PROPOSED RESIDENTIAL DEVELOPMENT
AT KIRBY DANIELS COURT
NEWPORT

DRAINAGE STRATEGY

Bradley Associates,
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31 Cardiff Road,
Taffs Well,
Cardiff.
CF15 7RB

Reference: 16230

Nov 2018

Revision:

OVERVIEW

This report has been prepared for our client 'Pobl Group' and comprises an assessment of the existing drainage conditions and proposals for the disposal of surface water and foul water in accordance with relevant current regulations and accepted good practices.

An assessment of flood risk or consequence has been undertaken by Earth Science Partnership and their advice note can be seen within Appendix B.

DEVELOPMENT PROPOSALS

The existing site is located off Charlotte Drive, Newport. It is currently occupied by existing residential units. Site topography is generally consistent across the development site in the region of 9.10m to 9.30m with a general FFL of the existing dwelling being 9.40m approximately. Refer to Appendix C for the existing topographical land survey.

The proposed development consists of the demolition of the existing residential units and hard areas making way for the construction of 16 No. new residential units and associated parking and hard areas. Refer to Appendix D for the proposed site layout.

DRAINAGE DESIGN PROPOSALS

A site investigation report was carried in Jun 2018 by Integral Geotechnique and the report concluded that Soakaways were not recommended for use on this site, extract as follows:

8.6 Storm Water Drainage

> *During the site investigation two soakaway tests were undertaken in general accordance of BRE 365 (2016) but on a small scale in boreholes. The soakaway tests were carried out in WS03 and WS07.*
>
> *Soakaway tests recorded negligible infiltration failing to reach a 25% outflow over a four hour period. The tests were typically undertaken between ground level and 1.00m within made ground deposits.*
>
> *The soakaway calculation sheets are presented in Annex E for reference.*
>
> *It is considered that soakaway storm water drainage is unsuitable at the site.*

Given the above it is proposed that surface water serving the new residential development will discharge (as existing situation) to the existing 950 x 675mm brickwork public combined sewer located within Charlotte Street. Flows from the new residential development will be restricted to the existing 1 year flow and a minimum 51% betterment is to be provided for all storm events.

Foul water is proposed to gravitate to the existing public foul manhole (Ex. FW1) located within the North eastern corner of the development site.

A CCTC survey of the existing drainage serving the site was undertaken by Draintech on September 2018, generally the existing on-site drainage is in a poor condition. As a result, it's proposed to lay new foul and surface water drainage serving the new dwellings, where both foul and surface water is to be offered for adoption under a Section 104 agreement with DCWW. It is proposed to abandon the existing on-site drainage where it is proven to only serve existing (to be demolished) units. The section of public foul sewer between FW2 & EX. FW1 is to be re-laid due to its poor condition and also the existing gradient being approx. 1:178.

There is an existing 225 diameter public surface water sewer running along the northern site boundary which has live connections from the existing dwellings to the North East of the development site, this sewer will be maintained up to Ex. SW0 where it is proposed to be diverted into the existing 300 diameter public surface water sewer located with Charlotte Drive.

A copy of the DCWW record plan can be seen within Appendix C and a copy of the proposed drainage layout can be found within Appendix D.

ASSESSMENT OF EXISTING SURFACE WATER DRAINAGE

It is understood that the discharge from the existing roof and hard standing serving the existing dwellings is directed to the existing public surface water manhole located at the junction of Charlotte Drive and Charlotte Street which then connects to the existing 950 x 675mm public combined sewer running down Charlotte Street. For a plan showing the existing impermeable areas, refer to Appendix C.

The following calculations for the estimated rate of run-off from the existing impermeable areas are as follows:

- Existing total imp. area drained = 1390m^2
- Rainfall Intensity = 35mm
- Estimated run-off = (1390/10000) x 2.78 x 35 = **13.5 l/s**

Table 1.

Estimate of the existing flows for all major storm events:

Event	Growth factor	Flow
1 year	1	13.5
30 year	1.78	24.0
100 year	2.18	29.4

PROPOSED SURFACE WATER DRAINAGE ASSESSMENT

Discharge from the site will be controlled by a Hydrobrake flow control device located within Surface Water manhole SW3. A minimum 51% betterment over the existing 1 year discharge is required, as stipulated by DCWW, therefore the discharge rate from the new development is calculated as follows:

- Existing 1 Year flow = **13.5 l/s**
- Betterment = **51%**
- Controlled site discharge = 13.5 x 51%

  = **6.6 l/s**

This attenuated rate of run-off will be maintained for all events up to and including the site critical 1 in 100yr return event plus an additional 30% allowance for climate change factors.

The surface water being offered to DCWW for adoption under a section 104 agreement has been designed not to surcharge during a 1 in 2 year return event and for no flooding for all storm events up to and including a 1 in 30 year storm duration. Attenuation to cater for the 30 year event is comprised of approximately 37.5m of 825mm diameter pipe.

A private, below ground cellular attenuation tank has been provided to cater for all storm events up to and including the site critical 1 in 100 year event plus an additional 30% increase for climate change.

The entire network has been simulated for all storm durations up to and including the site critical 1 in 100 year plus an additional increase in rainfall of 30% as an allowance for climate change.

The results of the simulations are summarised in Table 2 below and a full print out can be found within Appendix E.

Table 2

Event	Site Discharge (Microdrainage – Pipe 1.001)	Existing flows (Table 1)	% Betterment over existing
1 Year	5.2	13.5	61.5%
30 Year	5.2	24.0	78.3%
100 Year	5.3	29.4	82%
100 Year + 30%cc	6.5	38.2 (Est)	83%

FOUL WATER DESIGN

The new foul water system serving the development is being offered for adoption under a Section 104 Agreement. The foul network is proposed to discharge, via gravity, to the existing public foul manhole (Ex. MH FW1) located within the North eastern corner of the development site. Microdrainage foul calculations can be found within Appendix F.

CONCLUSION

The proposed surface water system has been designed in accordance with current best practices.

The discharge from the site is designed to provide a minimum 51% betterment over the existing flows and Table 2 shows that during the greater storm events an 83% betterment is achieved. No surface flooding is generated within the site curtilage up to the site critical 1 in 100 year return event plus 30% increase in rainfall intensity as an allowance for anticipated climate change, within the design life of the development.

Considering the above, and having utilised current recommended best practices, we anticipate that the proposed development would not cause any additional overloading to the existing surface water infrastructure.

APPENDIX A -

Location Plan

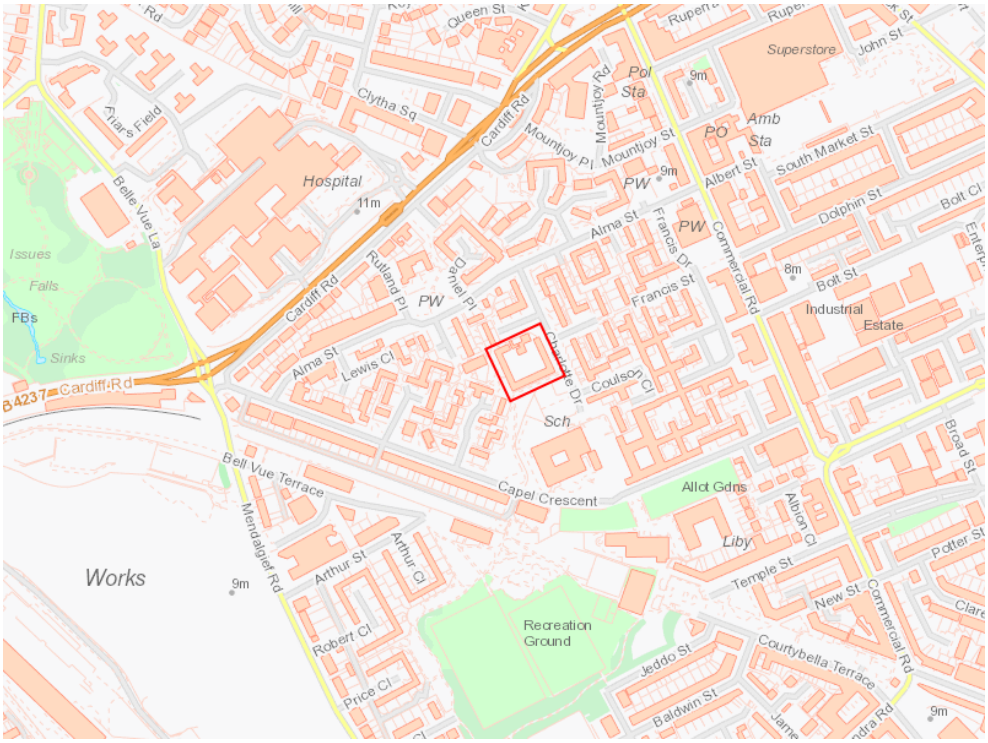

Figure 1 – Site Location Plan

Figure 2 – Existing Aerial Plan

APPENDIX B -

Earth Science Partnership

Advice note on Flooding

Kirby Daniel Court, Newport – Advice Note on Flooding
[ESP.6856b - November 2018]

Pobl Group are proposing to redevelop Kirby Daniel Court in Newport for residential housing with associated gardens, parking and access. The City of Newport, along with other South Wales cities, is relatively low lying and forecast to be affected by flooding during extreme tidal events.

As shown on Insert 1 below, the site is situated in Flood Risk Zone B (FRZ-B), which is used to describe areas that were historically affected by flooding, but are not within the contemporary flood plain. Developments of this scale in FRZ-B do not require a formal assessment of flood risk; however, to support the planning application, this advice note has been prepared to provide context.

Insert 1: Welsh Government Development Advice Map – Accessed Online (October 2018)

The proposed development layout, prepared by Bradley Associates (Ref: 16011-08[P0]) shows that all habitable areas of the site will be slightly raised to 9.4mAOD or higher, with Finished Floor Levels for the properties >9.5mAOD. A limited part of the development access road is <9.4mAOD where required to fall to the level of surrounding ground levels.

A data-output from the Natural Resources Wales (NRW) flood model has been obtained (Ref: ATI-15917a – September 2018). The forecast water levels for the "design event" used by NRW for Planning Purposes, show peak elevations as 9.34mAOD for the forecast 100-year development lifetime during the 0.5% annual probability event. Through the assumed 100-year development lifetime the development is forecast to remain dry during the 0.5% event.

For more extreme events (0.1% annual probability event) peak elevations are forecast to be 9.77mAOD and the resulting flood depths at the site are within the suggested tolerable depths as defined within *Welsh Government Technical Advice Note 15: Development and Flood Risk (2004)*. Because the mode of flooding is tidal, potential displacement effects during a flood event will not be significant.

Both Newport Council and NRW Planning officers have been consulted ahead of preparing this advice note, and on the above basis we consider the potential impacts on the development from flooding to be acceptable and tolerable within the requirements of published guidelines.

End of Advice Note

APPENDIX C -

Existing Site Survey
(16230 - 01)

DCWW Record Plan

&

Existing Contributing Area Plan.

NOTES

GENERAL:

1. All levels are in metres and refer to the station points shown on the survey drawing.
2. All dimensions are in millimeters unless stated otherwise.
3. Do not scale from this drawing use figured dimensions only.
4. All drawings to be checked prior to construction or manufacture. Any discrepancies to be reported to the Engineer immediately.
5. This drawing shall be used solely for it's intended purpose as described in the drawing title.
6. All levels and grid related to Ordnance Survey Datum derived by GPS.
7. The survey information was supplied by 3 Point Surveys Ltd.
8. Survey stations affected by the works are to be transferred by the contractor prior to the commencement of the works.

KEY TO ABBREVIATIONS

Asp	Asphalt	JB	Junction Box
B	Bollard	KO	Kerb Outlet
BB	Belisha Beacon	LP	Lamp Post
BP	Brick Paviors	MH	Manhole
BT	British Telecom Cover	NB	Name Board
BU	Bush/Shrub	OHC	Overhead Cable
CB	Telephone Control Cabinet	PO	Post
CATV	Cable Television Cover	PB	Post Box
Conc.	Concrete	RE	Rodding Eye
CPS	Concrete Paving Slabs	RG	Road Gully
DK	Drop Kerb	RS	Road Sign
Elec.	Electricity Inspection Cover	RSJ	Rolled Steel Joint
EP	Electricity Pole	RWP	Rain Water Pipe
ER	Earth Rod	Sap.	Sapling
FB	Flower Bed	SP	Sign Post
FFL	Finished Floor Level	SV	Stop Valve
FH	Fire Hydrant	SVP	Soil Vent Pipe
G	Gully	TCB	Telephone Box
GP	Gate Post	TL	Traffic Lights
GV	Gas Valve	TP	Telegraph Pole
IC	Inspection Cover	WM	Water Meter

Fence And Wall Features:

B/RW	Brick Retaining Wall
B/W	Barbed Wire
BW	Brick Wall
C/RW	Concrete Retaining Wall
CB	Close Boarded
CM	Corrugated Metal
CP/B/W	Concrete Post & Barbed Wire
CP/CL	Concrete Post & Chainlink
CP/CP	Concrete Post & Post
CP/W	Concrete Post & Wire
G/W	Gabion Wall
HR	Hand Rail
Ir	Metal Railings
Iwn	Interwoven Wood Slat
MM	Metal Mesh
L/L	Larch Lap
S/RW	Stone Retaining Wall
Wlap	Wood Lap
WP/B/W	Wood Post & Barbed Wire
WP/R	Wood Post & Rail
WP/W	Wood Post & Wire

Drainage Features:

CL	Cover Level
IL	Invert Level
FWS	Foul Water Sewer
SWS	Storm Water Sewer
CWS	Combined Water Sewer
UTL	Unable To Lift
Ø	Pipe Diameter (mm)
SL	Soffit Level
←	Arrow indicates direction of flow
WL	Water Level with date and time taken

Embankment

9 EXISTING TREE (SPREAD - NEAREST METRE)
D. DIAMETER
S. SPREAD

Station Coordinates			
Station	Easting	Northing	Level
S1	331297.162	187079.819	9.035
S2	331282.035	187114.264	9.160
S3	331274.494	187149.184	9.118
S4	331238.435	187115.919	9.506
S5	331214.924	187103.392	9.311
S6	331242.759	187055.804	9.241
S7	331265.697	187118.219	9.368
S8	331261.076	187098.458	9.158
S9	331272.493	187089.381	9.139
S10	331254.953	187081.704	9.173
S11	331245.244	187091.502	9.293
S12	331243.697	187104.770	9.157
S13	331251.999	187108.892	9.404
S14	331249.979	187113.813	9.359

Rev.	Description	Drawn	Date

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PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
KIRBY DANIEL COURT
NEWPORT

DRAWING
EXISTING SITE SURVEY

Drawn	Checked	Date	Scale
S.A.M.	P.B.	Nov.18	1:200

Drawing Size	Job No.	Drawing No.	Rev.
A1	16230	01	-

DRAWING STATUS: P = PRELIMINARY T = TENDER C = CONSTRUCTION

Dŵr Cymru
Welsh Water

Kirby Daniel Court, Newport

N
W E
S

LEGEND(Representative of most common features)

Waste network:

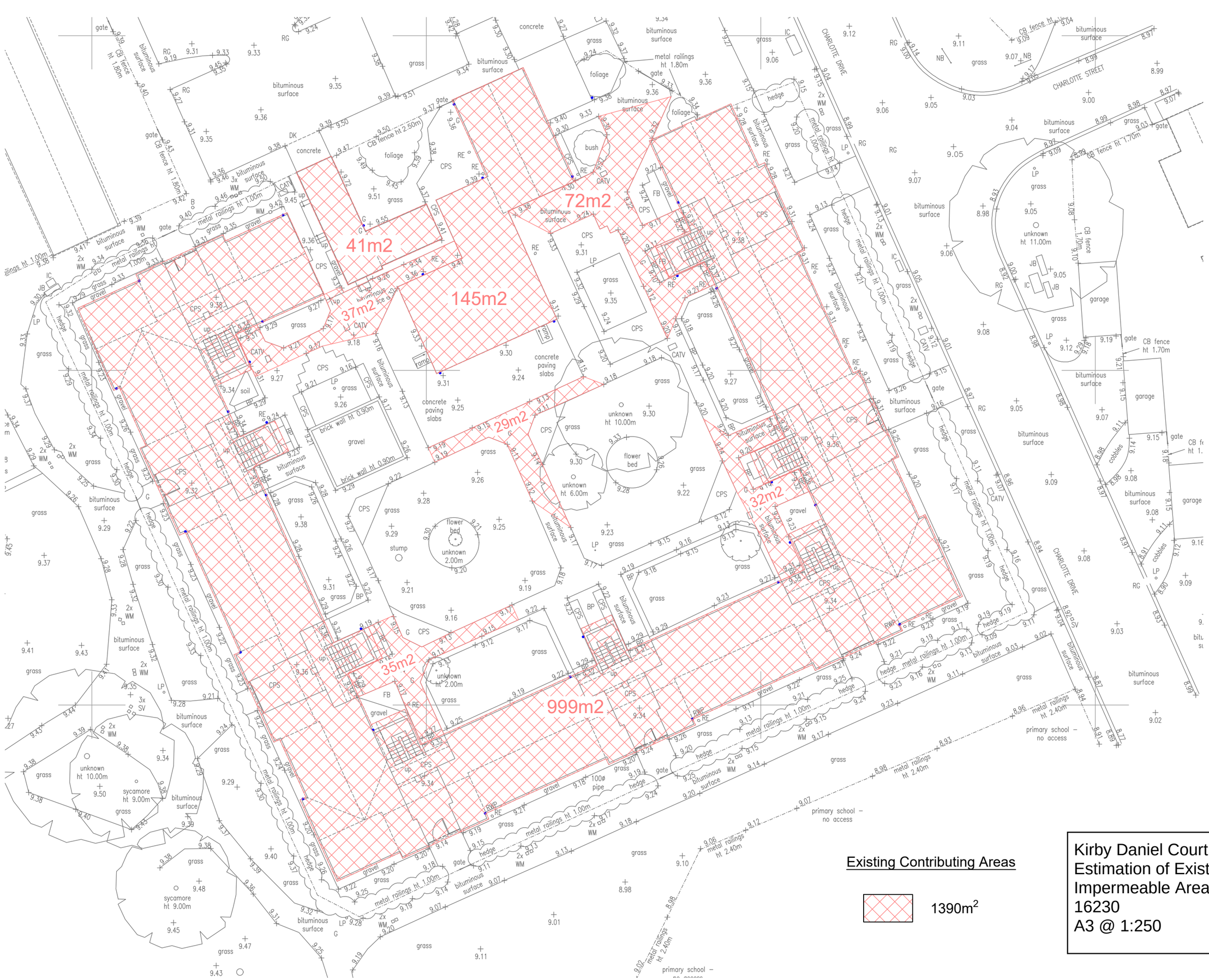
- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow (CO)
- Special purpose chamber (SPC)
- Treatment works
- Pumping station
- Outfall
- Lamphole (LH)
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement (S 104)
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

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

Notes:

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

Map Ref:	331254,187106
Map scale:	1:1500
Printed by:	Parker Amanda
Printed on:	17 Jan 2018


41m2
37m2
145m2
72m2
29m2
35m2
999m2
32m2
CHARLOTTE DRIVE
CHARLOTTE STREET
CB fence ht 1.80m
CB fence ht 2.50m
CB fence ht 1.70m
metal railings ht 1.00m
metal railings ht 2.40m
brick wall ht 0.90m
primary school – no access
unknown ht 10.00m
unknown ht 11.00m
unknown ht 6.00m
unknown ht 2.00m
sycamore ht 9.00m
flower bed
concrete paving slabs
bituminous surface
garage
cobbles
Existing Contributing Areas
1390m2
Kirby Daniel Court
Estimation of Existing Impermeable Areas
16230
A3 @ 1:250

APPENDIX D -

Proposed Drainage Layout
(16230 - 09)

&

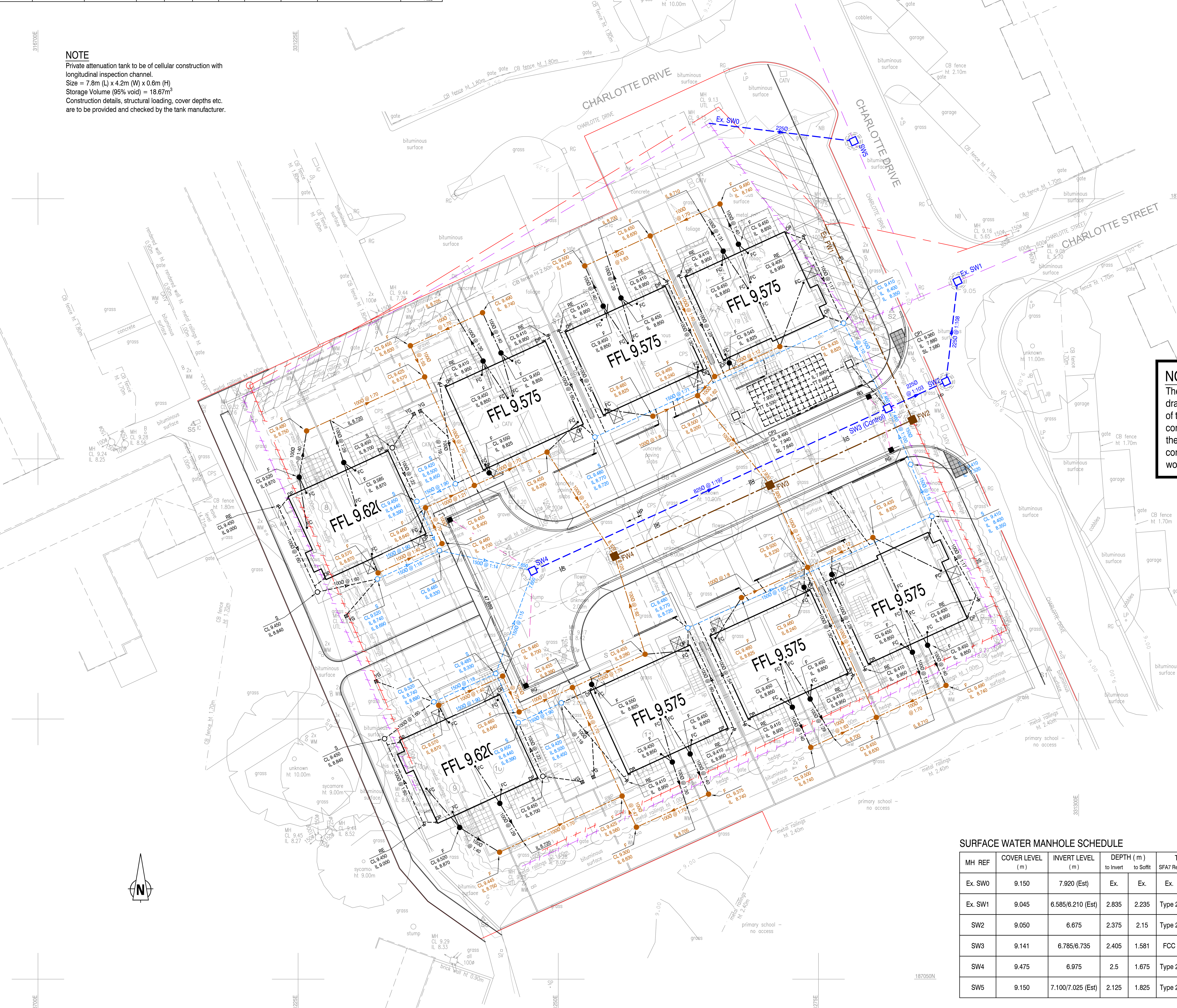
Contributing Area Plan

FOUL WATER MANHOLE SCHEDULE

MH REF	COVER LEVEL (m)	INVERT LEVEL (m)	DEPTH (m) to Invert	DEPTH (m) to Soffit	TYPE SFA7 Ref	TYPE Material	SIZE (mm)	COVER (mm)	REMARKS	PLAN
Ex. FW1	9.210	7.570	1.640	1.490	Ex.	Ex.	Ex.	Ex. Ex.	Benching modified to suit new 150Ø connection.	Ex. 150Ø, Ex. 150Ø, 150Ø
FW2	9.098	7.710	1.388	1.238	Type C*	BWK	1220 x 675	D400 1220 x 600	-	150Ø, 150Ø
FW3	9.464	7.880	1.584	1.434	Type C	BWK	1220 x 675	D400 1220 x 600	2 No. 100Ø branch connections IL = 7.930m.	100Ø, 150Ø, 150Ø, 100Ø
FW4	9.536	8.120/8.070	1.466	1.316	Type C*	BWK	1220 x 675	D400 1220 x 600	1 No. 100Ø branch connection IL = 8.120m.	100Ø, 150Ø, 100Ø

NOTE

Private attenuation tank to be of cellular construction with longitudinal inspection channel.
Size = 7.8m (L) x 4.2m (W) x 0.6m (H)
Storage Volume (95% void) = 18.67m^3
Construction details, structural loading, cover depths etc. are to be provided and checked by the tank manufacturer.



NOTE

The line and level of all existing drainage and services in the area of the proposed works are to be confirmed on site and reported to the Engineer for checking prior to the commencement of any drainage works on site.

Legend

- Existing Foul Sewer.
- Existing Foul Sewer to be Abandoned
- Existing Surface Water Sewer.
- Existing Surface Water Sewer to be Abandoned.
- Existing Drainage Easement
- Proposed Adoptable Foul Sewer.
- Proposed Adoptable Foul Lateral Drain.
- Proposed Private Foul Drain.
- Proposed Adoptable SW Sewer.
- Proposed Adoptable SW Lateral Drain.
- Proposed Private SW Drain.
- DP Proposed Rainwater Downpipe *.
- FC Proposed Foul Connection Point *.
- RG Proposed Road Gully.
- YG Proposed Drainage Channel.
- Proposed Drainage Channel.

Note.
* Exact position, number and type of internal foul connections and external rainwater down pipes to be checked and confirmed by the Architect prior to start on site. Architect to provide setting out information for all internal foul connections.

NOTES

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3. Do not scale from this drawing use figured dimensions only.
4. All drawings to be checked prior to construction or manufacture. Any discrepancies to be reported to the Engineer immediately.
5. This drawing shall be used solely for it's intended purpose as described in the drawing title.

ADOPTABLE DRAINAGE:

1. All sewers which are the subject of a Section 104 Agreement are to be designed and constructed in accordance with the "Sewer's for Adoption 7th Edition" and to the satisfaction of Dwr Cymru Welsh Water.
2. The developer must self-vet and certify that the design criteria, material standards and workmanship specifications for the proposed adoptable sewers are in accordance with those set out in 'Sewers for Adoption' (SFA) 7th Edition and the requirements of Dwr Cymru Welsh Water (DCWW) as the statutory Sewerage Undertaker.
3. All sewers are to have class S bed and surround unless otherwise shown.
4. All road gully spur connections to be 150mm dia.
5. All sewer trenches located within the proposed roads are to be backfilled with stone unless specific written approval to return excavated material is sought and received from the Local Authorities Engineer.
6. All easements to adoptable drains shall be free of all services.
7. Installation of structured wall plastic pipes must be carried out by a contractor who is accredited to the British Plastics Federation - Plastic Pipe Group. A certificate confirming the contractors accreditation must be supplied to DCWW. Individual pipe lengths must not exceed 3m.
8. When in a highway the outside of the sewer should be at least 1m from the kerb line. The outside of manhole (to include the 150mm concrete surround) should be at least 0.5m from the kerb line.
9. Pipe saddle connections are not permitted. Connections should be made either directly to a manhole chamber or via a pre-formed pipe junction.
10. All pipework beneath carriageways and vehicular circulation areas and within 1.0m of such areas shall, where cover to the pipes is less than 1.2m, receive a full concrete bed and surround.
11. Full concrete surround is required at all pipe crossing locations within the adoptable highway.
12. The length of pipework between manholes to include for any short length pipes as necessary to achieve the configuration of rocker pipes and standard short length pipes at fixed manhole positions.
13. All pipework built into manholes to be either standard short lengths or cut lengths as appropriate.
14. Rocker pipes to be a maximum of 600mm long.

Note - Inspection Chambers.

250Ø inspection chamber 0.45m - 0.6m deep. Sewers For Adoption 7, Type 4 (Flexible material).

315Ø inspection chamber 0.6m - 0.9m deep. Sewers For Adoption 7, Type 4 (Flexible material).

450Ø inspection chamber 0.6m - 0.9m deep. Sewers For Adoption 7, Type 3 (Flexible material).

NB. Inspection chambers greater than 1m deep to be Sewers For Adoption 7, Type 3 (Flexible material), 450Ø with 350mm access restriction which prevents man-entry (e.g. Osmadrain universal inspection chamber with 6D931 cover and frame). Alternatively a standard manhole construction can be used.

SURFACE WATER MANHOLE SCHEDULE

MH REF	COVER LEVEL (m)	INVERT LEVEL (m)	DEPTH (m) to Invert	DEPTH (m) to Soffit	TYPE SFA7 Ref	TYPE Material	SIZE (mm)	COVER (mm)	REMARKS	PLAN
Ex. SW0	9.150	7.920 (Est)	Ex.	Ex.	Ex.	Ex.	Ex.	Ex. Ex.	Benching modified to suit new 225Ø outlet pipe. Invert level to checked and confirmed on site.	Ex. 225Ø, 225Ø
Ex. SW1	9.045	6.585/6.210 (Est)	2.835	2.235	Type 2	PC	1500Ø	D400 675 x 675	New manhole built over line of existing 600Ø public foul sewer. IL to be checked and confirmed on site.	Ex. 600Ø, 225Ø
SW2	9.050	6.675	2.375	2.15	Type 2	PC	1200Ø	D400 675 x 675	-	225Ø, 225Ø
SW3	9.141	6.785/6.735	2.405	1.581	FCC	PC	2400Ø	D400 675 x 675	Flow Control Chamber (FCC) refer to detailed drawing.	150Ø, 225Ø, 825Ø, 150Ø
SW4	9.475	6.975	2.5	1.675	Type 2	PC	1800Ø	D400 675 x 675	3 No. 150Ø branch connection IL = 7.650m.	150Ø, 150Ø, 825Ø, 150Ø, 150Ø
SW5	9.150	7.100/7.025 (Est)	2.125	1.825	Type 2	PC	1200Ø	D400 675 x 675	New manhole built over line of existing 300Ø public surface water sewer. IL to be confirmed on site.	Ex. 300Ø, 225Ø, Ex. 300Ø

Rev.	Description	Drawn	Date

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PROPOSED RESIDENTIAL DEVELOPMENT
KIRBY DANIEL COURT
NEWPORT

DRAWING
PROPOSED DRAINAGE LAYOUT

Drawn	Checked	Date	Scale
S.A.M.	P.B.	Nov.18	1:200

Drawing Size	Job No.	Drawing No.	Rev.
A1	16230	09	-

DRAWING STATUS: P = PRELIMINARY T = TENDER C = CONSTRUCTION

Kirby Daniel Court
Contributing Area Plan
16230
A3 @ NTS

Existing Contributing Areas

- 1.000 - 742m²
- 1.001 - 950m²

APPENDIX E -

Microdrainage Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.308	Minimum Backdrop Height (m)	1.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.155	4-8	0.014

Total Area Contributing (ha) = 0.169

Total Pipe Volume (m^3) = 20.984

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	37.500	0.190	197.4	0.074	4.00	0.0	0.600	o	825	Pipe/Conduit	
2.000	7.740	0.040	193.5	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	6.160	0.060	102.7	0.095	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	9.700	0.090	107.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.30	6.975	0.074	0.0	0.0	0.0	2.11	1127.8	10.0
2.000	50.00	4.14	7.890	0.000	0.0	0.0	0.0	0.94	37.2	0.0
1.001	50.00	4.38	6.735	0.169	0.0	0.0	0.0	1.29	51.3	22.9
1.002	49.95	4.50	6.675	0.169	0.0	0.0	0.0	1.26	50.1	22.9

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
SW4	9.450	2.475	Open Manhole	1800	1.000	6.975	825				
CP1	9.360	1.470	Open Manhole	1200	2.000	7.890	225				
SW3	9.141	2.406	Open Manhole	2400	1.001	6.735	225	1.000	6.785	825	650
								2.000	7.850	225	1115
SW2	9.055	2.380	Open Manhole	1200	1.002	6.675	225	1.001	6.675	225	
Ex. SW1	9.045	2.460	Open Manhole	0		OUTFALL		1.002	6.585	225	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	825	SW4	9.450	6.975	1.650	Open Manhole	1800
2.000	o	225	CP1	9.360	7.890	1.245	Open Manhole	1200
1.001	o	225	SW3	9.141	6.735	2.181	Open Manhole	2400
1.002	o	225	SW2	9.055	6.675	2.155	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	37.500	197.4	SW3	9.141	6.785	1.531	Open Manhole	2400
2.000	7.740	193.5	SW3	9.141	7.850	1.066	Open Manhole	2400
1.001	6.160	102.7	SW2	9.055	6.675	2.155	Open Manhole	1200
1.002	9.700	107.8	Ex. SW1	9.045	6.585	2.235	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	Ex. SW1	9.045	6.585	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.308		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SW3, DS/PN: 1.001, Volume (m³): 30.0

Unit Reference	MD-SHE-0101-6600-2400-6600
Design Head (m)	2.400
Design Flow (l/s)	6.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	101
Invert Level (m)	6.735
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.400	6.6	Kick-Flo®	0.902	4.2
Flush-Flo™	0.441	5.2	Mean Flow over Head Range	-	5.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.7	2.000	6.1	4.000	8.4	7.000	10.9
0.200	4.7	1.000	4.4	2.200	6.3	4.500	8.9	7.500	11.3
0.300	5.1	1.200	4.8	2.400	6.6	5.000	9.3	8.000	11.7
0.400	5.2	1.400	5.1	2.600	6.8	5.500	9.8	8.500	12.0
0.500	5.2	1.600	5.5	3.000	7.3	6.000	10.2	9.000	12.3
0.600	5.2	1.800	5.8	3.500	7.9	6.500	10.6	9.500	12.7

Storage Structures for Storm

Cellular Storage Manhole: CP1, DS/PN: 2.000

Invert Level (m) 7.930 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	32.7	0.0	0.600	32.7	0.0	0.601	0.0	0.0

Manhole Headloss for Storm

PN	US/MH Name	US/MH Headloss
1.000	SW4	0.500
2.000	CP1	0.500
1.001	SW3	0.500
1.002	SW2	0.500

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	SW4	6.298	20.046	0.000	26.344
2.000	CP1	1.663	0.308	18.649	20.620
1.001	SW3	10.884	0.245	0.000	11.129
1.002	SW2	2.692	0.386	0.000	3.077
Total		21.537	20.984	18.649	61.171

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	SW4	6.298	18.923	0.000	25.222
2.000	CP1	1.663	0.236	18.649	20.548
1.001	SW3	10.884	0.173	0.000	11.058
1.002	SW2	2.692	0.362	0.000	3.054
Total		21.537	19.695	18.649	59.881

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.308	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW4	30 Winter	1	+0%	30/60 Winter				7.117	-0.683	0.000
2.000	CP1	60 Winter	1	+0%	100/15 Winter				7.890	-0.225	0.000
1.001	SW3	30 Winter	1	+0%	1/15 Summer				7.117	0.157	0.000
1.002	SW2	30 Winter	1	+0%					6.728	-0.172	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW4	0.01		7.2	OK	
2.000	CP1	0.00		0.0	OK	
1.001	SW3	0.15		5.2	SURCHARGED	
1.002	SW2	0.13		5.2	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.308	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW4	15 Summer	1	+0%	30/60 Winter				7.070	-0.730	0.000
2.000	CP1	60 Winter	1	+0%	100/15 Winter				7.890	-0.225	0.000
1.001	SW3	30 Winter	1	+0%	1/15 Summer				7.117	0.157	0.000
1.002	SW2	30 Winter	1	+0%					6.728	-0.172	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW4	0.01		9.4	OK	
2.000	CP1	0.00		0.0	OK	
1.001	SW3	0.15		5.2	SURCHARGED	
1.002	SW2	0.13		5.2	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.308	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW4	60 Winter	30	+0%	30/60 Winter				7.904	0.104	0.000
2.000	CP1	60 Winter	30	+0%	100/15 Winter				7.898	-0.217	0.000
1.001	SW3	60 Winter	30	+0%	1/15 Summer				7.904	0.944	0.000
1.002	SW2	60 Winter	30	+0%					6.728	-0.172	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW4	0.01		11.0	SURCHARGED	
2.000	CP1	0.00		0.0	OK	
1.001	SW3	0.15		5.2	SURCHARGED	
1.002	SW2	0.13		5.2	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.308	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW4	15 Summer	30	+0%	30/60 Winter				7.407	-0.393	0.000
2.000	CP1	60 Winter	30	+0%	100/15 Winter				7.898	-0.217	0.000
1.001	SW3	480 Winter	30	+0%	1/15 Summer				7.185	0.225	0.000
1.002	SW2	480 Winter	30	+0%					6.728	-0.172	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW4	0.02		20.2	OK	
2.000	CP1	0.00		0.0	OK	
1.001	SW3	0.15		5.2	SURCHARGED	
1.002	SW2	0.13		5.2	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.308	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW4	120 Winter	100	+30%	30/60 Winter				9.048	1.248	0.000
2.000	CP1	120 Winter	100	+30%	100/15 Winter				9.049	0.934	0.000
1.001	SW3	120 Winter	100	+30%	1/15 Summer				9.049	2.089	0.000
1.002	SW2	120 Winter	100	+30%					6.734	-0.166	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW4	0.02		14.2	SURCHARGED	
2.000	CP1	0.15		4.5	SURCHARGED	
1.001	SW3	0.19		6.5	FLOOD RISK	
1.002	SW2	0.16		6.5	OK	

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

Simulation Criteria

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

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.000	Cv (Summer) 0.750
Region England and Wales		Ratio R 0.308	Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	SW4	15 Summer	100	+30%	30/60 Winter				8.131	0.331	0.000
2.000	CP1	120 Winter	100	+30%	100/15 Winter				9.049	0.934	0.000
1.001	SW3	120 Winter	100	+30%	1/15 Summer				9.049	2.089	0.000
1.002	SW2	120 Winter	100	+30%					6.734	-0.166	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	SW4	0.04		33.1	SURCHARGED	
2.000	CP1	0.15		4.5	SURCHARGED	
1.001	SW3	0.19		6.5	FLOOD RISK	
1.002	SW2	0.16		6.5	OK	

APPENDIX F -

Microdrainage Foul Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	222.00	Maximum Backdrop Height (m)	1.500
Persons per House	3.00	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	16.410	0.190	86.4	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
1.001	15.060	0.170	88.6	0.000	8	0.0	1.500	o	150	Pipe/Conduit	
1.002	20.540	0.140	146.7	0.000	0	0.0	1.500	o	150	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	8.070	0.000	0.0	8	0.0	16	0.37	0.94	16.7	0.4
1.001	7.880	0.000	0.0	16	0.0	22	0.46	0.93	16.5	0.7
1.002	7.710	0.000	0.0	16	0.0	25	0.39	0.72	12.8	0.7

Manhole Schedules for Foul - Main

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
FW4	9.536	1.466	Open Manhole	1200	1.000	8.070	150				
FW3	9.464	1.584	Open Manhole	1200	1.001	7.880	150	1.000	7.880	150	
FW2	9.098	1.388	Open Manhole	1200	1.002	7.710	150	1.001	7.710	150	
FW1	9.210	1.640	Open Manhole	0		OUTFALL		1.002	7.570	150	

PIPELINE SCHEDULES for Foul - Main

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	FW4	9.536	8.070	1.316	Open Manhole	1200
1.001	o	150	FW3	9.464	7.880	1.434	Open Manhole	1200
1.002	o	150	FW2	9.098	7.710	1.238	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	16.410	86.4	FW3	9.464	7.880	1.434	Open Manhole	1200
1.001	15.060	88.6	FW2	9.098	7.710	1.238	Open Manhole	1200
1.002	20.540	146.7	FW1	9.210	7.570	1.490	Open Manhole	0

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.002	FW1	9.210	7.570	0.000	0	0