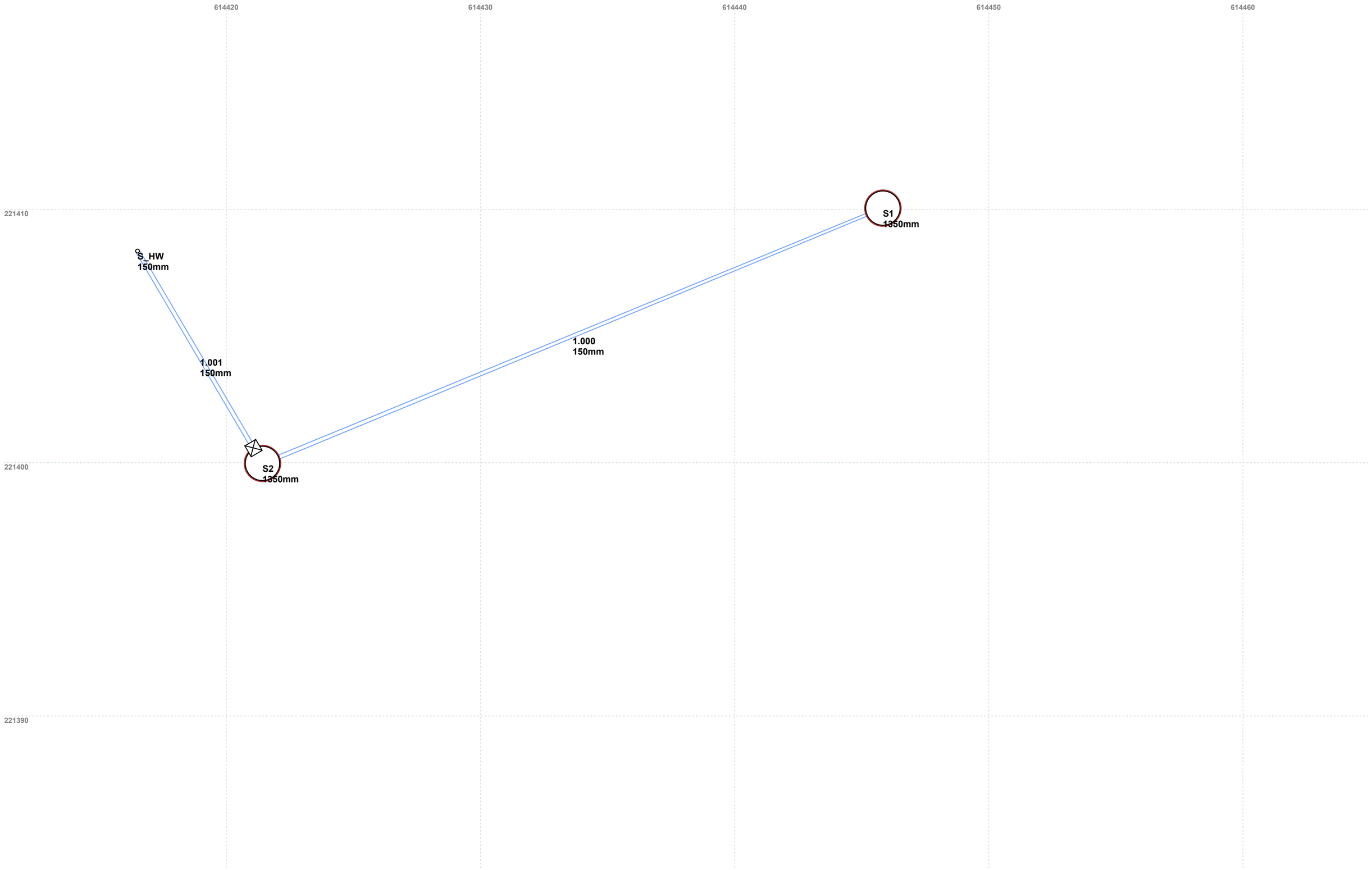
PERMEABLE PAVEMENT DETAIL

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	614445.834	221410.053	15.773	0.650	1350				
						0	1.000	15.123	150
S2	614421.422	221399.971	15.961	1.014	1350	1	1.000	14.947	150
						0	1.001	14.947	150
S_HW	614416.506	221408.358	15.483	1.134	150	1	1.001	14.349	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F1	614412.628	221388.808	16.009	0.850	1350				
						0	1.000	15.159	150
F5	614442.439	221411.341	15.790	0.950	1350				
						0	2.000	14.840	150
F2	614431.859	221397.171	15.890	1.406	1350	1	2.000	14.484	150
						2	1.000	14.540	150
						0	1.001	14.484	150
STP	614429.353	221401.388	15.919	1.497	1350	1	1.001	14.422	150
						0	1.002	14.422	150
F_HW	614418.677	221409.341	15.603	1.350	0	1	1.002	14.253	150



Node Name		S1		S2	S_HW
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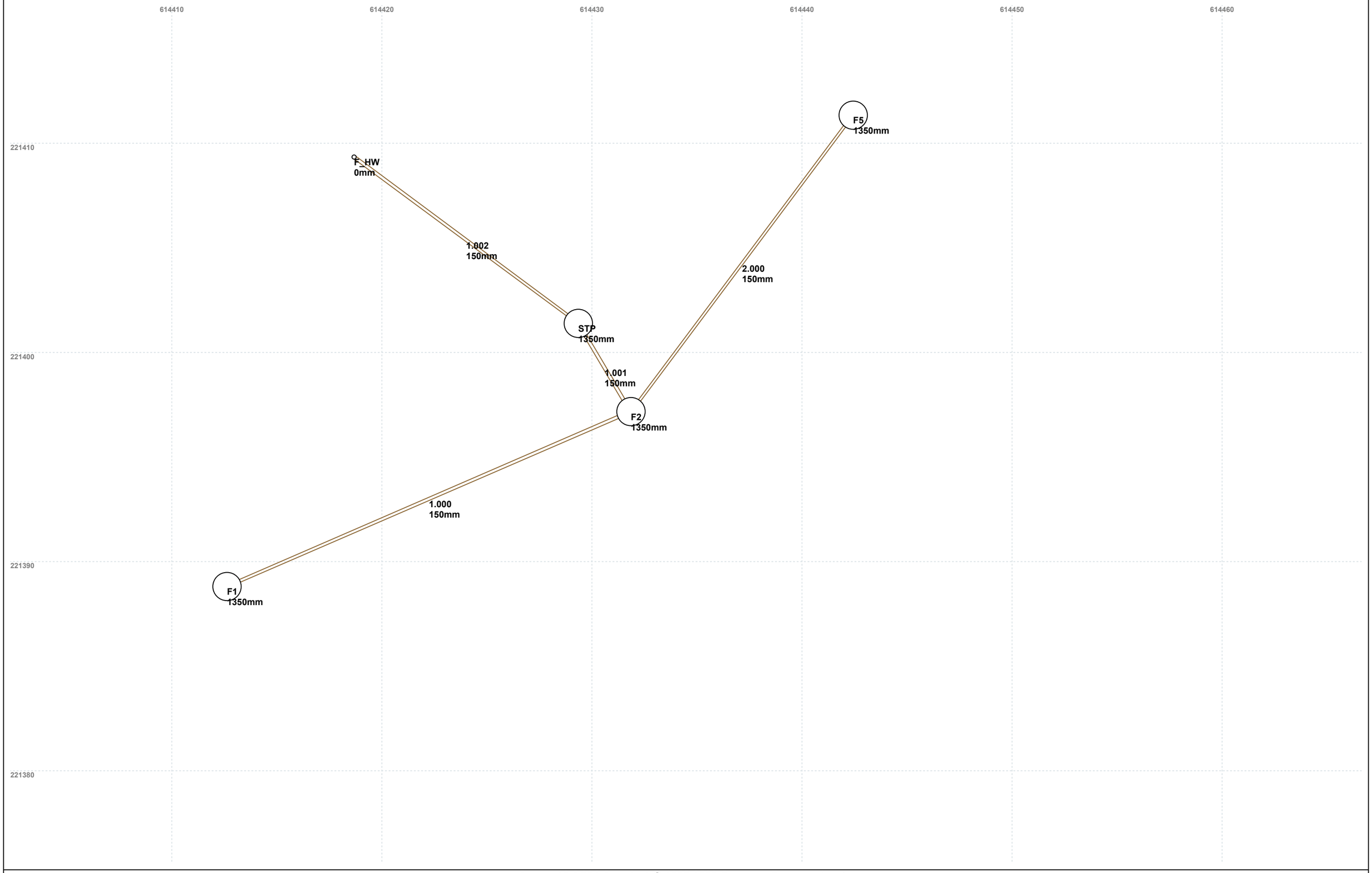
Link Name		1.000		1.001	
Section Type		150mm		150mm	
Slope (1:X)		150.1		16.3	
Cover Level (m)		15.773		15.961	15.483
Invert Level (m)		15.123	14.947	14.947	14.349
Length (m)		26.412		9.721	



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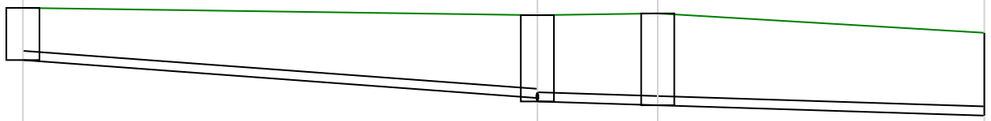
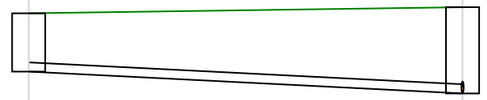
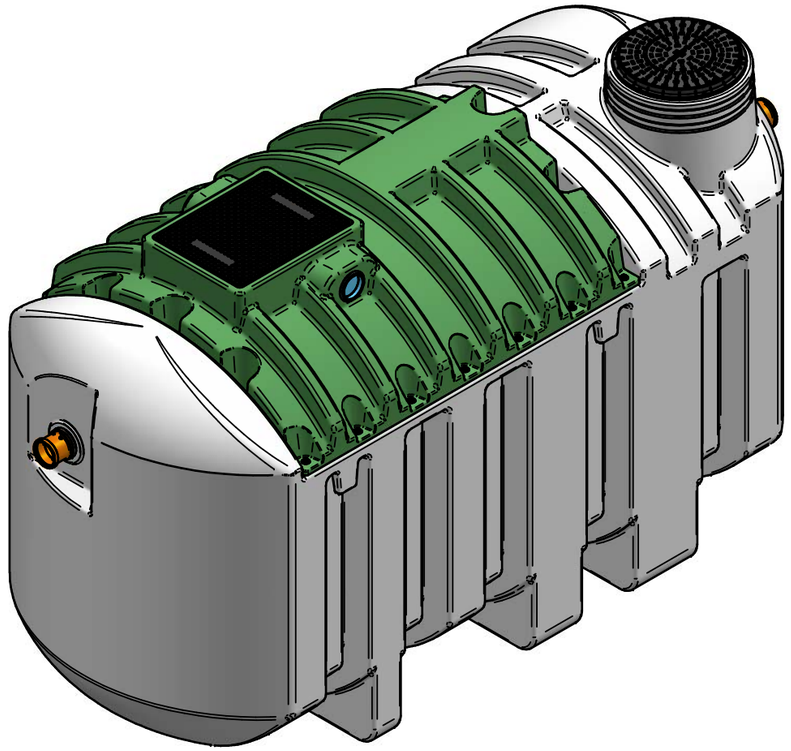
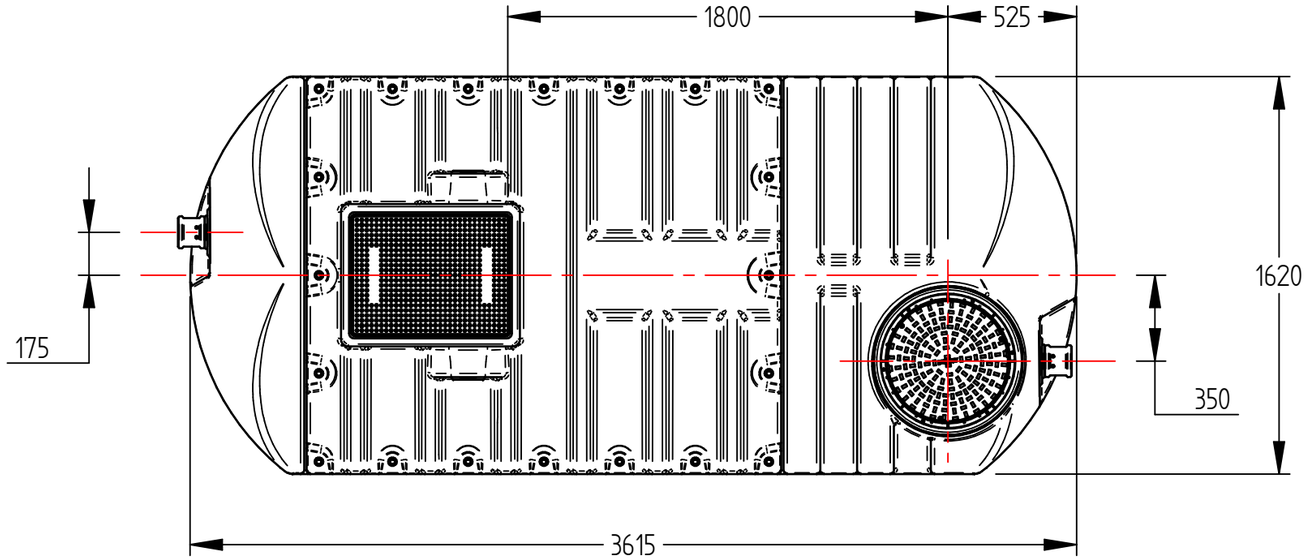
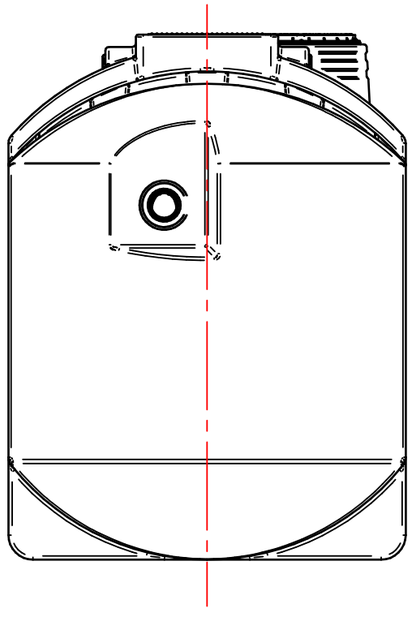
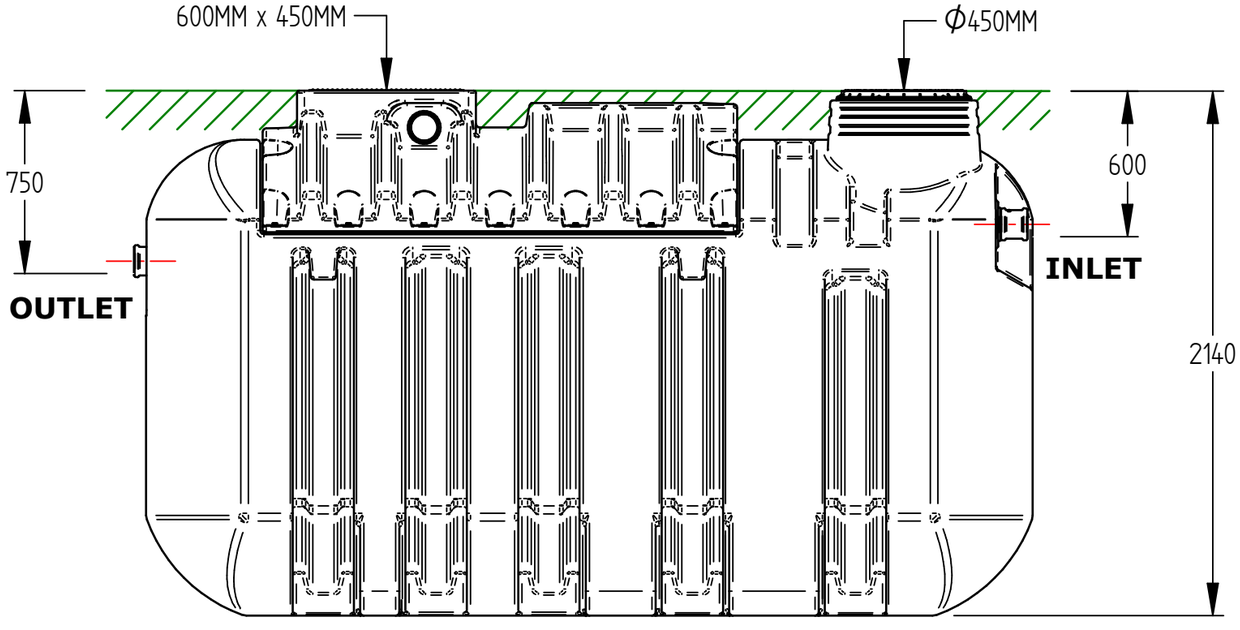
							
A3 drawing Hor Scale 250 Ver Scale 100 Datum (m) 5.000							
Link Name			1.000		1.001	1.002	
Section Type			150mm		150mm	150mm	
Slope (1:X)			33.9		79.1	78.8	
Cover Level (m)		16.009		15.890	15.919	15.603	
Invert Level (m)		15.159	14.540	14.484	14.422	14.422	14.253
Length (m)			20.971		4.906	13.312	

Node Name		F5	F2
A3 drawing Hor Scale 250 Ver Scale 100 Datum (m) 5.000			
Link Name		2.000	
Section Type		150mm	
Slope (1:X)		49.7	
Cover Level (m)		15.790	15.890
Invert Level (m)		14.840	14.484
Length (m)		17.684	









101 R01	01/01/2018	ECN22-003
101 R00	01/10/2017	ECN173
Revision	Issue Date	ECN Reference

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MM
LINEAR TOLERANCE ± 0.25mm, ANGLES ±0.5°

DO NOT SCALE DRAWING – Use Figure Dimensions Only

IF IN DOUBT, ASK

TITLE: HydroClear Pop12 Treatment Plant

NOTES:

DWG NO: 15-003-001	ISSUE DATE: 01/04/2022
REVISION: I02 R00	DRAWN BY: JC
SHEET: 1 of 1	
FILE NAME: Hydroclear HC12.dft	

Harlequin® MANUFACTURING FOR TOMORROW

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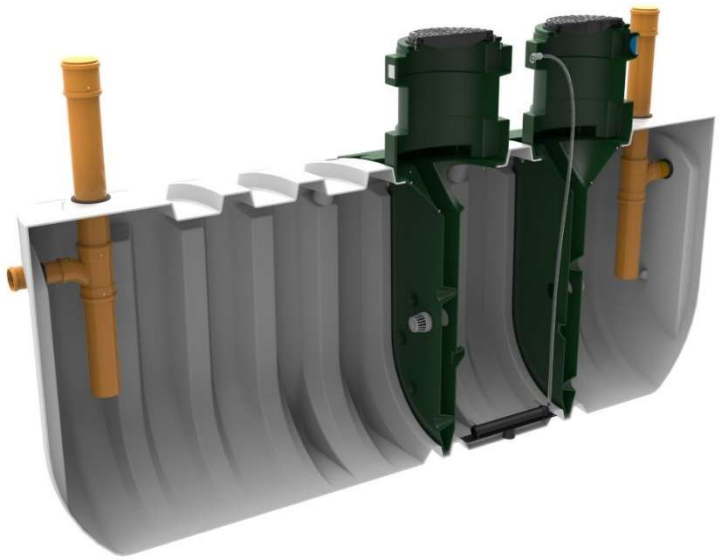
Harlequin® HydroClear SEWAGE TREATMENT PLANT

HydroClear HC12 Wastewater Treatment Plant

HydroClear represents significant progress for the domestic wastewater treatment industry.

Contemporary design engineering and analysis software and state-of-the-art manufacturing facilities combine to create this unique product which dominates the sewage treatment plant market with class-leading pollutant removal level of 97%.



Standard Features:

- Tank body moulded in one piece from durable medium density polyethylene material
- 110mm inlet and outlet connections
- Integrated lifting eyes for ease of handling and installation
- Fully secured 450mm pedestrian duty manhole covers comply with statutory regulations
- Adjustable turrets allowing for shallower invert levels
- Above ground air blower housing delivers more reliable and efficient operation, and allows easy access for maintenance
- Easy access to the bubble diffuser within the tank
- Virtually silent operation
- Cost effective installation
- 24 month service period reduces operating costs
- HydroClear owners can determine their own de-sludge intervals giving potential cost savings
- Mechanically reliable with no moving parts or electrics within the tank
- Certified to EN12566-3

Harlequin® HydroClear SEWAGE TREATMENT PLANT

HydroClear HC12 Wastewater Treatment Plant

Optional Equipment:

- Air blower function alarm
- Pumped outlet
- 300mm turret extension piece(s) – max. allowable invert level of 2m

Technical Data:

Treatment Efficiency		*Efficiency*	*Effluent*
	COD	91.2%	59 mg/l
	BOD_5	96.6%	11 mg/l
	NH_4-N	85.8%	4.5 mg/l
	SS	94.7%	19 mg/l
Nominal hydraulic daily load	2,400Litres / day		
Nominal organic daily load	720g BODs / day		
Inhabitants served	7 - 12		
Desludging interval	9 months *		
Electrical consumption	2.5 kWh/d		
Power requirements	230V 105W 0.9A (start-up current)		
Volumes (at operational height)	Primary settlement – 3400 Litres Aeration chamber – 1440 Litres Final settlement –1110 Litres		
Overall dimensions	L 4500 W 1400 H 2560 mm		
Standard inlet depth	1090 mm		
Standard outlet depth	1140 mm		
Depth from invert to base	1470 mm		
Depth from base to ground	2560 mm		
Pipe diameter	110 mm		
Net Weight	550 kg		

* *de-sludge interval up to 9 months depending on the number of inhabitants*

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Appendix B - Surface Water Hydraulic Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	15.00
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)	20.000	Minimum Backdrop Height (m)	1.000
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.046	5.00	15.773	1350	614445.834	221410.053	0.650
S2	0.038	5.00	15.961	1350	614421.422	221399.971	1.014
S_HW			15.483	150	614416.506	221408.358	1.134

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S1	S2	26.412	0.600	15.123	14.947	0.176	150.1	150	5.54	52.3
1.001	S2	S_HW	9.721	0.600	14.947	14.349	0.598	16.3	150	5.60	52.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.818	14.5	6.5	0.500	0.864	0.046	0.0	71	0.797
1.001	2.510	44.4	11.8	0.864	0.984	0.084	0.0	53	2.135

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	26.412	150.1	150	Circular	15.773	15.123	0.500	15.961	14.947	0.864
1.001	9.721	16.3	150	Circular	15.961	14.947	0.864	15.483	14.349	0.984

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1	1350	Manhole	Adoptable	S2	1350	Manhole	Adoptable
1.001	S2	1350	Manhole	Adoptable	S_HW	150	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	614445.834	221410.053	15.773	0.650	1350	 0	1.000	15.123	150
S2	614421.422	221399.971	15.961	1.014	1350	 1	1.000	14.947	150
						0	1.001	14.947	150
S_HW	614416.506	221408.358	15.483	1.134	150	1 	1.001	14.349	150

Simulation Settings

Rainfall Methodology	FSR	Summer CV	0.750	Drain Down Time (mins)	1440
FSR Region	England and Wales	Winter CV	0.840	Additional Storage (m³/ha)	0.0
M5-60 (mm)	20.000	Analysis Speed	Normal	Check Discharge Rate(s)	x
Ratio-R	0.400	Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0	100	40	0	0
30	0	0	0				

Node S2 Online Orifice Control

Flap Valve	x	Invert Level (m)	14.947	Design Flow (l/s)	1.0	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Depth (m)	0.500	Diameter (m)	0.026		

Node S1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	20.500	Depth (m)	0.350
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	15.123	Length (m)	20.500	Inf Depth (m)	0.350
Safety Factor	10.0	Time to half empty (mins)	0	Slope (1:X)	300.0		

Node S2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Width (m)	20.500	Depth (m)	0.350
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	14.947	Length (m)	20.500	Inf Depth (m)	0.350
Safety Factor	10.0	Time to half empty (mins)	736	Slope (1:X)	300.0		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
10 year 15 minute summer	211.819	59.937	30 year 360 minute summer	31.221	8.034
10 year 15 minute winter	148.645	59.937	30 year 360 minute winter	20.295	8.034
10 year 30 minute summer	136.831	38.718	30 year 480 minute summer	24.324	6.428
10 year 30 minute winter	96.022	38.718	30 year 480 minute winter	16.160	6.428
10 year 60 minute summer	90.826	24.003	30 year 600 minute summer	19.756	5.404
10 year 60 minute winter	60.342	24.003	30 year 600 minute winter	13.498	5.404
10 year 120 minute summer	54.899	14.508	30 year 720 minute summer	17.490	4.687
10 year 120 minute winter	36.474	14.508	30 year 720 minute winter	11.754	4.687
10 year 180 minute summer	41.666	10.722	30 year 960 minute summer	14.215	3.743
10 year 180 minute winter	27.084	10.722	30 year 960 minute winter	9.416	3.743
10 year 240 minute summer	32.645	8.627	30 year 1440 minute summer	10.161	2.723
10 year 240 minute winter	21.689	8.627	30 year 1440 minute winter	6.829	2.723
10 year 360 minute summer	24.632	6.339	100 year +40% CC 15 minute summer	488.233	138.153
10 year 360 minute winter	16.012	6.339	100 year +40% CC 15 minute winter	342.620	138.153
10 year 480 minute summer	19.260	5.090	100 year +40% CC 30 minute summer	320.551	90.705
10 year 480 minute winter	12.796	5.090	100 year +40% CC 30 minute winter	224.948	90.705
10 year 600 minute summer	15.690	4.291	100 year +40% CC 60 minute summer	214.603	56.713
10 year 600 minute winter	10.720	4.291	100 year +40% CC 60 minute winter	142.577	56.713
10 year 720 minute summer	13.925	3.732	100 year +40% CC 120 minute summer	129.587	34.246
10 year 720 minute winter	9.358	3.732	100 year +40% CC 120 minute winter	86.094	34.246
10 year 960 minute summer	11.365	2.993	100 year +40% CC 180 minute summer	97.729	25.149
10 year 960 minute winter	7.528	2.993	100 year +40% CC 180 minute winter	63.526	25.149
10 year 1440 minute summer	8.174	2.191	100 year +40% CC 240 minute summer	75.977	20.078
10 year 1440 minute winter	5.493	2.191	100 year +40% CC 240 minute winter	50.477	20.078
30 year 15 minute summer	268.706	76.035	100 year +40% CC 360 minute summer	56.677	14.585
30 year 15 minute winter	188.566	76.035	100 year +40% CC 360 minute winter	36.841	14.585
30 year 30 minute summer	174.929	49.499	100 year +40% CC 480 minute summer	43.979	11.622
30 year 30 minute winter	122.757	49.499	100 year +40% CC 480 minute winter	29.219	11.622
30 year 60 minute summer	116.589	30.811	100 year +40% CC 600 minute summer	35.604	9.738
30 year 60 minute winter	77.459	30.811	100 year +40% CC 600 minute winter	24.327	9.738
30 year 120 minute summer	70.438	18.615	100 year +40% CC 720 minute summer	31.433	8.424
30 year 120 minute winter	46.797	18.615	100 year +40% CC 720 minute winter	21.125	8.424
30 year 180 minute summer	53.298	13.715	100 year +40% CC 960 minute summer	25.432	6.697
30 year 180 minute winter	34.645	13.715	100 year +40% CC 960 minute winter	16.847	6.697
30 year 240 minute summer	41.604	10.995	100 year +40% CC 1440 minute summer	18.055	4.839
30 year 240 minute winter	27.641	10.995	100 year +40% CC 1440 minute winter	12.134	4.839

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	S1	23	15.184	0.061	9.6	3.5271	0.0000	OK
360 minute winter	S2	320	15.125	0.178	3.1	18.3206	0.0000	SURCHARGED
15 minute summer	S_HW	1	14.349	0.000	0.4	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	1.000	S2	5.1	0.607	0.351	0.2608	
360 minute winter	S2	Orifice	S_HW	0.6				26.8

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	S1	23	15.192	0.069	12.2	4.5344	0.0000	OK
360 minute winter	S2	344	15.163	0.216	3.9	23.2220	0.0000	SURCHARGED
15 minute summer	S_HW	1	14.349	0.000	0.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	1.000	S2	6.4	0.640	0.440	0.3071	
360 minute winter	S2	Orifice	S_HW	0.6				34.2

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	S1	464	15.266	0.143	3.1	13.8985	0.0000	OK
480 minute winter	S2	464	15.266	0.319	5.3	36.2711	0.0000	SURCHARGED
15 minute summer	S_HW	1	14.349	0.000	0.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute winter	S1	1.000	S2	2.8	0.259	0.197	0.4612	
480 minute winter	S2	Orifice	S_HW	0.8				64.2