Drainage Design Report for a

Proposed Residential Development off Church Street, Crowle North Lincolnshire DN17 4LF

Prepared for

Mr P Jackson

Issue 01

June 2020

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Date	:	2nd June 2020

1.0 INTRODUCTION

1.1. Planning Approval was obtained for the site off Church St, Crowle. North Lincolnshire, DN17 4LF. The Planning Reference is PA/2018/1391

1.2. Condition 22 of the approval requires that no development shall commence until a surface water drainage scheme is approved by the Local Planning Authority.

1.3. The Decision Notice also contained an Informative Note requiring that the surface water drainage scheme for this site and the site next door should be combined into one scheme discharging to the Severn Trent surface water sewer.

1.4. A shared drainage system was agreed provisionally for the both developments, connecting to an off site Severn Trent Surface Water Sewer. The system was hydraulically modelled and showed compliance with the 1 in 100 year plus climate change event and approval was obtained from NLC Drainage Engineers.

1.5. However, the Developers of the two sites have has a disagreement and as combined surface water system serving both sites is no longer possible. The Developers of the site to the north have designed and installed their own system. Therefore, the Developers of this site are now required to design and install their own independent system.

1.6. This has involved containing a reduced amount of storage wholly within the boundary of PA/2018/1391 and re-routing the discharge through the southern boundary of the site and then west, to the same discharge point on the existing Severn Trent surface water sewer.

1.7. This report provides information on the revised the hydraulic design requested by the Council, but for the PA/2018/1391 site only.

2.0 PROPOSED DEVELOPMENTS

2.1. The development is shown on Drawing 696-001 contained in Appendix 1.

2.2. The development comprises of

a) 345m^2 of new roof areas

b) 253m^2 of new shared access road, parking bays and footpaths

3.0 SURFACE WATER MANAGEMENT STRATEGY

3.1. Discussions between the Developers and North Lincolnshire Council Drainage Engineers (NLCDE) revealed that NLCDE had reservations that a surface water drainage system based wholly on discharge via infiltration would not be effective for the lifetime of the development.

3.2. This has been repeated in the Informative Note on the planning decision.

3.3. The location of the existing 300mm public surface water sewer has been established as being in the access road at the north of the block of flats to the west of the site. It is understood that this access road is not adopted highway but in the ownership or North Lincolnshire Council Housing Department.

3.4. There is a route for the surface water drainage to the existing sewer which laying a new sewer in the un-adopted road that is owned by NLC Housing Department.

3.5. It is understood that North Lincolnshire Housing Department have agreed to the sewer being constructed in their land.

3.6. The 300mm public surface water sewer only runs for approximately 80m to the west before it discharges to an open ditch. A copy of the Severn Trent Sewer Record Drawing is provided in Appendix 1.

3.7. Although this is the third preferred option in the 'Hierarchy of Drainage' in Part H of Building regulations it can be viewed as close as practical to the second preferred option of discharge to a watercourse.

3.8. Severn Trent Water has been approached and confirmed that a controlled discharge to this sewer is acceptable.

3.9. There are no areas of public open space available so the option of surface features is not available.

3.10. The previous surface water drainage design serving both sites also had a shared access road. This has now been removed and vehicular access will be from the south.

3.11. Previously, with road access from the north the southern end of the access road could be set higher than the road to the south. However, now access is to be taken from it the levels need to tie in and the southern end of the access road is approximately 0.5m lower than the previous scheme.

3.12. Having a soffit to soffit connection to the existing 300mm Severn Trent Surface Water sewer and a 150mm outlet pipe laid at the minimum gradient of 1 in 150 means that the lowest level of the new surface water pipe at the entrance to the site is 4.075m. With the road level at around 4.5m this only leaves 340mm cover to the pipe.

3.13. The reduced cover effectively rules out storage solutions based on oversized pipes, as proposed for the previous shared drainage scheme.

3.14. The only practical alternative is to provide attenuation in the permeable sub-base of the access road and parking areas with a controlled discharge to the Severn Trent Surface Water sewer.

3.15. Roof drainage would be discharged directly to the permeable sub-base after passing through suitable silt traps.

4.0 CLIMATE CHANGE

4.1. The Environment Agency in February 2016 has published updated information on Climate Change. The new guidance advises that for more vulnerable developments in Anglian Region the Flood Risk should be assessed against climate change allowances of 35% and 65% for river flows and increases in peak rainfall intensity of up to 40%.

4.2. It should be noted that the projected increase peak rainfall intensities do not result in a similar increase in storage volume required i.e. peak intensity may increase by up to 40% but average rainfall will not increase by the same amount.

4.3. Previous guidance published by the Environment Agency states that for the period in which peak rainfall intensities may rise by up to 30%, the increase in the volume of run-off would only increase by 20%. Therefore it is reasonable to assume that for a 40% increase in rainfall intensity the increase in volume of run-off will not increase by more than 30%

5.0 OUTLINE DESIGN OF THE PROPOSED SURFACE WATER DRAINAGE SYSTEM

5.1. The floor levels of the proposed dwellings have been selected by others to tie in with existing ground levels, planning requirements and the adjacent site.

5.2. This results in a north to south fall across the site of approximately 1.0m, a gradient of 1 in 17. To provide storage in the permeable sub-base, this would require the bottom of the sub-base to be level resulting in over 1.3m thickness at the northern end.

5.3. This would be un-economical and the upper part of the sub-base would not provide any storage, as before it could fill it would flow out of the surface at the lower end.

5.4. This could be prevented by stepping the sub-base follow and incorporating a number of check dams within the sub-base. Flow control between the check dams would be required and with the discharge of the roof water.

5.5. Stepping the sub-base was considered over complicated fro this small site. Instead it is proposed to install the northern half of the access road and parking along with the parking to the two detached houses at the higher level.

5.6. The roof drainage from all the properties can be discharged to the permeable sub-base to the higher area and discharged at a controlled rate.

5.7. The southern half of the access road and parking will then slope down to meet the existing road beyond the southern boundary. As this section of road and car parking will only need to deal with the rainfall falling on it and a small area of adjacent footpath, there is sufficient capacity in the lower half of the sub-base so that the stored water level will be lower than the top of the lowest section of sub-base.

5.8. As the depth of storage is limited to the depth of permeable sub-base, flow control using devices such as a hydro-brake is not practical. Therefore, it is proposed to control the outflow with the use of rainwater diffuser/collection units such as Permavoid manufactured by Polypipe. Details are provided in Appendix 1

5.9. A single unit has dimensions of 708 x 354 x150mm deep. Flow in/out of the unit is limited by the permeability of the surrounding Type 3 sub-base, which is nominally 3600mm/hr. Multiple units can laid together to increase the discharge but only the external faces count towards the discharge rate. Similarly, the discharge rate increases when the water levels rises above the sides to allow flow through the top of the unit.

5.10. Calculations of discharge rates for single double and triple units are presented in Appendix 1. Average flow rates are around 65% of the peak flow rate and peak flow rates vary between 1.14 to 2.57 l/s for single and triple units in 300mm of permeable sub-base.

5.11. It is proposed to use a triple unit in the upper road area and a single unit in the lower road area. This will limit the peak discharge to around 3.7 l/s. Flow rates should be confirmed with Polypipe prior to purchase of the units.

5.12. Similar units are manufactured under the trading name of Skeletank. Both these units are suitable for installation in trafficked areas.

5.13. For the upper area, calculations were undertaken on an iterative basis to determine the depth of permeable sub-base required to attenuate a 1 in 100 year storm with 30% climate change. As the depth of sub-base increases so does the peak discharge. It was determined that a 425mm depth of permeable sub-base, which increases the peak flow rate to limiting the discharge to 3.01 l/s with an average discharge of 1.96 l/s requires a permeable sub-base depth 425mm. Calculations are presented in Appendix 1.

5.14. For the lower area, a minimum sub-base depth for structural purposes of 300mm is proposed. As the sub-base is sloping only the volume of sub-base below the level of the top at the lower end is available for storage. This is approximately 25% of the total sub-base. The peak outflow for a double unit is 1.85 l/s with an average flow of 1.20 l/s. The calculation sheet provided in Appendix 1 demonstrates that there is sufficient storage volume available to attenuate flows from the 1 in 100 year plus 30% climate change event.

5.15. For the 1 in 100 year plus climate change event the peak flow discharging from the site will be 3.01 + 1.85 = 4.86 l/s but for lesser storms the discharge will be reduced, as the depth of water stored in the sub-base is lower.

5.16. In addition, subject to a suitable sub-grade, it is not proposed to tank the permeable sub-base and allow some percolation through the sub-grade. This would reduce the attenuation volume required and reduce the peak discharges due to the reduced head on the collection unit.

5.17. Calculations presented in Appendix 1 demonstrate that there is sufficient fall available to discharge the roof water drainage from the furthest properties to the rainwater disposal units located at the bottom of the permeable sub-base.

5.18. The areas of permeable sub-base will either still need to be protected from mud/silt contamination during construction or a temporary construction road installed and removed and the permeable sub-base installed after the main mud/silt generating activities have been completed.

5.19. The above surface water drainage strategy is shown on Drawing 696-002 contained in Appendix 1.

6.0 FOUL SEWERAGE

6.1. There is also a public foul sewer located to the south of the site. This sewer is shown on the Severn Trent Water Sewer Records as a 2011 transfer sewer. Investigations have been undertaken by the Developer, which indicates that this October 2011 transfer sewer actually extends close to the site.

6.2. Therefore, it is proposed to connect to the public foul sewer close to the site in the location shown on drawing 696-002.

7.0 CONCLUSIONS

7.1. This report demonstrates that the surface water drainage system shown on the drawings provides adequate storage for all storms up to and including the 1 in 100 plus 30% climate change event with the peak discharge limited to 4.86 l/s

7.2. The pipes from the last manhole on the site to the public sewer should be eligible for adoption by Severn Trent Water subject to the submission of a successful Section 104 application.

7.3. This report demonstrates that it is practical to connect the development to the public foul sewerage system.

8.0 APPENDIX 1 SUPPORTING INFORMATION

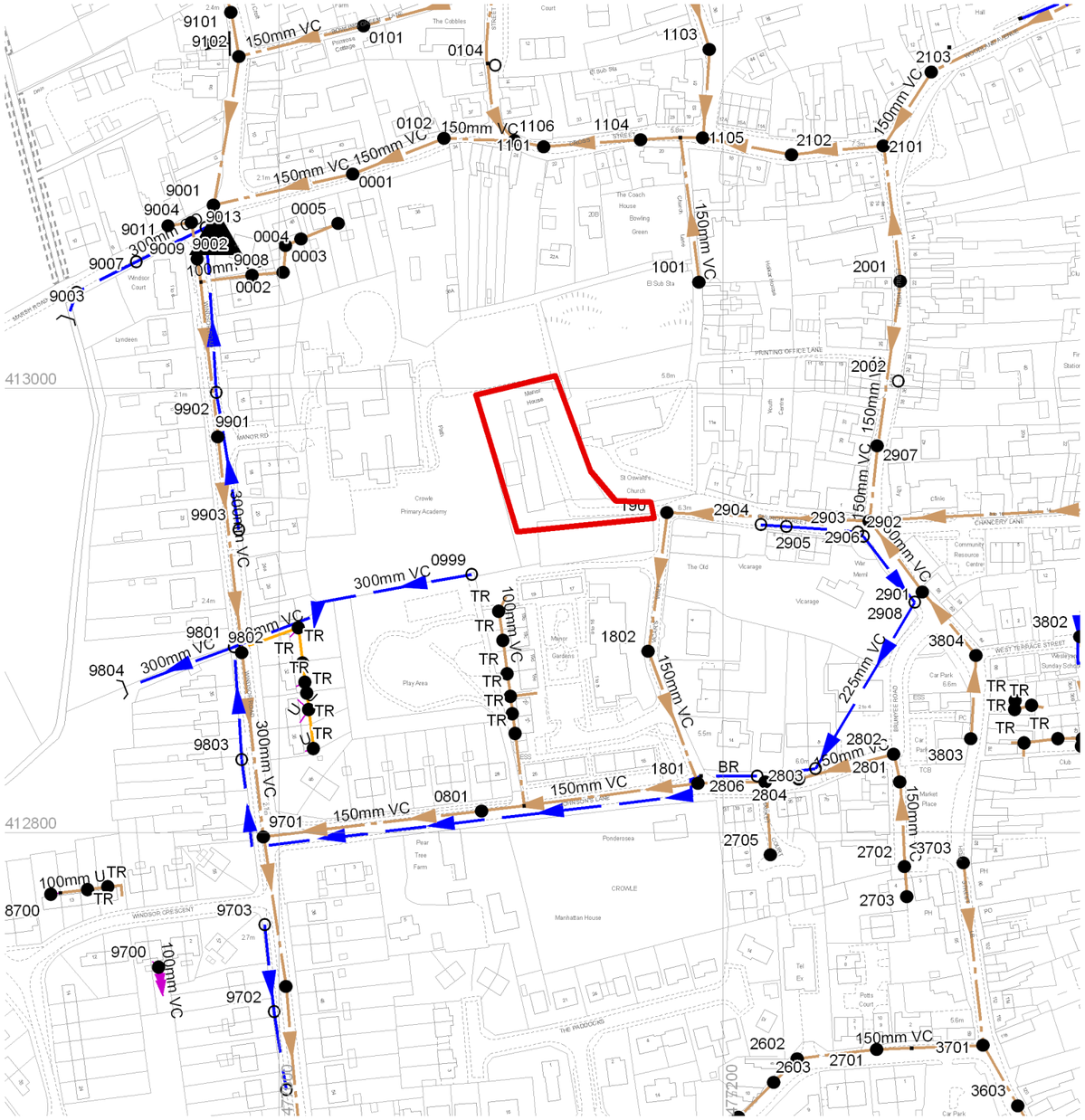
a) STW Sewer Record Drawing

b) Calculation Spreadsheets

c) Permavoid Information Sheet

d) Drawing 696-001- Proposed Development & Outline of Proposed Drainage

e) Drawing 696-00- Illustrative Section & Specification & Construction Notes



Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SE76128700	nil	nil	nil	F	U	C	100	nil	0.00	nill
SE76129701	2.80	nil	nil	F	VC	C	375	nil	0.00	1800
SE76129702	2.34	1.74	1.27	S	VC	C	225	nil	75.38	1800
SE76129703	2.75	2.16	1.75	S	VC	C	150	nil	96.83	1800
SE76129801	2.41	0.78	nil	S	VC	C	300	nil	0.00	1800
SE76129802	2.42	nil	nil	F	VC	C	300	nil	528.69	1800
SE76129803	2.69	1.15	0.79	S	VC	C	300	nil	143.39	1800
SE76129901	2.20	nil	nil	F	VC	C	300	nil	371.73	1800
SE76129902	2.34	1.40	0.94	S	VC	C	225	nil	161.85	1800
SE76129903	2.56	1.91	1.41	S	VC	C	150	nil	125.96	1800
SE76139001	2.05	0.91	0.57	F	PP	C	150	nil	30.18	2011
SE76139002	2.05	0.93	0.81	S	CO	C	300	nil	292.17	1800
SE76139004	2.06	nil	nil	F	VC	C	300	nil	0.00	1800
SE76139006	2.27	0.46	nil	S	CO	C	450	nil	9.74	1800
SE76139007	2.49	0.80	0.49	S	CO	C	300	nil	98.81	1800
SE76139008	2.31	1.17	nil	F	VC	C	100	nil	0.00	1800
SE76139009	nil	nil	nil	F	VC	C	300	nil	0.00	1800
SE76139011	2.13	1.00	0.82	F	PP	C	150	nil	56.67	2011
SE76139101	2.35	0.67	0.65	F	VC	C	225	nil	1011.00	1800
SE76139102	2.33	0.63	0.40	F	VC	C	225	nil	295.22	1800
SE77120701	2.54	nil	nil	F	VC	C	300	nil	293.54	1800
SE77120801	3.99	1.64	nil	F	VC	C	150	nil	41.32	1800
SE77120999	nil	nil	0.79	S	VC	C	300	nil	0.00	1800
SE77121801	5.41	2.49	1.64	F	VC	C	150	nil	116.56	1800
SE77121802	6.10	4.36	3.92	F	VC	C	150	nil	144.14	1800
SE77121901	6.28	4.68	4.36	F	VC	C	150	nil	198.59	1800
SE77122602	4.04	2.46	1.87	F	VC	C	150	nil	25.20	1800
SE77122603	3.52	1.82	1.42	F	VC	C	150	nil	56.58	1800
SE77122701	4.73	2.72	2.48	F	VC	C	150	nil	147.04	1800
SE77122702	6.90	5.33	4.68	F	VC	C	150	nil	57.00	nill
SE77122703	6.71	5.43	5.40	F	VC	C	150	nil	451.33	nill
SE77122705	5.51	3.30	2.83	F	VC	C	150	nil	68.23	1800
SE77122801	6.41	3.31	3.25	F	VC	C	150	nil	211.00	1800
SE77122802	6.32	3.24	2.93	F	VC	C	150	nil	142.81	1800
SE77122803	5.69	4.72	4.68	S	VC	C	300	nil	696.25	1800
SE77122804	5.65	2.92	2.83	F	VC	C	150	nil	177.00	1800
SE77122806	5.42	4.67	nil	S	BR	R	330	270	0.00	1800
SE77122808	5.42	2.70	2.51	F	VC	C	150	nil	157.95	1800
SE77122901	6.70	5.34	5.16	F	VC	C	150	nil	222.22	1800
SE77122902	6.84	5.43	5.36	S	VC	C	150	nil	534.43	1800
SE77122903	6.59	5.44	5.44	S	VC	C	150	nil	0.00	1800
SE77122904	6.83	6.34	5.57	S	VC	C	150	nil	14.47	1800
SE77122905	6.16	5.56	5.48	S	VC	C	150	nil	411.25	1800
SE77122906	6.86	5.15	4.70	F	VC	C	150	nil	202.62	1800

- Abandoned Gravity Sewer
- Private Combined Gravity Sewer
- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)

All Private Sewers are shown in magenta
All section 104 sewers are shown in green
All Sewers that have been transferred to Severn Trent Water after the 1st October 2011, but have not been surveyed and confirmed by Severn Trent Water are shown in orange

- Culverted Watercourse
- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Housing, Building
- Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet

- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor

- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Pre-1937 Properties

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.

B. Where the node bifurcates (splits) X and Y indicates downstream sewer pipe.

C. Gradient is stated a 1 in...

MATERIALS

- - NONE
- AC - ASBESTOS CEMENT
- BR - BRICK
- CC - CONCRETE BOX CULVERT
- CI - CAST IRON
- CO - CONCRETE
- CSB - CONCRETE SEGMENTS (BOLTED)
- CSU - CONCRETE SEGMENTS (UNBOLTED)
- DI - DUCTILE IRON
- GRC - GLASS REINFORCED CONCRETE
- GRP - GLASS REINFORCED PLASTIC
- MAC - MASONRY IN REGULAR COURSES
- MAR - MASONRY RANDOMLY COURSED
- PE - POLYETHLENE
- PF - PITCH
- PP - POLYPROPYLENE
- PSC - PLASTIC STEEL COMPOSITE
- PVC - POLYVINYL CHLORIDE
- RPM - REINFORCED PLASTIC MATRIX
- SI - SPUN (GREY) IRON
- ST - STEEL
- U - UNKNOWN
- VC - VITRIFIED CLAY
- XXX - OTHER

SHAPE

- C - CIRCULAR
- E - EGG SHAPED
- O - OTHER
- R - RECTANGLE
- S - SQUARE
- T - TRAPEZOIDAL
- U - UNKNOWN

PURPOSE

- C - COMBINED
- E - FINAL EFFLUENT
- F - FOUL
- L - SLUDGE
- S - SURFACE WATER

CATEGORIES

N / W / E / S

- W - WEIR
- C - CASCADE
- DB - DAMBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SIPHON
- HD - HIGHWAY DRAIN
- S104 - SECTION 104

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD (Tabular)

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Date of issue: 05.07.18
Sheet No. 1 of 2

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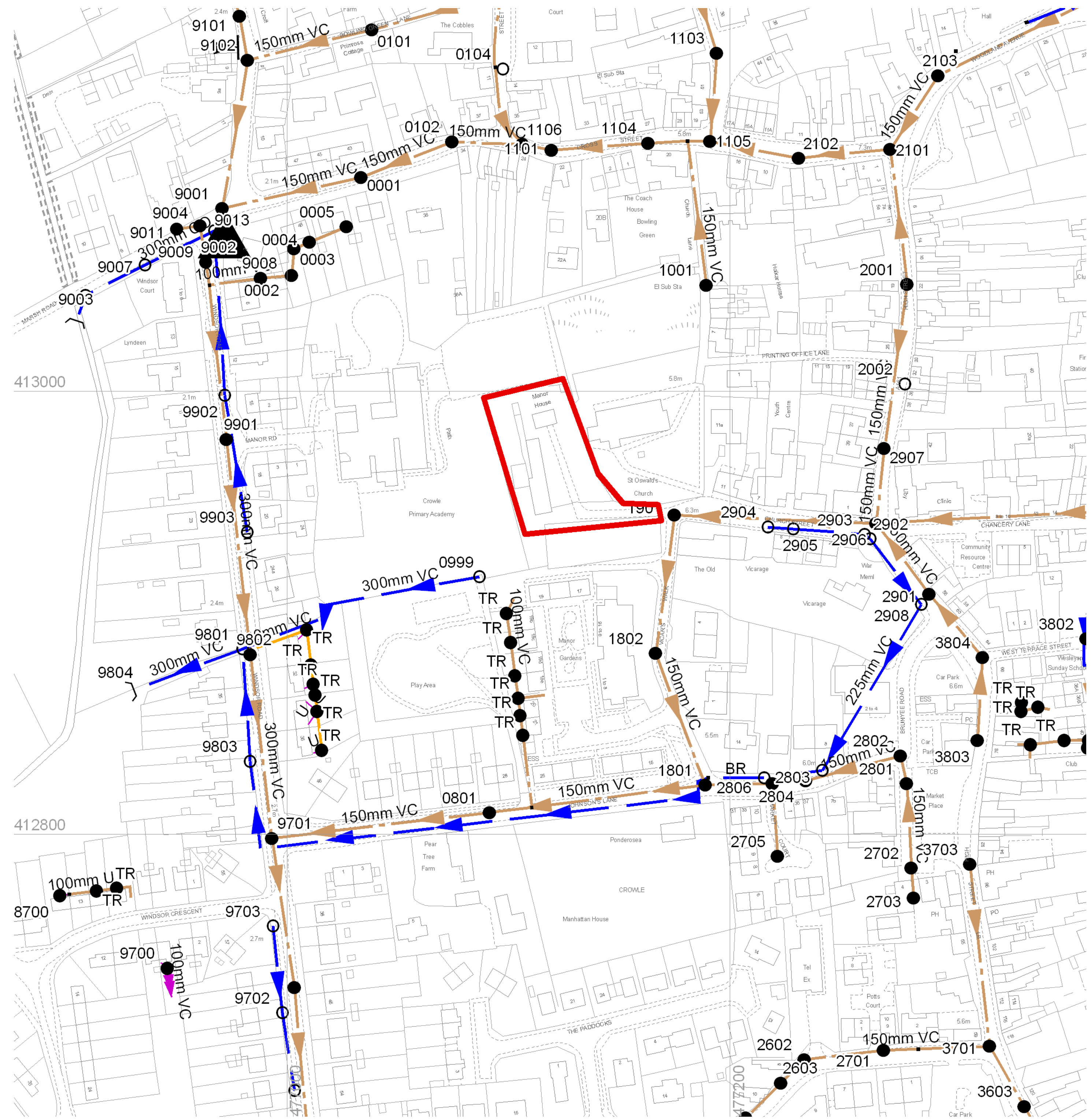

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SE77122907	7.04	5.33	5.17	F	VC	C	150	nil	213.63	1800
SE77122908	6.75	5.30	4.76	S	VC	C	225	nil	160.15	1800
SE77123603	5.29	3.44	2.96	F	VC	C	150	nil	85.79	1800
SE77123701	5.71	3.84	3.46	F	VC	C	150	nil	83.74	1800
SE77123703	6.78	4.99	4.11	F	VC	C	150	nil	92.78	1800
SE77123802	7.44	4.74	4.43	F	VC	C	150	nil	229.19	1800
SE77123803	7.44	5.70	5.53	F	VC	C	150	nil	220.88	1800
SE77123804	7.18	5.51	5.35	F	VC	C	150	nil	232.88	1800
SE77130001	2.61	1.50	0.60	F	VC	C	150	nil	70.62	1800
SE77130002	2.54	1.56	1.18	F	VC	C	100	nil	36.95	1800
SE77130003	2.55	1.68	1.60	F	PF	C	100	nil	150.50	1800
SE77130004	nil	nil	1.70	F	nil	C	nil	nil	0.00	1800
SE77130005	2.85	2.09	nil	F	PF	C	100	nil	0.00	1800
SE77130101	3.87	2.14	0.66	F	VC	C	150	nil	38.84	1800
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SE77131001	5.52	4.61	nil	F	VC	C	150	nil	0.00	1800
SE77131101	4.62	2.97	2.52	F	VC	C	150	nil	29.64	1800
SE77131103	6.03	4.51	4.20	F	VC	C	150	nil	129.19	1800
SE77131104	4.94	3.66	3.02	F	VC	C	150	nil	68.91	1800
SE77131105	5.73	4.19	nil	F	VC	C	150	nil	0.00	1800
SE77131106	4.30	2.49	2.24	F	VC	C	150	nil	128.08	1800
SE77132001	7.26	5.70	5.34	F	VC	C	150	nil	207.61	1800
SE77132001	7.26	5.70	5.36	F	VC	C	150	nil	183.85	1800
SE77132101	7.27	4.98	4.80	F	VC	C	150	nil	229.22	1800
SE77132102	6.08	4.80	4.23	F	VC	C	150	nil	71.44	1800
SE77132103	7.67	5.18	4.98	F	VC	C	150	nil	198.30	1800
nil	nil	nil	nil	F	U	nil	nil	nil	0.00	nill
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nill
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nill
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nill
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nill
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nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nill
nil	nil	nil	nil	F	U	nil	nil	nil	0.00	nill
nil	nil	nil	nil	F	U	nil	nil	nil	0.00	nill
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nill

Abandoned Gravity Sewer
Private Combined Gravity Sewer
Private Foul Gravity Sewer
Private Surface Water Gravity Sewer
Public Combined Gravity Sewer
Public Foul Gravity Sewer
Public Surface Water Gravity Sewer
Trunk Combined Gravity Sewer
Trunk Foul Use Gravity Sewer
Trunk Surface Water Gravity Sewer
Combined Use Pressurised Sewer
Foul Use Pressurised Sewer
Surface Water Pressurised Sewer
Highway Drain
Combined Lateral Drain (SS)
Foul Lateral Drain (SS)
Surface Water Lateral Drain (SS)

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Cable Junction
Cable, Optical Fibre/Instrumentation
Cable, Low Voltage
Cable, High Voltage
Cable, Other
Housing, Building
Housing, Kiosk
Disposal Site
Sewage Treatment Works
Housing, Other
Pipe Support Structure
Sewage Pumping Facility
Sewer Facility Connection Inlet / Outlet

Blind Shaft
Combined Use Manhole
Flushing Chamber
Foul Use Manhole
Grease Trap
Head Node
Hydrobrake
Lamphole
Outfall
Overflow
Penstock
Petrol Interceptor

Sewer Chemical Injection Point
Sewer Junction
Sewerage Air Valve
Sewerage Hatch Box Point
Sewerage Isolation Valve
Soakaway
Surface Water Manhole
Vent Column
Waste Water Storage
Pre-1937 Properties

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- DI - DUCTILE IRON
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- U - UNKNOWN
- VC - VITRIFIED CLAY
- XXX - OTHER

SHAPE

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- E - EGG SHAPED
- O - OTHER
- R - RECTANGLE
- S - SQUARE
- T - TRAPEZOIDAL
- U - UNKNOWN

PURPOSE

- C - COMBINED
- E - FINAL EFFLUENT
- F - FOUL
- L - SLUDGE
- S - SURFACE WATER

CATEGORIES

N W E S

- W - WEIR
- C - CASCADE
- DB - DAMBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SIPHON
- HD - HIGHWAY DRAIN
- S104 - SECTION 104

SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
Telephone: 0845 601 6616

SEWER RECORD (Tabular)

O/S Map scale: 1:2500
Date of issue: 05.07.18
Sheet No. 2 of 2

This map is centred upon:
O / S Grid reference:
x : 477118
y : 412922

Disclaimer Statement:
1. Do not scale off this Map.
2. This map and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this Map and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of Severn Trent Water's assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.
3. On **1 October 2011** most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012 (date to be confirmed).
Private pumping stations, which form part of these sewers or lateral drains, will transfer to the ownership of Severn Trent Water on or before 1 October 2016.
Severn Trent Water does not possess complete records of these assets.
These assets may not be displayed on this Map.

George Shuttleworth Ltd
Consulting Engineers
www.george shuttleworthltd.co.uk

Ref No: 696
Project: Church St, Crowle
Date: 02/06/2020
Engineer: GS

Proposed Areas

Description	No	Roof	Garage Roof	Parking	Total	Run-Off (l/s)
Detached House Plot T01		73	0	23	96	1.022
Detached House Plot T02		73	0	20	93	1.022
Plot T03		71	0	27	98	0.994
Plot T04		57	0	27	84	0.798
Plot T05		71	0	27	98	0.994
Totals		345	0	123	468	

Main Access Road

Road Area	103
Footpath Draining to Parking	27
Total	130

Roads & Roofs	475
All Artificial Surfaces	598

Flow Capacity of 100mm pipe laid at 1 in 100 = 6 l/s.

Therefore all pipes have required capacity

Upper Road and Parking	155
Roof Drainage	345
Footpath Draining to Parking	13.5
Hydraulic Loading Rate	2.31
Lower Road and Parking	69
Footpath Draining to Parking	13.5
Hydraulic Loading Rate	1.20
Check on Total	596

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ATTENUATION & DISCHARGE TO DITCH

Calculation of Rain Profiles

M5-60	20							
r	0.4							
D (mins)	15	30	60	120	240	360	720	1440
Z1	0.64	0.81	1	1.21	1.4	1.62	1.8	2.2
M5-D	12.8	16.2	20.0	24.2	28.0	32.4	36.0	44.0
Z2(100)	1.94	1.99	2.03	2.02	2.01	1.95	1.92	1.86
Z2(30)	1.50	1.52	1.53	1.54	1.53	1.51	1.49	1.45
Z2(2)	0.80	0.80	0.81	0.82	0.83	0.83	0.84	0.85
Z2(1)	0.62	0.62	0.64	0.65	0.67	0.68	0.69	0.71
MT-D(100)	24.83	32.24	40.60	48.88	56.28	63.18	69.12	81.84
MT-D(30)	19.20	24.62	30.60	37.15	42.84	48.92	53.64	63.80
MT-D(2)	10.24	12.96	16.20	19.84	23.24	26.89	30.24	37.40
MT-D(1)	7.87	10.04	12.70	15.73	18.76	22.03	24.84	31.24
I(100)	99.33	64.48	40.60	24.44	14.07	10.53	5.76	3.41
I(30)	76.80	49.25	30.60	18.57	10.71	8.15	4.47	2.66
I(2)	40.96	25.92	16.20	9.92	5.81	4.48	2.52	1.56
I(1)	31.49	20.09	12.70	7.87	4.69	3.67	2.07	1.30

Note: Intensity I() limited to 100mm/hr

Calculation of Flows and Volumes

Contributing Impermeable Area = 500 m2
Climate Change of 30%
Flows (l/s) = 2.78 x I x A(ha) x Global warming

Storm	15	30	60	120	240	360	720	1440
1 in 100 yr	17.95	11.65	7.34	4.42	2.54	1.90	1.04	0.62
1 in 30 yr	13.88	8.90	5.53	3.36	1.94	1.47	0.81	0.48
2 in 30 yr	7.40	4.68	2.93	1.79	1.05	0.81	0.46	0.28
1 in 1 yr	5.69	3.63	2.29	1.42	0.85	0.66	0.37	0.24

Volume (m3) = Cv x A(ha) x I x D/60 Cv= 1.00

Storm	15	30	60	120	240	360	720	1440
1 in 100 yr	16.14	20.95	26.39	31.77	36.58	41.07	44.93	53.20
1 in 30 yr	12.48	16.01	19.89	24.15	27.85	31.80	34.87	41.47
1 in 2 yr	6.66	8.42	10.53	12.90	15.11	17.48	19.66	24.31
1 in 1 yr	5.12	6.53	8.26	10.22	12.19	14.32	16.15	20.31

Initial Estimate of Balancing Volume Required

For Peak Discharge of 3.01 l/s Av Discharge Factor= 0.65 Av Qout = **1.96** l/s

Storm	15	30	60	120	240	360	720	1440
1 in 100 yr	14.38	17.43	19.35	17.70	8.42	0.00	0.00	0.00
1 in 30 yr	10.72	12.49	12.85	10.07	0.00	0.00	0.00	0.00
1 in 2 yr	4.90	4.90	3.49	0.00	0.00	0.00	0.00	0.00
1 in 1 yr	3.36	3.01	1.22	0.00	0.00	0.00	0.00	0.00

Storage required for 1 in 30 yr storm **12.9** m3
Storage required for 1 in 100 yr storm **19.4** m3

Perm Parking Area 155 Depth 0.425 Void Ratio 0.3 Vol= 19.7625

Total Storage 19.7625 m3

LOWER ACCESS RD & PARKING

Soil Infiltration Rate		20	mm/hr			
		0.000006	m/s			
Connected Impermeable Area		14				
Area of Perm Sub-base		68				
Impermeable Area		82	m2			
Hydr Loading Rate		1.20				
Total rainfall (10 Year)						
M5-60		20				
r		0.4				
Sub-base Depths	Max	0.3		Average	0.075	m
Void Ratio		0.3				
Storage Vol in Sub-base		1.53	m3			
a50		69	m2			
Percolation Outflow		0.00000	m3/s			
		0.0	l/s			
		0	l/hr			
Discharge to SW Sewer		0.00185	m3/s	1.85	l/s	
Average Outflow		0.00120	m3/s	1.2025	l/s	

Storm Duration D mins		**15**	**30**	**60**	**120**	**240**	**360**	**720**	**1440**
1 in 10 year STORM EVENT									
Z1		0.63	0.8	1	1.21	1.4	1.62	2	2.2
M5-D		12.6	16	20	24.2	28	32.4	40	44
Z2		1.23	1.24	1.24	1.23	1.23	1.21	1.2	1.18
M10-Dmin		15.498	19.84	24.8	29.766	34.44	39.204	48	51.92
I	m3	1	2	2	2	3	3	4	4
Outflow	m3	1.1	2.2	4.3	8.7	17.3	26.0	51.9	103.9
S	m3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time to Empty to 50%	hrs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volume Check		OK	OK	OK	OK	OK	OK	OK	OK
1 in 30 year STORM EVENT									
Z1		0.63	0.8	1	1.21	1.4	1.62	2	2.2
M5-D		12.6	16	20	24.2	28	32.4	40	44
Z2		1.5	1.52	1.54	1.53	1.53	1.49	1.47	1.45
M30-Dmin		18.9	24.32	30.8	37.026	42.84	48.276	58.8	63.8
I	m3	2	2	3	3	3	4	5	5
Outflow	m3	1.1	2.2	4.3	8.7	17.3	26.0	51.9	103.9
S	m3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Time to Empty to 50%	hrs	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Volume Check		OK	OK	OK	OK	OK	OK	OK	OK
1 in 100 year STORM EVENT				Climate Change Volumetric Allowance				30.00%	
Z1		0.63	0.8	1	1.21	1.4	1.62	2	2.2
M5-D		12.6	16	20	24.2	28	32.4	40	44
Z2		1.94	1.99	2.03	2.02	2.01	1.95	1.92	1.86
M100-Dmin inc CC		31.78	41.39	52.78	63.55	73.16	82.13	99.84	106.39
I	m3	2.6	3.4	4.3	5.2	6.0	6.7	8.1	8.7
Outflow	m3	1.1	2.2	4.3	8.7	17.3	26.0	51.9	103.9
S	m3	1.5	1.2	0.00	0.00	0.0	0.0	0.0	0.0
Time to Empty to 50%	hrs	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Volume Check		OK	OK	OK	OK	OK	OK	OK	OK
Shortfall		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

WORK UPSTREAM FROM EX STW MH

MH	Cover Level	Cover	Inlet Pipe	Invert level	Depth to IL	Distance	Grad 1 in	US Invert Level
EX ST MH	4.565	0.470	150	3.925	0.640	7	150	3.972
SW01	4.45	0.318	150	3.972	0.478	31	300	4.075
SW02	4.575	0.340	150	4.075	0.500	12	300	4.115

CHECK DISCHARGES TO PERMEABLE SUB-BASE

Depth of Permeable Sub-base	0.425
Depth of Permeable Block & Sand	0.13
Depth of Pipe IL to Crown	0.11
Max Cover to Pipe	0.445

Terrace block to permeable sub_base

MH	Ground Level	Cover	Inlet Pipe	Invert level	Depth to IL	Distance	Grad 1 in	D/S Invert Level
RWP	6.6	0.15	0.1	6.34	0.26	30	21.5	4.945
RDU	5.5	0.435	0.1	4.945				
RWP	5.9	0.15	0.1	5.64	0.26	22	32	4.953
RDU	5.5	0.428	0.1	4.953				

Detached house to permeable sub_base

MH	Ground Level	Cover	Inlet Pipe	Invert level	Depth to IL	Distance	Grad 1 in	D/S Invert Level
RWP	5.3	0.15	0.1	5.04	0.26	14	49	4.754
RDU	5.3	0.426	0.1	4.754				

Conclusion Steeper than min gradients will be required to discharge into RDU's

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Ref No: 696
Project: Church St, Crowle
Date: 02/06/2020
Engineer: GS

Consider Permavoid RDU

Percolation Rate in Type 3 0.001 3600 mm/hr

	Single Unit		Double Unit		Triple Unit	
Length	0.708	m	0.708	m	0.708	m
Width	0.354	m	0.708	m	1.062	m
Depth	0.15	m	0.15	m	0.15	m
Base Area	0.250632	m2	0.501264	m2	0.751896	m2
Top Area	0.250632	m2	0.501264	m2	0.751896	m2
Side Area	0.3186	m2	0.4248	m2	0.531	m2
Side Area/m,	2.124	m2/m	2.832	m2/m	3.54	m2/m

	Head	Flow (l/s)	Cumulative	Av	%		Flow (l/s)	Flow (l/s)	Cumulative	Av	%
1	0.000	0.25	0.25	0.25	100.00	100	0.50	0.75	0.75	0.75	100.00
2	0.025	0.30	0.55	0.28	0.91	54.789272	0.57	0.84	1.59	0.80	0.95
3	0.050	0.36	0.91	0.30	0.85	39.160839	0.64	0.93	2.52	0.84	0.90
4	0.075	0.41	1.32	0.33	0.81	31.028939	0.71	1.02	3.54	0.88	0.87
5	0.100	0.46	1.78	0.36	0.77	25.952381	0.78	1.11	4.64	0.93	0.84
6	0.125	0.52	2.30	0.38	0.74	22.437673	0.86	1.19	5.84	0.97	0.81
7	0.150	0.57	2.87	0.41	0.72	19.837158	0.93	1.28	7.12	1.02	0.79
8	0.175	0.87	3.74	0.47	0.54	23.325766	1.50	2.12	9.25	1.16	0.54
9	0.200	0.93	4.67	0.52	0.56	19.836215	1.57	2.21	11.46	1.27	0.58
10	0.225	0.98	5.65	0.56	0.58	17.337345	1.64	2.30	13.76	1.38	0.60
11	0.250	1.03	6.68	0.61	0.59	15.4531	1.71	2.39	16.15	1.47	0.61
12	0.275	1.09	7.77	0.65	0.60	13.977024	1.78	2.48	18.62	1.55	0.63
13	0.300	1.14	8.90	0.68	0.60	12.78626	1.85	2.57	21.19	1.63	0.64
14	0.325	1.19	10.10	0.72	0.61	11.803072	1.92	2.65	23.84	1.70	0.64
15	0.350	1.24	11.34	0.76	0.61	10.975838	1.99	2.74	26.59	1.77	0.65
16	0.375	1.30	12.64	0.79	0.61	10.268908	2.06	2.83	29.42	1.84	0.65
17	0.400	1.35	13.99	0.82	0.61	9.6568479	2.14	2.92	32.34	1.90	0.65
18	0.425	1.40	15.39	0.86	0.61	9.1210156	2.21	3.01	35.35	1.96	0.65
19	0.450	1.46	16.85	0.89	0.61	8.6474222	2.28	3.10	38.44	2.02	0.65
20	0.475	1.51	18.36	0.92	0.61	8.2253586	2.35	3.19	41.63	2.08	0.65
21	0.500	1.56	19.92	0.95	0.61	7.8464819	2.42	3.27	44.90	2.14	0.65
								44.90136			
								21			
	Average							2.13816			
	% Peak							65			

Permavoid Rainwater Diffuser Unit

Data Sheet

PRODUCT INFORMATION **P1** **ISSUE 2 - MAY 2017**

Run-off from building roofs is collected into downpipes and flows into a back inlet gully incorporating an internal filter or catchpit inspection chambers. The back inlet gully or chamber discharges the filtered stormwater into the permeable sub-base via Permavoid Rainwater Diffuser Unit encapsulated in a 2mm mesh fabric. The run-off will then diffuse out of the Permavoid Rainwater Diffuser Unit and into the modified granular sub-base layer. The Permavoid unit is a 150mm deep modular interlocking plastic unit storage system designed for use as a combined drainage component and sub-base replacement system, ideal for shallow infiltration/attenuation.

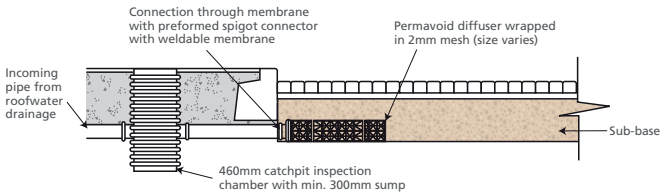
Permavoid Rainwater Diffuser Unit - Configuration Options

Length \ Width	354mm	708mm	1062mm	1416mm	2124mm
708mm	✓	✓	✓	✓	✓
1062mm	✓	✓	✗	✓	✓
1416mm	✓	✓	✓	✓	✓
2124mm	✓	✓	✓	✓	✓

Depths available are either 150mm or 300mm.
Connections available are either Ø110mm or Ø160mm.

Catchpit: 460mm diameter catchpit with 160mm inlet - PSMST 160
460mm diameter catchpit with 110mm inlet - PSMST 110

Typical Layout - Rainwater downpipe drainage into sub-base reservoir



Technical Support

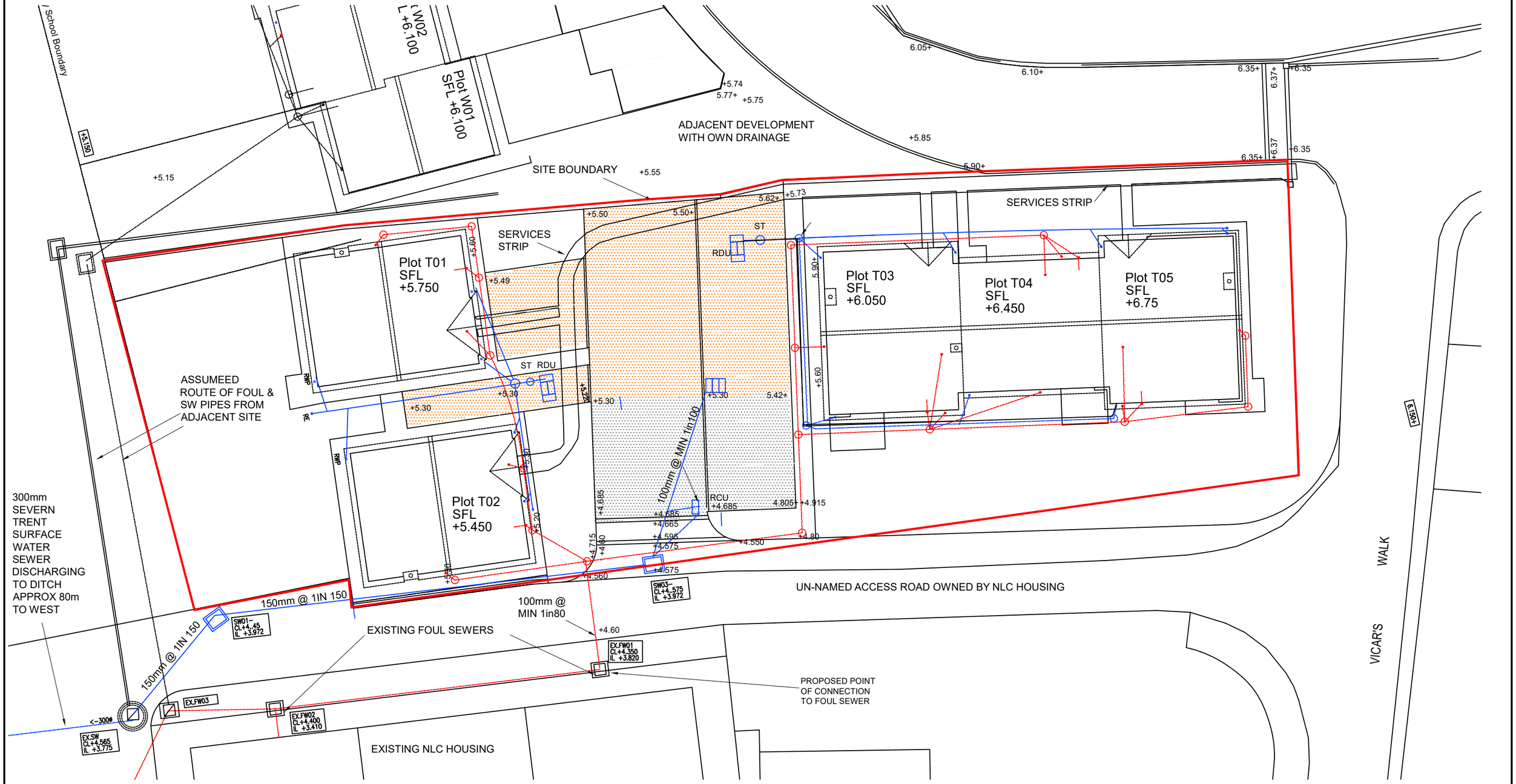
Detailed guidance and assistance is available.
For further information, please contact our Technical Team on **+44 (0) 1509 615 100** or email **civils@polypipe.com**

ELEMENT	VALUE
PHYSICAL PROPERTIES	
Weight per unit	3kg
Length	708mm
Width	354mm
Depth	150mm
SHORT TERM COMPRESSIVE STRENGTH	
Vertical	715kN/m²
Lateral	156kN/m²
SHORT TERM DEFLECTION	
Vertical	1mm per 126kN/m²
Lateral	1mm per 15kN/m²
TENSILE STRENGTH	
Of a single joint	42.4kN/m²
Of a single joint at (1% secant modulus)	18.8kN/m²
Bending resistance of unit	0.71kN/m
Bending resistance of single joint	0.16kN/m
Volumetric void ratio	95%
Average effective perforated surface area	52%
OTHER PROPERTIES	
Intrinsic permeability (k)	Minimum 1.0 x 10^{-5}
Ancillary	Permavoid Permatie Permavoid Shear Connector
Material	Polypropylene (PP)

HYDRAULIC PERFORMANCE						
3 units wide, 1 unit deep (1.06m x 0.15m)						
FREE DISCHARGE						
Gradient (%)	0	1	2	3	4	5
Flow rate (l/m/s)	8	13	15	17	19	21

Polypipe Civils,
Charnwood Business Park, Loughborough, Leicestershire LE11 1LE
Tel: +44 (0) 1509 615100 Fax: +44 (0) 1509 610215 Email: civils@polypipe.com
www.polypipe.com/wms

Polypipe



KEY

UPPER ROAD & PARKING WITH PERMEABLE SURFACE ASSUMED 130mm THICK & MIN 425mm TYPE 3 SUB-BASE OR TYPE 3 HYDRAULICALLY BOUND GGA COMBINATION

LOWER (SLOPING) ROAD & PARKING ITH PERMEABLE SURFACE ASSUMED 130mm THICK & MIN 300mm TYPE 3 SUB-BASE OR TYPE 3 HYDRAULICALLY BOUND GGA COMBINATION

ST RDU — ROOF DRAINAGE TO DISCHARGE TO PERMEABLE SUB-BASE VIA SILT TRAPS & PERMAVOID RAINWATER DISPOSAL UNITS OR SIMILAR APPROVED

REFER TO SPECIFICATION NOTES ON DRG 696/002

RCU — RAINWATER COLLECTION UNIT MIN TWO PERMAVOID CELLS WRAPPED IN TERRAM 1000 WITH 100mm PIPED CONNECTION TO MH'S IN ROAD

REV	DESCRIPTION	AP	DATE

CLIENT: THREE J DEVELOPMENTS

PROJECT: DEVELOPMENT OFF CHURCH STREET, CROWLE.

DRAWING TITLE: PROPOSED DEVELOPMENT & OUTLINE DRAINAGE DESIGN

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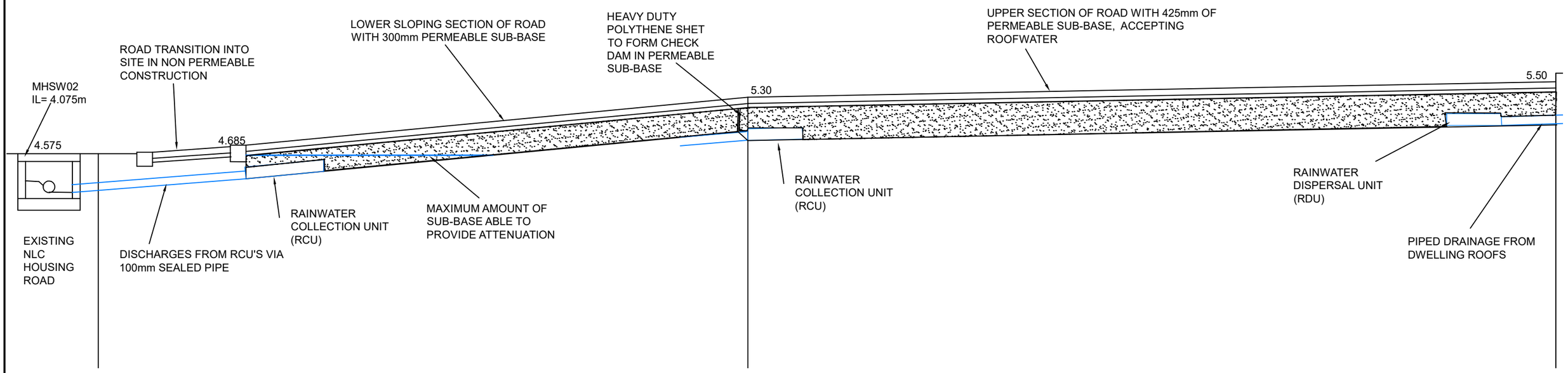
43 Hall Drive, Lincoln LN6 7SW
01522 787710

SCALE AT A3	DATE	APPROVED BY	DRG SIZE	DRAWING NO.	REV.
1:200	JUNE 20	GS	A3	696-001	-



ILLUSTRATIVE SECTION THROUGH RISING MAIN
SCALE 1:50

SPECIFICATION & CONTRUCTION NOTES

1.NO WORK TO COMMNCE UNTIL APPROVAL OBTAINED FROM NLC & SEVERN TRENT WATER.
2.LEVELS OF ALL EXISING MH'S TO BE CHECKED PRIOR TO COMMENCEMENT.
3.FOUL DRAINAGE SHOWN FOR ILLUSTRATION ONLY. DESIGN BY OTHERS. REFER TO FOUL DRAINAGE DESIGN DRAWINGS. FOUL DESIGNER RESPONSIBLE FOR AVOIDING CLASHES WITH SW PIPES & STRUCTURES.
4. ALL PIPES TO BE 100mm LAID AT 1 IN 100 UNLESS STATED OTHERWISE.
5. WHERE PIPES HAVE LESS THAN MIN COVER CONCRETE PROTECTION TO BE PROVIDED IN ACCORDANCE WITH BUILDING REGULATIONS PART H.
6. ALL PIPES TO HAVE MIN 100mm CLASS S BED & SURROUND
7.ALL DRAINAGE IN ACCESS ROAD TO BE CONSTRUCTED TO SEWERS FOR ADOPTION 6 STDS WHETHER ADOPTED BY STW OR NOT.
8. .ALL INSPECTION CHAMBERS UPSTREAM OF SILT TRAPS TO BE 450mm PPIC WITH B125 COVERS IN DRIVES & ADJACENT FOOTPATHS, A15 WHERE PEDESTRIAN LOADING ONLY.
9.PERMEABLE PAVING TO BE CONSTRUCTED ON A FORMATION WITH A MIN CBR OF 5%. ANY SOFT SPOTS TO BE REMOVED AND BACKFILLED WITH 6F5 CAPPING.
13.DEVELOPER TO PROTECT PERMEABLE SUB-BASE FROM CONTAMINATION DURING CONSTRUCTION OR INSTALL ONLY AFTER RISK OF MUD/SILT CONTAMINATION HAS ENDED.
10.ACCESS ROAD STRUCTURAL DESIGN BY OTHERS
11. ALL MH'S IN ACCESS ROAD TO HAVE D400 COVERS.

RCU

REV	DESCRIPTION	AP	DATE

CLIENT: THREE J DEVELOPMENTS

PROJECT: DEVELOPMENT OFF CHURCH STREET, CROWLE.

DRAWING TITLE: OUTLINE DRAINAGE DESIGN SECTION THROUGH ROAD & SPECIFICATION NOTES

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SCALE AT A3	DATE	APPROVED BY	DRG SIZE	DRAWING NO.	REV.
1:50	JUNE 20	GS	A3	696-002	-