

Technical Note V1.0

Discharge of Planning Condition 20

Project	Elizabeth Huggins Cottages Gravesend
Project Number	23504

By Sonya Macandrew BEng GMICE

Date 17 November 2022



The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA
01273 424424
reception@civil.co.uk
www.civil.co.uk

1 Introduction

- 1.1 This Technical Note has been produced in support of the Discharge of Condition Application for discharging of Condition 20 of Planning Application 20210672 for Phase 1 of a three phase development for the demolition of the existing bungalows and the construction of 34 new dwellings at Elizabeth Huggins Cottages, Gravesend, Kent.
- 1.2 The Phase 1 element of the development comprises the demolition of three existing bungalows and construction of 14 flats within a single building together with access road and parking for 12 vehicles.
- 1.3 The Drainage Statement version 1.1, issued on 2 September 2021, provides a complete surface and foul water drainage strategy for the site and has been provided separately for reference.
- 1.4 This Technical Note is to be read in conjunction with all planning, architectural and other reports that accompany the Planning Application for the proposed development.

2 Condition 20

- 2.1 Condition 20 of Planning Application 20210672 states:

'No building hereby permitted shall be occupied until surface water drainage works have been implemented in accordance with details that have been submitted to and approved in writing by the Local Planning Authority. Before these details are submitted an assessment shall be carried out of the potential for disposing of surface water by means of a sustainable drainage system in accordance with the principles set out in Annex F of PPS25 (or any subsequent version), and the results of the assessment provided to the Local Planning Authority. Where a sustainable drainage scheme is to be provided, 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 the receiving groundwater and/or surface waters;

- ii. include a timetable for its implementation; and*
- iii. provide a 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.*

3 Summary of Surface Water Drainage Design for Discharge of Condition 20

3.1 Non Technical Summary

- 3.1.1 In accordance with Annex F of PPS25, the surface water drainage design is designed to mitigate surface water flood risk by limiting flows entering the surface water sewer system, thereby providing betterment on the existing situation.
- 3.1.2 The above is achieved by suitably restricting the surface water discharge to the existing surface water sewer located beneath Cross Lane West to the north of the site and providing onsite attenuation storage for all storm return periods up to and including the 1:100 year rainfall event with an allowance for climate change.
- 3.1.3 Critical storm durations of 2 year¹, 30 year, 100 year plus 20% and 100 year plus 40% have been modelled in Causeway Flow. The model shows adequate storage is provided by the design and that no exceedance will occur for all events up to and including the 1:100 year plus 40% storm event. A copy of the modelled calculations is provided in Appendix 1.
- 3.1.4 The Surface Water Drainage Strategy is to be completed in accordance with the Drainage Strategy and Construction Drawings provided prior to first occupation. A copy of the Construction Drawings is provided in Appendix 2.
- 3.1.5 A Drainage Maintenance plan is to be implemented in accordance with the Drainage Maintenance Schedule located in Appendix 3.

3.2 Design Criteria

- 3.2.1 The design has been undertaken in compliance with the principles of the outline design and with reference to the National Planning Policy Framework, Kent County Council's Flooding Drainage and Water Management Policies, Gravesham Borough Council Local Plan and recognised best practice.

¹ FEH 13 data is the most up to date and recommended for modelling, however it does not provide data for 1 year storm events, so the minimum 2 year event has been modelled.

3.3 Existing Drainage

- 3.3.1 Surface water and foul water from the existing properties are currently discharged in an unrestricted manner to the existing public sewers located beneath Cross Lane West to the north of the site and the A227 Wrotham Road to the west.

3.4 Surface Water Drainage

- 3.4.1 All surface water drainage systems have been designed to attenuate all storm events up to and including the critical 1 in 100 year storm with a 40% allowance for climate change. The design for exceedance events has been accommodated within the attenuation systems to ensure that all surface water is retained on site.
- 3.4.2 CIRIA report C753 The SuDS Manual-v6 provides guidance on surface water drainage. The aim for surface water runoff is to match greenfield runoff rates and volumes where reasonably achievable.
- 3.4.3 For surface water discharge, the drainage hierarchy notes the following list of drainage options in order of preference:
1. Infiltration to ground
 2. Discharge to a watercourse
 3. Discharge to a surface water sewer
 4. Discharge to a foul water sewer
- 3.4.4 The preferred surface water drainage strategy should where possible be based on infiltration to ground.
- 3.4.5 The geology of the area is free draining, however, concern was raised within the Site Investigation in respect of the potential for infiltration in this locality to affect foundations. A 10m exclusion zone has been recommended around the proposed buildings.
- 3.4.6 With this constraint there is no area of the site which can suitably be used for infiltration.
- 3.4.7 Furthermore the structureless nature of the chalk substrata is characteristic of chalks liable to solution features and infiltration in such material is inherently subject to a relatively high level of risk.
- 3.4.8 The proposed surface water drainage strategy is therefore based on a restricted discharge to the existing public surface water sewer beneath Cross Lane West adjacent to the northwest corner of the site mimicking the pre developed greenfield runoff of the Phase 1 site.

3.4.9 Pre-developed greenfield runoff rates have been established using the HR Wallingford tool for Greenfield runoff estimation.



Calculated by: Steve Doughty

Site name: 23504

Site location: Gravesend

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SCD30219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Site Details

Latitude: 51.42957° N

Longitude: 0.36548° E

Reference: 2071299098

Date: Aug 10 2021 11:04

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 1

Methodology

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

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

Hydrological characteristics

	Default	Edited
SAAR (mm):	576	576
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	2.29	2.29
1 in 1 year (l/s):	1.94	1.94
1 in 30 years (l/s):	5.26	5.26
1 in 100 years (l/s):	7.29	7.29
1 in 200 years (l/s):	8.55	8.55

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UKSuds terms and conditions and license agreement, which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these estimates is the responsibility of the user of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrology Tools or any other organisation for the use of this data in the design or operation of a drainage system or any drainage scheme.

Image 1: Greenfield Runoff Calculation

3.4.10 The pre-developed greenfield runoff rates are as follows:

- Q_{bar} 2.29 l/s/ha
- 1:100 year 7.28 l/s/ha

3.4.11 The total impermeable area of the Phase 1 site is approximately 1,382m². The equivalent Q_{bar} greenfield runoff is 0.32l/s and the Q₁₀₀ runoff is 1l/s.

3.4.12 Such low levels of restriction are impractical and HR Wallingford guidance recommends a maximum restriction of 5l/s. Rates of 2l/s are however now achievable.

3.4.13 Calculations have been prepared in order to demonstrate that surface water drainage can be restricted to 2l/s and attenuated beneath the permeable paving used for the access and parking areas.

3.4.14 This is provided in a voided crate storage system at the eastern side of the site with the permeable paving above providing surface water treatment.

3.4.15 A total storage volume of 103m³ is required. The preliminary storage design for an 800mm deep 95% voided crate system (two layers). This requires a total of 536 crates spanning an area of 134m².

3.4.16 Water Quality

3.4.16.1 The proposed development is for residential use. In accordance with CIRIA SuDS Manual 2015 (Report C753), the pollution hazard level for this type of development is between very low and low depending on the use / area of the site.

3.4.16.2 The surface water scheme will include mitigation to ensure that surface water is suitably treated and any pollution risk adequately managed prior to discharge.

3.4.16.3 Table 26.2 in Chapter 26 of CIRIA report C753 The SuDS Manual provides Pollution Hazard Indices for varying land types. Those of relevance to the development proposals are as follows:

Land Use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very Low	0.2	0.2	0.05
Individual property driveways, residential car park, low-traffic roads	Low	0.5	0.4	0.4

Table 1: Pollution Hazard Indices

3.4.16.4 The use of permeable paving will meet the target treatment level required for residential car parking and roads. A filter strip is included within the storage crates to meet treatment requirements for residential roofs.

SuDS Type	Total suspended solids (TSS)	Metals	Hydrocarbons
Filter Strip	0.4	0.4	0.5
Permeable pavement	0.7	0.6	0.7

Table 2: Pollution Mitigation Indices

3.4.16.5 A Drainage Maintenance Schedule is located in Appendix 3 at the rear of this report.

3.5 Detailed Surface Water Drainage Design

3.5.1 The proposed drainage layout and drainage construction details are included on the following drawings which are included within the Application Pack. A copy of these is provided in Appendix 2:

- 101_Existing Site Layout Plan
- 201_G_Proposed Drainage and Levels Layout Plan
- 301_Proposed Surface Finishes Layout Plan
- 501_B_Construction Details
- 502_Construction Details

3.5.2 A copy of the Causeway Flow calculations for the surface water drainage model for critical durations 2 year*, 30 year, 100 year plus 20% and 100 year plus 40% is included within the Application Pack. The model indicates adequate storage is provided and that no flooding will occur for all events up to and including the 1:100 year plus 40% storm event. A copy of the calculation is provided in Appendix 1.

Appendix 1
Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.850	Preferred Cover Depth (m)	0.600
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
RE1	0.009	5.00	22.400	250	564555.194	172765.802	0.750
S1	0.009	5.00	22.400	450	564555.194	172747.236	1.112
S2	0.005	5.00	22.400	450	564522.243	172747.236	1.439
S3	0.061	5.00	22.100	450	564514.755	172739.748	1.319
S4	0.013	5.00	21.775	450	564506.444	172748.166	1.064
S5	0.005	5.00	21.550	450	564498.670	172756.031	0.905
S5 Crates	0.000	5.00	21.550		564497.216	172757.503	0.918
RE2	0.005	5.00	22.400	250	564506.529	172763.211	0.700
S6	0.005	5.00	22.400	480	564512.872	172757.436	0.845
S7	0.000		22.400	480	564516.716	172760.867	0.932
S8	0.005	5.00	22.400	1050	564522.512	172760.928	1.030
S9	0.000		22.300	1050	564522.613	172763.252	1.148
S10	0.014	5.00	22.400	1050	564543.379	172763.252	1.042
S11	0.005	5.00	22.400	480	564543.379	172771.057	0.860
RE3	0.005	5.00	22.400	250	564552.872	172771.057	0.700
S9 Crates	0.000	5.00	22.400		564521.400	172764.687	1.373
Hydrobrake	0.000		21.900	1200	564502.542	172765.622	2.200
Public Sewer			20.800	1200	564499.923	172767.918	1.200

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	RE1	S1	18.566	0.600	21.650	21.338	0.312	59.5	100	5.31	50.0
1.001	S1	S2	32.951	0.600	21.288	20.961	0.327	100.8	150	5.86	50.0
1.002	S2	S3	10.590	0.600	20.961	20.856	0.105	100.9	150	6.03	50.0
1.003	S3	S4	11.829	0.600	20.781	20.711	0.070	169.0	225	6.23	50.0
1.004	S4	S5	11.059	0.600	20.711	20.645	0.066	167.6	225	6.41	50.0
1.005	S5	S5 Crates	2.069	0.600	20.645	20.632	0.013	159.2	225	6.45	50.0

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	1.000	7.9	1.4	0.650	0.962	0.009	0.0	29	0.754
1.001	1.001	17.7	2.8	0.962	1.289	0.018	0.0	40	0.731
1.002	1.000	17.7	3.5	1.289	1.094	0.023	0.0	45	0.782
1.003	1.003	39.9	12.9	1.094	0.839	0.084	0.0	87	0.895
1.004	1.007	40.0	14.9	0.839	0.680	0.097	0.0	95	0.936
1.005	1.034	41.1	15.7	0.680	0.693	0.102	0.0	96	0.965

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)
2.000	9.493	59.3	100	Circular	22.400	21.700	0.600	22.400	21.540	0.760
2.001	7.805	59.1	100	Circular	22.400	21.540	0.760	22.400	21.408	0.892
2.002	20.766	100.8	150	Circular	22.400	21.358	0.892	22.300	21.152	0.998
3.000	8.578	59.2	100	Circular	22.400	21.700	0.600	22.400	21.555	0.745
3.001	5.152	59.2	100	Circular	22.400	21.555	0.745	22.400	21.468	0.832
3.002	5.796	59.1	100	Circular	22.400	21.468	0.832	22.400	21.370	0.930
3.003	2.326	13.8	100	Circular	22.400	21.370	0.930	22.300	21.202	0.998
3.004	1.879	15.0	150	Circular	22.300	21.152	0.998	22.400	21.027	1.223
Crates Dummy 1	9.710	10.4	225	Circular	21.550	20.632	0.693	21.900	19.700	1.975
Crates Dummy 2	18.881	14.2	150	Circular	22.400	21.027	1.223	21.900	19.700	2.050
Outfall	3.483	34.8	225	Circular	21.900	19.700	1.975	20.800	19.600	0.975

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.000	RE3	250	Manhole	Private	S11	480	Manhole	Private
2.001	S11	480	Manhole	Private	S10	1050	Manhole	Private
2.002	S10	1050	Manhole	Private	S9	1050	Manhole	Private
3.000	RE2	250	Manhole	Private	S6	480	Manhole	Private
3.001	S6	480	Manhole	Private	S7	480	Manhole	Private
3.002	S7	480	Manhole	Private	S8	1050	Manhole	Private
3.003	S8	1050	Manhole	Private	S9	1050	Manhole	Private
3.004	S9	1050	Manhole	Private	S9 Crates		Junction	
Crates Dummy 1	S5 Crates		Junction		Hydrobrake	1200	Manhole	Private
Crates Dummy 2	S9 Crates		Junction		Hydrobrake	1200	Manhole	Private
Outfall	Hydrobrake	1200	Manhole	Private	Public Sewer	1200	Manhole	Private

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
RE1	564555.194	172765.802	22.400	0.750	250		0	1.000	21.650	100
S1	564555.194	172747.236	22.400	1.112	450		1	1.000	21.338	100
							0	1.001	21.288	150
S2	564522.243	172747.236	22.400	1.439	450		1	1.001	20.961	150
							0	1.002	20.961	150
S3	564514.755	172739.748	22.100	1.319	450		1	1.002	20.856	150
							0	1.003	20.781	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S4	564506.444	172748.166	21.775	1.064	450		1 1.003	20.711	225
S5	564498.670	172756.031	21.550	0.905	450		0 1.004 1 1.004	20.711 20.645	225 225
S5 Crates	564497.216	172757.503	21.550	0.918			0 1.005 1 1.005	20.645 20.632	225 225
RE2	564506.529	172763.211	22.400	0.700	250		0 3.000	21.700	100
S6	564512.872	172757.436	22.400	0.845	480		1 3.000	21.555	100
S7	564516.716	172760.867	22.400	0.932	480		0 3.001 1 3.001	21.555 21.468	100 100
S8	564522.512	172760.928	22.400	1.030	1050		0 3.002 1 3.002	21.468 21.370	100 100
S9	564522.613	172763.252	22.300	1.148	1050		0 3.003 1 3.003 2 2.002	21.370 21.202 21.152	100 100 150
S10	564543.379	172763.252	22.400	1.042	1050		0 3.004 1 2.001	21.152 21.408	150 100
S11	564543.379	172771.057	22.400	0.860	480		0 2.002 1 2.000	21.358 21.540	150 100
RE3	564552.872	172771.057	22.400	0.700	250		0 2.001	21.540	100
S9 Crates	564521.400	172764.687	22.400	1.373			0 2.000 1 3.004	21.700 21.027	100 150
Hydrobrake	564502.542	172765.622	21.900	2.200	1200		0 Crates Dummy 2 1 Crates Dummy 2 2 Crates Dummy 1	21.027 19.700 19.700	150 150 225
							0 Outfall	19.700	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Public Sewer	564499.923	172767.918	20.800	1.200	1200	1	Outfall	19.600	225



Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.850	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.900	Drain Down Time (mins)	2160	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 %)
2	0	0	0
30	0	0	0
100	20	0	0
100	40	0	0

Node Hydrobrake Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	19.700	Product Number	CTL-SHE-0060-2000-1600-2000
Design Depth (m)	1.600	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	2.0	Min Node Diameter (mm)	1200

Node Hydrobrake Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	19.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	808

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	134.0	0.0	0.800	134.0	0.0	0.801	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	RE1	10	21.678	0.028	1.4	0.0082	0.0000	OK
15 minute winter	S1	11	21.327	0.039	2.7	0.0127	0.0000	OK
15 minute winter	S2	11	21.007	0.046	3.4	0.0106	0.0000	OK
15 minute summer	S3	10	20.874	0.093	12.5	0.1007	0.0000	OK
15 minute summer	S4	11	20.810	0.099	14.4	0.0400	0.0000	OK
15 minute summer	S5	11	20.739	0.094	15.1	0.0253	0.0000	OK
15 minute summer	S5 Crates	10	20.686	0.053	15.1	0.0000	0.0000	OK
15 minute winter	RE2	10	21.721	0.021	0.8	0.0041	0.0000	OK
15 minute summer	S6	10	21.586	0.031	1.6	0.0093	0.0000	OK
15 minute winter	S7	11	21.499	0.031	1.5	0.0057	0.0000	OK
15 minute winter	S8	11	21.397	0.027	2.2	0.0264	0.0000	OK
15 minute summer	S9	11	21.191	0.039	5.9	0.0341	0.0000	OK
15 minute summer	S10	11	21.406	0.048	3.7	0.0547	0.0000	OK
15 minute winter	S11	10	21.571	0.031	1.6	0.0091	0.0000	OK
15 minute winter	RE3	10	21.721	0.021	0.8	0.0041	0.0000	OK
15 minute summer	S9 Crates	10	21.065	0.038	5.9	0.0000	0.0000	OK
240 minute winter	Hydrobrake	180	19.835	0.135	5.0	17.2764	0.0000	OK
15 minute summer	Public Sewer	1	19.600	0.000	1.0	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)
15 minute winter	RE1	1.000	S1	1.3	0.742	0.171	0.0337	
15 minute winter	S1	1.001	S2	2.7	0.656	0.152	0.1367	
15 minute winter	S2	1.002	S3	3.4	0.757	0.192	0.0476	
15 minute summer	S3	1.003	S4	12.4	0.769	0.310	0.1906	
15 minute summer	S4	1.004	S5	14.4	0.886	0.359	0.1797	
15 minute summer	S5	1.005	S5 Crates	15.1	1.380	0.369	0.0233	
15 minute summer	S5 Crates	Crates Dummy 1	Hydrobrake	15.3	3.314	0.094	0.0551	
15 minute winter	RE2	3.000	S6	0.8	0.473	0.098	0.0141	
15 minute summer	S6	3.001	S7	1.5	0.733	0.191	0.0106	
15 minute winter	S7	3.002	S8	1.5	0.791	0.192	0.0111	
15 minute winter	S8	3.003	S9	2.2	1.369	0.137	0.0038	
15 minute summer	S9	3.004	S9 Crates	5.9	1.672	0.128	0.0067	
15 minute summer	S10	2.002	S9	3.6	0.855	0.206	0.0889	
15 minute winter	S11	2.001	S10	1.5	0.757	0.189	0.0154	
15 minute winter	RE3	2.000	S11	0.8	0.480	0.098	0.0153	
15 minute summer	S9 Crates	Crates Dummy 2	Hydrobrake	6.0	2.297	0.127	0.0769	
240 minute winter	Hydrobrake	Hydro-Brake®	Public Sewer	1.4				27.1

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	10	21.701	0.051	3.9	0.0147	0.0000	OK
15 minute summer	S1	10	21.357	0.069	7.8	0.0222	0.0000	OK
15 minute summer	S2	11	21.042	0.081	9.9	0.0186	0.0000	OK
15 minute summer	S3	11	20.996	0.215	36.6	0.2326	0.0000	OK
15 minute summer	S4	11	20.928	0.217	41.1	0.0875	0.0000	OK
15 minute summer	S5	11	20.826	0.181	43.4	0.0489	0.0000	OK
15 minute summer	S5 Crates	10	20.716	0.083	42.4	0.0000	0.0000	OK
15 minute summer	RE2	10	21.736	0.036	2.2	0.0069	0.0000	OK
15 minute winter	S6	10	21.613	0.058	4.4	0.0173	0.0000	OK
15 minute winter	S7	11	21.525	0.057	4.3	0.0103	0.0000	OK
15 minute summer	S8	11	21.422	0.052	6.5	0.0497	0.0000	OK
15 minute summer	S9	11	21.224	0.072	16.7	0.0623	0.0000	OK
15 minute summer	S10	10	21.445	0.087	10.4	0.0985	0.0000	OK
15 minute winter	S11	10	21.596	0.056	4.4	0.0167	0.0000	OK
15 minute summer	RE3	10	21.736	0.036	2.2	0.0069	0.0000	OK
15 minute summer	S9 Crates	11	21.089	0.062	16.8	0.0000	0.0000	OK
240 minute winter	Hydrobrake	236	20.098	0.398	11.5	51.1487	0.0000	SURCHARGED
15 minute summer	Public Sewer	1	19.600	0.000	1.5	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)
15 minute summer	RE1	1.000	S1	3.9	0.981	0.490	0.0730	
15 minute summer	S1	1.001	S2	7.7	0.872	0.434	0.2904	
15 minute summer	S2	1.002	S3	9.8	0.928	0.556	0.1420	
15 minute summer	S3	1.003	S4	35.7	0.918	0.896	0.4637	
15 minute summer	S4	1.004	S5	41.3	1.110	1.031	0.4070	
15 minute summer	S5	1.005	S5 Crates	42.4	1.782	1.032	0.0491	
15 minute summer	S5 Crates	Crates Dummy 1	Hydrobrake	43.5	3.717	0.268	0.1894	
15 minute summer	RE2	3.000	S6	2.2	0.604	0.277	0.0310	
15 minute winter	S6	3.001	S7	4.3	0.930	0.549	0.0240	
15 minute winter	S7	3.002	S8	4.3	0.990	0.546	0.0252	
15 minute summer	S8	3.003	S9	6.4	1.751	0.393	0.0086	
15 minute summer	S9	3.004	S9 Crates	16.8	2.211	0.363	0.0143	
15 minute summer	S10	2.002	S9	10.3	1.092	0.582	0.1957	
15 minute winter	S11	2.001	S10	4.3	0.988	0.546	0.0340	
15 minute summer	RE3	2.000	S11	2.2	0.617	0.277	0.0336	
15 minute summer	S9 Crates	Crates Dummy 2	Hydrobrake	16.8	2.512	0.354	0.2156	
240 minute winter	Hydrobrake	Hydro-Brake®	Public Sewer	1.5				67.2

Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 99.68%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	10	21.719	0.069	6.2	0.0199	0.0000	OK
15 minute summer	S1	12	21.459	0.171	12.3	0.0550	0.0000	SURCHARGED
15 minute summer	S2	11	21.331	0.370	14.1	0.0847	0.0000	SURCHARGED
15 minute summer	S3	11	21.254	0.473	53.3	0.5132	0.0000	SURCHARGED
15 minute summer	S4	11	21.079	0.368	61.8	0.1483	0.0000	SURCHARGED
15 minute winter	S5	11	20.865	0.220	64.1	0.0594	0.0000	OK
15 minute winter	S5 Crates	10	20.731	0.099	72.2	0.0000	0.0000	OK
15 minute summer	RE2	10	21.746	0.046	3.4	0.0088	0.0000	OK
15 minute summer	S6	10	21.637	0.082	6.8	0.0244	0.0000	OK
15 minute summer	S7	11	21.548	0.080	6.7	0.0144	0.0000	OK
15 minute summer	S8	11	21.441	0.071	10.0	0.0683	0.0000	OK
15 minute summer	S9	11	21.248	0.096	26.1	0.0834	0.0000	OK
15 minute summer	S10	10	21.478	0.120	16.3	0.1365	0.0000	OK
15 minute summer	S11	10	21.618	0.078	6.8	0.0231	0.0000	OK
15 minute summer	RE3	10	21.746	0.046	3.4	0.0088	0.0000	OK
15 minute summer	S9 Crates	11	21.107	0.080	26.1	0.0000	0.0000	OK
360 minute winter	Hydrobrake	352	20.446	0.746	14.1	95.8603	0.0000	SURCHARGED
15 minute summer	Public Sewer	1	19.600	0.000	1.5	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)
15 minute summer	RE1	1.000	S1	6.1	1.081	0.773	0.1232	
15 minute summer	S1	1.001	S2	11.4	0.889	0.644	0.5801	
15 minute summer	S2	1.002	S3	17.8	1.027	1.010	0.1864	
15 minute summer	S3	1.003	S4	53.3	1.339	1.336	0.4705	
15 minute summer	S4	1.004	S5	61.9	1.557	1.546	0.4384	
15 minute winter	S5	1.005	S5 Crates	72.2	2.420	1.757	0.0581	
15 minute winter	S5 Crates	Crates Dummy 1	Hydrobrake	64.2	3.821	0.396	0.2629	
15 minute summer	RE2	3.000	S6	3.4	0.651	0.429	0.0443	
15 minute summer	S6	3.001	S7	6.7	0.996	0.851	0.0348	
15 minute summer	S7	3.002	S8	6.7	1.061	0.851	0.0366	
15 minute summer	S8	3.003	S9	10.0	1.902	0.612	0.0122	
15 minute summer	S9	3.004	S9 Crates	26.1	2.435	0.566	0.0201	
15 minute summer	S10	2.002	S9	16.1	1.185	0.910	0.2804	
15 minute summer	S11	2.001	S10	6.7	1.074	0.849	0.0486	
15 minute summer	RE3	2.000	S11	3.4	0.673	0.430	0.0476	
15 minute summer	S9 Crates	Crates Dummy 2	Hydrobrake	26.2	2.556	0.552	0.2558	
360 minute winter	Hydrobrake	Hydro-Brake®	Public Sewer	1.5				121.3

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.68%

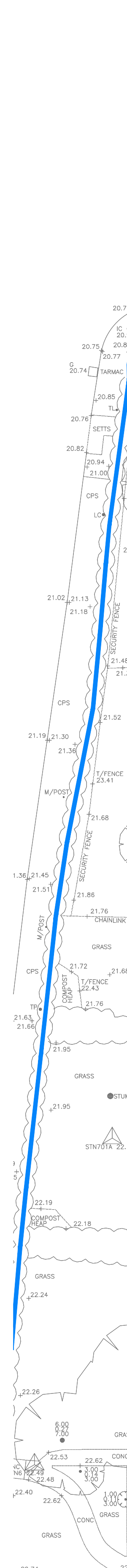
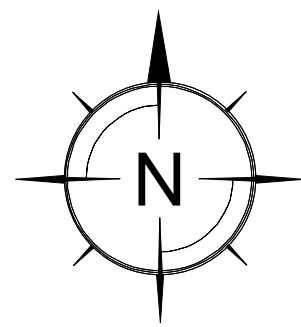
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	RE1	12	21.855	0.205	7.2	0.0592	0.0000	SURCHARGED
15 minute summer	S1	11	21.647	0.359	13.6	0.1152	0.0000	SURCHARGED
15 minute summer	S2	11	21.488	0.527	15.7	0.1206	0.0000	SURCHARGED
15 minute summer	S3	11	21.389	0.608	61.4	0.6591	0.0000	SURCHARGED
360 minute winter	S4	352	21.363	0.652	11.2	0.2628	0.0000	SURCHARGED
360 minute winter	S5	352	21.363	0.718	11.8	0.1938	0.0000	FLOOD RISK
360 minute winter	S5 Crates	352	21.362	0.730	11.8	0.0000	0.0000	FLOOD RISK

15 minute summer	RE2	10	21.750	0.050	4.0	0.0096	0.0000	OK
15 minute summer	S6	11	21.670	0.115	8.0	0.0345	0.0000	SURCHARGED
15 minute summer	S7	11	21.560	0.092	7.6	0.0167	0.0000	OK
15 minute summer	S8	11	21.449	0.079	11.4	0.0764	0.0000	OK
360 minute winter	S9	352	21.362	0.210	4.6	0.1819	0.0000	SURCHARGED
15 minute summer	S10	11	21.513	0.155	18.8	0.1756	0.0000	SURCHARGED
15 minute summer	S11	11	21.653	0.113	8.0	0.0337	0.0000	SURCHARGED
15 minute summer	RE3	10	21.750	0.050	4.0	0.0096	0.0000	OK
360 minute winter	S9 Crates	352	21.362	0.335	4.6	0.0000	0.0000	SURCHARGED

360 minute winter	Hydrobrake	352	21.362	1.662	16.4	103.7832	0.0000	SURCHARGED
15 minute summer	Public Sewer	1	19.600	0.000	1.5	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)
15 minute summer	RE1	1.000	S1	6.5	1.085	0.821	0.1453	
15 minute summer	S1	1.001	S2	13.4	0.880	0.756	0.5801	
15 minute summer	S2	1.002	S3	18.8	1.068	1.064	0.1864	
15 minute summer	S3	1.003	S4	61.4	1.544	1.540	0.4705	
360 minute winter	S4	1.004	S5	11.2	0.830	0.279	0.4398	
360 minute winter	S5	1.005	S5 Crates	11.8	1.347	0.287	0.0823	
360 minute winter	S5 Crates	Crates Dummy 1	Hydrobrake	11.8	1.885	0.073	0.3862	
15 minute summer	RE2	3.000	S6	4.0	0.659	0.503	0.0504	
15 minute summer	S6	3.001	S7	7.6	1.010	0.967	0.0396	
15 minute summer	S7	3.002	S8	7.6	1.089	0.963	0.0412	
15 minute summer	S8	3.003	S9	11.4	1.934	0.696	0.0136	
360 minute winter	S9	3.004	S9 Crates	4.6	1.602	0.100	0.0331	
15 minute summer	S10	2.002	S9	18.3	1.204	1.034	0.3185	
15 minute summer	S11	2.001	S10	7.7	1.055	0.973	0.0611	
15 minute summer	RE3	2.000	S11	4.0	0.682	0.504	0.0554	
360 minute winter	S9 Crates	Crates Dummy 2	Hydrobrake	4.6	1.434	0.097	0.3324	
360 minute winter	Hydrobrake	Hydro-Brake®	Public Sewer	2.0				139.4

Appendix 2
Construction Drawings



- NOTES:
1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
 2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.
 3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.
 4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.

REV	DATE	BY	DESCRIPTION	CHK
-----	------	----	-------------	-----

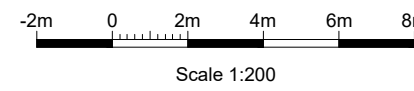
Issue Status **FOR TENDER**

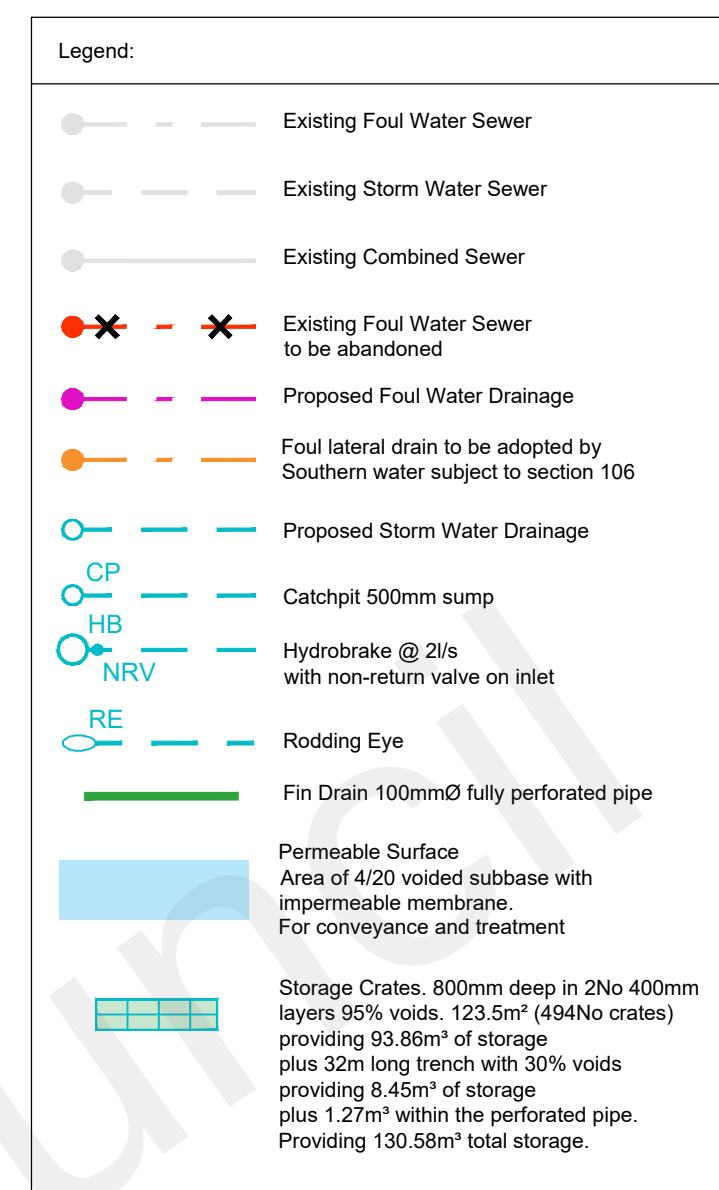
The Civil Engineering Practice
11 Tungsten Building
George Street
Fishergate
SUSSEX
BN41 1RA
01273 424424
reception@civil.co.uk
www.civil.co.uk

CLIENT
Stonechart Developments Ltd
PROJECT
Elizabeth Huggins Cotages, Gravesend

TITLE
Existing Site Layout Plan

DRAWN M Pacifico	DATE Sept 2021	PROJECT NO. 21504
ENGINEER S Doughty	CHECKED	DRG. NO. 101
SCALE 1:200 @ A1		REV. -





STORM WATER MANHOLE SCHEDULE						
MANHOLE REFERENCE	COVER LEVEL	INVERT LEVEL	DEPTH TO INVERT	DIAMETER / SIZE	COVER TYPE	MANHOLE TYPE
S1	22.250	21.488	0.762	450mmØ	A15	FIG B_18 Type D
S2	22.400	21.417	0.983	450mmØ	A15	FIG B_18 Type D
S3	22.440	21.286	1.154	600mmØ	A15	Wavin Range 600
S4	22.575	21.174	1.401	600mmØ	D400	Wavin Range 600
S5	22.575	21.141	1.434	600mmØ	A15	Wavin Range 600
S6	22.400	21.864	0.536	450mmØ	A15	FIG B_18 Type D
S7	22.400	21.762	0.638	450mmØ	A15	FIG B_18 Type D
S8	22.400	21.605	0.795	450mmØ	A15	FIG B_18 Type D
S9	22.400	21.547	0.853	450mmØ	A15	FIG B_18 Type D
S10	22.400	21.485	0.915	450mmØ	A15	FIG B_18 Type D
S11	22.600	21.097	1.503	450mmØ	A15	Wavin Range 600
S12	22.300	20.981	1.319	450mmØ	A15	FIG B_18 Type D
S13	22.310	20.912	1.398	450mmØ	A15	FIG B_18 Type D
S14	22.200	20.787	1.413	450mmØ	A15	FIG B_18 Type D
S15 HB	22.000	20.720	1.280	1200mmØ	A15	Hydrobrake
S16	22.600	21.097	1.503	600mmØ	D400	Wavin Range 600
S17	22.600	21.097	1.503	600mmØ	A15	Wavin Range 600
S18	21.750	20.978	0.772	450mmØ	A15	FIG B_18 Type D
S19	21.800	20.879	0.921	450mmØ	A15	FIG B_18 Type D

FOUL WATER MANHOLE SCHEDULE						
MANHOLE REFERENCE	COVER LEVEL	INVERT LEVEL	DEPTH TO INVERT	DIAMETER / SIZE	COVER TYPE	MANHOLE TYPE
F1	22.400	21.750	0.650	450mmØ	A15	FIG B_18 Type D
F2	22.400	21.725	0.675	450mmØ	A15	FIG B_18 Type D
F3	22.400	21.656	0.744	450mmØ	A15	FIG B_18 Type D
F4	22.400	21.300	1.100	450mmØ	A15	FIG B_18 Type D
F5	22.400	21.750	0.650	450mmØ	A15	FIG B_18 Type D
F6	22.400	21.727	0.673	450mmØ	A15	FIG B_18 Type D
F7	22.400	21.644	0.756	450mmØ	A15	FIG B_18 Type D
F8	22.400	21.572	0.828	450mmØ	A15	FIG B_18 Type D
F9	22.525	21.058	1.467	1200mmØ	A15	FIG B_09 Type B
F10	22.600	20.907	1.693	1200mmØ	A15	FIG B_09 Type B
F11	22.300	20.696	1.604	1200mmØ	A15	FIG B_09 Type B
F12	22.060	20.478	1.582	1200mmØ	A15	FIG B_09 Type B

NOTES:

1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.
3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.
4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.
5. All pipes, bends and junctions shall be verified clay to BS EN 295-1, with flexible joints and kilnmarked certified. Alternatively all pipes and fittings can be conforming to BS EN 1401-1 and shall be laid in accordance with the manufacturers specification. If UPVC pipes are to be used then the manufacturer shall be approved by the Engineer prior to construction.
6. All Adoptable sewers shall be in strict accordance with the current edition of Sewers For Adoption. Unless otherwise stated adoptable sewers shall be 150mm diameter and shall be laid in a class S bedding. Where the depth to soffit is less than 1.2m under a public highway or 0.9m elsewhere the pipe shall be laid with a class Z bedding.
7. All private building drainage shall be constructed in strict accordance with BS EN 752:1996. Unless otherwise specified building drainage shall be 100mm diameter and shall be laid at a minimum gradient of 1 in 40 for foul drains and 1 in 80 for surface water drains. All building drains shall be laid in class B bedding unless otherwise specified.
8. Where the service trench is near to the foundation of any building, refer to the guidance in Approved Document H, Building Regulations Part H1.
9. Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN 3 concrete encasement (150mm thick). In all other cases the pipes shall be bedded and surrounded with 100mm thick granular material.
10. In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided. Compressible boards (fibreglass or polystyrene) shall be provided at a maximum of 8m centres (coinciding with pipe joints). The boards shall be pre-cut to pipe diameter as a height and width equal to the concrete cross section. A board thickness of 18mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.
11. All pipe shall have ridding access plates fitted at their bases (ground floor level).
12. Where existing pipes are to be abandoned they shall be dug out together with any abandoned manholes.

EXISTING SERVICES

1. Information compiled from services plans received and reproduced in good faith. Specific locations to be confirmed on site prior to construction.

1. Information compiled from services plans received and reproduced in good faith. Specific locations to be confirmed on site prior to construction.

G	15.06.22	MJP	Crates layout updated	SRM
F	25.05.22	MJP	S04 & S50 Invert levels updated on plan	SRM
E	19.05.22	MJP	Updated stormwater drainage layout	SRM
D	13.04.22	MJP	Updated storm outfall	SRM
C	12.01.22	MJP	Updated site layout	SRM
B	11.01.22	MJP	Drawing updated to suit IL received	SRM
A	23.11.21	MJP	Drawing updated to client comments	SRM
REV	DATE	INT	DESCRIPTION	CHK

Issue Status	FOR TENDER
--------------	------------

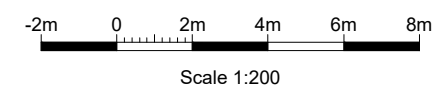
 **The Civil Engineering Practice**
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA

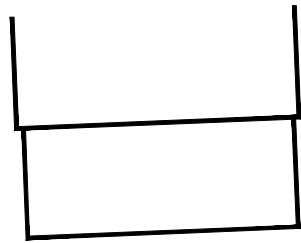
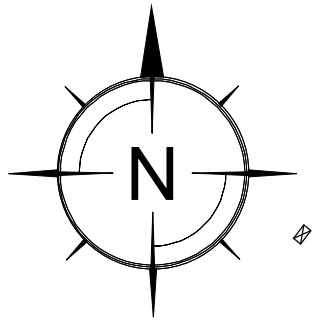
01273 424424
reception@civil.co.uk
www.civil.co.uk

CLIENT	Stonechart Developments Ltd
PROJECT	Elizabeth Huggins Cotages, Gravesend

TITLE
Proposed Levels and Drainage Layout Plan

DRAWN		DATE		PROJECT NO.	
M Pacifico		Sept 2021		23504	
ENGINEER		CHECKED		DRG. No. REV. 201 G	
S Doughty					
SCALE					
1:200 @ A1					





Legend:

- HB2 Kerb 100mm upstand
- BN Kerb 0-6mm upstand with transition kerb to each end
- EF Edging Flush
- Permeable block paving
- Paving slab path / patio
- Tarmac footpath

See CEP Drawing 22504 / 501 for Construction Details

- NOTES:
1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
 2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.
 3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.
 4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.
 5. All pipes, bends and junctions shall be vitrified clay to BS EN 295-1, with flexible joints and kitemark certified. Alternatively all pipes and fittings can be UPVC conforming to BS EN 1401-1 and shall be laid in accordance with the manufacturers specification. If UPVC pipes are to be used then the manufacturer shall be approved by the Engineer prior to construction.
 6. All Adoptable sewers shall be in strict accordance with the current edition of Sewers For Adoption. Unless otherwise stated adoptable sewers shall be 150mm diameter and shall be laid in a class S bedding. Where the depth to soffit is less than 1.2m under a public highway or 0.9m elsewhere the pipe shall be laid with a class Z bedding.
 7. All private building drainage shall be constructed in strict accordance with BS EN 752:1996. Unless otherwise specified building drainage shall be 100mm diameter and shall be laid at a minimum gradient of 1 in 40 for foul drains and 1 in 80 for surface water drains. All building drains shall be laid in class B bedding unless otherwise specified.
 8. Where the service trench is near to the foundation of any building, refer to the guidance in Approved Document H, Building Regulations Part H1.
 9. Where pipes, external to the structures, have a depth to soffit from ground level of less than 450mm they shall have a class GEN 3 concrete encasement (150mm thick). In all other cases the pipes shall be bedded and surrounded with 100mm thick granular material.
 10. In any circumstances where pipes are bedded and surrounded in concrete flexible joints should be provided. Compressible boards (fibreboard or polystyrene) shall be provided at a maximum of 8m centres (coinciding with pipe joints). The boards shall be pre-cut to pipe diameter and to a height and width equal to the concrete cross section. A board thickness of 18mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.
 11. All svps shall have rodding access plates fitted at their bases (ground floor level).
 12. Where existing pipes are to be abandoned they shall be dug out together with any abandoned manholes.

EXISTING SERVICES

1. Information compiled from services plans received and reproduced in good faith. Specific locations to be confirmed on site prior to construction.

A	12.01.22	MJP	Updated hydrobrake levels	SRM
REV	DATE	INT	DESCRIPTION	CHK

Issue Status FOR TENDER

The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA
01273 424424
reception@civil.co.uk
www.civil.co.uk

CLIENT

Stonechart Developments Ltd

PROJECT

Elizabeth Huggins Cotages, Gravesend

TITLE

Proposed Surface Finishes Layout Plan

DRAWN

M Pacifico

DATE

Sept 2021

PROJECT NO.

23504

ENGINEER

S Doughty

CHECKED

DWG. No.

301

REV.

A

SCALE

1:200 @ A1

Technical drawing illustrating the construction details of a precast concrete chamber section, showing both an elevation view (top) and a plan view (bottom).

Elevation View Details:

- Mortar bedding and haunching to cover and frame to Clause E2.7
- Minimum 1 course of Class B engineering bricks or precast concrete cover frame seating rings
- 675 mm maximum to first step rung from cover level
- Lifting eyes in concrete rings to be pointed
- Surface of benching and channel formed monolithically with high-strength concrete base or a proprietary liner
- Self-cleaning toe holes to be provided where channel exceeds 600 mm wide
- Cover complying with Clause E2.32, 600 mm x 600 mm clear opening
- Precast concrete slab complying with E2.30
- Minimum clear access 600 mm
- Precast concrete chamber sections complying with Clause E2.29 jointed with mortar, elasticomeric or plasticomeric seals
- Chamber wall to be minimum 125 mm
- Chamber height (not less than 900 mm)
- Benching slope to be 1:10 to 1:30
- Precast concrete base unit
- 150 mm to underside of channel
- Detail to Clause BS 2.12

Plan View Details:

- Joint to be within chamber wall to permit satisfactory joint and subsequent movement
- Double step rungs complying with Clause E2.33
- See Figure B 13.2 and Figure E5.6.2 for rocker pipe details
- Minimum width of benching to be 225 mm
- 450 mm
- minimum from edge of stepping (See Clause BS 2.29)

Not to scale

Plastic chambers and rings shall comply with Clause E2.31

Mortar bedding and haunching to cover and frame to Clause E6.7

Surface course

Binder course

Base course

Minimum 50 mm gap between slab and chamber unit

Flexible seal (Seal needs to be watertight and provide a suitable specification for the details and material)

Temporarily cap shaft during construction

Joints between base and shaft and between shaft components to be fitted with watertight seals

Joint to be as close as possible to face of chamber to permit satisfactory joint and mortar movement

Cover complying with Clause E2.32

If distance from cover level to soffit of pipe is < 1m, access opening shall be restricted to 300 mm diameter or 300 mm x 300 mm

Class B engineering brickwork or precast concrete cover frame

sealing rings

Precast concrete slab to support covers and frame

Granular type 1 sub-base material to Clause E2.43 (thickness varies)

Minimum internal dimensions 450 mm diameter or 450 mm x 450 mm

Minimum 150 mm thick granular type 1 sub-base material to Clause E2.43 or GEN3 Special-duty surround complying with E4.1 and BRE Special Design 1 in accordance with the manufacturer's instruction

Base unit to have all connections with soffit levels set no lower than that of the main pipe

Granular bedding material

Invert of connecting pipe at least 30 mm above that of the main pipe

Plastic chambers and rings shall comply with BS EN 13598-1 and BS EN 13598-2 or have equivalent independent approval

Mortar bedding and haunching to cover and frame to Clause 63.7

Precast concrete slab or in-situ concrete slab to support cover and frame

Flexible seal

Temporally cap shaft during construction

Joints between base and shaft and between shaft components to be fitted with watertight seals

Manhole cover to suit BS EN 124 loading
Highways - Class D400
600 mm clear opening

Access opening restricted to 350 mm diameter or 300 mm x 300 mm if depth of chamber to invert is > 1 m

Class 8 engineering brickwork or precast concrete frame

DOT Type 1 sub base (thickness varies)

DOT Type 1 sub base (thickness varies) or concrete surround

Minimum internal dimensions
450 mm diameter or
450 mm x 450 mm

Not to scale

CATCHPIT CHAMBER
500mm SUMP

Diagram illustrating the cross-section of a kerb and channel construction, showing the following layers and dimensions:

- 40mm thick 600mm x 300mm concrete paving slabs with contrasting colour non-slip edge inlay or groove detail
- 20mm cement mortar bed
- 100mm Class GEN1 concrete bed and surround
- 150mm thick DoT type 1 granular subbase
- 50mm thick x 250mm EF edging to form edge of steps
- 40mm thick 600mm x 300mm concrete paving slab cut to form riser

Dimensions shown:

- 800mm (width of the concrete bed and surround)
- 100mm (height of the concrete bed and surround)
- 300mm (width of the concrete bed and surround)
- 100mm (height of the concrete bed and surround)

Technical drawing showing a cross-section and plan view of a kerb and gutter detail. The drawing includes the following dimensions and specifications:

- Top Dimensions:** 150 (kerb width), 125 (kerb width).
- Vertical Dimensions:** 50 (kerb height), 255 (total height), 150 (height of concrete and backing).
- Material and Construction:**
 - HB2 kerb to BS 7263 Part 1 1990
 - EN1 concrete and backing
 - 75 x 25 min shear key
 - 20mm nominal mortar bed
- Text:** Unless otherwise stated all HB2 kerbs shall have a 125mm upstand from the carriageway

Technical drawing of a concrete kerb cross-section. The drawing shows a rectangular concrete kerb with a width of 250 mm (150 mm + 100 mm) and a height of 300 mm (150 mm + 150 mm). The top 150 mm is labeled 'Type BN kerb to BS 7263 Part 1 1990'. The bottom 150 mm is labeled 'Glass GEN1 concrete bed and backing'. The kerb is shown in cross-section with a hatched pattern. Dimensions are given in millimeters.

The diagram illustrates a rainwater pipe installation. A vertical pipe is shown with a 'Rodding access point' and a 'Rainwater pipe with 68/100 adapter'. The pipe is connected to a foundation labeled 'Indicative foundation'. The 'F.F.L.' (Finished Floor Level) and 'F.G.L.' (Finished Ground Level) are indicated. A 'Plastic to clay coupling (where required)' is shown at the base of the pipe, which then curves into a horizontal pipe labeled 'To drain'. The curve has a radius of '87.5" long radius'.

PIPE BEDDING FOR RIGID APPLIES (NON ADOPTIVE DRAINS)

80mm Aquapave permeable block paving or similar agreed

50mm 2-6mm open graded crushed rock

Permeable non-woven geotextile

450mm minimum thickness 4/20 Coarse. Based on minimum 5% CBR

Graded Aggregate subbase compacted in 150mm intervals

If CBR less than 2% please inform the civil engineer

CBR of sub grade %	<=2	<=5	<=15	>15
6fl capping thickness mm	600	450	200	0

30mm 3-6mm gravel bedding

1mm thick Impermeable membrane with welded joints to base and sides

Fin drain 100mm perforated pipe wrapped in geomembrane and connected to storm water drain

Welded fin drain where pipe penetrates the impermeable membrane

The diagram illustrates the trenchless installation of a 45° bend pipe using the pipe bedding method. Key components and labels include:

- Rodding point (minimum)** with sealing plate and safety valve.
- Safety valve.**
- Finished ground level.**
- 45° bend.**
- Coupling.**
- Set in GEN1 concrete.**
- 450** (vertical distance from ground level to the top of the pipe bedding).
- Depth to invert of less than 600mm.**
- Pipe bedding to suit location and loading.**

1. All dimensions to be checked on site. All details and dimensions relating to sub-Contractors work must be checked and agreed between the sub-Contractor or supplier and the general Contractor.
2. This drawing is to be read in conjunction with all relevant Architect's and Engineer's drawings and specification.
3. The main Contractor is responsible for ensuring the stability of the structure whilst the works are in progress.
4. Any information given regarding existing underground services is given in good faith after consultation with the relevant authority. No liability is accepted by the Consultant and the main Contractor is responsible for obtaining and checking all information and taking due care and attention whilst undertaking the works.
5. All pipes, bends and junctions shall be vitrified clay to BS EN 295-1, with 100mm diameter and shall be certified. Alternatively all pipes and fittings can be UPVC conforming to BS EN 1401-1 and shall be laid in accordance with the manufacturers specification. If UPVC pipes are to be used then the manufacturer shall be approved by the Engineer prior to construction.
6. All Adoptable sewers shall be in strict accordance with the current edition of Sewers For Adoption. Unless otherwise stated adoptable sewers shall be 100mm diameter and shall be laid in a class S bedding. Where the depth to soil is less than 1.2m under a public highway or 0.9m elsewhere the pipe shall be laid with a class Z bedding.
7. All private building drainage shall be constructed in strict accordance with BS EN 752:1996. Unless otherwise specified building drainage shall be 100mm diameter and shall be laid at a minimum gradient of 1 in 40 for foul drains and 1 in 80 for surface water drains. All building drains shall be laid in class B bedding unless otherwise specified.
8. Where the service trench is near to the foundation of any building, refer to the guidance in Approved Document H, Building Regulations Part H1.
9. Where pipes, external to the structures, have a depth to soil from ground level of less than 450mm then pipes shall have a class GEN 3 concrete bedding and shall be surrounded with 100mm thick granular material.
10. In any circumstances where pipes are bedded and surrounded in concrete joints should be provided. Compressible boards (fibresorb or polystyrene) shall be provided at a maximum of 8mm centres (coinciding with pipe joints). The boards shall be pre-cut to pipe diameter and shall be cut to the correct length to suit the concrete section. A board thickness of 15mm for pipes up to 450mm nominal diameter and 36mm for pipes over 450mm nominal diameter.
11. All pipes shall have rodding access plates fitted at their bases (ground level and above).
12. Where existing pipes are to be abandoned they shall be dug out together with any abandoned manholes.

PIPE BORE	BEDDING CLASS	Fields and gardens		Light traffic roads		Heavy traffic roads	
		MIN	MAX	MIN	MAX	MIN	MAX
100mm	D or N	0.4	4.2	0.7	4.1	0.7	3.7
	F	0.3	5.8	0.5	5.8	0.5	5.5
	B	0.3	7.4	0.4	7.4	0.4	7.2
150mm	D or N	0.6	2.7	1.1	2.5	--	--
	F	0.6	3.9	0.7	3.8	0.7	3.3
	B	0.6	5.0	0.8	5.0	0.6	4.6
225mm	D or N	--	--	--	--	--	--
	F	0.6	2.5	1.2	2.1	--	--
	B	0.6	3.3	0.8	3.2	0.9	2.4

Selected fill: free from stones larger than 40mm, lumps of clay over 100mm, timber frozen material and vegetable matter

Granular material: should conform to BS 882:1983 table 4 or BS8301:1985 Appendix D. Compaction fraction > 0.3 for class N > 0.2 for class F and B.

Selected fill or granular fill free from stones larger than 40mm

'x' - Denotes external pipe diameter.

CBR of sub grade %	<=2	<=5	<=15	>15
6f1 capping thickness mm	600	450	200	0

Appendix 3

Drainage Maintenance Schedule

Drainage Maintenance Schedule



The Civil Engineering Practice
11 Tungsten Building
George Street
Fishersgate
Sussex
BN41 1RA
01273 424424
reception@civil.co.uk
www.civil.co.uk

Project	Elizabeth Huggins Cottages, Gravesend
Project Number	23504

By Sonya Macandrew

Date 17 November 2022

1 Schedule of Maintenance

- 1.1 Once appointed the Contractor will prepare a site specific method statement for the control of silt and other pollutants during construction. CIRIA Report C532, Control of water pollution from construction sites, provides further guidance on this.
- 1.2 The Contractor will maintain the proposed drainage system during construction and until the handing over of the site.
- 1.3 Upon completion management of the shared drainage facilities (where not adopted) will be passed on to a Management Company appointed by the Developer on behalf of the Residents.
- 1.4 In the event that the Management Company becomes unable to discharge its duties within two years of first appointment the Developer will endeavour to appoint an alternative on behalf of the Residents.
- 1.5 Maintenance of individual property drainage connections is the responsibility of the individual property owners.
- 1.6 The following maintenance schedule details the typical tasks to be undertaken at different intervals.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Manage vegetation and remove nuisance plants – aesthetics	As required
	Litter and debris removal – catchpits and gulleys	Monthly or as required
	Remove sediment and debris from silt trap chambers, channel drains and inlet chambers	6 monthly
	Visual inspection of permeable paving for defects and settlement	Annually
	Sweeping / brushing of permeable paving	Every 2 years
	Storage crates and surface and foul water pipework – jetting / rodding	Every 2 years or as required



Maintenance Schedule	Required Action	Frequency
Corrective Maintenance	Remove debris / blockages to silt traps / channel drains	As required
	Repairs to access chambers / manhole covers	As required
	Replace any broken permeable blocks / surface, remedial works to any depressions or rutting	As required
	Inspect inlet, outlet from downpipes and gullies for blockages, standing water and clear	As required

Indicative Schedule of Maintenance for the Proposed Drainage System

2 Financing

- 2.1 The regular and corrective maintenance of all shared elements of the drainage system will be managed and funded through the Management Company on behalf of the Residents.

Inspection / Action Required	Gullies, Channels and Gutters	Catchpits	Permeable Surface	Surface Water Pipework
6 Months	✓	✓	✓	
1 Year			✓	
After leaf fall in Autumn	✓	✓		
2 Years				✓

Drainage System Maintenance Summary

3 Design Life

- 3.1 The design life of the development is likely to exceed the design life of the components within the SuDS network. During the routine drainage inspections it may be determined that some components have reached the end of their functional life cycle.
- 3.2 Where possible repairs should be the first option considered however if repairs are unviable it will be necessary for the property owner / Management Company to replace the faulty component.

4 Emergency Plan

- 4.1 Potential flood and maintenance indicators:
- Manholes or inspections chambers overflowing
 - Gullies overflowing or ponding
 - Channel drains overflowing or ponding
 - Other visual indicators of the drainage system not performing as it should
- 4.2 Should any of the items above occur then immediate action as outlined below should be undertaken:
- Inspect for blockages in the problem area
 - Should the problem not be identified via an initial inspection:

- o For unadopted onsite drainage the Management Company should appoint a suitable drainage engineer to inspect and survey the system and jet any blockages
- o For adopted onsite drainage the relevant statutory undertaker should be alerted
- o Where it is suspected that there is a problem with the downstream drainage network the Owner or relevant statutory undertaker of that system should be alerted

Gravesham Borough Council